



[Home](#) [Message Boards](#) [Photos](#) [Videos](#) [Reviews](#) [Classifieds](#) [Arcade](#) [Contact](#) [Advertise](#)

[GoFastNews.com - All Racing News All the Time!](#) > [General Discussions and Site Information](#) > [Technical Articles](#)
[Porting School #3 Budget Bench Calibration](#) **Porting School**
#3 Budget Bench Calibration

User Name ☐ Remember Me?
 Password

[Register](#) [Blogs](#) [Gallery](#) [FAQ](#) [Community](#) [Calendar](#) [Today's Posts](#) [Search](#)

Technical Articles Learn from our staff of Technical Writers!



Page 1 of 4 [1](#) [2](#) [3](#) > [Last](#) >>

[View First Unread](#)

[LinkBack](#)

[Thread Tools](#)

[Display Modes](#)

06-18-2008, 11:47 AM

#1 (permlink)



DavidVizard-GFN [OFF](#)
 Pit Crew

Join Date: Apr 2007
 Posts: 840

Porting School #3 Budget Bench Calibration

GFN Porting School

Here is where you can learn the intricacies of cylinder head design, porting techniques, building of flow benches and anything else that pertains to the flow of air through an engine.

Principle Contributor - David Vizard

#3 Calibrating a Budget Bench

By
David Vizard

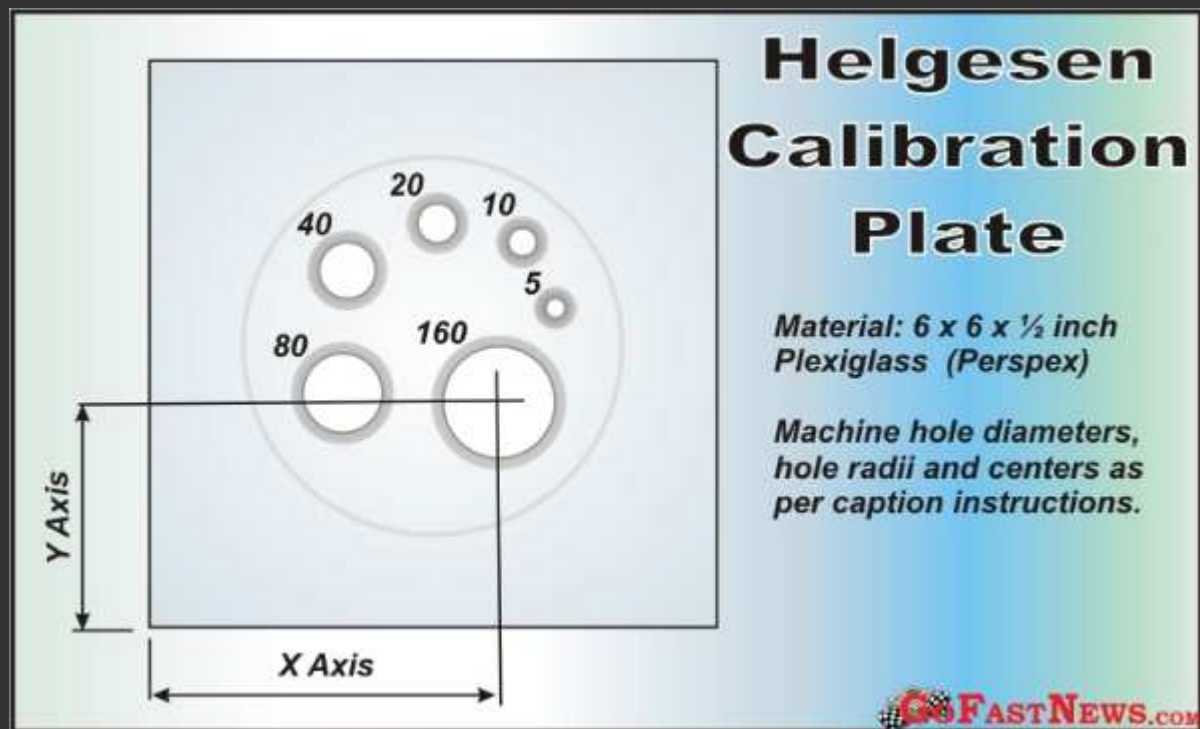
OK so you have built the budget flow bench detailed in part 2 ([Porting School #2 - Super Cheap Flow Bench](#)). While this may allow you to establish if you have made a move that helps or hinders flow it does not allow you to compare your efforts with the rest of the world (or at least most of it). Within reasonable limits we will look at a simple, low cost, method to fix that.

