Finding Valves

My 1995 Universal M-35A(C) has past-due scheduled maintenance I will tackle this winter. That includes checking my valve clearances. I rebuilt a couple of motorcycle engines in my teens, but that was (ahem) awhile ago and, any way, one of them was a two-stroke.

Envisioning the task, I was brought up short by two simple questions. Which valve to adjust? And, when? When I pull off my valve cover, I want a diagram in hand to answer those questions. I have developed one.

First, The End Result

Actually, I developed two diagrams. They follow immediately below (and are combined at the last page). But, before presenting them, pay attention to these:

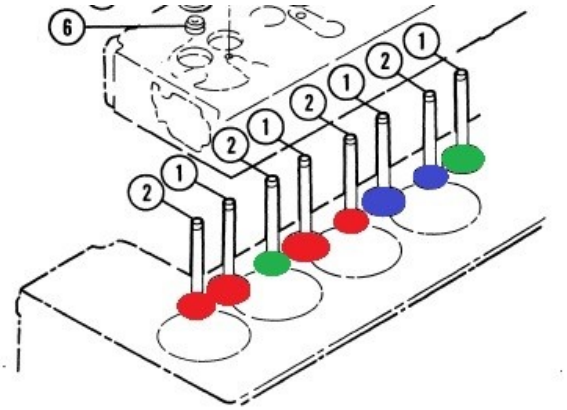
Caveats:

- My results are based upon my review of my engine's literature and my research reading articles and forum discussions and, of course, watching videos. I have no relevant real world experience on my engine or anyone else's. Add my information to your own research and determine for yourself whether to follow it.
- My **Table 1** results should apply to all four cylinder engines with a 1-3-4-2 (aka "1342") firing order. From my review of Universal and Kubota manuals, this should apply to Universal's M-35, M-35A and M-35B. The firing order is common for 4 cylinders. Check your manual.
- My **Valve Diagram** (Image 1) applies to Universal's M-35 and M-35A. I think, but am not certain, that it also applies to the M-35B. Only use this diagram if your valve locations match the M-35A's.

Okay, here is my **Table 1**. How it was made and how to use it will be covered in detail below.

	Cylinder #1		Cylinder #2		Cylinder #3		Cylinder #4	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
Cylinder #1 at TDC - Power	X	X	X			X		
Cylinder #3 at TDC (Cylinder #1 + 180°)					X			X
Cylinder #4 at TDC (Cylinder #1 + 360°)				X			X	

And, here is the **Valve Diagram** that applies to my M-35A(C). Check this against your own valve locations.



VALVE ROCKER ASSEMBLY

Item	Part No.	Quantity	Name/Description
1	300152	4	Intake Valve
2	300153	4	Exhaust Valve

Cylinder #1 at TDC - Power	
Cylinder #3 at TDC (Cylinder #1 + 180°)	
Cylinder #4 at TDC (Cylinder #1 + 360°)	

Image 1

Finding TDC – Power Stroke

Before reviewing how, let's consider why. I think all of the resources I reviewed begin adjusting valves with cylinder #1 at TDC (top dead center) at the beginning of its power stroke. Here is a visual aid.

