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Distributor Vacuum Advance Control units Specs and facts for GM Distributors

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I've been seeing a lot of discussion and questions regarding distributor vacuum advance control units; what do they do, which ones are best, what was used on what, etc., etc. To clarify some of this, I thought I'd summarize a few facts and definitions, and provide a complete part number and specification listing for all vacuum advance control units used by Chevrolet on the points-style and HEI (non-computer controlled) distributors. I'm also providing a listing of the specs for all other GM (non-Chevrolet) control units, but without the specific application listed for each (it would take me a bit too much time to research each part number by application across each of the GM Motor Divisions – it took me long enough to compile just the Chevy stuff...!). This paper also includes an outstanding technical article on the subject of timing & vacuum advance by renowned automotive engineer Duke Williams.

As always, I'm going to include the disclaimer that many of these are my own comments and opinions based on my personal tuning experience. Others may have differing opinions & tuning techniques from those presented here. I have made every attempt to present factual, technically accurate data wherever possible. If you find factual errors in this information, please let me know so I can correct it.

CAUTION: The procedures and recommendations outlined in this paper apply **ONLY** to pre-1981 non-ECM controlled vehicles. The timing methods outlined in this paper **CANNOT** be used on any ECM ("computer") controlled vehicle. Setting the timing per this paper on an ECM-equipped vehicle will result in improper timing and **probable engine damage. DO NOT USE** this procedure on any ECM-equipped vehicle.

Background

The vacuum advance control unit on the distributor is intended to advance the ignition timing above and beyond the limits of the mechanical advance (mechanical advance consists of the initial timing plus the centrifugal advance that the distributor adds as rpm comes up) under light to medium throttle settings. When the load on the engine is light

or moderate, the timing can be advanced to improve fuel economy and throttle response due, in part, to the slower flame travel in the combustion chamber under these lean conditions. Once the engine load increases, this “over-advanced” condition must be eliminated to produce peak power and to eliminate the possibility of detonation (“engine knock”). A control unit that responds to engine vacuum performs this job remarkably well.

Most GM V8 engines (not including “fast-burn” style heads) will produce peak torque and power at wide open throttle with a total timing advance of 36 degrees (some will take 38, and some smaller bore engines will take as little as 32, and this number can vary a little with altitude). Also, a GM V8 engine, under light load and steady-state cruise on modern pump gas, will accept a maximum timing advance of about 46-48 degrees (on “vintage” pump gas in the 60’s and up through the 90’s, you could typically run in the 52 – 54 range – this is no longer advised). Some will take up to 50 degrees advance under these conditions. Once you advance the timing beyond this, the engine/car will start to “chug” or “jerk” (aka, “trailer hitching”) at cruise, and may experience occasional misfire, due to the over-advanced timing condition. Anything less than 46 degrees produces less than optimum fuel economy at cruise speed.

The additional timing produced by the vacuum advance control unit must be tailored and matched to the engine and the distributor’s mechanical advance curve. The following considerations must be made when selecting a vacuum advance spec:

How much engine vacuum is produced at cruise? If max vacuum at cruise, on a car with a radical cam, is only 15 inches of Mercury (expressed as inches Hg), a vacuum advance control unit that needs 18 inches to peg out would, obviously, be a poor selection.

How much centrifugal advance (“total timing”) is in effect at cruise rpm? If the distributor has very stiff centrifugal advance springs in it that allow maximum timing to only come in near red-line rpm, the vacuum advance control unit can be allowed to pull in more advance without the risk of exceeding the 46-48 degree maximum limit at cruise. If the engine has an advance curve that allows a full 36-degree mechanical advance at cruise rpm, the vacuum advance unit can only be allowed to pull in 10-12 degrees of advance.

Are you using “ported” or “manifold” vacuum to the distributor? “Ported” vacuum allows little or no vacuum to the distributor at idle. “Manifold” vacuum allows actual manifold vacuum to the distributor at all times. Ported vacuum was used as an emissions control method to retard timing at idle (by eliminating vacuum advance) in order to reduce hydrocarbon emissions. Use of ported vacuum will result in higher engine operating temperatures, and will often not produce best quality idle. Unless emissions are a concern, manifold vacuum is usually the best choice for a performance engine, but ported vacuum can be used as a tuning aid and tuning method depending on the timing needs of the engine and the length of the mechanical advance curve: It’s one of the variables you can “play” with in the tuning process.

