



## U.S. Coast Guard Auxiliary, Division 20

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### Articles By Vincent Pica

#### United States Coast Guard Auxiliary



Vincent Pica, Chief of Staff, First District, Southern Region

#### **Strokes Go Up, Weigh Goes Up, Pollution Goes Down**

So, I go out to buy a new engine for my dinghy. The old 2-stroke 5hp engine had finally, after nearly 10 faithful years, become too aged for further service. As I look at the options – all 4-stroke engines – I realize that I have to drop down to 3.5hp or face putting 80 pounds on the transom where formerly 40 pounds had ridden. This column is about that.

#### **The Old 2-Stroke engine – What is a “stroke”?**

The basics of a 2-stroke engine versus 4-stroke engine has to do with what is known as “Thermodynamic” cycle. Basically in a 2-stroke engine, the beginning of a compression stroke and the end of the combustion stroke also occurs at the same time as the intake and exhaust functions. In a 4-stroke each of these functions takes place within its own stroke. The return of the engine to its original position after going through these strokes is the “Thermodynamic” cycle – 2 strokes for the old model and 4 strokes for the newly legislated, current state of the art.

#### **So, What’s the Problem?**

A decade ago, the two-stroke motor, found on 75 percent of all boats and personal watercraft (jet skis), generated 1.1 *billion* pounds of hydrocarbon emissions each year. This was the annual equivalent of spilling as much oil and fuel into US waterways as the Exxon Valdez – 15 times over. These high emissions were attributed to the design inefficiency of the two-stroke motor, which had remained essentially unchanged since World War II. What made it so inefficient? Largely, it was this – about a quarter of the fuel and oil, mixed directly into the furl, went unburned and thus was emitted directly into the water and air. Imagine having the gas dock operator selling you 3 gallons of gasoline and charging for 4 gallons, putting the pollution aside... The EPA estimated that one hour of operation by a 70-horsepower two-stroke motor

emitted the same amount of hydrocarbon pollution as driving from New York to Los Angeles in a modern automobile – and back.

4-stroke engines emit 97% less pollution than conventional two-strokes. Why? Simple – 4-stroke outboards use the same combustion process used in automotive engines. This means that, unlike the 2-stroke engine, 4-stroke engines never have an exhaust and intake valve open at the same time. This keeps any unburned fuel from being ejected from the engine. Also, 4-stroke engines don't require additional lubricating oil to be blended in with the gasoline to operate and aren't part of the exhaust, unburned or otherwise. Like your car engine, the lubricating oil is a separate system within the engine complex, stored in the crankcase, unmixed with the gasoline. Also, they burn hotter, [read: more efficiently] and thus are more efficient at gas consumption.

Manufacturers quote as much a 25% better fuel mileage. (Of course, slowing down would help even more – tests show that you burn over 50% more fuel at WOT than at mid-ranges. See what the effect on your speed over the water is if you just throttle back. See SSP, "[Fuel Efficiency on the Water](#)", 7/23/08.)

### **OK, So What's the Problem Now?**

Well, they are heavy. When I went to replace my 5hp engine, I found that the 4-stroke replacement weighed 80 pounds – 2x's what the 2-stroke engine that it was to replace. When I contemplated trying to get that engine in and out of an 8-ft dinghy, floating dock-side, I said, "Ah, that's not going to happen without me and/or the engine ending up in the drink – what's the next size down?" 3.5hps in a 4-stroke weigh about what 5hps do in a 2-stroke. A car engine, not a weed wacker...

But the 2-stroke guys haven't missed some this dialogue. The latest technology response is DFI – direct fuel injection (DFI). The required fuel mixture is injected directly into the cylinder after the piston passes the exhaust port. This prevents any unburned fuel from being prematurely forced out of the engine. DFI retains the advantages of a two-stroke engine's efficient power cycle and lighter weight and greatly lowers pollution levels normally generated by 2-strokes. In short, they're not your father's 2-strokes any more.

All this can't be bad for boaters...