

Trying to find the carburetor needle that will correct the jetting problems on your new bike can be worse than looking for a needle in a haystack. You know the needle in the haystack by its appearance. That's not the case with modern carbs, like the Keihin on Hondas and Kawasakis and the Mikunis on Yamahas and Suzukis. These carbs place more of the mixture-control responsibility with the needle than earlier carbs. As a result, they are far more tunable with the needle than carburetors of the past. However, it's hard to tell how a given needle will affect carburetion. Needle codes and fuel delivery characteristics of the needles aren't as obvious as with carburetor jets, where bigger numbers mean more fuel. Have you ever wondered how a one-step-richer-than-stock needle for your KX250 compares to the stock needle? Is it richer overall, or just off the bottom? How does this year's stock needle compare to one from last year's? Is there an aftermarket Keihin needle that will work?

We were confused, too. We searched for some common logic among the strangely coded OEM and aftermarket carbs. We found that logic has little to do with carburetor needles—but we did discover ways to navigate this sea of non-logic.

NEEDLE POINTS

Most carburetor parts follow simple larger-number-means-more logic. A 370 main jet passes more fuel than a 360, making the fuel/air mixture richer. A 4.0 slide lets more air through than a 3.0, resulting in a "leaner" mixture.

Most jets have fairly clearly defined areas of influence with respect to fuel delivery at given throttle settings, though there is overlap. The pilot jet and the air screw dominate

the fuel mixture from fully closed to about one-eighth open, but they contribute to the mixture all the way to full throttle. The slide cutaway is most significant from one-eighth to one-half throttle. The main jet dominates the mixture from three-quarters open to full throttle but it begins affecting the mixture at throttle settings as small as one-third open. Needles are different. A needle's length, the diameter and length of its untapered section and the angle of its tapered

part (or angles of its multiple tapers) all affect fuel delivery and engine performance in different ways.

Needle diameter is the easiest needle characteristic to understand and is the only one you really need to know about for simple tuning. That's a good thing because it's all some needle codes tell you. Needle diameter is the size of the needle at any point along its untapered section, which is often called the "straight" section. The needle is basically a plug for the needle jet hole. A bigger-diameter plug closes off more of the hole. A bigger-diameter number means less fuel and a leaner mixture. Normally, the optional needles available from the factory for original equipment carburetors will vary in the needle diameter only.

Even when you have the throttle closed, the needle is affecting the low-speed mixture because some fuel is making its way up through the main jet, past the clearance between the needle and the needle jet and then into the intake airstream. The diameter of the straight section is most important at throttle openings from zero to about one-quarter.