When I was using the flow bench described in Porting School #2 I never made the connection between using a floating pressure drop and actually calibrating the setup to give CFM. Instead I built a monster of a bench to British Standards with all the corrections then known to man. It is not a job that I would

recommend to other would-be porters/cylinder head development engineers. Your time is better spent on developing heads and selling what you are producing. Doing otherwise means investing what is potentially a huge amount of time and effort and, for that matter – money – in a bench that at the end of the day serves you little or no better than one built along the lines described in part #2.

So my recommendation here are build a bench as described in part #2 and if you are looking for more in the way of performance from the bench just build it bigger and with more powerful motors.

But let's get back to reading out our results in CFM. Here's where the revelation came in. For many years I knew my good friend Roger Helgesen had a flow bench but the deal here was we always hung out at my place (maybe that's because the Serdi seat and guide machine was there). But one day I found myself over at his house where he had his flow equipment, porting bench and tools. What an eye opener that was. If ever there was a guy that could come up with ultra simple ways of doing ultra complex jobs it's RH. (another good friend of mine, Steve Dulcich, the editor of Engine Masters magazine christened Roger 'Dr. Air' and I always thought that to be a very appropriate moniker). What really caught my attention here was the calibration plate Roger had made up and the graph he was using to simply read off the CFM at 28 inches of depression. The plate is shown below along with the dimensions to produce it. The size of the holes in it are such as to flow 5, 10, 20, 40, 80 and 160 cfm at 28 inches of depression across the plate. Not only can you use this plate to figure out how much flow is passing through a head on a floating depression bench but also it can be used as a reference tool for a regular bench such as a Superflow.



These holes need to be machined with a very smooth surface. As for tolerances make them as accurate as possible (+/- 0.001 is acceptable)

The hole sizes and X-Y co-ordinates are:

Hole 5:- 0.210 Dia. on 4.30/3.40 inches. Hole 10:- 0.296 Dia. on 3.95/4.10 inches. Hole 20:- 0.419 Dia. on 3.05/4.30 inches. Hole 40:- 0.594 Dia. on 2.10/3.80. Hole 80:- 0.840 Dia. on 2.05/2.5 inches. Hole 160:- 1.185 Dia. on 3.70/2.40 inches. Radius entry for all holes is 0.25 inches. This is machined such that the edge of the radius goes out to 80 degrees not the full 90. The back of the 5 and 10 size holes must be chamfered with a 90 degree cutter. For the 5 hole the chamfer should be 0.460 diameter and for the 10 hole 0.546 diameter.

For details on making an accurate calibration of a bench be sure to read the main text fully.

A few words about producing/acquiring a Helgesen plate. With Roger's kind permission I have put up dimensions here so you can produce your own. The intent was not that a GFN reader would go into

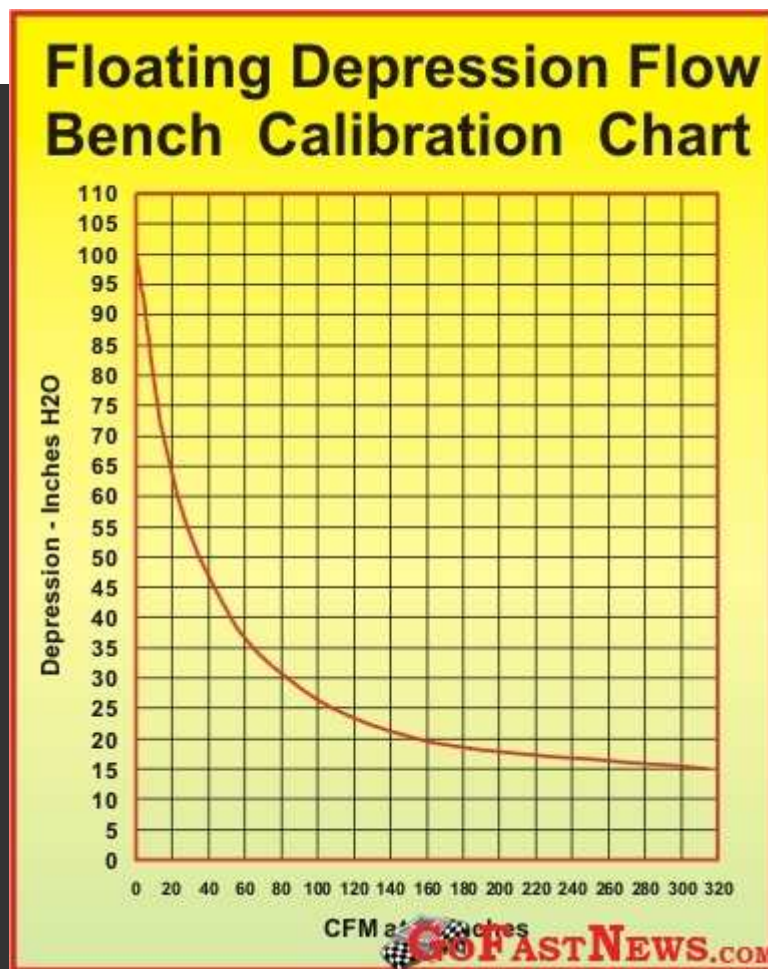
production with these and sell them as after all it's RH's idea and just out of political correctness I would ask you respect that. If you are not in the position to make one then, if the demand is there for say 20 or more, RH will sort out the manufacture of them and sell you one.