Does your engine require additional timing advance at idle in order to idle properly? Bigger cams will often require over 18 degrees of timing advance at idle in order to produce acceptable idle characteristics. If all of this initial advance is created by advancing the mechanical timing, the total mechanical advance may exceed the 36-degree limit by a significant margin. An appropriately selected vacuum advance unit, plugged into manifold vacuum, can provide the needed extra timing at idle to allow a fair idle, while maintaining maximum mechanical timing at 36. **A tuning note on this:** If you choose to run straight manifold vacuum to your vacuum advance in order to gain the additional timing advance at idle, you *must* select a vacuum advance control unit that pulls in *all* of the advance at a vacuum level 2” below (numerically less than) the manifold vacuum present at idle (See Duke Williams’ article starting on page 11 about the “2-inch Rule.”). If the vacuum advance control unit is not *fully* pulled in at idle, it will be somewhere in its mid-range, and it will fluctuate and vary the timing while the engine is idling. This will cause erratic timing with associated unstable idle rpm. **A second tuning note on this:** Advancing the timing at idle can assist in lowering engine temperatures. If you have an overheating problem at idle, and you have verified proper operation of your cooling system components, you can try running manifold vacuum to an appropriately selected vacuum advance unit as noted above. This will lower engine temps, but it will also increase hydrocarbon emissions on emission-controlled vehicles. Running straight manifold vacuum to the vacuum advance control unit is recommended for most applications where emissions are not an immediate concern.

Thus, we see that there are many variables in the selection of an appropriate control unit. Yet, we should keep in mind that the control unit is somewhat of a “finesse” or “final tuning” aid to obtain a final, refined state of tune; we use it to just “tweak” the car a little bit to provide that last little bit of optimization for drivability and economy. The vacuum advance unit is not used for primary tuning, nor does it have an effect on power or performance at wide open throttle.

With these general concepts in mind, let’s review a few concepts and terms. Then it’s on to the master listing of specs and parts.....:

Part Number

There are many different sources for these control units. Borg Warner, Echlin, Wells, and others all sell them in their own boxes and with their own part numbers. Actually, there are very few manufacturers of the actual units: Dana Engine Controls in Connecticut was the manufacturer of the units for all three of the brands just mentioned, but Standard Motor Products (SMP) bought Dana a few years ago, making them the manufacturer of the units. So it doesn’t make much difference who you buy from: They’re made by the same manufacturer. The part numbers I have listed here are the NAPA/Echlin part numbers, simply because they are available in any part of the country. For Wells part numbers (Autozone), drop the “VC” prefix and use a “DV” prefix.

ID#

Every vacuum advance control unit built by Dana, and sold under virtually any brand name, has a stamped ID number right on top of the mounting plate extension. This ID, cross referenced below, will give you all specifications for the unit. So now, when you’re shopping in a junkyard, you’ll be able to quickly identify the “good” vs. the “bad” control units. Original GM units do not have the same identifier. However, the original units can be identified in that the last two digits in the stamped number indicate the number of crankshaft degrees that the vacuum advance control unit will pull in at its maximum (i.e. number 724 16 is a vacuum advance unit that will pull 16 degrees of vacuum advance maximum).

Starts @ “Hg

Vacuum is measured in “inches of Mercury.” Mercury has the chemical symbol “Hg.” Thus, manifold vacuum is measured and referred to as “Hg. The “Start” spec for the control unit is a range of the minimum vacuum required to get the control unit to just barely start moving. When selecting this specification, consideration should be made to the amount of vacuum that a given engine produces, and what the load is on the engine at this specification. For example, an engine with a very radical cam may be under very light load at 7 inches Hg, and can tolerate a little vacuum advance at this load level. Your mom’s Caprice, on the other hand, has such a mild cam that you don’t want the vacuum to start coming in until 9 – 10 inches Hg. For most street driven vehicle performance applications, starting the vacuum advance at about 8” Hg produces good results.

Max Advance

Since the vacuum advance control unit is a part of the distributor, the number of degrees of vacuum advance is specified in DISTRIBUTOR degrees – NOT crankshaft degrees. When talking about these control units, it is important that you know whether the person you’re talking to is referring to the distributor degrees, or if he’s talking crankshaft degrees. All of the listings shown in the following chart, and in any shop manual & technical spec sheet, will refer to distributor degrees of vacuum advance. You must DOUBLE this number to obtain crankshaft degrees (which is what you “see” with your timing light). Thus, a vacuum advance control unit with 8 degrees of maximum advance produces 16 degrees of ignition advance in relationship to the crankshaft. When selecting a unit for max advance spec, the total centrifugal timing at cruise must be considered. Thus, a car set up to produce 36 degrees of total mechanical advance at 2500 rpm needs a vacuum advance control unit producing 10 - 12 degrees of crankshaft advance. This would be a 5-6-degree vacuum advance control unit (which doesn’t exist – see section below outlining how to limit the vacuum advance).

