The following document was provided to the Twin Cities Ford Model A Club as part of a Technical Seminar. The document is being updated as new information is available and better procedures are developed. Please look for the latest version of the document on the Services page of my website.
www.durableperformance.net
Thank you, Dave Gerold

PERFORMANCE TUNING OF THE MODEL "A" ZENITH CARBURETOR

Steve Pargeter the author of Zenith Model "A" Carburetor Restoration Guidelines made the following statement in his restoration manual.

"The operation of the Zenith Model A carburetor can be affected by the way it was rebuilt and by the use of the correct parts. Of all the parts in the Zenith, the jets (which are more accurately called orifices) are key to making it operate as well as when it was new."

I recently had a fellow club member mention to me that he had rebuilt a number of carburetors over the years and out of all of them, only one carburetor clearly worked better than all the rest in his car. I explained to him that most jets are not sized correctly and that his best performing carburetor, just by chance, had the correct combination of properly sized jets for his car and also had all of the other important parts of the carburetor operating correctly. We can leave the combination of jets in our carburetors to chance and hope it works well or we can measure and adjust their flow to set specifications and assure that our carburetors are at their best

My testing of jets, old and new, has revealed to me that there is very little consistency in their performance. I have included suggested flow rates and measured performance of old and new jets in the following charts.

The following Suggested Flow Rates for Zenith jets is from Steve Pargeter's manual.

Jet Name	***Suggested Flow***		***Starting Jet Size***	***Drill Size***
Idling Jet	44 - 48	ml/mn	0.021	#76
Cap Jet	150 - 185	ml/mn	0.036	#64
Main Jet	150 - 160	ml/mn	0.035	#65
Compensator Jet	138 - 142	ml/mn	0.037	#63
Secondary Well (Top)	N/A		N/A	#70
Secondary Well (Bottom)	N/A		N/A	#54

The following chart shows the measured flow of jets I recently tested. 17 of the 31 jets I tested were new. N designates new and O designates original or used jets.

Main Jet	***Cap Jet***	***Compensator Jet***	***Idle Jet***
150 - 160	***150 - 185***	***138 - 142***	***44 - 48***
192 N	175 N	152 O	38 O
165 O	160 N	150 N	49 N
162 O	144 O	170 N	55 N
178 O	180 O	170 N	50 N
156 O	196 O	162 O	
180 N	142 O	160 O	
196 N	166 N	166 N	
180 N	190 O	172 N	
172 N	196 N		
182 N			

The following chart shows how the tested jets performed in relation to the suggested rate of flow. Note that only 6 of the 31 or about 19% of all the jets tested were within the suggested rate of flow.