Seen here are the calibration plates we use to check our bench. These plates have been run on an accurate bench and so have odd numbers for the holes such as 161.5. With this setup we can calibrate our bench up to 480 cfm at 28 inches.

Let us assume at this point you have a plate – how is it used to give cfm at 28 inches? Here is how that is done. First make sure your bench is sealed up so no leakage will take place except through the test piece. Position the Helgesen plate on the bench with all holes plugged with clay (or any convenient plugs). Next start with a reading on the manometer with the plate completely blocked off for a 'zero flow' depression test and note the pressure drop seen on the manometer. Note this stalled depression. (if you did not make your manometer tall enough the vacuum cleaner will have now drunk all the water from it!) Now open the 5 cfm orifice (note – when I was talking about machining this plate they were referred to as holes – now we are flowing through them they are orifices!) and note the depression seen. Next plug the 5 cfm orifice and open the 10 – flow test and note the depression, next open the 5 and 10 cfm orifices together and again, note the depression. Keep going here in 5 cfm increments until all the orifices are open and you have recorded the depression at each 5 cfm increment.

Now go and get yourself a couple of large sheets of graph paper. The larger the better here. I recommend something in the order of 20 x 20 inches. Now for the intake, make up a graph as shown below.



To read CFM off this chart look up the depression on the left hand scale and go across the chart until you intersect with the red line. Drop down the chart and the bottom scale gives you the CFM at 28 inches. Remember the scales on your graph will be different to this example shown here.

If you plot out your results you should get a curve such as that seen here. Where it starts and finishes will be totally dependant on the vacuum/pressure source. Once you have a curve for the intake repeat the test but using the blower side of the vacuum cleaner and the plate reversed. Now blow through all the holes in the same progression used for the intake and make up a graph for the exhaust. At this point you can now flow a head and get some respectably accurate flow figures for comparative purposes.

Accuracy – How good?

Although what we have done here is very basic it can produce results comparable to benches costing ten grand and considered the industry standard. However there are many points at which errors can creep in and considerably reduce the accuracy of the results.

Let's start first with leakages. For the numbers to stand even a half way decent chance of being right the bench must not leak at any point. The only leak that can be present is the item you are flow testing.

The amount of suction a vacuum cleaner or any electric air mover can produce is influenced by the voltage input to the motor. You must monitor the voltage at the motor input and make sure you test at the same voltage each time. For the record RH (Dr. Air) has a step up transformer that puts the line voltage up from whatever it may be (it varies between 110 and 115) to 130 volts and then a rheostat device is used to adjust it to 115 volts.

The way the plate is mounted on the flow bench also effects the reading it produces. The ideal situation is to mount a box about 9 inches down each side (9x9x9) with a 5 inch hole in the top and whatever size hole mates up to the block or whatever you are using to simulate a block. The calibration plate is then placed directly over the 5 inch hole in the box and flow tested. If the plate is mounted on top of a bore even as large as 4 inches there will be a residual effect from the down stream velocity of the air and the plate will produce numbers that are 2-3% higher than if flowed into an open box.

Big changes in temperature and pressure will also affect the reading but this will only be minor if the bench is in a constant temperature indoors. If there is any doubt about the figures recheck the depression with the plate at say 160 cfm. Using this reading correct the numbers up or down by whatever percentage error was seen.

Be aware the best accuracy is seen when the depression falls between 160 inches and 15. If at high valve lifts the depression drops much below about 10 inches you can figure that when corrected they could read higher than they should. Just how much is dependant on how sever any flow break away that occurs is and at what pressure drop it starts to happen.