Max Advance @ “Hg

This is the range of manifold vacuum at which the maximum vacuum advance is pegged out. In selecting this specification, you must consider the vacuum produced at cruise speed and light throttle application. If your engine never produces 20” Hg, you better not select a control unit requiring 21” Hg to work. Generally, you want to select a vacuum advance control unit which pulls in its full advance at a vacuum level 2”Hg numerically lower than your

engine's operating vacuum at idle (and in "drive" if automatic). This will allow you to run manifold vacuum to your advance system with reliable results.

Other Tuning Notes and Observations

With new gasoline formulations and blends, we're seeing that the old-school tuning methods and numbers are no longer "cast-in-stone." Vapor pressure, flame propagation rates, and octane numbers of the fuel vary by regions across the country, so some special tuning may be required to assure the elimination of any detonation symptoms. Specifically, we're seeing that the fuels available in most parts of the country will not allow the use of a 16-degree (or more) vacuum advance curve without causing part-throttle and light-throttle acceleration detonation or other performance problems, such as misfire. Detonation is extremely harmful to an engine, and it must be avoided at all cost. The RFG ("Reformulated Gas") blends, with their faster burn rates, can also contribute to the "trailer hitching" symptom at cruise, as they will not support the old-school 52-degree total combined ignition lead specification. In these cases, you may find that you must limit your vacuum advance curve length to only 10-12 degrees. You can do this in one of three ways:

1. Procure a Vacuum Advance Corrector (VAC) to limit the vacuum advance to 10-12 degrees. These correctors are available for \$15 from:
(e-mail V8FastCars@msn.com for additional info):

Lars Grimsrud
Tuned by Lars Corvettes
1285 Cressida Court
Lafayette CO 80026

Use of this VAC will correct the vacuum advance curve length on any GM points-type (non-HEI) distributor with any vacuum advance control unit installed.

2. You can press a tubular bushing (using tube stock available in most hobby stores) onto the "pin" portion of the vacuum advance control unit. You can vary the outer diameter of the bushing to control the length of the vacuum advance unit's stroke.
3. You can weld a little metal into the limit slot of the vacuum advance unit and file it to the size needed to limit the curve length. Here's how to calculate exactly how much to shorten the slot:
 - Let's say you put your distributor in the engine and checked the curve and parameters with your timing light. You observe that the vacuum advance is adding 18 degrees of timing when it's fully "sucked in." Note the 18-degree number.
 - Remove the vacuum advance control unit. You can do this without pulling the distributor: Put a long hose on the nipple and suck on it to retract the vacuum advance – this will move the breaker plate to expose the attach screws.
 - Using a set of calipers, measure the travel distance, or "stroke," of the vacuum advance control rod. This will be the distance from the end of the limit slot to the contact surface of the control rod. Let's say this stroke length is 0.20".
 - Now we know that 18 degrees = 0.20". How do we find what is equal to 1 degree? 7th grade math tells us to divide both sides of the equation by 18:
 - $18/18 = 0.20/18$
 - Dividing this out we get that 1 degree = 0.011"
 - Since we want to shorten our vacuum advance from 18 to 12 degrees, we want to shorten it by 6 degrees:
 - $6 \times 0.011 = 0.067$ ". We want the stroke to be shorter by .067".
 - Push the control rod down and out of the slot so it's on the outside of the support arm, getting it out of the way. Measure the total actual length of the slot without the rod in the slot and subtract 0.067". This is the new target length of the slot. Weld a dab into the slot's end, and use a Swiss file or a ball end grinder on a high speed to shape the slot to the new calculated length.
 - Put it back together and test it.

NOTE: When you shorten the slot, it will take less vacuum to pull the vacuum advance control unit to the end of the slot: If it took 10" of vacuum to pull your vacuum advance control unit to its original 16-degree limit, it may only take 8" of vacuum to pull it to a shortened 12-degree limit.