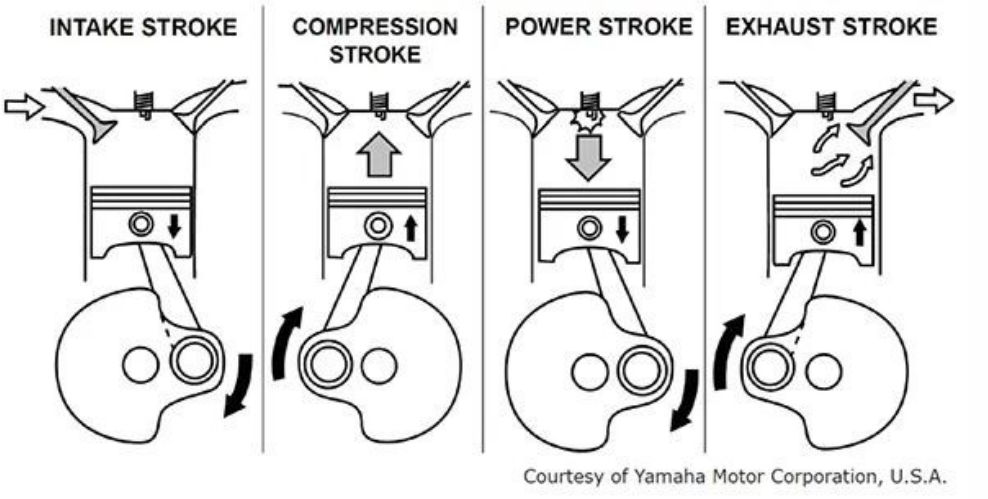


Image 2

Ignore the spark plug. Imagine that it is an injector. During the power stroke, the intake and exhaust valves are both closed. So, both can be adjusted. And, importantly, *both valves are also closed during the preceding stroke* (this will become useful later). Which means that you don't have to hit TDC perfectly. The valves are not moving as the cylinder moves from compression stroke to power stroke.

So, how do you find the cylinder that is beginning its power stroke? You don't. You find the cylinder whose valves are "rocking."

Rocking? This is when both valves of a single cylinder are moving at the same time, in opposite directions. It happens only once in the four stroke cycle, when the cylinder is at TDC, moving from its exhaust stroke to its intake stroke. The valve movements overlap, with the intake valve opening slightly before TDC and the exhaust valve closing slightly after TDC. Identify when a cylinder is at its TDC – Intake stroke, apply the cylinder firing order, and you can determine which cylinder is at its TDC - Power stroke.

The Rule of Fives

I made up this rule (though it probably has been described elsewhere). It is a variation of the "Rule of Nines" that I found in my research. It goes like this:

(Cylinder at TDC – Power) + (Cylinder at TDC – Intake) = 5

As examples:

- To bring cylinder #1 to TDC – Power, get cylinder #4 rocking.
- When cylinder #2 is rocking, you know that cylinder #3 is at TDC – Power.

The Mother of all Tables

Table 1, above, and the Rule of Fives are derived from the following Table 2. I would like to credit Stephan Fouquaert, @D3Sshooter, for demonstrating the usefulness of this type of table.

	Cylinder #1			Cylinder #2			Cylinder #3			Cylinder #4		
Stroke	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve
1	Power	Closed	Closed	Exhaust	Closed	Open	Compression	Closed	Closed	Intake	Open	Closed
2	Exhaust	Closed	Open	Intake	Open	Closed	Power	Closed	Closed	Compression	Closed	Closed
3	Intake	Open	Closed	Compression	Closed	Closed	Exhaust	Closed	Open	Power	Closed	Closed
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open

Table 2

Stroke 1 begins with cylinder #1 at TDC of its power stroke. I then followed the firing order, with cylinder #3 firing at the beginning of stroke 2, cylinder #4 at stroke three and, finally, cylinder #2 at stroke four.

In Table 3, I have added an additional "stroke 4" row, preceding stroke 1, to make the table easier to use. Table 3 shows the companion TDC – Intake cylinder (with its rocking valves) for each cylinder's TDC – Power stroke. For example, as cylinder #1 is moving into its power stroke, cylinder #4 is

moving from its exhaust stroke to its intake stroke. This is the origin of the Rule of Fives.

The "Rocking" Valves

	Cylinder #1			Cylinder #2			Cylinder #3			Cylinder #4		
Stroke	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open
1	Power	Closed	Closed	Exhaust	Closed	Open	Compression	Closed	Closed	Intake	Open	Closed
2	Exhaust	Closed	Open	Intake	Open	Closed	Power	Closed	Closed	Compression	Closed	Closed
3	Intake	Open	Closed	Compression	Closed	Closed	Exhaust	Closed	Open	Power	Closed	Closed
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open

Table 3

Valve Adjusting Sequence

Many of the resources I reviewed move from cylinder to cylinder, adjusting valves by bringing each cylinder to its TDC-Power stroke, adjusting both valves, and then bringing the next cylinder to its TDC-Power stroke. This, of course, works. But, the job can be done with fewer rotations. Remember, what we are looking for at each TDC are *those valves which are closed before and after TDC is reached.*

Table 4 shows that cylinder #1's exhaust and intake valves closed both at the end of its compression stroke and the beginning of its power stroke.