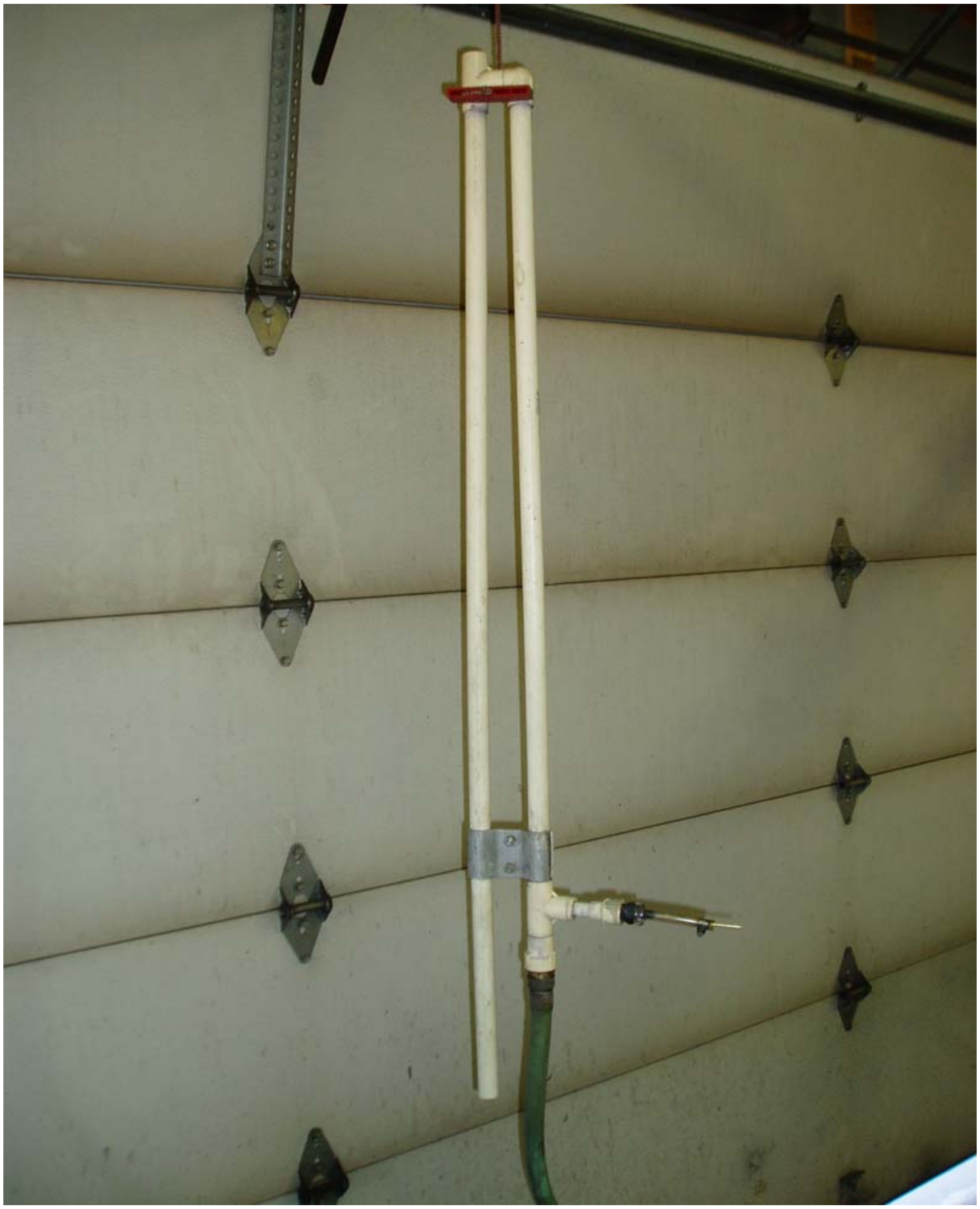
Jet	Greater than 10% Lean	0 - 10% Lean	Within Specs	0 - 10% Rich	10 -20% Rich	Greater than 20% Rich
Main	0	0	1	3	4	2
Cap	0	2	4	3	0	0
Compensator	0	0	0	2	5	1
Idle	1	0	1	2	0	0

The testing indicates that original jets more often have lower flow rates than new jets. If you study the flow test results, you will see there are a greater number of jets that provide too much flow. This results in poor fuel economy and often poor performance.

I won't go into detail on the methods of flow testing and adjusting jets in this document, but Steve Pargeter the author of Zenith Model "A" Carburetor Restoration Guidelines has clearly described and illustrated the equipment you will need. He then goes on to describe the methods for testing your jets and how to adjust their flow. If you are interested in improving your Zenith's performance by flow testing the jets, I suggest you purchase Steve Pargeter's booklet. This booklet is available from most Model A parts suppliers, from MARC and our Club's library. Mr. Pargeter explains in easily understood terms the theory and operation of the Zenith carburetor for our wonderful Model A. By reading and understanding the purpose and function of all the components of the carburetor, it becomes easier to diagnose and fix carburetor problems.