We are also seeing that the quality control and accuracy of the vacuum advance control units is erratic at best. Most 16-degree units have a curve length of 17 to 18 degrees. Start points and "all-in" end points vary by several inches of vacuum. When you have installed your new control unit, be sure you test it and get the "real" numbers off of it to make sure it is meeting your tuning needs: If you need the vacuum advance to be "all-in" at 8" and the "B28" unit you bought isn't pulling the full curve until 10", you need to yank it out and try another one. **Test and verify everything.** Accuracy and attention to detail are the keys to successful tuning. I call this the "50% Hobby." That's because only about 50% of the parts fit right and perform as they should. Don't expect a part to meet spec just because it's new and in a nice box when you buy it.

The following listing (Non-HEI) is as follows: The first three part number listings are the numbers that cover most performance tuning applications. Although the old "B1" unit has been highly touted as the general performance replacement unit, I have found that it is simply too "stiff" to function well in any performance application: I use it very seldom. Rather, the "B22" should be used as the baseline unit for a mild performance engine, such as a stock 73 Vette. The B26 (same as a B20) is the most generally usable high performance unit, and it can be used on most performance engines with a factory high performance cam or a modest aftermarket cam. It works very well in engines with cams up to the equivalent of the CompCams XE262. MSD uses this unit in all of their vacuum advance controlled distributors. The "B28" can was used on fuel injected engines and a few select engines that produced very poor vacuum at idle. The advance comes in very quick on this unit – too quick for many performance engines. Do not use this very quick unit unless you have a cam/engine combination that really needs an advance like this. It can be used as a tuning aid for problem engines that do not respond well to other timing combinations, and can be successfully used in applications where direct manifold vacuum is applied to the can (see paragraph and discussion on this above). I use it in engines with cams bigger than, and including, the CompCams XE268 and in auto trans cars that pull poor vacuum in "drive."

After this, the listing is by Echlin part number. The Chevrolet applications are listed first by application, followed by a complete listing of all of the units used on any GM product (all GM units are interchangeable, so you can use a Cadillac or GMC Truck unit on your Vette, if that's what you want to do).

Non-HEI Distributors:

P/N	ID#	Application	Starts @ "Hg	Max Adv (Distr. Degrees @ "Hg.)
VC1802	B22	1971-72 350 4-bbl <i>Comments:</i> This part is still available through NAPA stores	7-9	8 @ 14-16
VC1765	B26 or B20	1965 396 Impala High Perf 1966-67 Corvette Exc. High Perf. 1966-67 Impala 427 Exc. High Perf. 1966-68 327 Powerglide Exc. High Perf. 1969 307 All 1969-70 396, 427 Camaro, Chevelle High Perf. 1970 400 2-bbl 1970 307 MT 1973 Camaro 350 High Perf. <i>Comments:</i> This part is still available through NAPA stores. Sold by Wells under part number DV1808. Available from Rock Auto under Hygrade part number VC181 for half the price of the NAPA part	5-7	8 @ 11-13
VC1810 GM stamp	B28 236-16	1965 409 High Perf. 1965 327 High Perf. 1966 327 High Perf. 1964-67 Corvette High Perf. FI	3-5	8 @ 5.75-8

Comments: The VC1810 High Performance unit has now been discontinued by NAPA/Echlin and all other sources. You can find occasional remnant inventory at some of the parts warehouses, such as Rock Auto, Stock Wise Auto, and others, but it's rare. Amazon and eBay are also good search sources. Crossover part numbers for searching are:

AC/Delco part number D1312C

Standard Hygrade part number VC177

Wells part number DV1810

Borg Warner part number V329

Airtex part number 4V1053

GM part number 88924985

VC680	B1	1959 – 63 All Chevrolet 1964 Corvette exc. FI 1964 Impala, Chevy II 1965 396 High Perf. 1965-67 283, 409 1966-68 327 exc. Powerglide 1967-68 All 396 1969 Corvette 427 High Perf. 1969 396 Exc. High Perf. 1969 Corvette 350 TI 1969-70 302 Camaro 1970 400 4-bbl 1970 396 High Perf. 1970 Corvette 350 High Perf. 1973-74 454 Exc. HEI <i>Comments:</i> This part is still available through NAPA stores. BW part number V280.	8-11	8 @ 16-18
VC1605	B9	1965 impala 396 Exc. High Perf. 1965 327 All Exc. FI 1969 327 Camaro, Chevelle, Impala 1969-70 Corvette 350 Exc. High Perf. 1969-70 350 4-bbl Premium Fuel 1970 350 Camaro, Chevelle, Impala High Perf. 1971-72 350 2-bbl AT 1971-72 307 All <i>Comments:</i> This part is still available through NAPA stores	7-9	10.3 @ 16-18
VC1675	B13	1968 327 Camaro Powerglide 1968 327 Impala AT 1968 307 AT 1968 302, 307, 327, 350 Camaro, Chevy II 1970 350 Camaro, Chevelle Exc. High Perf. <i>Comments:</i> This part has been discontinued by NAPA	9-11	8 @ 16-18
VC1760	B19	1969 350 Camaro, Chevelle, Impala 4-bbl 1969-70 350 2-bbl <i>Comments:</i> This part is still available through NAPA stores	5.5-8	12 @ 14-18
VC1801	B21	1971 350 2-bbl 1971-72 400, 402 1971-72 307 AT	7-9	10 @ 16-18

