# Two Stroke Engines

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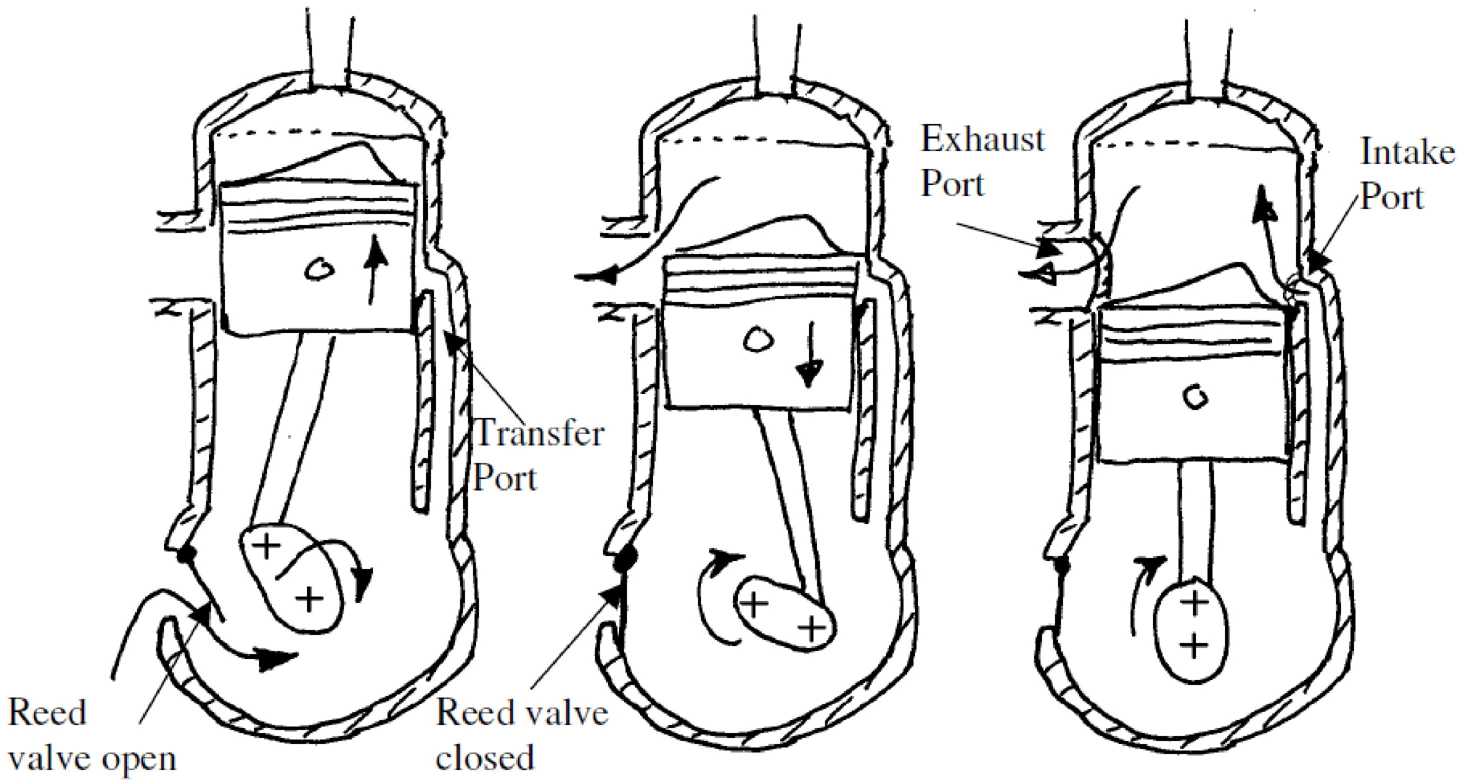



Figure 8.1: Basic processes in a 2-stroke engine gasoline engine.