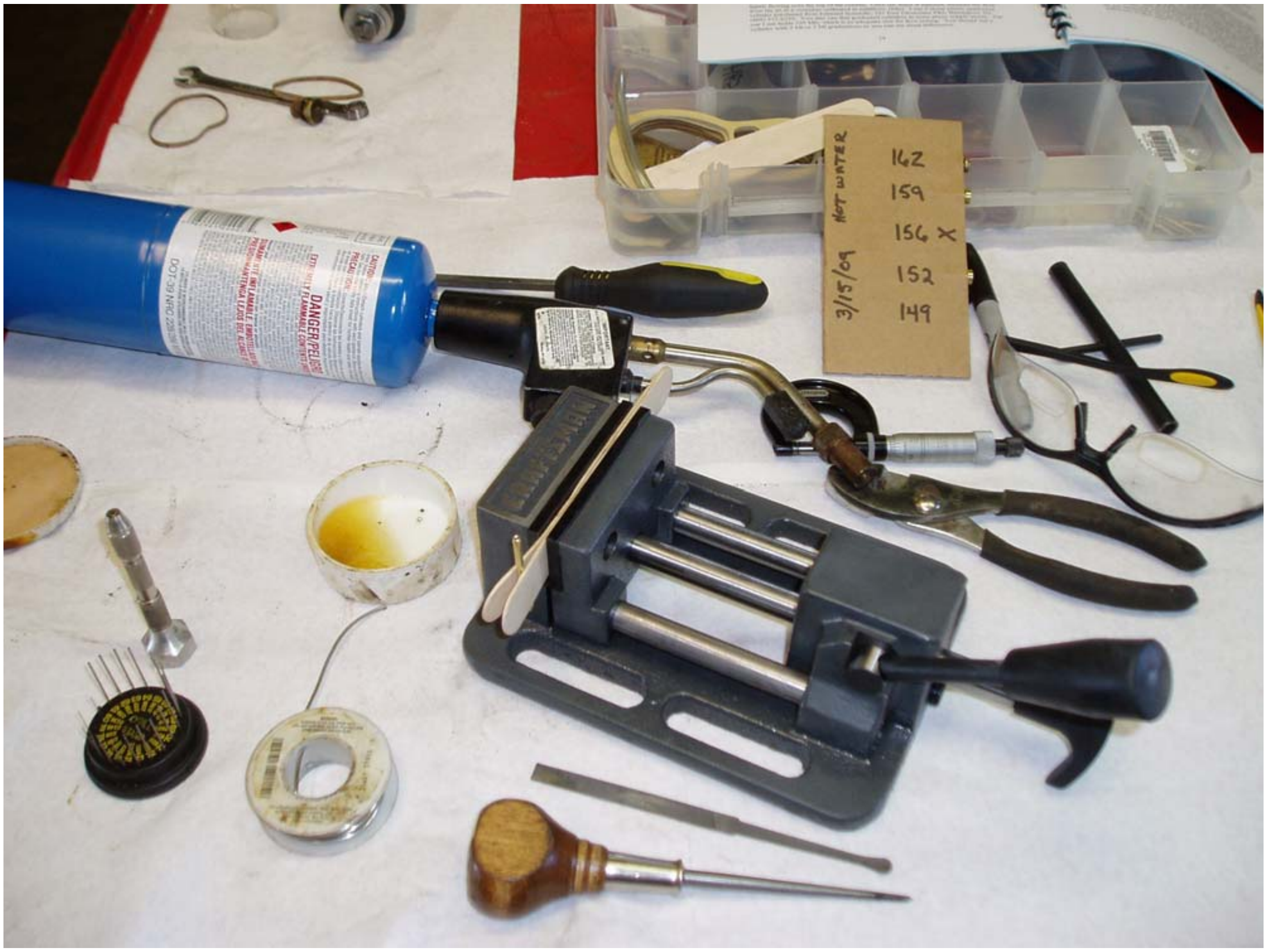
The following will give you a brief overview of the process.