Comments: This part has been superseded and replaced by part number VC1605.

Other Part Numbers & Specs:

VC700	B3	8-10	11.5 @ 19-21
VC1650	B12	8-10	10 @ 15-17
		<i>Comments:</i> This part has been discontinued by NAPA	
VC1725	B18	8-10	12 @ 13-16
		<i>Comments:</i> This part has been discontinued by NAPA	
VC1740	A5	6-8	12 @ 15-17.5
VC1755	A7	8-10	12.5 @ 18-20.5
VC1804	B24	6.5-8.5	10 @ 12-14
		<i>Comments:</i> This part has been discontinued by NAPA	
VC1807	B25	5-7	8 @ 13-15
		<i>Comments:</i> This part has been discontinued by NAPA	
VC1808	B26	5-7	8 @ 11-13
		(The 1808 part number has been discontinued by Echlin. It is the same as part number VC1765)	
VC1809	B27	This part has been discontinued by NAPA	5-7 9 @ 10-12
VC1812	B30	5-7	12 @ 11.75-14
		<i>Comments:</i> This part has been discontinued by NAPA	

HEI Listing

NOTE: The HEI distributors use a longer control unit, so **the non-HEI and HEI vacuum advance control units cannot be interchanged.**

The following listing (HEI) is as follows: The first five part number listings are the 5 numbers that are most commonly used in a Chevrolet performance application. The “AR12” can is the most versatile and user-friendly unit for a good, mild performance street engine. The AR 15 and AR23 are almost identical, with only slight variations in their “start-stop” specs. The “AR31” can is the HEI equivalent to the “B28” Hi-Perf can used on the early engines: The advance comes in very quick on this unit – too quick for many performance engines. Do not use this very quick unit unless you have a cam/engine combination that really needs an advance like this. It can be used as a tuning aid for problem engines that do not respond well to other timing combinations, and can be successfully used in applications where direct manifold vacuum is applied to the can (see paragraph and discussion on this above). The VC1703 has a very short advance curve which makes it a great unit to use in cases where part-throttle detonation or “trailer hitching” is a problem on today’s pump gas.

After this, the listing is by Echlin part number. All GM HEI vacuum advance units are interchangeable, so you can use a Cadillac or GMC Truck unit on your Vette, if that’s what you want to do.

HEI Distributors:

P/N	ID#	Application	Starts @ “Hg	Max Adv (Distr. Degrees @ “Hg.)
VC1838	AR12	1975 350 Buick <i>Comments:</i> This part is still available through NAPA stores and through Wells under part number DV1838. Standard part number VC204.	7-9	7 @ 10-12
VC1703	N/A	1978-79 Vette Special Hi Perf 1979 305 El Camino Calif. 1978-79 350 Blazer & Suburban 1979 Buick 305/350 <i>Comments:</i> This part is still available through NAPA stores	3-6	5 @ 7-9
VC1853	AR23	1976 350 All Calif. 1976 350 Vette Calif., Exc. Hi Perf 1976 400 All, Exc. Calif 1975 350 4-bbl 1974 350 All w/1112528 Distr. 1978 350/400 Heavy Duty Truck, Exc. Calif, Exc. Hi Alt. <i>Comments:</i> This part is still available through NAPA stores	5-7	7.5 @ 11-12.5
VC1843	AR15	1977 305 All Exc. Hi Alt, Exc, Calif. 1974 400 All w/2-bbl 1977 305 El Camino 1976 262 Monza Exc. Calif 1976 350 Vette Hi Perf, Incl. Calif 1975 350 Z-28 1977 305 Buick Skylark <i>Comments:</i> This part is still available through NAPA stores as a “Special Order” class part	3-5	7.5 @ 9-11
VC1862	AR31	<i>Comments:</i> This part is still available through NAPA stores	2-4	8 @ 6-8