Summary

Lets assume you are not in a position to make your own Helgesen Plate. where would you get one? Fortunatly a source has opened up here. **I seems that Bryce Mulvey of Dr J's Performance and Roger 'Dr Air' Helgesen have teamed up and Dr J's Performance will be selling all of the Helgesen developed porting tools. For more info check out their site as per below. If you have any enquiries email them at: sales@dr-js.com**

Dr J's Performance, 436 Montgomery Street, Orange CA 92868 Tel: 714-943-3404 Fax 714 -527-2769 [Dr J's Performance - Dr. J's Performance - Home](#) email

What you have at this point is a bench that is both cheap to build and can deliver CFM numbers. The next step for an upgrade here is to write an Excel program that does the number crunching for you. I have a program that I am currently updating that will allow you to input the depression numbers into your PC and produce a professional looking chart of the flow tests. That's still a ways of and is very work load dependat for a finish date. but if you are interested watch this space (as they say).

But let me ask a question here. How would you like to upgrade what we have built here with an electronics package that, **for under about 700 bucks**, will allow your bench to read out in corrected CFM and directly integrate with your computer so you can do fancy print-outs? Sound good? (Yeh - almost too good to be true.)This story is in the works right now and will be the next installment of GFN's Porting School

David Vizard

Other parts in this series are at:

- #1 [Porting School #1 - Why engines need airflow](#)
- #2 [Porting School #2 - Super Cheap Flow Bench](#)
- #3 [Porting School #3 Budget Bench Calibration](#)
- #4 [Porting School #4 - Budget Bench Electronics](#)
- #5 [Porting School #5 Identifying Primary Restrictions](#)
- #6 [Porting School #6 - Secrets to reduce valve shrouding](#)
- #7 [Porting School #7 - Power & Port Volumes](#)
- #8 [Porting School #8 Optimal Port area's](#)
- #9 [Porting School #9 - 5 Rules to Goof-Proof Porting!](#)
- #10 [Porting School #10 - Pushrod Pinch Point Power Issues](#)

In addition to the Porting School articles there are directly related cylinder head development subjects at the following locations:

Wet Flow

[Six Wet Flow Mistakes](#)

Combustion Dynamics Series

#1:- [Turbulence and Combustion Dynamics](#)

#2:- [In cylinder Turbulance and Combustion Dynamics](#)

#3:- [Turbulence and Combustion Dynamics - Part 3](#)

#4:- Coming soon

#5:- [Turbulence and Combustion Dynamics - Crevice Volumes - Stealth Power Thief](#)

**Want to learn how to develop and port heads for high performance professionally?
If so click on the link below.**

Last edited by DavidVizard-GFN; 09-18-2008 at 09:23 PM.



06-18-2008, 09:22 PM

#2 ([permalink](#))

[Nick Campagna](#)

OFF

Garage Sweeper

Join Date: May 2008
Posts: 37

This is a v good series for people to study. If someone made a mold of their port, and then cast a hard plaster shell around it, they could make real progress in seeing how shape affects flow by porting the plaster. The original port can still be returned to by not destroying the original port mold plug.



06-19-2008, 10:08 PM

#3 ([permalink](#))

[Travis Gibson](#)

OFF

Garage Sweeper

Join Date: Mar 2008
Posts: 22

Vacuum Source affecting accuracy...

David,

Could you give some guidelines as to what would constitute a sufficient vacuum source for say a factory rectangular or aftermarket oval big block Chevy? Maybe more accurately, how about 340 max CFM with a 2.30" valve? I understand completely that the depression can't drop 10-15" of H2O and retain turbulent flow and accuracy, and was just wondering if you had any idea what could work. I don't know if I'm in the ballpark but would two commercial shop vacs inline be enough or would you need a custom box with several electric vacuum motors?

If you were to build a bench with enough suction to accurately read BBC heads, would you need to use trimming holes to make low-lift flow on stock port small block Chevys possible? Would that be too much of a problem with multiple calibrations and would it eliminate any accuracy?

I'm unsure if this question made its way into the other thread, but are there any digital manometers that you would know of that could replace that large homemade one? My shop only has a 7' ceiling. ☺



06-20-2008, 09:56 AM

#4 ([permalink](#))

8sgreat OFF
Garage Sweeper

Join Date: May 2008
Posts: 2

Finally I can not only check out my porting skills (or lack of) but also quantify them without spending a fortune on equipment. Thank you Mr. V and Dr Air.

8 is great



06-20-2008, 08:25 PM

#5 ([permalink](#))



Dusty OFF
Contributor

Join Date: Apr 2007
Location: Charlotte, NC
Posts: 183

use a Rheostat

!!!WARNING!!! Not Edited For Content



06-21-2008, 10:36 PM

#6 ([permalink](#))

old blue 75 OFF
Garage Sweeper

Join Date: Mar 2008
Posts: 83

Quote:

Originally Posted by **Dusty**
use a Rheostat

I have been working on a flow bench project and am planning on using a router speed controller hooked to one of 8 vacuum motors.