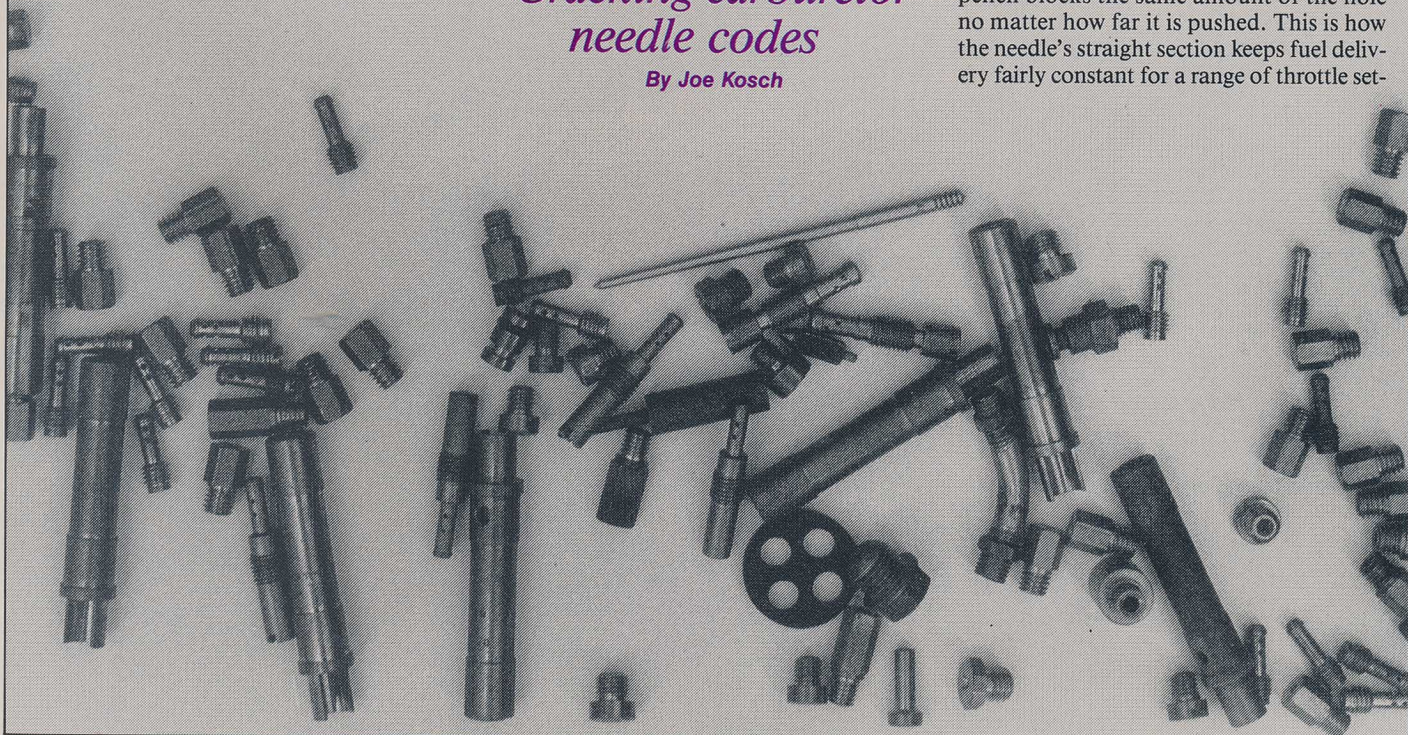
The straight section's length is important, too, because it controls the range of throttle openings where fuel delivery is held nearly constant through the needle jet as the throttle opens. You must remember that the air delivery *isn't* constant; it increases as the slide goes up. Therefore, the longer the straight section, the leaner the mixture, especially as the throttle nears wide-open.

If this seems hard to grasp, think of the straight section as the unsharpened portion of a pencil. If you push the pencil through the binder hole in a notebook, you'll see how the unsharpened "straight" section of the pencil blocks the same amount of the hole no matter how far it is pushed. This is how the needle's straight section keeps fuel delivery fairly constant for a range of throttle set-

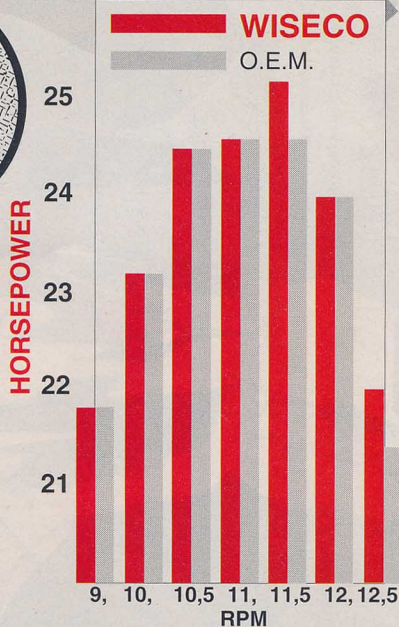
THE JET AGE

Cracking carburetor needle codes

By Joe Kosch



WISECO PISTON ProTru



ENDORSED BY:



Available for: **HONDA - KAWASAKI - SUZUKI - YAMAHA**

Dynamometer tests indicate:

Wiseco's computerized machined **anti-detonation grooves** create a turbulent flow of combustible gases sealing the ring to the cylinder wall virtually eliminating ring blowby while providing maximum power and performance.