VC1825	AR1	1976 454 Caprice, Impala 1975 454 Caprice, Chevelle, Monte, Suburban	3-5	9 @ 6-8
VC1826	AR2		5-7	12 @ 10-13
VC1827	AR3		5-7	9 @ 9-11
VC1828	AR4	1975-76 350 Buick & Olds 1976 350 Pontiac	6-9	10 @ 12-14
VC1831	AR7	<i>Comments: This part has been discontinued by NAPA</i>	6-8	12 @ 14-16
VC1832	AR8	1975-76 455 Buick Electra	4-6	12 @ 12-14
VC1833	AS1	1975-76 500 Cadillac Exc. Calif.	4-6	14 @ 15-16
VC1834	AR9		4-6	13 @ 13-16
VC1835	AS2	1975-76 350 Olds	5.5-7.5	12 @ 15-17
VC1836	AR10	1977 305 All Hi Alt, Exc. Calif. 1977 350 All exc. Calif. 1977 350 Vette Exc. Calif, Exc. Hi Perf 1976 305 All Exc. Calif 1976 350 All Exc. Vette, Exc. Calif 1976 350 Vette Exc. Calif., Exc. Hi Perf 1975 262, 350 All w/2-bbl carb 1975 350 All 4-bbl w/ 1112880 & 1112888 Distr. 1977 305 Chev Truck Light Duty 1975-76 350 El Camino 2-bbl	3-5	9 @ 11-13
VC1837	AR11	1976 305 Blazer, Exc. Calif 1976 350/400/455 Pontiac 4-bbl	6-8	12.5 @ 10.5-13.5
VC1839	AR13		4-6	12 @ 11-13
VC1840	AR14	1975-76 350/400/455 Pontiac Firebird	6-8	10 @ 9-12
VC1841	AS3	1975-76 500 Cadillac Calif.	5-7	10 @ 13-14
VC1842	AS4	1976 350 Olds Cutlass	5-7	12 @ 13-15
VC1844	AR16		3-5	12 @ 13.5-15.5
VC1845	AS5	1978-79 425 Cadillac w/F.I. 1977 425 Cadillac	4-6	14 @ 14-16
VC1846	AR17	1977 301 Buick Skylark 1977 301 Pontiac	3-6	13 @ 10-13
VC1847	AS6	1978 403 Motor Home 1977-79 350/403 Buick LeSabre Hi Alt, Riviera, Olds 1977-79 350/403 Pontiac Hi Alt	4-6	12 @ 12-14

VC1848	AR18		4-6	12 @ 9-12
VC1849	AR19		4-6	12 @ 7-10
VC1850	AR20	1977 350/400 Pontiac	4-6	10 @ 8-11
VC1851	AR21	1977-79 350 Buick LeSabre, Century 1978-79 350 Pontiac	5-7	12 @ 11-13
VC1852	AR22	77-78 305/350/400 Chev Truck, Heavy Duty 1975-76 350/400 Chev Truck Heavy Duty	7-9	5 @ 12-14
VC1854	AR24		3-5	13 @ 10-13
VC1855	AS7	1977-79 260 Olds Cutlass	3-5	15 @ 10-12
VC1856	AR25		3-6	15 @ 10-14
VC1857	AR26		3-6	12 @ 13-16
VC1858	AR27	1978-79 305 All 1978 350 Camaro 1978 305 Chev Truck, M/T, Light Duty 1978 350 Chev Truck Hi Alt 1978 305/350 Buick & Olds 1978-79 305 Pontiac	3-6	9 @ 11-13
VC1859	AR28	1979 350 Vette Exc Hi Perf 1978-79 305 w/1103282 Distr., Incl. El Camino A/T 1979 350 Camaro, Impala, Nova, Malibu, Monte 1979 350 Suburban 1979 350 Buick Century 1978 305/350 Buick & Olds 1978-79 305 Pontiac Hi Alt.	3-6	10 @ 9-12
VC1860	AR29		3-6	12 @ 10-13
VC1861	AR30	1978-79 301 Buick 1979 301 Olds 1978-79 301 Pontiac	3-5	13 @ 11-13
VC1863	AR32		2-4	10 @ 11-13
VC1864	AR33	1978 305 Chev Truck, A/T, Light Duty	4.5-6.5	13 @ 11-13
VC1865	AR34	Special Hi Perf <i>Comments: This part has been discontinued by NAPA</i>	3-5	15 @ 8.5-11.5
VC1866	AS8	1978-79 425 Cadillac w/carb	3-5	14 @ 13-15
VC1867	AS9		2-4	10 @ 8-10
VC1868	AR35	1979 305 Chev Truck & El Camino 1979 305 Buick & Olds 1979 305 Pontiac A/T	2-4	10 @ 6-9
VC1869	AS10		2-4	12 @ 8-11