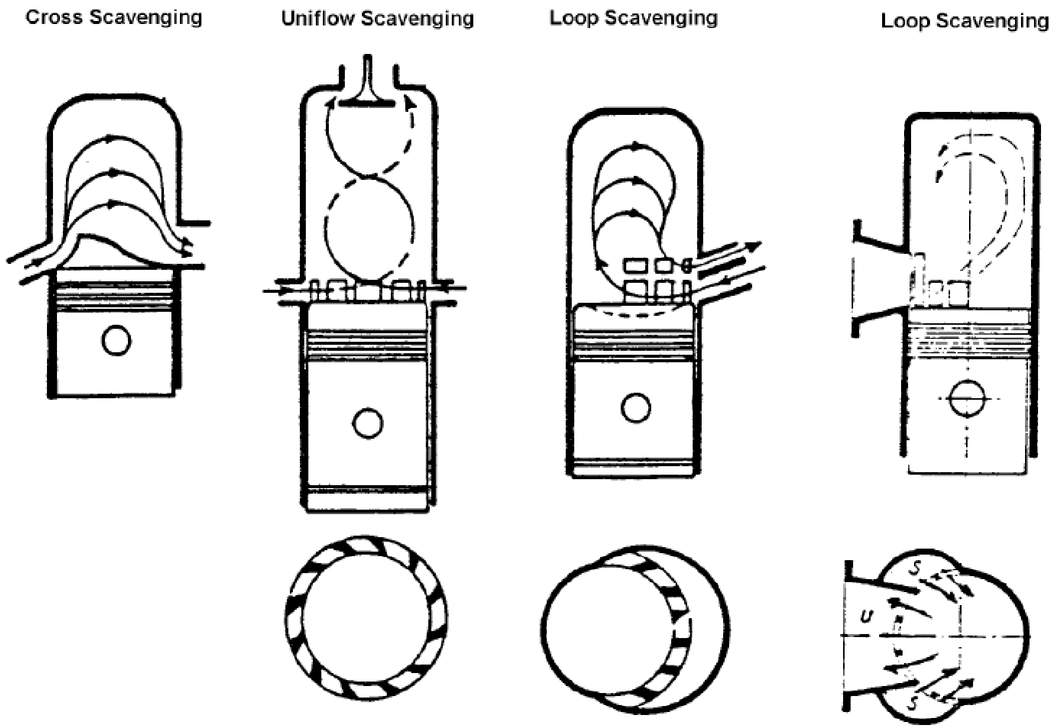



Figure 8.2: Commonly used scavenging systems in 2-stroke engines.

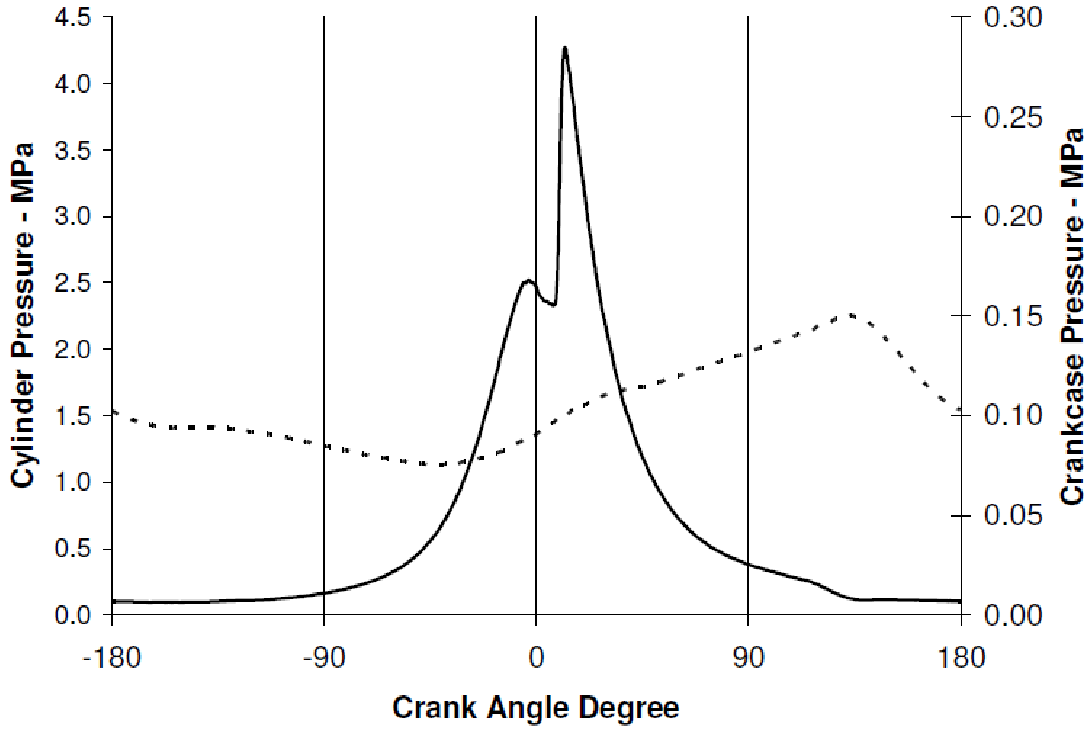
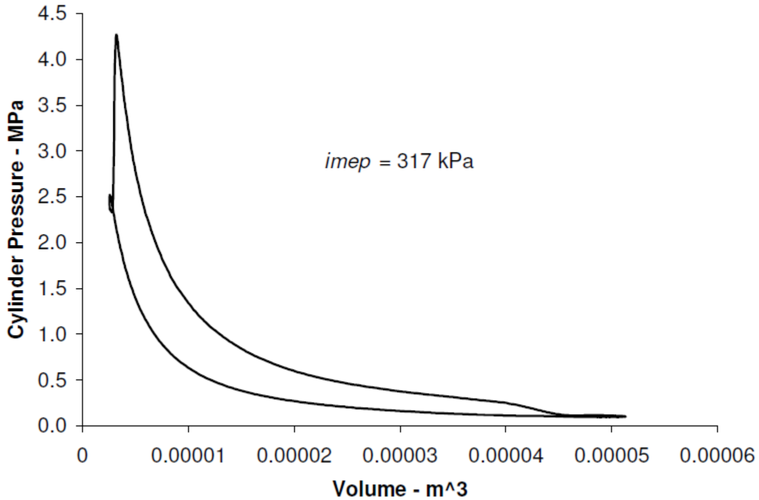
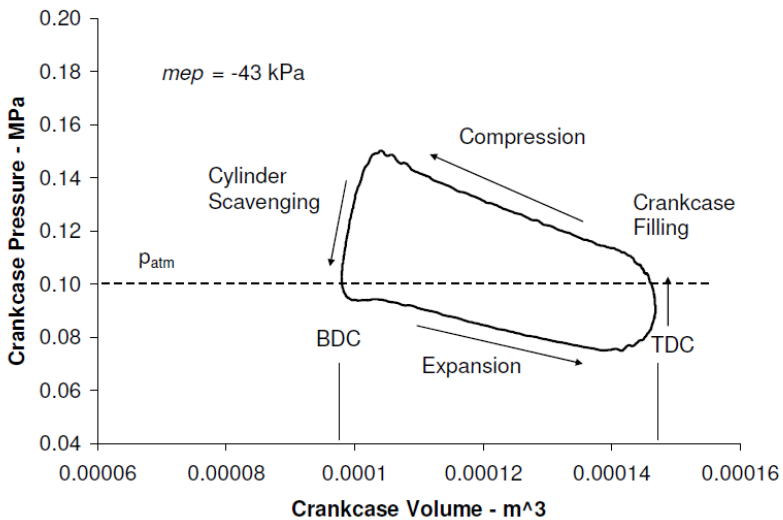



