Cylinder Balance and Percent Changes
Lesson 11

Remember:
Pretty **P**lease **M**y **D**ear **A**unt **S**ally
(From left to right; **P**arentheses; **P**ower; **M**ultiply; **D**ivide; **A**dd, **S**ubtract)

Identify The Math, Math Terms, Vocabulary, Description Or Definitions

- **PERCENT** – changing a fraction to parts per hundred to make easier comparisons of fractional numbers to each other.
- **PERCENT OF CHANGE** – converting into a percentage the difference of two quantities.
- **CYLINDER** – that part of an engine where combustion is taking place.
- **Cylinder Disable** - Manually shorting the secondary ignition to a particular cylinder to prohibit combustion in that cylinder

What you will learn in this lesson will not only be useful in working on engines, but you will find it to be useful in your everyday life just like the opening pay raise and decrease problem. You will learn how to use words such as “mark up” – “mark-down” – “percent increase & decrease” – “percent drop & rise” all in conjunction with “Percent Change”. I’ll give you the formulas you will use, explain all the steps, go over sample problems and give you sample problems to work on independently that address both automotive problems and other problems outside of automotive that you will encounter in other real life situations.

- What affects compression ratio?
- Why is compression ratio when you are rebuilding an engine?
- What happens to the compression ratio if the piston displacement is increased and the chamber volume stays the same? What is the term for this?
- What happens to the compression ratio if the chamber volume is raised and the piston displacement stays the same? What is the name for this?
- What is the difference between DIRECT VARIATION and INDIRECT VARIATION?

DIRECT VARIATION — when two variables in an expression increase or decrease together.

INDIRECT VARIATION — when an increase in one variable in an expression causes another variable in the equation change to decrease and vice versa.

Remember: CID = CC/16.39 and CC = CID x 16.39

1. What is the compression ratio of a V8 5.0 L Mustang with a piston displacement of 302cu.in., and a combustion chamber volume of 75cc? If only the piston displacement were increased to 318cu.in., would the compression ratio increase or decrease? Find the new compression ratio and calculate the percent change to the original compression ratio.

2. What is the compression ratio of a V8 5.0 L Mustang with a, a piston displacement of 302cu.in and a combustion chamber volume of 68 cc?. If only the combustion chamber volume were increased to 80 cc, would the compression ratio increase or decrease? Find the new compression ratio and calculate the percent change to the original compression ratio.

3. Prior to tuning up a 1998 Geo Metro, you test it on a dyno and find its horsepower to be 49hp. After tuning it up you test it again and find its horsepower to be 53hp. What is the percent change (Percent Rise in horsepower) based on the horsepower before the tune-up?

4. If the temperature changes from 64 degrees to 72 degrees, what is the percent increase in temperature?

5. Given the equation $R = \frac{E}{I}$, R varies (directly or indirectly) with E?

6. Given the equation $I = \frac{E}{R}$, I varies (directly or indirectly) with R?

HP = TORQUE X RPM ÷ 5252

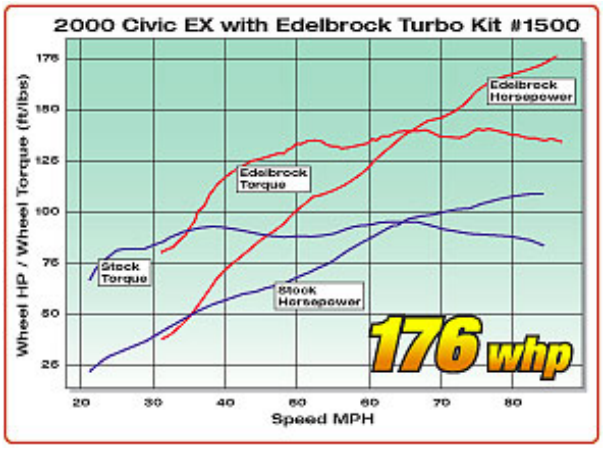
TORQUE = HP X 5252 ÷ RPM

Example: What torque is required to generate 329 HP at 6000 RPM?

