

Carb Shoot-out

Well, ever get in an argument with your riding buddy over which carb is better while guzzling brews? Getting kind of tired of it? Figured you talked it all out? Well here's some fresh ammo..

The Carbs

I managed to get my hands on a Super Flow SF110 to try my hand at flow testing. Since I'm a big carb kind of guy, I picked the most common larger carbs used on the higher performance HDs. My choice of carbs included Keihin, Mikuni, and S&S., which probably cover 90% of the carb brands used on late model Harleys. From Keihin, I selected the CV51 which is the biggest available from them. For Mikunis I managed to scrounge up an HSR45 and HSR48. The S&S carbs include 2 Gs, one stock, one with bored venturi plus T-jet and a stock late model Super D. I also ran across a latecomer, a Super E with a thunder-jet that a friend had sitting in a box. He also offered an Edelbrock but I refused.. ☺ For reference I've included a take off CV40.

After gathering all of the carbs, first step in this test required building fixtures to hold the carb to the SF110. The SF110s main measuring orifice is a 5-inch round hole that sits in the center of the tester with 4 1/4-20 treaded holes spaced equally around the bigger hole. This configuration allowed me to build a couple of test plates out of 3/16-inch thick aluminum. To make the test plates universal, I set one up for the largest carb bolt pattern then made adapters that necked down to the smaller carbs as necessary. The D carb had the largest bolthole pattern since it was the same as the Super G and various carb spacers were available, it provided the greatest flexibility. Another plate was designed to take a manifold spigot, flange and seal to allow testing with intake manifolds.



The above picture includes most of the items used. The top section shows velocity stacks, carb back plates, various fittings and an adapter plate for the SF110. The top row of carbs includes the CV40, HSR45, Super E, and modified Super G. The bottom row shows a CV51, HSR48, stock G and stock D. I took measurements off of all the carbs and stored them in a table. This table can be used to help look into fitting the carbs to different applications and as something to compare their flow performance to.

Carb Name	Venturi Diameter	Venturi Area	Percent Greater than Stock	Carb Exit Diameter	Carb Mouth Diameter
Keihin 40mm CV	1.535	1.851	1.000	1.590	2.336
Keihin 51mm CV	1.930	2.926	1.581	1.995	2.520
Mikuni HSR45	1.770	2.461	1.330	1.770	1.861
Mikuni HSR48	1.885	2.791	1.508	1.885	1.975
SnS Super E Tjet	1.563	1.917	1.036	1.875	2.190
SnS Super G Stock	1.750	2.405	1.300	2.060	2.190
SnS Super G Modified w Tjet	1.860	2.717	1.468	2.060	2.190
SnS Super D	1.950	2.986	1.614	2.247	2.375

This table gives you a general idea of what is going on inside the carb. It gives the venturi size, venturi area, diameters of the intake and exit of the carb. With this information one can make predictions as to carb flow and get an idea as to how much the venturi necks down expands as it exits the carb. Notice that Mikuni carbs have the least venturi neck down and don't expand any before exiting. The CVs are next with a small increase at the carb exit. SnS has the greatest increase at the exit. The differences in venturi style come from the type of carb. The Mikuni need the least venturi as the slide creates the venturi at partial throttle. The CV carbs need a little more venturi to create a pressure drop to help pull the slide up and the slide helps to keep the velocity across the main jet constant. The SnS carbs need the most venturi as they need it to pull fuel out of the main jet over a broader range of flows since there isn't any slide.

So how do you size a carb? Most carb manufacturers like to use the exit diameter of the carb for sizing. I prefer to use the venturi diameter, as this is where peak velocity occurs and where fuel is added to the air. Both carb exit and venturi are listed in the table so for reference so you can draw your own conclusions.