Figure 8.3: Pressure crank angle diagrams for the cylinder (solid line) and crankcase (dashed line) of a single cylinder 2-stroke engine using the crankcase to provide scavenging air.



Cylinder Pressure - MPa
Volume - m^3
imep = 317 kPa
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
0.00001
0.00002
0.00003
0.00004
0.00005
0.00006

Crankcase Pressure - MPa
Crankcase Volume - m^3
mep = -43 kPa
Compression
Cylinder
Scavenging
Crankcase
Filling
patm
BDC
TDC
Expansion
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.00006
0.00008
0.0001
0.00012
0.00014
0.00016

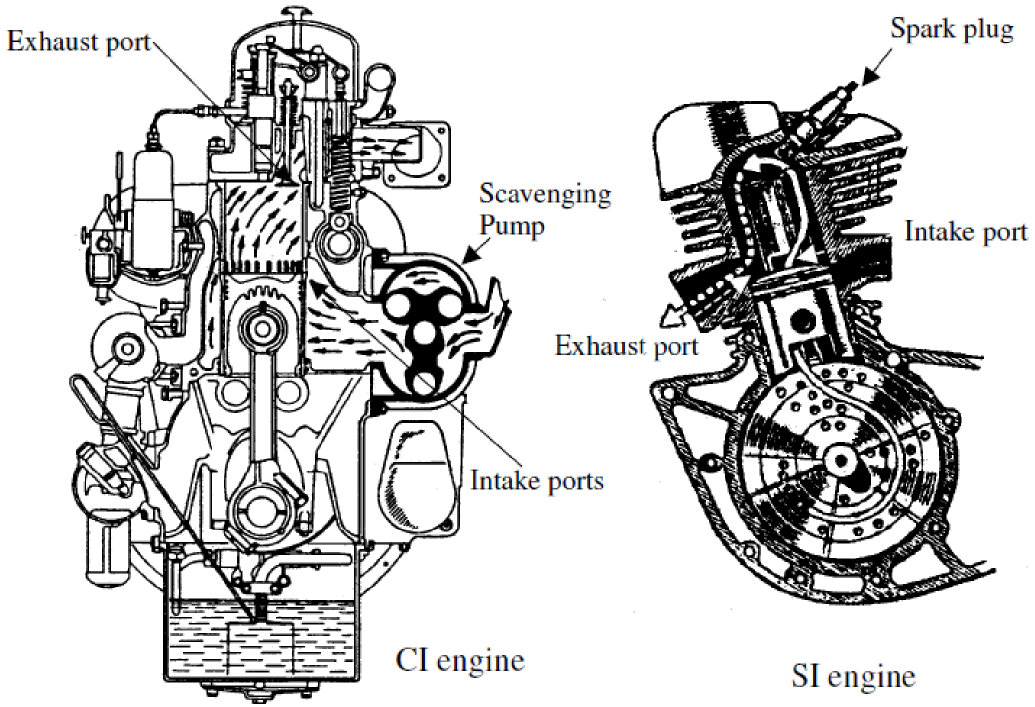



Figure 8.5: Examples of 2-stroke engines. A diesel engine with a blower to aid scavenging (left) and a small SI engine for a scooter or power tool application.

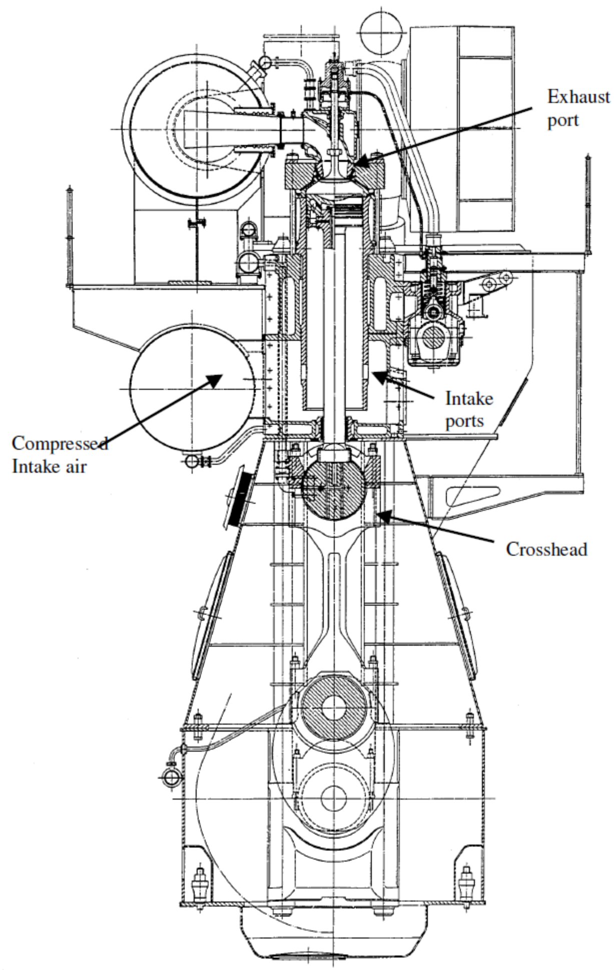



Figure 8.6: A large 2-stroke Marine diesel engine, the engine shown has a bore of 60 cm and a stroke of 2.29m.