After attaching the jet to the plastic pipe, wait until the water builds up in the primary column and starts to spill through the discharge tube before starting to collect the flow from the jet. Direct the main jet flow into a graduated cylinder for exactly one minute.



The flow tester can be constructed of schedule 40 PVC. The jets connect to the plastic tubing exactly 36” down from the column’s overflow fitting. Water is fed into the tester through the hose shown. The water fills the primary tube with the jet connected to it then spills over the top elbow through the tee to the adjoining discharge tube. The overflow water is discharged at the bottom of the (longer) discharge tube. The tester can be hung from the top as shown or it can be clamped to the side of a laundry tub.

The photo below shows the typical setup for soldering a jet to reduce its flow.



The tip of the jet is dipped into soldering flux, then placed in the vice and held by two tongue depressors or Popsicle sticks to speed the heating of the jet. When heated, the tip of the jet is touched with the acid core solder. Just enough solder is applied to close the hole. While the solder is still fluid, press the tip of an awl into the solder at the tip of the jet to form a concave well. This step is necessary only on the cap and main jets to minimize overflow due to capillary action. File the top of the jet with a point file to level any high spots in the solder. Proceed to re-drilling the orifice with hobby drills held in a pin vise. Start small and work up to the correct flow. When the flow is close, just insert the same drill bit previously used and drag it along one side of the jet without spinning the bit. The flutes of the drill bit will cut a small amount of solder from the opening and it will increase the flow. Pin vises and small bits are available at most larger hobby stores. Take care in using the small drill bits as they are very easy to break. I have not found a local source for individual bits if one happens to break but they can be ordered online. Place the adjusted jets into the side of corrugated cardboard and record the flow as shown in the upper right corner of the photo.

Performance Tuning

We can take the level of carburetor rebuilding to the next level for those of you that want specific performance from your car. It is possible to achieve 25 miles per gallon fuel economy with a well maintained Model A Town Sedan (a heavy car) with little loss of top end power by fine tuning your jet selections. We can also get every bit of power out of your engine to help keep up with modern traffic when needed with only a small drop in fuel economy. I like a slow and even idle for my stock ’28 pickup engine, so slow that at times, you barely hear it running. This performance can be achieved with careful carburetor rebuilding, jet selection and final tuning. All of the above described characteristics can be achieved by performance tuning your carburetor.

To start the process of performance tuning your carburetor, the first three adjustments or tests you must make have nothing to do with the carburetor. They are: Check and adjust if necessary the sparkplug gap (.032), the distributor, including point gap (.018) and timing and make sure there is a strong spark. The best tuned carburetor will not overcome problems with your sparkplugs, distributor and a weak spark. The following procedure assumes you are just finishing a complete rebuild of the carburetor with careful attention paid to eliminating any air leakage at the throttle shaft and the gas passages have been cleaned and checked to confirm there are no blockages.

Performance tuning the Zenith is the sequential process of flow testing jets under controlled conditions, adjusting their flow rate to within suggested ranges and then combining them and testing them in the carburetor for the performance you desire.

The Process: The results of the all the following flow tests should be recorded for later reference and fine tuning of the carburetor. Flow test the idle jet and adjust it if necessary to within the suggested flow rate. Flow test the compensator jet next and also adjust if necessary. The cap jet should then be adjusted to the suggested flow rate and must always flow greater than the compensator jet by 30 to 40 ml/min. Why 30 to 40 ml/min greater? The cap jet must handle the combined flow of fuel from the compensator jet and the Gas Adjusting Valve (GAV). So when you need to open your GAV an undersized cap jet will not allow the fuel mixture to richen adequately.

Assemble your collection of main jets and flow test them recording the flow for each one. It is often the quickest to flow test and adjust 5 main jets in about 3 ml/min. increments starting midpoint within the suggested flow rate and slip them into the side of a piece of corrugated cardboard with the flow written on the cardboard over the jet.