Computerized high-speed

Wiseco ProTru pistons are supplied with tapered wall wrist pins, rings and circlips.

Call for your FREE! Motorcycle/ATV piston catalog today!

diamond tooled turning centers hold exact tolerances with no size variations.

Forged from hi-silicon aluminum alloy for superior strength and reliability, the reinforced waffle dome design offers additional dome strength with improved heat transfer.

WISECO PISTON INC. 7201 Industrial Park Blvd. Mentor, OH 44060
(216) 951-6600 In Canada: (519)-537-6281

tings. The length and diameter of a needle's straight section affects fuel delivery to some degree at all throttle openings because it is always somewhat of an obstruction in the fuel path, but it is of most importance from one-quarter to three quarters throttle.

Now that we've covered the role of the straight section, it's a good time to discuss the influence of needle clip positions on fuel delivery. Many riders make the mistake of assuming that raising or lowering the needle clip will affect fuel delivery equally throughout the middle throttle openings. In truth, raising or lowering the needle clip only changes the point where the straight section ceases to control fuel delivery and the tapered section takes over. For most common needle profiles, this happens around one-half throttle. You can set the needle to keep fuel delivery very lean for a slightly larger or smaller range of throttle openings. You're adjusting the effective length of the needle's straight section with the clip. You're not really changing the richness of the whole mid-range of throttle openings; only the needle profile can do that.

Taper angles determine the amount of extra fuel delivered as the needle is raised. To get an idea how this works, get out your pencil and notebook paper again. Put the very tip of the pencil into the hole. See how the pencil's tapered tip can gradually plug and unplug the hole as it is moved in and out? Larger taper angles, those that cause the needle to come to a point over a relatively short distance, mean more gas gets through. The opposite is true of needles with small taper angles. A two-taper needle, as the name suggests, has two tapers, a three-taper needle has three tapers.

Needle length is important for safety reasons, not tuning. You can't use too short a needle because it will pull completely out of the needle jet hole at full throttle and be drawn forward by the intake airstream. It may then miss the needle jet hole when the rider tries to close the throttle, propping the slide up in the wide-open position. Most of us would be faster riders if we could force ourselves to leave the throttle on a bit longer, but this isn't the way to do it. Too long a needle props the slide up even when its tip drops into the needle jet. Again, not much fun.

With that out of the way, we're ready to discuss the needle codes used on today's popular carbs.

UNDERSTANDING THE O.E. KEIHIN NEEDLE CODE

Original equipment Keihin carburetors for Hondas and Kawasakis use codes for their needles that are entirely different from each other and different from aftermarket Keihins. It's not hard to see how this situation came about. After spending hefty amounts of time, money and effort on developing special needle profiles for specific machines, the factories don't want to hand the results of their research to competitors who could make use of it in similar machines. It's also likely the clever folks in Japan figured that naming similar parts

FASTER—GUARANTEED

"How do you make a good bike into a great one? Ask Paul Theide; he seems to have it down to a science." *DIRT BIKE*