Carb Name	Back Type	Carb Mount	Carb Front Type	AC Mount	Carb Front to Back Length
Keihin 40mm CV	Spigot	1.810	Flange	2.736	3.924
Keihin 51mm CV	Spigot	2.245	Flange	3.020	3.920
Mikuni HSR45	Spigot	1.937	Spigot	2.568	3.550
Mikuni HSR48	Spigot	2.092	Spigot	2.565	3.550
SnS Super E Tjet	Flange Bolt space	2.750	Flange	2.690	3.500
SnS Super G Stock	Flange Bolt space	3.100	Flange	2.690	3.500
SnS Super G Modified	Flange Bolt space	3.100	Flange	2.690	3.500
SnS Super D	Flange Bolt space	3.100	Flange	3.025	4.913

This table provides information as to the external dimension of the carb. From this you can see that all the carbs are about the same length with the exception of the Super D. The AC Mount column represents either the outside diameter of a spigot or the circle diameter of the holes for a flange. Notice that the super G has the same bolt pattern as the D and that the E and G are the same size except for the manifold bolts. It's real easy to swap from a E to a G if you just replace the manifold. The same goes for the HSR48 and HSR45.

Thoughts Behind Testing

The plan was to try each carb to determine how much each one flowed. Originally I planned on testing each carb 3 ways, first with mounted to the plate without anything else. Second, I planned on using an air cleaner backing plate. Third, I planned on also testing with a velocity stack. Well I was able to get most of the backing plates and air cleaners but had some holes in my selection. As it turned out there was enough different tests that I could estimate flows for configurations I couldn't construct in most cases. Initially I planned to only test the carbs connected directly to the flow bench but later decide to add an intake manifold to the mix. This addition turned out to be a good idea as the additional results provided some interesting information.

Testing

With all components collected, I first needed to determine what the pressure to test the carbs. To accomplish this all I had to do was see how much vacuum I could pull through the largest carb. I figured that the best flowing carb would be the Super D with a velocity

stack on it. The SF110 could only pull about 3.5 inches of water through the D with the flow set to maximum so I used 3 inches as the test pressure (vacuum). After a quick calibration of the flow bench, I started to test carbs. I wired the throttle wide open and started with the CV40. The first thing I noticed was that at 3 inches of water vacuum, the slide did not move up all the way. Since this was a smaller carb I increased vacuum to about 8 inches before the slide opened fully. This vacuum was way too high for the other carbs. Since Superflow manual states that all measurements should be done at the same test pressure, my solution was to remove the slide spring and use a piece of modeling clay to hold the needle in place. Both the CV40 and CV51 required this procedure.



Here is a picture of the first flow test using a CV40 without air cleaner.



CV with air cleaner backing plate.



CV51 on flowbench.



Here is an HSR48 with the Superflow running. Notice that the pressure is about 3 in of water vacuum and the flow is about 86%.



Super G with velocity stack. SF110 is on and running.



This is a modified G with stock SnS carb backing plate.



The King, Super D carb.

After finishing this series of run runs I decided to add a short group of runs using a modified manifold off of an 116CI twin cam. This manifold is an early S&S TC version for a Super G with 1.78-inch port spigots but has been modified to handle a D. It can run a number of carbs with proper spacers, added to smooth the transition from carb exit to the manifold. 1.78-inch ports are about the largest port used on street heads. The more common port size is about 1.62 inches, which is close to the stock TC88 port size. Since flow measurements between the carbs can vary pretty much depending on the manifold, I also ran some additional tests with different manifolds to show these variations. All these runs included a carb backing plate or velocity stack to ensure that flow was optimum through the carb.



CV51 on manifold.



HSR45 in manifold with velocity stack.



Super D with velocity stack on the intake manifold.

Here is how the flow test results ended up.

Flow At 10 in Water

Carb Name	Run	Flow No back Plate	Run	Flow with Backplate	Run	Flow With Velocity stack	Run	Flow On D manifold
Keihin 40mm CV	1	159.2	2	160.1	3	X	25	X
Keihin 51mm CV	4	250.1	5	252.7	6	X	26	178.0
Mikuni HSR45	7	214.7	8	224.4	9	224.4	27	178.6
Mikuni HSR48	10	263.5	11	268.4	12	268.4	28	186.0
SnS Super E T-jet	13	197.2	14	198.6	15	198.6	29	X
SnS Super G Stock	16	225.3	17	231.9	18	231.9	30	174.7
SnS Super G Modified	19	240.3	20	246.8	21	250.1	31	181.1
SnS Super D	22	265.1	23	X	24	278.2	32	191.0

Since the SF110 was only able to pull 3 inches of water during the test, I multiplied the results times the square root of 10 divided by 3 to adjust the flow to 10 inches water. This is a popular flow pressure for heads and the flows can be compared to the port flows of various head porters. Examples of intake port flow can range from the 110 to 130s for a stock heads at 0.50 inches lift to 150s for SE heads at 0.5 inches lift to 170/180s for heads from BC Gerolamy WA3 heads at 0.6 lift or Harley HTCC CNC heads that flow slightly less.