Note: I keep a card of jets set up at the following ml/min flow rates. 149, 152, <u>155</u>, 158, 161. I start the carb test by installing the midpoint 155 jet **and substitute towards lean first.**

The combined suggested flow rates of the compensator and main jets is 295 ml/min. (140 + 155) If the compensator jet is at the lower edge of the suggested range, you can install a larger main jet that offsets the lower compensator flow rate. The suggested flow rate of the compensator jet is within a 5 ml/min spread. This will not allow much variance in the main jet to stay within the combined total flow of 295 but it could save you some time in your initial jet selection.

Pick or adjust jets to be within the suggested flow rate and then install all the jets in the carburetor halves. All jets are installed with fiber washers except the idle jet. Check that the throttle plate fully closes sealing off all light. Loosen the plate screws and adjust the plate position within the throttle shaft if necessary, retighten the screws. Slowly turn the idle speed screw until the front edge of the plate just comes off its seat and then turn the screw one full turn clockwise. Finish assembling all the components of the carburetor paying attention to the correct initial setting of the float for proper fuel level. Mount the carburetor to the engine, connect the gas line and use an external fuel level gauge to make final float adjustments. These gauges are available from Model A suppliers or you can build your own. Most carburetor restoration books show how to make and use them.

Ensure that the car is in a place that will safely provide adequate ventilation for a prolonged period of time while adjusting its idle. Place the transmission in neutral and firmly set the parking brake or chock the wheels. Start the engine, let it warm up, once warm turn the gas adjusting valve to ¼ turn off the seat, raise the hand throttle all the way up and fully retard the spark.

The next adjustments need to be completed while the engine is running. The fan and fan belt are hazards when the hood is up. With the fan blade spinning, it is easy to loose track of it and put a tool or body part into its path. Keep focused on working safe. The idle air adjustment screw and throttle shaft stop screw should now be adjusted for best idle. The idle jet flow may have to be altered if best idle is not achieved with the idle air adjustment screw about ¾ to 1 turn open. If the idle air adjustment screw must be turned all the way in to get the best idle, enlarge the idle jet. Try opening the jet up to allow about 5 ml/min more flow and install it in the carb and try setting the idle again. Repeat if necessary. If you need to open the idle air adjustment screw more than 2 turns off the seat, reduce the flow of the idle jet. Try reducing the flow by 5 ml/min (more if greater than 2 full turns open) and then reinstall and try setting the idle again. **Get the idle correct before making any other adjustments.**

When the idle is set correctly, a test drive is necessary to reveal the combined performance of the compensator and main jets. The following test procedures require that the engine be brought up to normal operating temperatures. Drive the car until the engine and coolant are very warm. For the following tests close the gas adjusting valve. Run the "A" through the gears up to normal cruising speed. If the engine feels to be lacking power during any portion of the test or it backfires while quickly decelerating and using the engine as the brake, the carb is set too lean so a larger main jet should be installed.

If you have plenty of power and no backfiring, the combination of the compensator and main jet may be too large. Install a main jet with a reduced flow of 3 ml/min. and test again. Take the card of main jets along during the test drive and when a safe place to park is found, stop and change the main jet. Keep reducing the size of the main jet until you experience a backfire upon quick deceleration. At this point, you are too lean and need to increase one 3ml/min jet size.