# Some Definitions

- Delivery Ratio – actual air flow rate to ideal flow rate that would fill the cylinder
- Trapping efficiency – ratio of fresh charge mass trapped in the cylinder to that supplied to the engine. *How much air bypasses during scavenging?*
- Scavenging Efficiency – ratio of fresh air charge mass trapped in the cylinder to the total cylinder charge at the end of scavenging. *What does it take to scavenge the engine?*

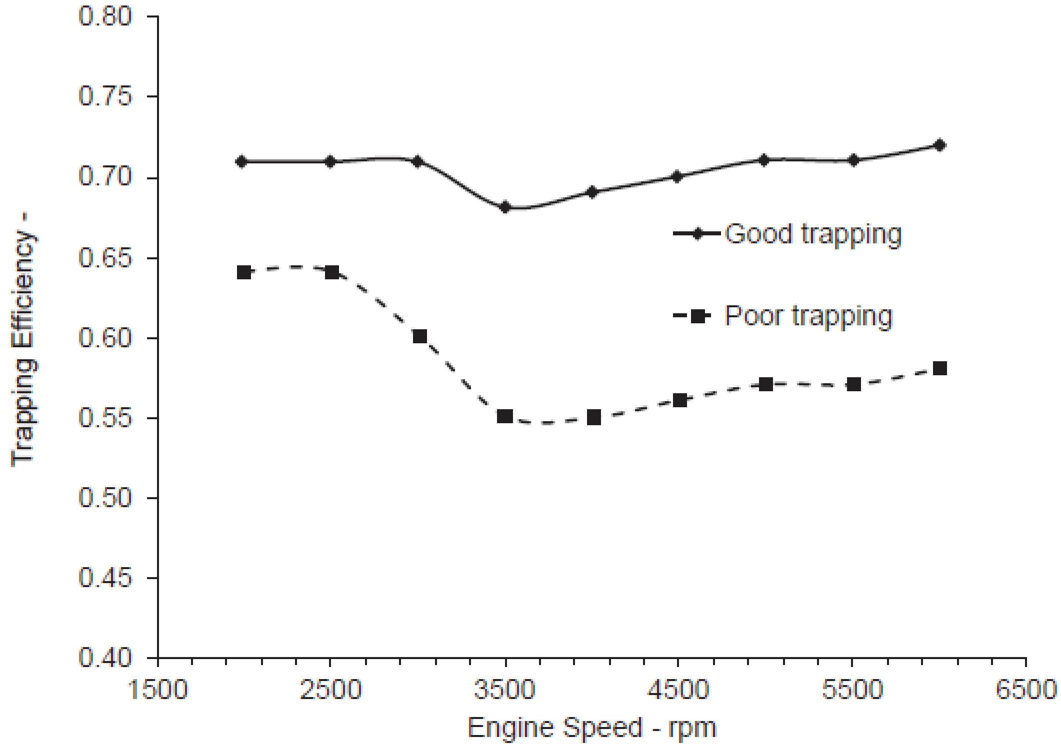



Figure 8.9: Typical trapping efficiencies for a 2-stroke SI engine efficiency as a function of engine speed for good trapping and poor trapping [84].