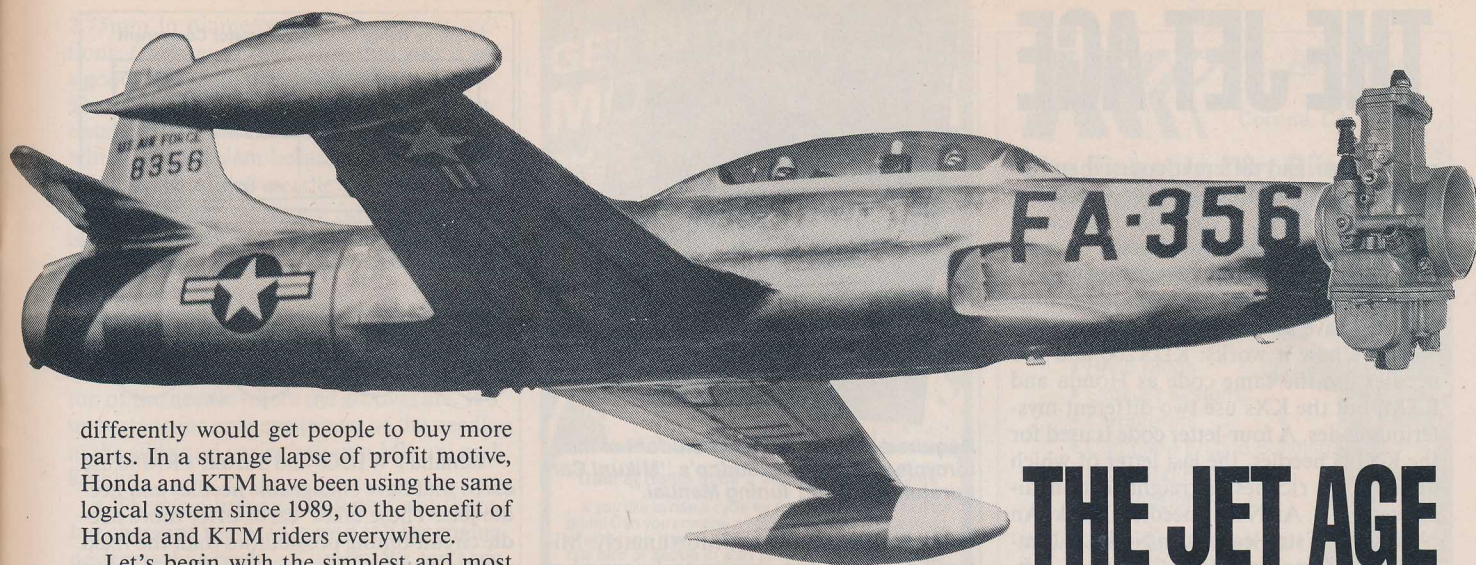
Leading edge motor and suspension modification for all models including XR, DR, KTM & ATK.

"Compared to the stock suspension, the Race Tech performed phenomenally well." *MOTORCROSS ACTION*



RACE TECH
SATISFACTION GUARANTEED

3227 Producer, #127
Pomona, CA 91768
(714) 594-7755



THE JET AGE

differently would get people to buy more parts. In a strange lapse of profit motive, Honda and KTM have been using the same logical system since 1989, to the benefit of Honda and KTM riders everywhere.

Let's begin with the simplest and most sensible system, the code used by Honda and KTM. It lets you understand most of the dimensions and characteristics of the needle you've got by looking at the markings on the needle; no star charts or Ouija boards are needed. The code consists of a letter, two two-digit numbers and two letters. A typical needle would be a R1467NS. The first letter corresponds to the length of the needle. An "R" needle is 65mm long. The first number indicates the angle of the taper in degrees and minutes of degrees (all of the Honda and KTM needles are single-taper types). Fourteen, as it appears on the R1467NS needle means one degree, 40 minutes. If the number were larger, like 15, that would mean one degree, 50 minutes, so the needle would be richer, especially at large throttle openings.

The second number tells you how much larger than 2mm the diameter of the straight section is (in fractions of a millimeter). An R1467NS needle's straight section is 2.67mm in diameter.

The second letter refers to a fine adjustment in clip-groove positioning. The grooves on an "N" clip give you a one-half-step richer setting than those on a "P" clip.

The third letter, which is always "S" (at the time we researched this information—expect changes in the future) doesn't appear on every needle. If the needle has an S, it has a smoother blend between the tapered and straight sections for a more gradual transition from the very lean straight section to the richer tapered section. What about the number that tells you the length of the straight section and the length of the tapered section? Keihin doesn't care to tell you that, so it's not part of the code. If you can operate a vernier caliper you can measure these things for yourself. You should find some comfort in the fact that stock needle choices cover real world tuning requirements so well that even factory team mechanics seldom have to stray from them and measure needles.