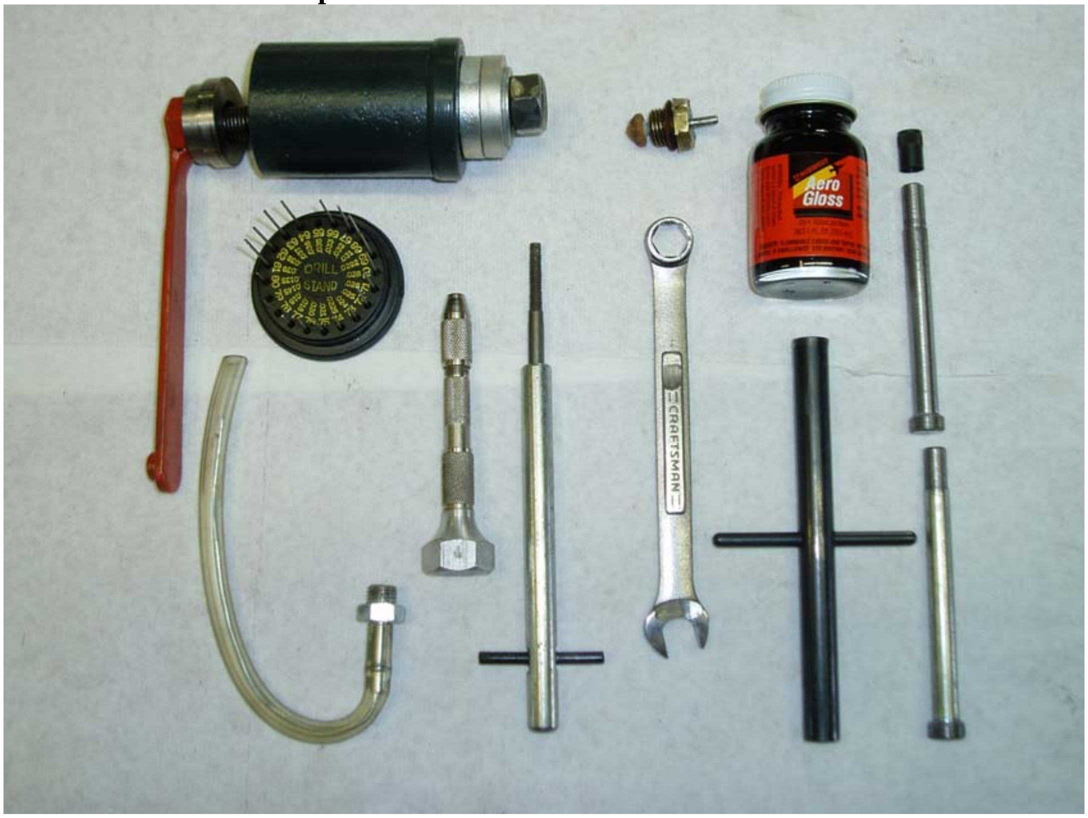
Carb set too Lean

If the road test indicates the gas air mixture is too lean, install a main jet with 3 ml/min greater flow and take the "A" for another road test. Keep increasing the main jet size until you no longer experience a back fire on quick deceleration from cruising speed. At this point, you have your carb set for maximum fuel economy, but you may be a little short on power. Open up the gas adjusting valve (GAV) up to 1/4 turn off the seat. If you have adequate power, you are almost finished…good power and good fuel economy…all within a turn of the gas adjusting valve. If you need to open the gas adjusting valve more than a turn to get desired power, increase the main jet size until you only have to open the GAV no more than 1/2 turn off the seat for full power. If you want more power all the time over fuel economy, increase the main jet size by 3 ml/min. test and increase again if necessary.