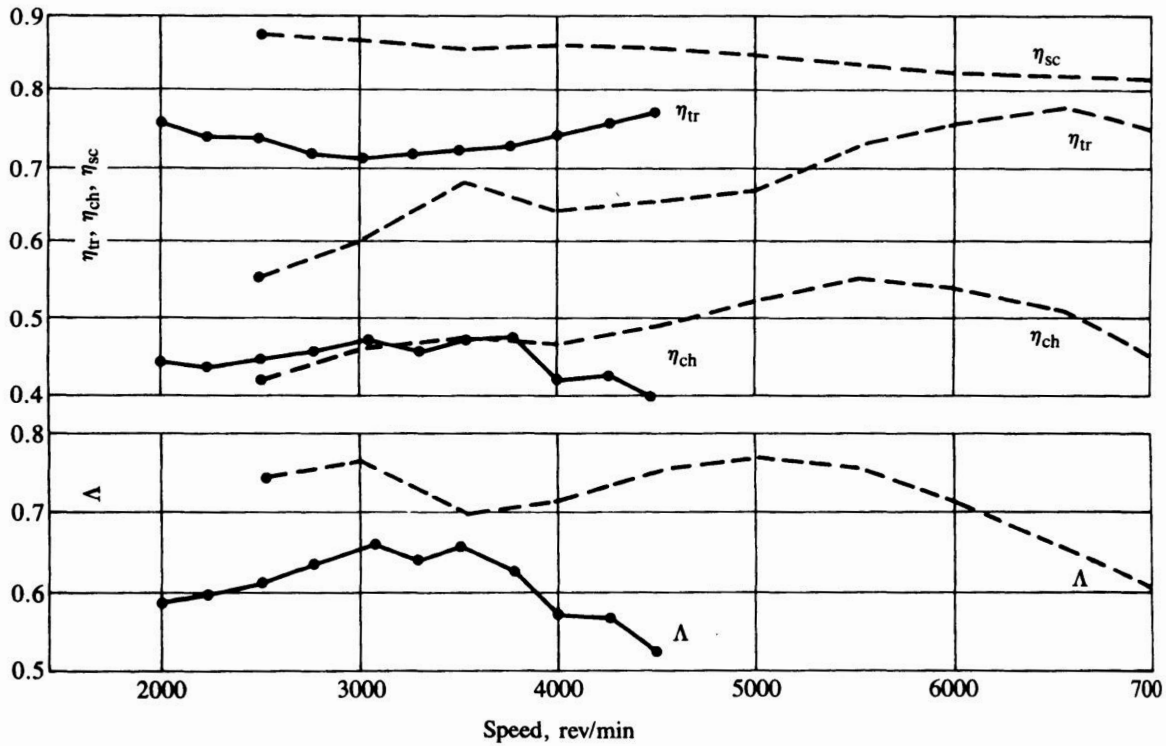



**FIGURE 6-30**
Delivery ratio Λ, trapping efficiency $\eta_{tr}$, charging efficiency $\eta_{ch}$, and scavenging efficiency $\eta_{sc}$, at full load, as functions of speed for two single-cylinder two-stroke cycle spark-ignition engines. Solid line is 147 $cm^3$ displacement engine.[34] Dashed line is loop-scavenged 246 $cm^3$ displacement engine.[35]

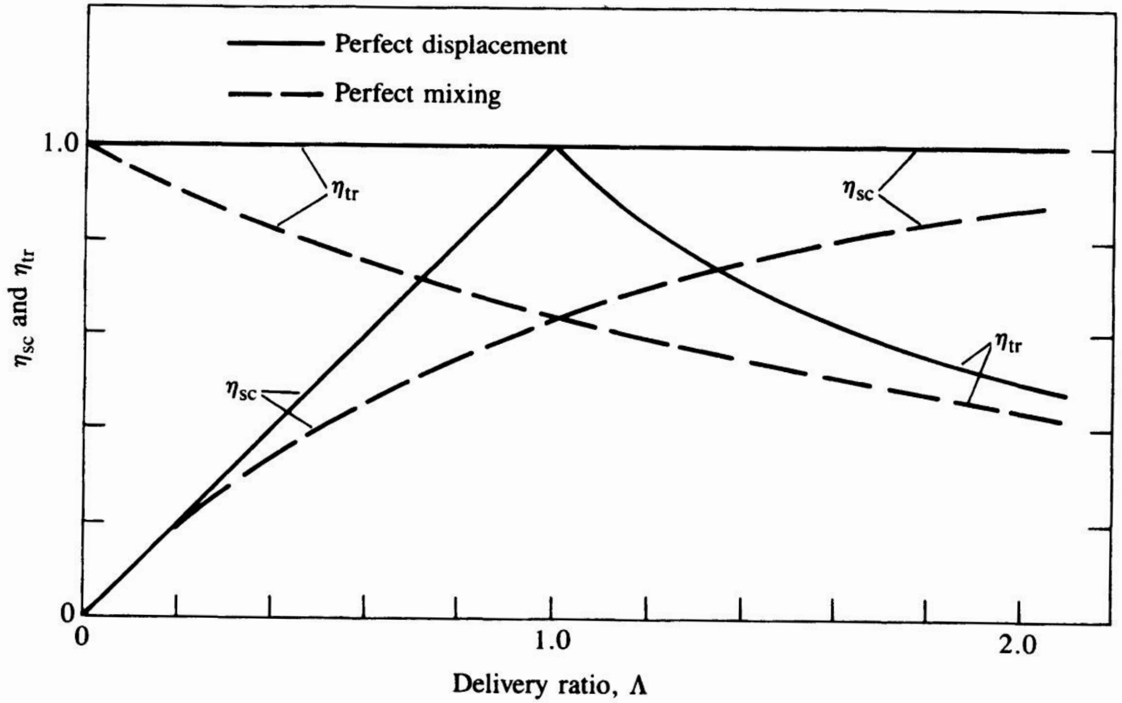



**FIGURE 6-27**
Scavenging efficiency $\eta_{sc}$ and trapping efficiency $\eta_{tr}$ versus delivery ratio Λ for perfect displacemen and complete mixing models.