What about Kawasaki's code? Unfortunately, they've got several codes just for the '91 models and even they haven't got a key to decipher them all. Previous years'

'91 HONDA NEEDLE CHART

	CR80	CR125	CR250	CR500
Two steps richer	*	R1467N	*	*
One step richer	F1341H24NAAA	R1468NS	R1368N	*
Stock	F1343H24NAAC	R1469N	R1369NS	R1368NS
One step leaner	F1345H24NAAE	R1470NS	R1370NS	R1369NS
Two steps leaner	*	R1471N	R1371NS	R1370NS

*Option not available from original equipment manufacturer.

'91 KAWASAKI NEEDLE CHART

	KX60	KX80	KX125	KX250	KX500	KDX200	KDX250
Two steps richer	*	N68S	NOEH	N85A	N82K	R1170N	R1366H
One step richer	*	N68T	NOEI	N85B	N82L	R1171N	R1367H
Stock	5114-3	N68U	NOEJ	N85C	N82M	R1172N	R1368H
One step leaner	*	N68V	NOEK	N85D	N82N	R1173N	R1369H
Two steps leaner	*	N68W	NOEL	N85E	N82P	R1174N	R1370H

*Option not available from original equipment manufacturer.

AFTERMARKET KEIHIN NEEDLE CODE KEY

Meanings of the first letters used in the three-letter code (taper angle):

A=one degree; B=one degree, 15 minutes; C=one degree, 34 minutes; D=one degree, 45 minutes; E=two degrees.

Meanings of the second letters used in the three-letter code (untapered length):

E=38.15mm; G=39.95mm; J=41.75mm.

Meanings of the third letters used in the three-letter code (diameter):

F=2.655mm; G=2.665mm; H=2.675mm; J=2.685mm; K=2.695mm; L=2.705mm; M=2.715mm; N=2.725mm; P=2.735mm; Q=2.745mm

'91 SUZUKI NEEDLE CHART

	RM80	RM125	RM250	RMX	RMX(+kit)
Two steps richer	†	6ACJ263	6AEL58	*	6AEJ61
One step richer	†	6ACJ264	6AEL59	*	6AEJ62
Stock	SDP394	6AEJ265	6AEL60	6AAY167	6AEJ63
One step leaner	†	6AEJ266	6AEL61	*	6AEJ64
Two steps leaner	†	*	6AEL62	*	6AEJ65

*Option not available from original equipment manufacturer.

†No optional needles are available from the original equipment manufacturer. Needle circuit tuning is done by changing needle jets.

'91 YAMAHA NEEDLE CHART

	YZ80	YZ125	YZ250	WR250	YZ500WR
Two steps richer	†	J86EN15-54	J86DJ8-59	**	†
One step richer	†	J86EN15-55	J86DJ8-60	**	†
Stock	†	J86EN15-56	J86DJ8-61	**	†
One step leaner	†	J86EN15-57	J86DJ8-62	**	†
Two steps leaner	†	*	J86DJ8-63	**	†

*Option not available from original equipment manufacturer.

**Same as YZ250

†No optional needles are available from the original equipment manufacturer. Needle circuit tuning is done by changing needle jets.

THE JET AGE

models have had different codes than this year. Are you turning greener than your bike? Don't worry. If your bike is stock, or reasonably stock, you won't need to crack the codes. Kawasaki's stock needles work—you just need to know how to recognize the one you have and the one you need.

Here's how it works: KDX200 and 250 needles use the same code as Honda and KTM, but the KXs use two different mysterious codes. A four-letter code is used for the KX125 needles, the last letter of which denotes the richness (straight-section diameter only). An NOEJ needle is stock. An NOEL is one step leaner. An NOEL is leaner still and makes a fine Christmas gift. There is one additional leaner step and two richer steps above the stock NOEJ.

