# WORK-ENERGY-POWER

Units 10 & 11 Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & New York Times, Oct. 13, 2016 by Jerry Garrett

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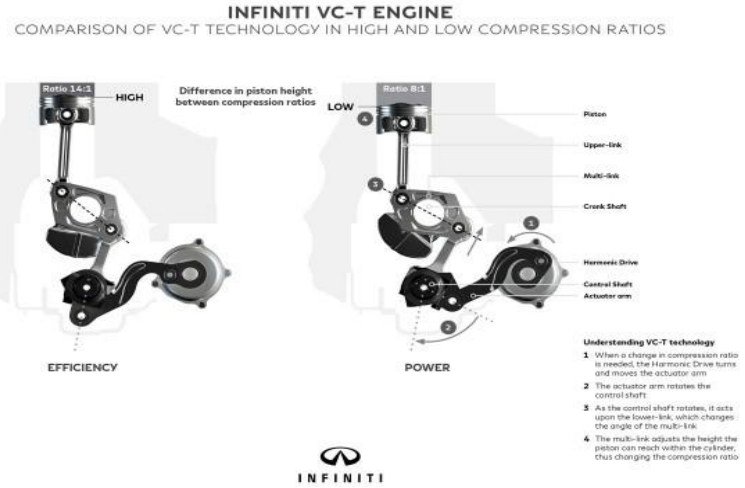
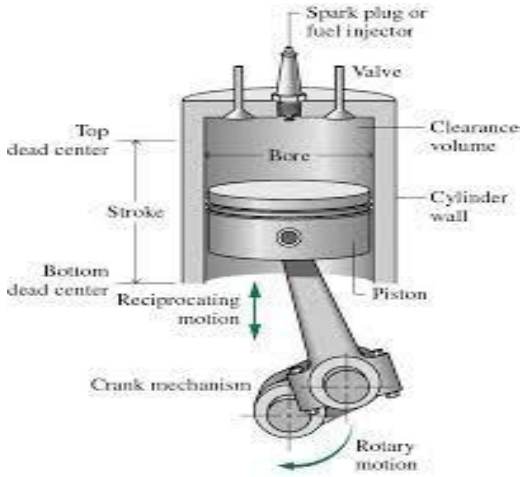
# Infiniti's VC-Turbo S.U.V.: A 'Leap Ahead' in Efficiency




**INTRODUCTION:** Cylinder bore (diameter…see graphic at right) is 84 mm and stroke 94.1 mm. Average cylinder pressure is 150 psi .(p'). While accelerating engine frequency is about 5000 rpm (f). The purpose of this application is to verify that one cylinder would produce per cycle about ¼ of the HP of this 268 HP (~ 67 HP) variable compression (VC) engine. P = Power = work/time = W/t = F x /t , but volume = (area) x = A x = V , thus, x = V/A , then P = [F V/A]/t = [F/A] V / t Where pressure = p' = F/A , Thus, Power = **P = p' V / t**

**QUESTIONS:** (a) Find volume V of cylinder in cc ?, (b) Convert volume of cylinder in cc to $ft.^3$ ?, (c) Convert 150 psi to $lb./ft.^2$ ? , (d) Find period (t) ( in seconds for one engine stroke) knowing the frequency f = 5000 rpm? , (e) Find power (P) produced by one cylinder in ft. lb./s. & HP ? (f) Find total power produced by a four-cylinder engine?

**HINTS:** 144 $in.^2/ ft.^2$ , 3.53 X $10^{-5}$ $ft.^3/$ cc , period = 1/f = t , area of circle = $\pi r^2$ , cylinder volume V = A x, 550 ft. lb./s. = HP

**ANSWERS:** (a) V = 521.48 cc , (b) V = 1,841.42 X $10^{-5}$ $ft.^3$ , (c) p' = 21,600 $lb./ft.^2$ , (d) t = ~ 0.012 seconds , (e) P = 33,135.56 ft. lb./s. or 60.25 HP/cylinder , (f) $P_{4\ cylindre\ engine}$ = 241 HP, **NOTE:** 4 cylinder turbo (~ 2000 cc) = 268 HP .close!))

**PARIS One of those "tricks" may have surfaced here at the 2016 Paris Motor Show.**

The technology, displayed by Nissan's Infiniti luxury brand and called VC-Turbo, would make it possible for the **first time in a production-ready vehicle to vary the compression ratio in the engine's combustion chambers while the car is being driven.** So what? A **lower compression ratio is desirable when the goal is to use less fuel and to produce fewer greenhouse gas emissions. A higher ratio is what you want when the purpose is to drive fast,** temporarily ignoring fuel economy and environmental concerns**. Infiniti demonstrated VC-Turbo technology here in a 2.0-liter turbocharged four-cylinder engine on display.** (Here's a video rendering of the inner workings.) The VC part of its nomenclature refers to variable compression. In today's fixed-compression engines the most common ratios are in the range of 8:1 to 14:1 — although they might go as low as 6:1 for economy cars, or up to 17:1 for Formula 1 beasts. In the case of the Infiniti engine, this is a range of 8:1 to 14:1 (and every ratio in between). Besides offering the range of performance, the VC-Turbo technology fits in a smaller engine size — just two liters — but it churns out about as much power as Infiniti's own much-larger 3.5-liter V6. Because it is smaller, it also saves weight: The 2.0 turbo here is 25 kilos, or 55 pounds, lighter than the V6. Infiniti says **(((the little 2.0-liter turbo here, which produces 268 horsepower)))** and 288 foot-pounds of torque, is 27 percent more efficient in terms of fuel economy and operation than a V-6 of similar output.