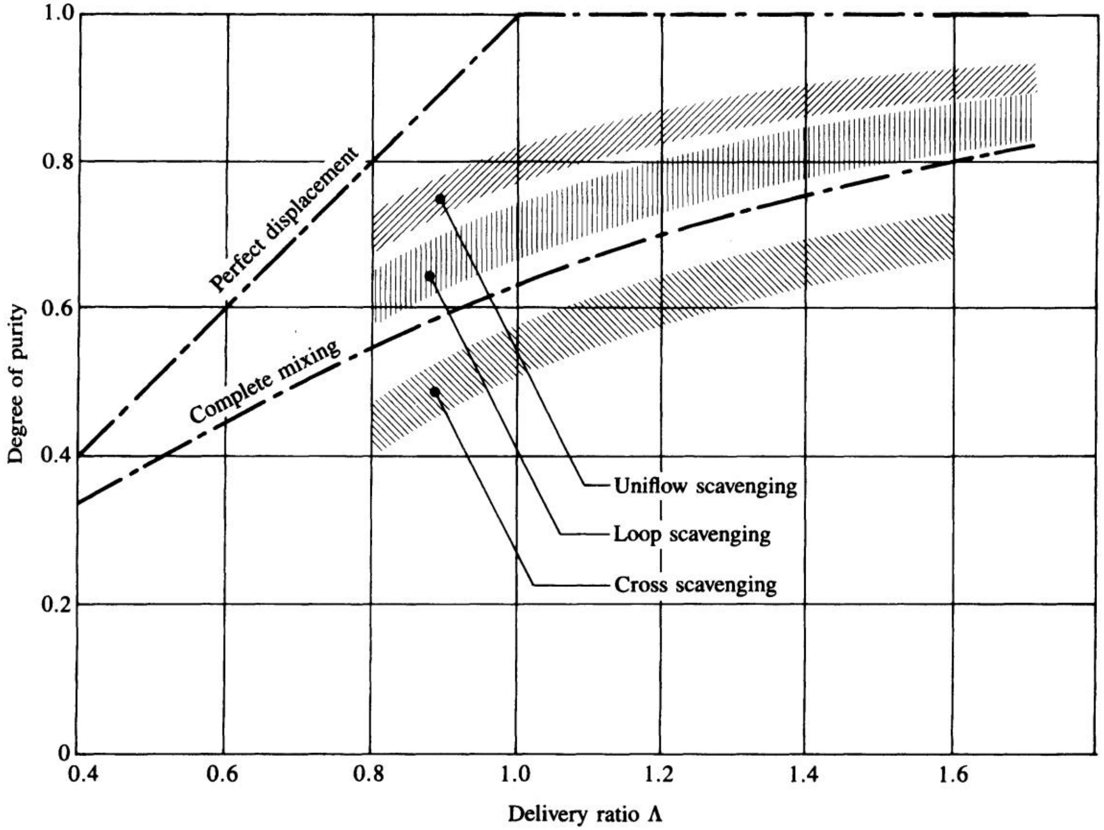



**FIGURE 6-31**
Purity as a function of delivery ratio Λ for different types of