Stroke 1 – Cylinder #1 at TDC-Power

	Cylinder #1			Cylinder #2			Cylinder #3			Cylinder #4		
Stroke	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open
1	Power	Closed	Closed	Exhaust	Closed	Open	Compression	Closed	Closed	Intake	Open	Closed
2	Exhaust	Closed	Open	Intake	Open	Closed	Power	Closed	Closed	Compression	Closed	Closed
3	Intake	Open	Closed	Compression	Closed	Closed	Exhaust	Closed	Open	Power	Closed	Closed
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open

Table 4

Table 5 adds the other valves in the same condition, that is, the valves which are closed before and after TDC-Power is reached at cylinder #1. All of the valves in green can be adjusted. This is the origin of the first row of Table 1, above.

Stroke 1 – Cylinder #1 at TDC-Power

	Cylinder #1			Cylinder #2			Cylinder #3			Cylinder #4		
Stroke	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open
1	Power	Closed	Closed	Exhaust	Closed	Open	Compression	Closed	Closed	Intake	Open	Closed
2	Exhaust	Closed	Open	Intake	Open	Closed	Power	Closed	Closed	Compression	Closed	Closed
3	Intake	Open	Closed	Compression	Closed	Closed	Exhaust	Closed	Open	Power	Closed	Closed
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open

Table 5

We now turn the engine over 180° to stroke 2 and the beginning of cylinder #3's power stroke. In Table 6, the valves we have already adjusted are shown in yellow. The new valves that we can adjust are in green. This is the origin of the second row of Table 1.

Stroke 2 – Cylinder #3 at TDC-Power

	Cylinder #1			Cylinder #2			Cylinder #3			Cylinder #4		
Stroke	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open
1	Power	Closed	Closed	Exhaust	Closed	Open	Compression	Closed	Closed	Intake	Open	Closed
2	Exhaust	Closed	Open	Intake	Open	Closed	Power	Closed	Closed	Compression	Closed	Closed
3	Intake	Open	Closed	Compression	Closed	Closed	Exhaust	Closed	Open	Power	Closed	Closed
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open

Table 6

Another turn of 180° brings us to stroke 3 and cylinder #4 to its TDC-Power stroke. We can now adjust the remaining two valves. See Table 7. Again, the valves we adjusted earlier are in yellow. The valves which we can now adjust are in green. This is the origin of row 3 of Table 1.

Stroke 3 – Cylinder #4 at TDC-Power

	Cylinder #1			Cylinder #2			Cylinder #3			Cylinder #4		
Stroke	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve	Stroke	Intake Valve	Exhaust Valve
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open
1	Power	Closed	Closed	Exhaust	Closed	Open	Compression	Closed	Closed	Intake	Open	Closed
2	Exhaust	Closed	Open	Intake	Open	Closed	Power	Closed	Closed	Compression	Closed	Closed
3	Intake	Open	Closed	Compression	Closed	Closed	Exhaust	Closed	Open	Power	Closed	Closed
4	Compression	Closed	Closed	Power	Closed	Closed	Intake	Open	Closed	Exhaust	Closed	Open

Table 7

That's it. All of the valves have been adjusted moving through the first three strokes.

You do not have to start with cylinder #1. Bring any cylinder to its TDC-Power stroke, review The Mother of All Tables (Table 2), and figure out which valves can be adjusted.

I hope this information is useful. I encourage corrections, questions and comments.

Dan Cross
sv Hiatus
1995 C36 MKII TR/SK M-35A(C)

Table 1

	Cylinder #1		Cylinder #2		Cylinder #3		Cylinder #4	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
Cylinder #1 at TDC - Power	X	X	X			X		
Cylinder #3 at TDC (Cylinder #1 + 180°)					X			X
Cylinder #4 at TDC (Cylinder #1 + 360°)				X			X	

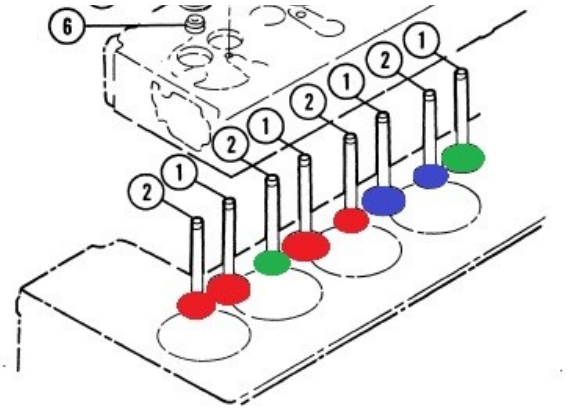


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Image 1