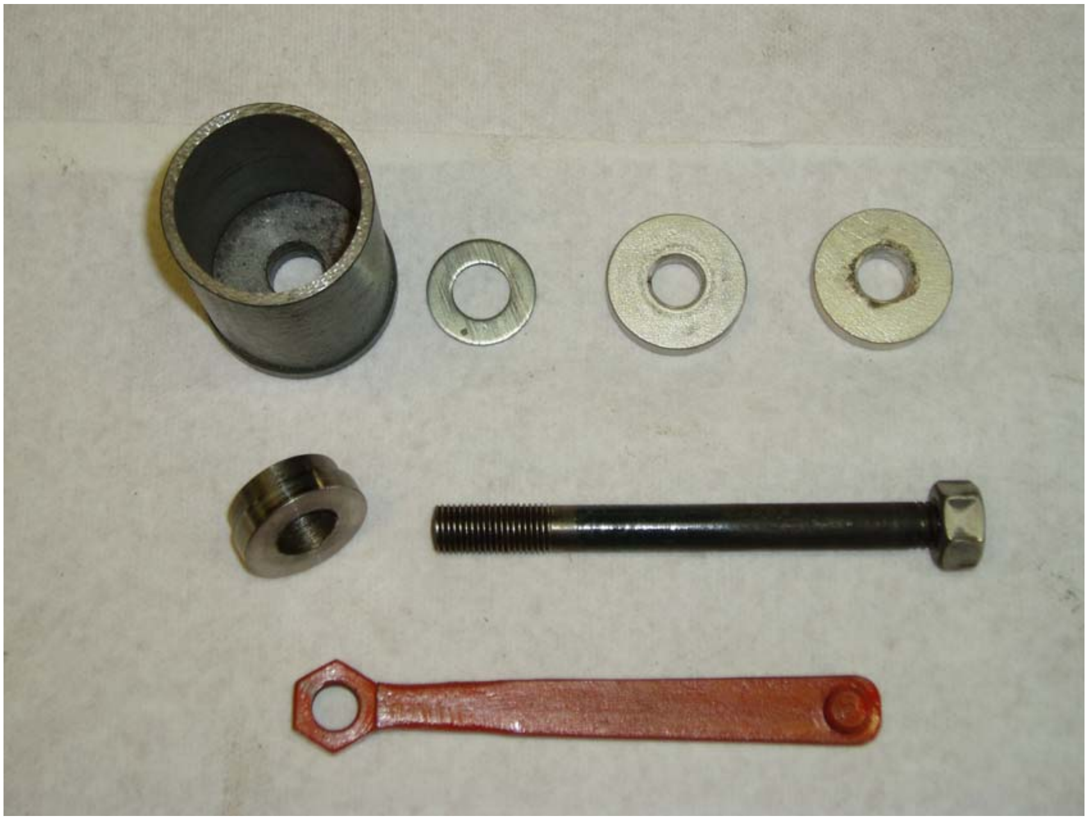
When you have reached this point in the fine tuning of your carb, close the GAV to ¼ turn off the seat. Find a long shallow hill and try accelerating up the hill. Lug the engine a bit and judge if the engine is lacking power in the lower rpms. If so, study your recorded flow rates for the compensator and main jets presently installed in the carb. If you are lacking low rpm power, you will need to increase the size (or flow) of your compensator jet and at the same time reduce the flow of your main jet the same amount. Any change in the compensator jet flow should be offset with a change in the main jet size.

Watch the temperature of your engine after setting up a carburetor for maximum fuel economy. Check the color of your plugs often during the first couple outings. If your engine temp and plug color indicate correct operating conditions, you have finished your performance tuning.