The KX250 and 500 use a one-letter/two-number/one-letter code. Kawasaki will not release the key to the first part of the code. Again, the final letter tells you how rich or lean the needle is with respect to other needles for that specific bike, but nothing more. Check the Kawasaki needle chart in this article for all of the '91 Kawasaki KX and KDX needle choices.

How does Team Green get their bikes to rip? The hard way—measurement, trial and error and experience. Kawasaki chose the tapers carefully, so the five needles they offer for each of the KXs and KDXs cover every tuning need for the stock machines, but heavily modified bikes can require a needle search that may lead you to needles from previous Kawasakis, Hondas or aftermarket Keihin carbs.

UNDERSTANDING AFTERMARKET KEIHIN NEEDLE CODE

Needle dimensions for these carbs are expressed in a three-letter code. There's no letter to indicate needle length because all of the aftermarket needles are 66mm long. The first letter indicates the angle of the tapered section of the needle. The farther you go into the alphabet, the larger the taper angles are and the richer the needles become.

The second letter tells the length of the straight or untapered part of the needle. The farther you go into the alphabet, the longer the needle's straight section is and the leaner the needle becomes.

Letter number three in the code designates the diameter of the straight section of the needle. The farther you go into the alphabet, the fatter the needle's straight section is and the leaner the needle becomes.

UNDERSTANDING MIKUNI TMX NEEDLE CODE

Unlike Keihin carbs, there is agreement in the codes used by the two major users for Mikuni's original-equipment-type TMX carburetors and the aftermarket.

Mikuni code uses a single digit number, two letters, two two-digit numbers (or, in the case of Suzuki, three letters rather than two two-digit numbers) and a single-digit num-



Required reading for every student of motorcycle carburetion: Sudco's "Mikuni Carburetor, Parts and Tuning Manual."

ber to code its needles. Unfortunately, Mikuni doesn't want anyone to know what most of the code means. You'll notice we haven't made up a code key for the Mikunis. That's because the information to create such a key isn't available. We will explain the code to the extent that we can and give you enough information so you have some idea as to the profiles of Mikuni needles.

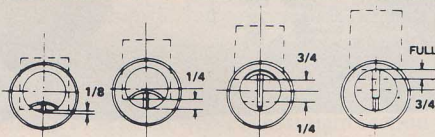
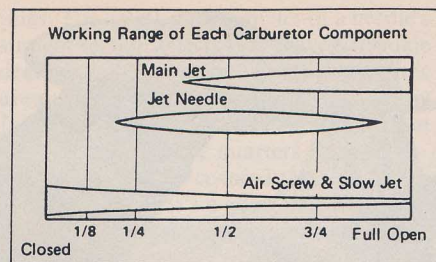
The code for a standard YZ250 needle is 6EN15-56-3. The first number indicates the needle series, which relates to length. Unfortunately, it doesn't tell you the exact length. A 6-series needle, which is standard on Yamaha YZ250s, can be 60-66mm long. Stock YZ250 needles happen to be 66.5mm long.

The two letters are taper codes. Each letter indicates a taper. Yamaha YZ250 needles have two tapers. They're pretty trick and took a ton of time to develop so Yamaha would not like everyone to know the taper angles. There is no chart that tells you what angle corresponds to what letter. You can double jump this smelly void of secrecy by whipping out the old caliper, doing some measuring along the tapered part of the needle and calculating the angles yourself—if you need to know.

After the taper code comes the factory code, or as some call it, the voodoo code. On Yamahas it's a two-digit number. On Suzukis it may be the third letter. Call it what you like, it's not explained anywhere. This is the length-to-taper measurement, an item the factories would love to keep secret. It's only a secret from those who don't care or don't want to expend the effort to measure things.

The second two-digit number is there to tell you something useful: how much bigger than 2mm the needle diameter is in hundredths of a millimeter. The stock needle, the 6EN15-56-3, is 2.56mm in diameter along its straight section.