Background on the author on the following article:

The following article about vacuum advance controls and timing was written by Automotive Engineer Duke Williams. Duke has an in-depth engineering understanding of internal combustion engines, being one of a few hundred living graduates of The University of Wisconsin Engine Research Center where he did emissions related research and earned a MSME.

Over the last several years he has put together a desktop PC based suite of engine system engineering tools - a toolset that engineers would have killed for 30 years ago - and he is able to do professional level engine system engineering. In particular, he has an interest in projects that maintain original engine appearance and overall operating characteristics, while improving overall performance, which is primarily expressed by torque bandwidth. He works closely with enthusiasts who have a genuine understanding and appreciation of engine system engineering principles.

I have personally met and talked to Duke, and I can attest to his in-depth knowledge, both theoretical and practical, of internal combustion engine principles and applications. His article that follows accurately describes the requirements for ignition timing and vacuum advance.

Lars Grimsrud

Vacuum Advance Principles and Applications

By Duke Williams, MSME

The basic rule for vacuum advance control (VAC) selection (henceforth referred to as THE RULE):

THE VAC SHOULD PROVIDE FULL ADVANCE AT NOT LESS THAN 2" LESS THAN PREVAILING IDLE VACUUM AT NORMAL IDLE SPEED WITH APPROXIMATELY 24-32 DEGREES TOTAL IDLE TIMING.

This is a system engineering rule of thumb, and total idle timing should be in the upper half of the range for "big" (high overlap) cams and the lower half for "mild" (low overlap) cams. With a 16 degree VAC this is achieved with 8-12 degrees of initial timing for mild to medium cams and 12-16 degrees for medium to big cams. Based on overlap, the "300HP cam" is "mild", 327/350 and all BB cams, except L-88/ZL-1, are "medium", and all SB mechanical lifter cams are "big". L-88/ZL-1 cams are "REAL big".

Idle vacuum in neutral is an inverse function of effective overlap, and the range on C1/C2 engines is the very high overlap 30-30 cam, which only pulls 10"@900 to the low overlap base engine SB cams (which were also used on some optional engines) that pull about 18"@500. All others are in between, except L-88/ZL-1, which are pure racing engines that were never intended for street use so they were not equipped with functional VACs. In all cases, typical idle vacuum is affected by both idle speed and total idle timing. Higher idle speed increases vacuum and, up to a point, so does increasing total idle timing, which is why high overlap cams need both higher idle speed and higher total idle timing.

Initial timing should also be established to keep maximum WOT timing in the 34-40 degree range for SBs and 36-42 degree range for BBs, and WOT detonation may dictate the lower end of these ranges depending on compression ratio, cam, and operating conditions such as ambient air temperature and altitude. Higher ambient temperatures promote detonation as do low altitudes where average air density is higher.

Higher overlap increases exhaust gas dilution at idle and cruise, which slows flame propagation speed, which increases the timing requirement. Insufficient total timing at idle and low speed cruise increases EGT, which will

cause more heat to be absorbed by the cooling system, which can result in high operating temperatures and, in extreme cases, overheating to the boilover point, even if all cooling system components are within their original performance range.

Using THE RULE, one of the following three NAPA/Echlin vacuum cans should be appropriate for all C1/C2 OE engines, including those converted from ported to full time vacuum advance and C1 engines that are converted from the non-vacuum advance dual-point distributor to a single point vacuum advance distributor.

VACs for modified engines (such as cams that alter OE idle vacuum characteristics) should be selected using THE RULE.

My system engineering "best fit" for all OE engines is also listed including those not originally equipped with VACS, but a few "best fit" VACs (396/425, 427/435 and '63 327/340,360) are significantly different than OE, due to either a poor match to engine idle vacuum characteristics i.e. don't meet THE RULE ('63 327/340, '65 396/425) or will not meet THE RULE when converted from ported to full time vacuum advance (427/435, '63 327/360). My "best fit" for 327/350 is also different than OE, which I discuss below.