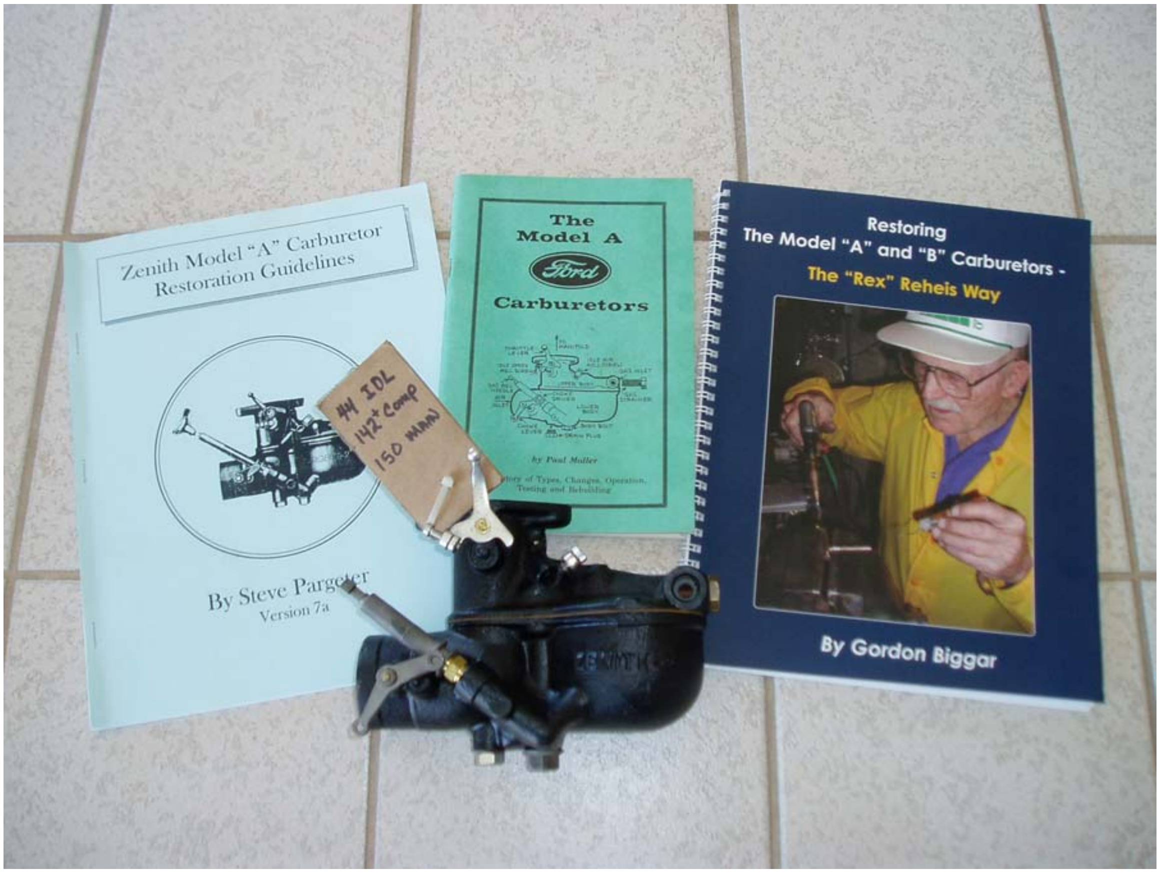
Tools and paint for the Ford Model "A" Zenith carburetor



Puller for removing a "stuck" Zenith venturi from the top or bottom casting.



The books shown below are excellent sources of information for rebuilding a carburetor.



Model "B" Carburetor Restoration

The restoration of the "B" carburetor is covered in detail in Gordon Biggar's RESTORING THE MODEL "A" AND "B" CARBURETORS – THE "REX" REHEIS WAY. Mr. Biggor states that Dave Renner supplies rebuild kits that are flow tested and have the correct inverted cone nose. He also markets "B" adapter gas fittings and manifold bolts that allows the 'B"carburetor to be installed on the "A" without modifications to any of the original parts. Dave has written two articles: "B" Zenith Repair & Rebuild Tricks" and "Model "B" Zenith Part III" for the Secrets of Speed. Dave Renner can be reached at Renner's Corner, Manchester, MI.

I just ordered and received Biggor's book and have not had the time to fully study it, but the sections I have looked at are very detailed. The book describes and illustrates many of the "tricks" and tools necessary to make the rebuild process easier.

This clinic handout was prepared for the Twin Cities Model A Ford Club Technical Clinic, March 19, 2009

Carburetor History and Theory of operation by Jim Peters
Carburetor displays, Q&A session: Selection of parts for judging by Richard Darling
Performance Tuning by Dave Gerold and Bruce Remington