The final number, which is present in original equipment codes only, tells you the standard clip position for the needle. The top clip groove is position one, the next one down is two and so on. Most needles have five clip grooves and the most common stock clip position is number three, the center one.



Yamaha's WR500 and Suzuki's RM80 use carbs that have changeable needles and needle jets. These bikes' carbs offer more needle circuit tuning possibilities than the fixed needle jet carbs on most newer bikes but you'll need to contact an aftermarket Mikuni parts supplier to take advantage of all of them. Yamaha doesn't offer any optional needles or needle jets for the WR500. Suzuki offers no needle options for the RM80 but they do have several needle jets for it. The code for the needle jets is simple. All of the 80's needle jets are P-series. A P-4 is stock and there are two richer options, P-6 and P-8, and two leaner options, P-0 and P-2.

WHAT IT ALL MEANS

- In carburetor tuning these days, the needle is everything. Well, almost.

- You should be glad you can't change the needle jet on the latest Keihins and Mikunis—this whole deal would be even harder to figure out. You'd have a few more tuning options, though.

- A great deal of thought, time, money and testing went into the selection of the stock tapers used by motorcycle manufacturers for each of their machines. It's wise to test your bike with the optional needles available for it before moving on to the dark world of needle searching.

- Jet richer in cool temperatures, low elevations and low humidity unless you like to go slow and/or seize your engine.

- Jet leaner in hot weather, high elevations and high humidity unless you like to go slow and foul plugs.

- When you know a certain needle taper works for your bike, all you should need to compensate for temperature, humidity and elevation changes are a few needles of larger and smaller diameters than the one you use at your regular riding spot in typical riding weather and a size or two larger and smaller pilot jets and main jets.

- Manufacturers do blow it occasionally. It's unlikely that you'll get any big performance gains with needles from another machine or another carburetor company on a stock bike but the possibility exists. Yes, you can try aftermarket Keihin needles in original equipment Keihin carbs, original equipment needles from another brand of bike in your bike, even aftermarket Mikuni needles in Keihin carbs and any other combination you care to consider. After all, they're all about 66mm long and from 2.51-

2.75mm in diameter at their straight sections. Chances are very slim that you'll get a good result with parts foreign to your carb. There are several reasons: The largest-diameter Mikuni needle you'll find is 2.65, which is a problem because Keihin PJ and PWK carbs' fixed needle jet hole size is 2.9mm. Keihins require a fatter needle jet to create usable jetting with this size needle jet hole; 2.65 is the smallest Keihin needle. Mikuni needles in a Keihin would create jetting that would be impossibly rich for most normal applications. There's also the additional problem of the thick shoulder at the top of the needle where the grooves are. It's important for proper support of the needle in the slide and varies between Mikuni and Keihin.

• There's a universe of tapers out there, but choosing tapers is more a job for engine designers than backyard tuners. We can't say truthfully that a needle search outside the recommended tapers will yield a worthwhile result. Of course, we don't know your bike, or where or how you ride, so perhaps if your machine is heavily modified and you ride in unusual weather and elevation conditions you may find a solution in needles with non-stock tapers.

• Aftermarket needles can be used in original-equipment Keihin carbs but you'll probably be limited to the lower three needle clip positions because the aftermarket needles are 66mm long rather than 65mm, like stock needles. Sudco ([213] 747-5173) and DG ([714] 630-5471) are excellent sources of information on original equipment-to-aftermarket Keihin needle crosses. Sudco will help you with Mikuni tuning information, too, but would like you to have your dealer contact them for orders, unless there is no dealer in your area. DG is prepared to handle orders for Keihin products from retail customers and dealers.

• White Bros. ([714] 554-9442) is the largest retail Mikuni dealer in the country. They're a great source for Mikuni products and information.

• On Keihin carbs, jet size numbers reflect the diameter of the hole in the jet in millimeters and fractions of millimeters. A 175 main jet has a 1.75mm diameter hole. A 50 pilot jet has a .50mm hole. Simple, eh?