large marine two-stroke diesel engines.[37]

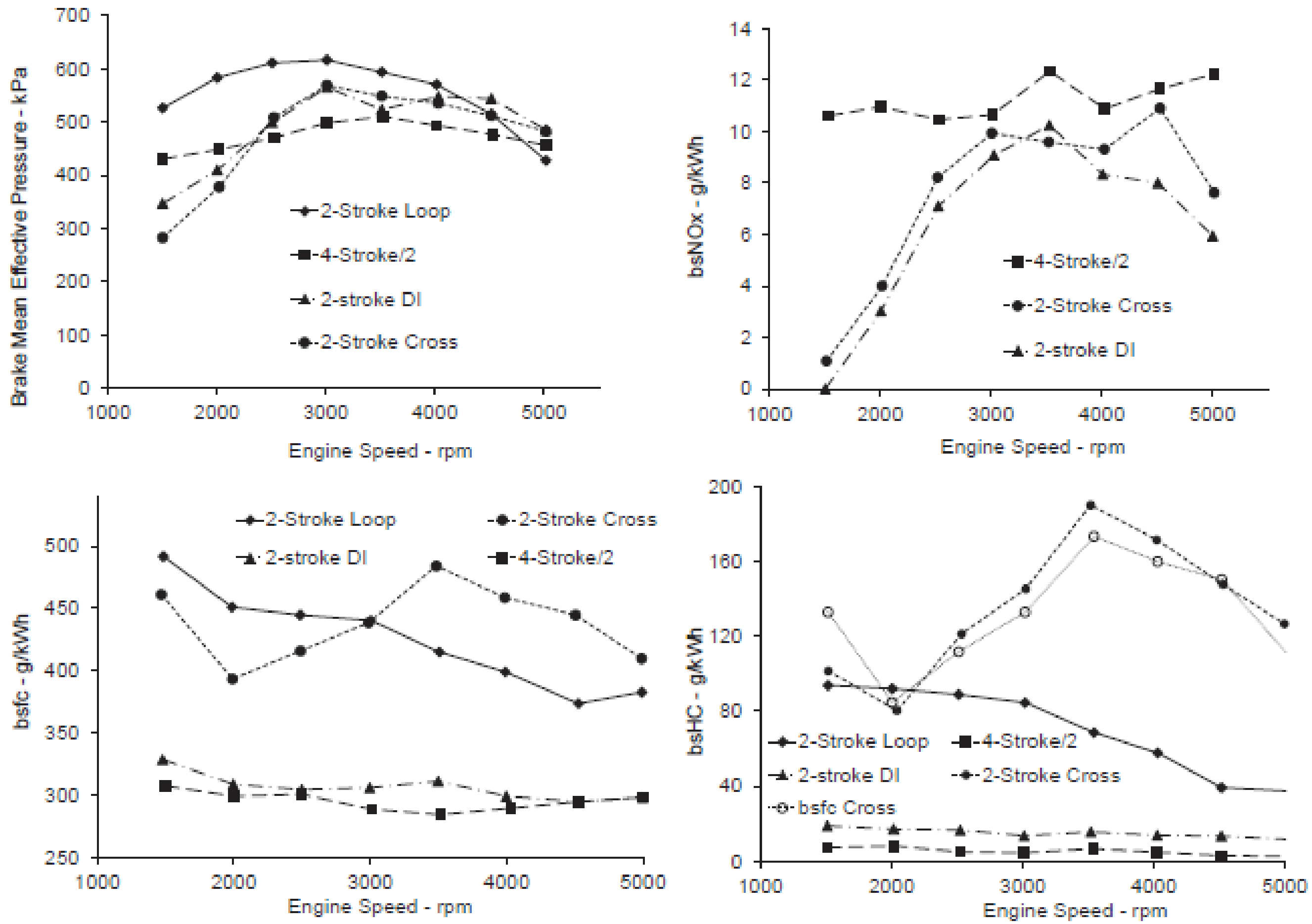
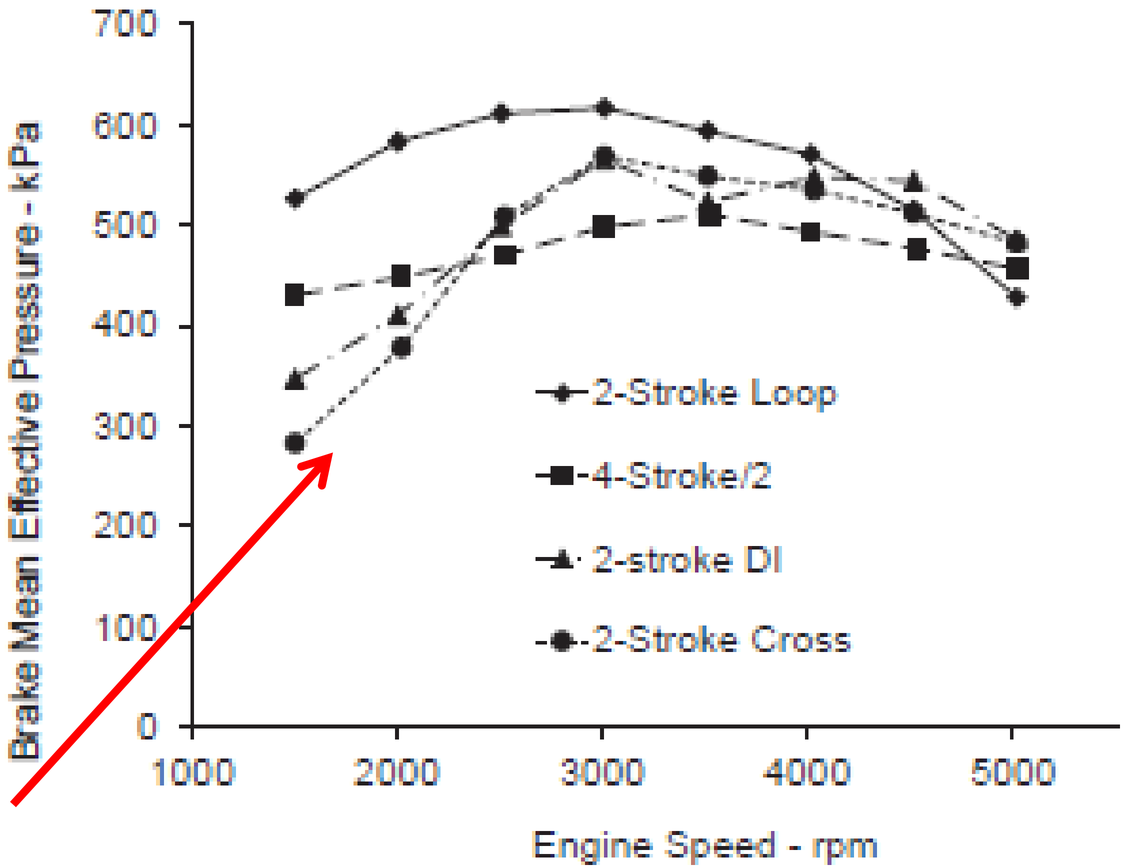