VC1802 (stamped "B22") 0@8" 16@16" (283/220, 230, 245, 250, 275; 327/250, 300)

VC1765 (stamped "B20" or "B26") both 0@6", 16@12" (327/350, 396/425, 427/390, 400, 425, 435)

VC1810 (stamped "B28") 0@4", 16@8" (283/270, 290, 315; 327/340, 360, 365, 375, L-88/ZL-1)

All these VACs are now manufactured by Standard Motor Products, and they can be cross referenced to other brands (Standard, BWD, Neihoff, Wells, Delco) at the other brands Web sites. The alphanumeric code stamped on the mounting bracket (B22, B20, B26, or B28) is the code that denotes the specifications regardless of the brand name/part number.

If you're at the ragged edge of THE RULE a small increase in idle speed - on the order of 50-100 revs - will usually achieve the 2" difference since vacuum increases with increasing idle speed, and IMO some OEM recommended idle speeds, especially on SHP/FI engines, are unrealistically low - mechanical lifter cam engines should be idled in the 800-1000 range, and add at least 100 revs with FI. OE VACs with Powerglide may not achieve the required 2" margin idling in Drive, in which case the next more aggressive VAC should be installed.

The correct total vacuum advance for most pre-emission Corvette engines is about 16 degrees. Any ported vacuum signal lines (such as SHP big blocks and '63 327/360) should be converted to full vacuum advance, and on some of these applications, a new VAC (B28 for 327/360 and B20 for 427/435) must be selected to comply with THE RULE. The OE '63 327/340 has full time vacuum advance, but the OE VAC does not comply with THE RULE, so it should be replaced with B28.

A "more aggressive" than necessary VAC (significantly more than 2" difference between idle vacuum and full vacuum advance) is okay (but not necessarily "ideal") as long as there is no detonation. Too aggressive vacuum advance may cause transient detonation, such as on upshifts or part throttle acceleration. One choice is to reduce initial timing, which may reduce total WOT timing below optimum. Another is to install a less aggressive VAC as long as it meets THE RULE. The "best choice" is to install the "best fit" vacuum can.

Using THE RULE, one of the three above mentioned VACs should provide full advance in the range of 2"-4" less than typical idle vacuum, which is the "best fit" range.

For example, the 327/350 (L-79) was originally equipped with a Delco VAC (stamped "236-16" - last three digits of the "long" GMPD number and maximum crank advance as are all other OE Delco VACs) equivalent to the current B28 replacement, which is more aggressive than necessary. Since 327/350 pulls enough idle vacuum (14"-15"@750-800) to keep B20 or B26 pulled to the stop at idle with 2"-3" margin, it is the "best fit".

A "not sufficiently aggressive" vacuum can - one that does not keep the diaphragm pulled to the limit at idle to "lock-in" maximum vacuum advance can cause high coolant temperatures due to insufficient total idle timing, and variation in total idle timing due to an "unlocked, dithering diaphragm" can lead to idle instability, poor idle quality, and even stalling! Engine run-on at shutdown is also a symptom of too little total idle timing, which heats up

combustion chamber surfaces and causes preignition that can also lead to detonation during normal operation. My '63 327/340 suffered from these problems for several years until I realized that the OE 15.5" VAC (essentially equivalent to the B22) was not suitable to an engine that only pulled 12" at idle. I replaced it with a Delco 236-16 8" VAC (equivalent to current B28), which solved my idle quality/stability/run-on/detonation problems, and THE RULE for VAC selection fell out as sure as $E=mc^2$ fell out of Einstein's Special Theory of Relativity.

One other issue. Some think that ported vacuum advance is "correct", but it is NOT on pre-emission controlled engines.

Ported vacuum advance is an emission control technique to increase EGT, which promotes oxidation reaction in the exhaust, but it also increases operating temperatures, increases the tendency to detonate and run-on at shutdown, and increases fuel consumption. With a handful of exceptions, all GM pre-emission engines equipped with vacuum advance used full time manifold vacuum.

For some inexplicable reason, the '63 FI engine used ported vacuum advance- the first year vacuum advance was used on Duntov-cammed engines. Maybe GM thought that idle quality (always a problem on FI engines) would be better with ported vacuum advance, but it wasn't, and the '64-'64 FI engines got full manifold vacuum advance.

L-72/71 have ported vacuum advance to meet CA emissions since there was only one version of this engine for all 50 states.

If your experience with Corvette engines does not go back to pre-emission engines, then all you've ever seen is ported vacuum advance on emission controlled engines.

Duke