T = 329 x 5252 ÷ 6000 = 288 foot pounds @ 6000 RPM

What torque is required for 296 HP at 4880 RPM?

What is the HP generated at 5800 RPM and 300 foot pounds?



Example of Cylinder Percentage Drop:

EXPLANATION	MATH
1. Determine the rpm before the cylinder is disabled and record value. This is RPM original.	1. From Chart = 650 RPM (original)
2. Disable number 1 cylinder and record RPM. This is RPM final.	2. From Chart = 550 RPM (final)
3. Subtract the RPM before the engine was disabled from the RPM after the engine was disabled. This will give you the drop in RPM.	3. (Original RPM – Final RPM) = RPM Change 650 – 550 = 100 (Drop on RPM)
4. Divide the "drop in RPM" by the original RPM before the cylinder was disabled. This will give you the decimal change.	4. 100 (Drop in RPM) divided by 650 (original) = decimal change 100/650 = .154
5. Multiply the decimal RPM change by 100% to get the RPM % change.	5. RPM decimal change X 100 = RPM % change .154 X 100 = 15.4% change

1. When doing a cylinder balance test on a 6-cylinder engine you come up with the following results:

Cylinder	RPM drop from 650 to
1	550
2	548
3	559
4	551
5	620
6	545

The manufacturer requires a least a 15% drop in RPM'S when a cylinder is killed. Complete the following chart. (Round to the nearest tenth of a percent)

Cylinder	RPM 650 TO	Total RPM drop (Original – Final)	$\frac{\text{(Original – Final)}}{\text{Original}}$	Multiply by 100
1	650 to 550			
2	650 to 548			
3	650 to 559			
4	650 to 551			
5	650 to 620			
6	650 to 545			

According to your calculations in the above chart, which cylinder is not producing power? Explain your answer.

North Montco Technical Career Center

Math-In-CTE

Lesson 11 Worksheet – Compression Ratio

Name: _____ AM-1: _____ PM _____ Date: _____

When doing a cylinder balance test on a 8-cylinder engine you come up with the following results:

Cylinder	RPM Drops from 825 to:
1	712
2	715
3	720
4	684
5	700
6	730
7	725
8	695

The manufacturer requires a least a 12% drop in RPM'S when a cylinder is disabled. Complete the following chart to determine which cylinder is not within the manufactures specs. (Round to the nearest tenth of a percent)

Cylinder	RPM 825 TO	Total RPM drop (Original – Final)	$\frac{\text{(Original – Final)}}{\text{Original}}$	Multiply by 100
1				
2				
3				
4				
5				
6				
7				
8				

Explain your answer:

Using the Ohm's Law formula $R=\frac{E}{I}$, what happens to the ohms (R) when the amps (I) are increased? Is this a direct or indirect variation?

North Montco Technical Career Center

Math-In-CTE

Lesson 11 Homework – Compression Ratio

Name: _____ AM-1: _____ PM _____ Date: _____

The manufacturer requires a least a 10% drop in RPM'S when a cylinder is disabled. Complete the following chart to determine which cylinder(s) is not within the manufactures specs. (Round to the nearest tenth of a percent).

Cylinder	RPM 650 TO	Total RPM drop (Original – Final)	(Original – Final) / Original	Multiply by 100
1	650 to 550			
2	650 to 548			
3	650 to 559			
4	650 to 551			
5	650 to 620			
6	650 to 545			
7	650 to 575			
8	650 to 535			

According to your calculations in the above chart, which cylinder is not producing power? Explain your answer.

1. What is the compression ratio of a V-8 engine with a piston displacement of 305cu.in., and a combustion chamber volume of 75cc? If only the piston displacement were increased to 327cu.in., would the compression ratio increase or decrease? Find the new compression ratio and calculate the percent change to the original compression ratio.

2. What is the compression ratio of an engine with a piston displacement of 396 cu.in., and a combustion chamber volume of 68 cc?. If only the combustion chamber volume were increased to 80 cc, would the compression ratio increase or decrease? Find the new compression ratio and calculate the percent change to the original compression ratio.