The first 3 measurement columns don't reveal vary much except that the CV carbs do not flow as well as other carbs when compared to by venturi size. For instance, the Super E flows 24% more than a CV40 even though the venturi is only 4% larger. This difference more than likely stems from the fact that the carb exit on a CV 40 is smaller so the butterfly offers more restriction to flow. The same phenomenon shows up when comparing the CV51 to the HSR48. The CV51 flows less than a HSR48 even though the venturi is 0.045 inch larger. Again, the butterfly limits flow where the HSR48 has none.

The more interesting changes occur when adding the intake manifold. The obvious difference is that all the carb flows dropped drastically. Larger carbs dropped around 30% and the smaller carb, HSR45, only dropped 20%.

Carb Name	Drop In flow
Keihin 51mm CV	30%
Mikuni HSR45	20%
Mikuni HSR48	31%
SnS Super G Stock	25%
SnS Super G Modified	27%
SnS Super D	31%

Another interesting change in flow was that some carbs that flowed better than other carbs, now flowed worse. The CV51 seem to loose the most ground. Now the modified G outflowed the CV51 and the HSR45 became comparable to the CV51. The Super D still lead the pack with the HSR48 closer behind and the modified Super G made a good showing in 3rd place. Notice that the lower flowing carbs flow close to the requirements for some of the higher flowing heads. Using a top end head like BC would require a higher flowing carb than an HSR45, Stock G or CV51 if going all out.

After examining this data, I decide to run a few more tests that I thought would be interesting. First, when installing a CV51 on an S&S manifold, the carb sits about ½ inch higher than the stock CV51 setup. On taller twin cam motors this can lead to interference problems with the gas tank. Some time ago I made an adapter that dropped the CV to the same level as a stock manifold. This adapters allowed use of the stock air cleaner mounts and allows use of the carb on a twin cam Dyna with an SnS 116 cubic inch bore and stroke kit.

Another run compared the CV51 on it's stock manifold with 1.6 inch port spigot compared to the modified super G on a D style manifold with 1.6 inch port spigot.



Dropped manifold on flow bench prior to fitting CV51.



CV51 with dropped manifold adapter on super D manifold.



CV51 on stock manifold.

Carb Name	Run	Flow
CV51 no adapter	5	252.7
CV51 on special adapter	33	223.7
CV51 on D Man	26	178.0
CV51 with Special Adapter On D	34	174.7
CV51 in stock Man	35	153.5
Modified G on 1.6 D Manifold	36	158.7

Notice that the special manifold caused almost a 30 CFM drop in flow performance for the CV51. This was unacceptable but looking at the flow with the same adapter on the D manifold shows only a 3.3 CFM drop which is much more acceptable. The stock CV51 manifold flows considerably worse than the D manifold for the CV51. It definitely would be the optimum choice for higher performance heads. In fact while I didn't test a stock G on the 1.6 manifold, I'd predict that a stock G in a stock G manifold flows comparable to the CV51 on a stock CV51 manifold.

Conclusion

So which carb is best? Well based on flow I'd predict carbs that flow slightly more than the heads would be the best choice. Going to a much larger carb may result in minimal gain over the carb that flows less and it could be harder to tune due to the lower peak velocity cause by maximum head flow. The CV51 does not seem as good a performer as

the larger carbs but my own personal shows that it can supply the requirements of a higher performance motor and at the same time make it much more civil for in town driving. The Mikuni HSR carbs are probably the easiest to tune of the lot. The HSR48 is not far behind the Super D in flow performance. The Super G is a good carb but needs tweaking to match the flow of CV51. It requires more knowledge to tune but can perform as well as the Mikunis at the expense of slightly poorer gas mileage.

So now you've got some more to argue about..