[Harbor Freight Tools - Quality Tools at the Lowest Prices](#)



06-22-2008, 09:13 AM

#7 ([permalink](#))



DavidVizard-GFN OFF
Pit Crew

Join Date: Apr 2007
Posts: 840

Quote:

Originally Posted by **Travis Gibson**
David,

Could you give some guidelines as to what would constitute a sufficient vacuum source for say a factory rectangular or aftermarket oval big block Chevy? Maybe more accurately, how about

340 max CFM with a 2.30" valve? I understand completely that the depression can't drop 10-15" of H2O and retain turbulent flow and accuracy, and was just wondering if you had any idea what could work. I don't know if I'm in the ballpark but would two commercial shop vacs inline be enough or would you need a custom box with several electric vacuum motors?

If you were to build a bench with enough suction to accurately read BBC heads, would you need to use trimming holes to make low-lift flow on stock port small block Chevys possible? Would that be too much of a problem with multiple calibrations and would it eliminate any accuracy?

I'm unsure if this question made its way into the other thread, but are there any digital manometers that you would know of that could replace that large homemade one? My shop only has a 7' ceiling. 😊

Travis,

Two decent sized shop vacs should be more than enough to flow a BB chevy head. for a small block one might be fine but you can still use two as the maximum depression is limited by the vacuum cleaner itself.

Yes there are some digital manometers - I can't remember the company name just now - any readers Know - if so can you help out Travis here?

DV



06-24-2008, 12:51 AM

#8 ([permalink](#))

rsicard 
Garage Sweeper

Join Date: Nov 2007
Posts: 23

Water Manometers

Quote:

Originally Posted by **DavidVizard-GFN** 
Travis,

Two decent sized shop vacs should be more than enough to flow a BB chevy head. for a small block one might be fine but you can still use two as the maximum depression is limited by the vacuum cleaner itself.

Yes there are some digital manometers - I can't remember the company name just now - any readers Know - if so can you help out Travis here?

DV

David and Travis:

Here is a good source for water manometers.

[Dwyer Instruments Series 1211-1212](#)



06-24-2008, 12:56 AM

#9 ([permalink](#))

rsicard 
Garage Sweeper

Join Date: Nov 2007
Posts: 23

Quote:

Originally Posted by **DavidVizard-GFN** 
Travis,

Two decent sized shop vacs should be more than enough to flow a BB chevy head. for a small

block one might be fine but you can still use two as the maximum depression is limited by the vacuum cleaner itself.
Yes there are some digital manometers - I can't remember the company name just now - any readers know - if so can you help out Travis here?

DV

David:

This is a fantastic set of articles. Sign me up for one of Dr. Airs calibrated flow tools. It is difficult to say if 11-12 more sign up for such a tool. I love Dr. Air and DV principles of Keep it Simple _tupid (KISS).



06-25-2008, 10:13 AM

#10 (permalink)



DavidVizard-GFN OFF
Pit Crew

Join Date: Apr 2007
Posts: 840

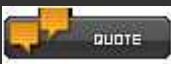
Quote:

Originally Posted by **rsicard**

David:

This is a fantastic set of articles. Sign me up for one of Dr. Airs calibrated flow tools. It is difficult to say if 11-12 more sign up for such a tool. I love Dr. Air and DV principles of Keep it Simple _tupid (KISS).

Everybody who wants one of these plates should post here so I can forward this to Dr.Air.
When we have about twenty he will get them made.
DV



Page 1 of 4 1 2 3 > Last »

Bookmarks

Digg del.icio.us StumbleUpon

Google Propeller

<< [Previous Thread](#) | [Next Thread](#) >>

Posting Rules

You **may not** post new threads
You **may not** post replies
You **may not** post attachments
You **may not** edit your posts

BB code is On
Smilies are On
[IMG] code is On
HTML code is On
Trackbacks are On
Pingbacks are On
Refbacks are On

[Forum Rules](#)

All times are GMT -4. The time now is 12:33 AM.

[Contact Us](#) - [Home](#) - [Archive](#) - [Top](#)

Powered by vBulletin® Version 3.8.0
Copyright ©2000 - 2010, Jelsoft Enterprises Ltd.
Search Engine Optimization by [vBSEO](#) 3.2.0
Copyright ©2007 - 2008 GoFastNews.com LLC