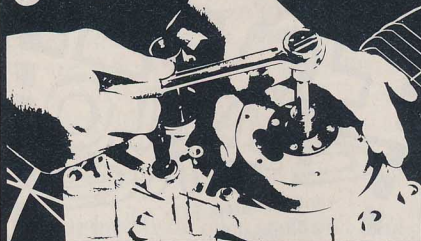
• Mikuni jet numbers are related to flow but don't indicate a direct measure of flow. The different styles (short hex, long hex, round) of Mikuni jets are not interchangeable. The flow characteristics of each are different.

• Keihin's choke knob/idle adjuster PJ carb meters air through the idle adjustment circuit and the slide seals almost completely at zero throttle. When you close the throttle at fairly high engine speeds with a zero idle setting it seals the intake enough to generate extreme vacuum—enough to pull a crank seal in.

• Keihin is pronounced *kay-heen*. Say it correctly when you talk about carbs to avoid sounding like a goob.

• Mikuni is pronounced *Me-koony*. Not Mikyou-ny or Mike-uni. □

GET INTO MOTORCYCLE REPAIR



Train at Home to Be a Motorcycle Mechanic

If you like to ride a cycle for fun...learn how to fix it for profit! Can you imagine a better way to earn your living, whether you choose to work in a cycle shop for someone else or decide to start your own cycle repair business? Now, thanks to International Correspondence Schools, there's a fast, easy way to get training at home in your spare time. No need to quit school or your job. Experts show you step by step everything from minor tune-ups to major overhauls.

T59B

ICS SCHOOL OF MOTORCYCLE REPAIR
SINCE 1890 925 Oak Street, Dept. AEF081S, Scranton, PA 18515

Rush free color brochure and full information on how I can learn motorcycle repair at home in my spare time. No salesman will visit.

Name _____ Age _____
Address _____ Apt. # _____
City/State _____ Zip _____
Phone () _____

HIGH SPEED SUSPENSION!

WP SUSPENSION...the best there is! Currently used by top racers like Mike Fisher, Mike Healey, Scott Summers, Jeff Russell, and Chris Crandall they rely on WP Suspension for all of their bikes. If you're racing to be the best, buy the best: WP.



Springs

4054 Forks

Exclusive U.S. Distributor
Complete Service & Tech Assistance.

WHITE Brothers

(714) 554-9442

14241 Commerce Dr.
Garden Grove, CA 92643

'91 Models Available

PLASTIC GAS TANKS



Priced From \$69.50 to \$98.50 Plus Postage



Clarke Mfg. Co.
29032 S. Salo Rd., Mulino, OR 97042; (503) 829-2156



139 N. Maple
Suite G
Corona, CA 91720

The Finest In Dirt Bike Performance Products

For all RMs, YZs, KXs and CRs; RMXs, KDXs and YZWRs:

- Cylinder Porting
- Head Mods
- Exhaust Systems
- Carburetors
- Complete Engine Building
- Front and Rear Suspension Setups

Awesome Big Bore Kits Now Available:

- Kawasaki KX301
- Honda CR301
- Suzuki RM301
- Kawasaki KX158
- Kawasaki KDX240
- Suzuki RMX301

Klemm Research

2 Cycle Performance Specialists

714 - 272 - 8480



XR600R	All Models 5-gal.
XL600R	All Models 4.3-gal.
CR450, 480, 500	All Models
CR250	'84-'91 All Models
YZ125	'89-'91 3.7-gal.
YZ250	'86-'91 All Models
YZ400, 465, 490	All Models
KX250, 500	'88-'91
KX125, 250	1990 Models

PLUS

Five Styles of Three-Wheel ATV Tanks, Stock Capacity
Nine Styles of Four-Wheel Tanks, Stock Capacity
54 Styles of Motorcycle Tanks for Many '69-'91 Models.