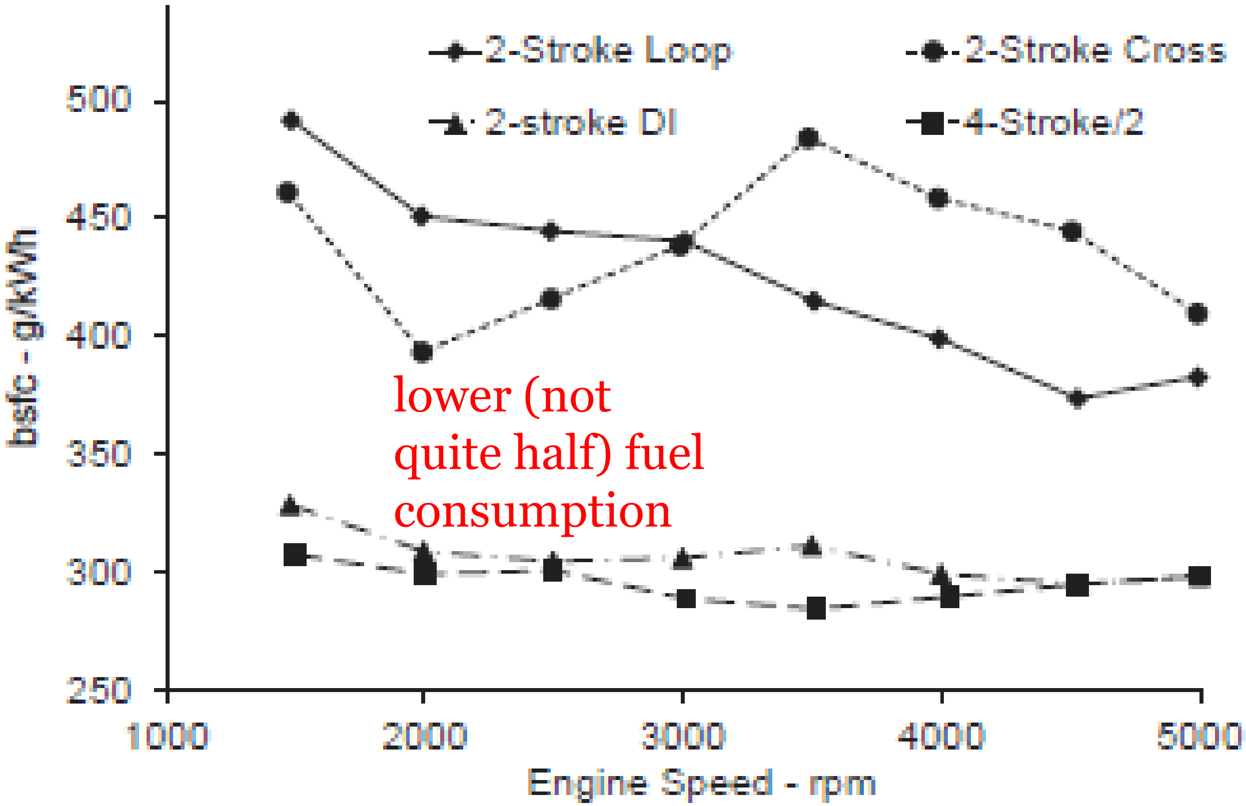

Figure 8.10: Full load performance, fuel consumption and emissions for different versions of 2-stroke engines compared to a 4-stroke SI engine with electronic fuel injection. [84]

1



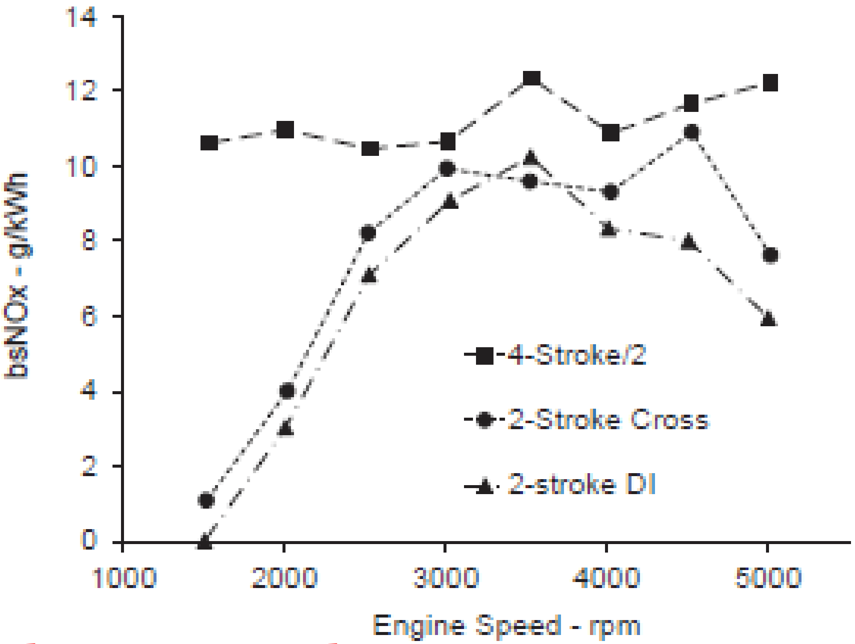

poorer performance at low engine speeds

2

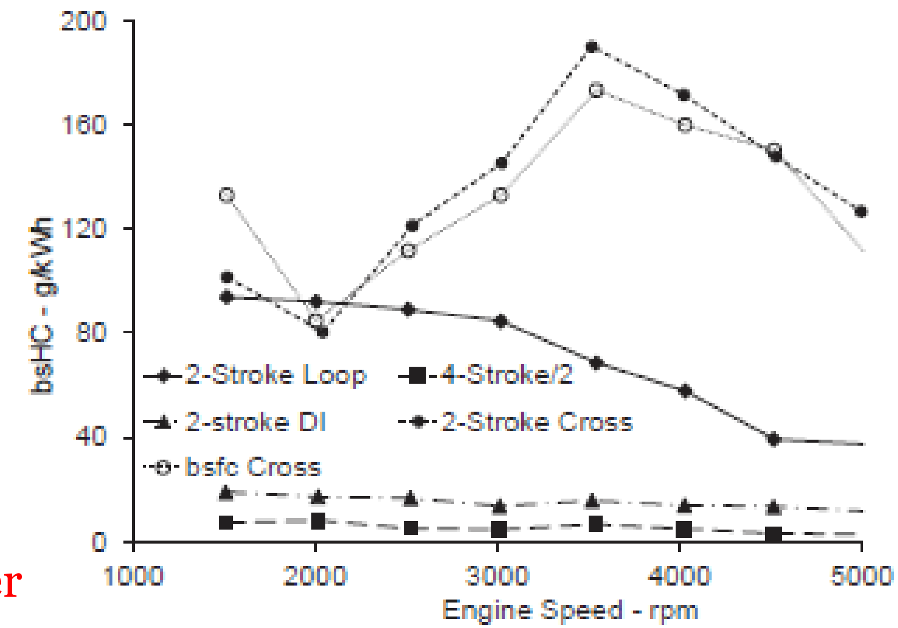


2-Stroke Loop
2-Stroke Cross
2-stroke DI
4-Stroke/2
500
450
400
350
300
250
bsfc - g/kWh
lower (not quite half) fuel consumption
1000
2000
3000
4000
5000
Engine Speed - rpm

3 & 4




lower NOx at low speed because of low temperature and high concentration of exhaust (exhaust valve open during intake)




much higher HC emissions