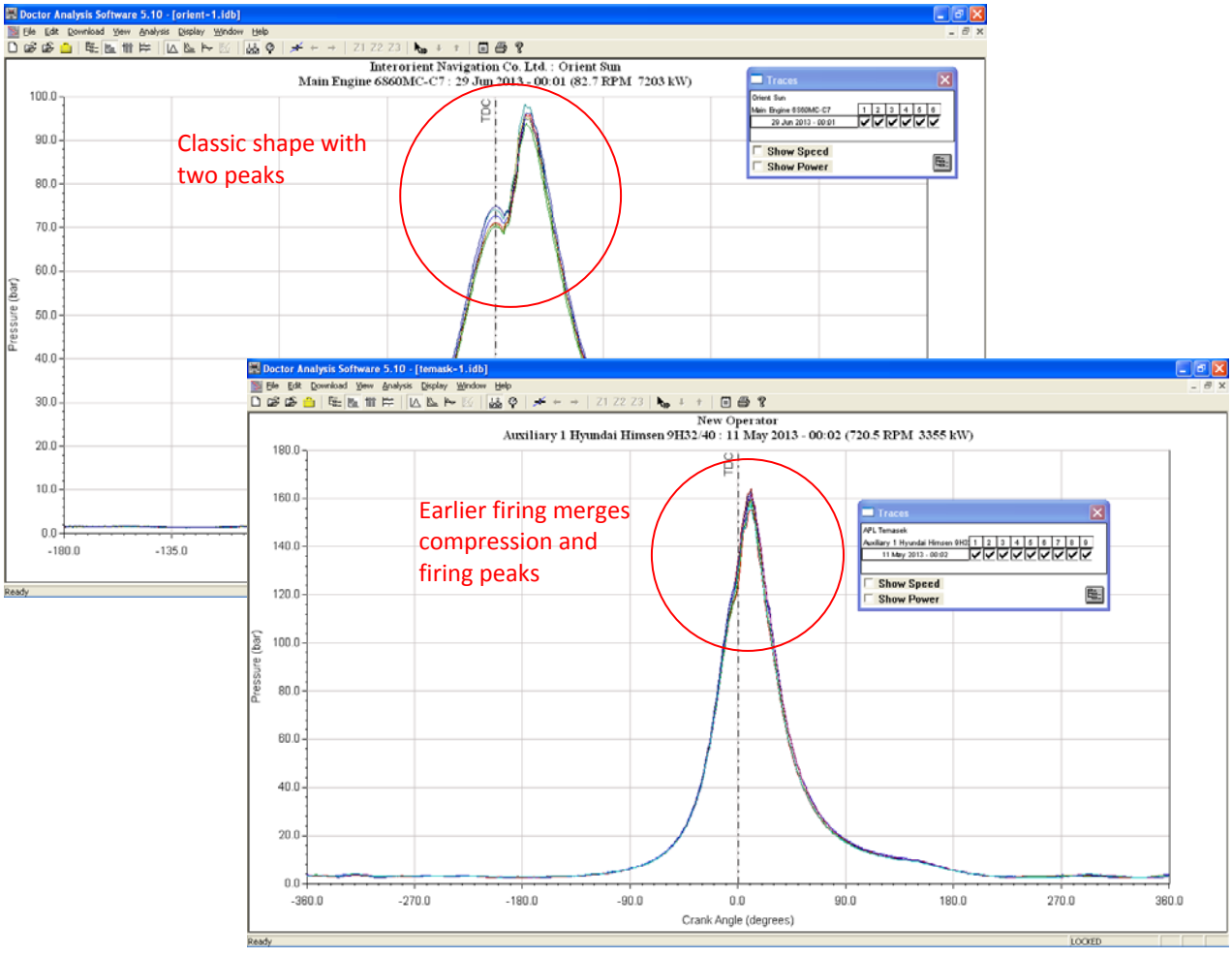
ICON RESEARCH LTD

Late Firing Engines

Many engines are nowadays timed later in order to reduce NOx emissions. On 2-strokes, it has been common for years to see a compression peak followed by a drop in pressure prior to ignition. This is now common on 4-strokes as well, and often leads to confusion. In addition, it is now common to have very high boost or scavenge pressures. This is to increase the mass of air in the cylinder and results in very high compression pressures. This is once again a NOx reduction strategy. High compression requires late ignition to make sure that the firing pressure doesn't go too high and damage the cylinder head. On 2-strokes a common limit is 140 bar, and on 4-strokes the limit is often higher but the principle is the same. So in both these cases late firing is required.

Most marine operators will be familiar with the 'classic' compression-firing-expansion traces as shown in Figure 1 below.

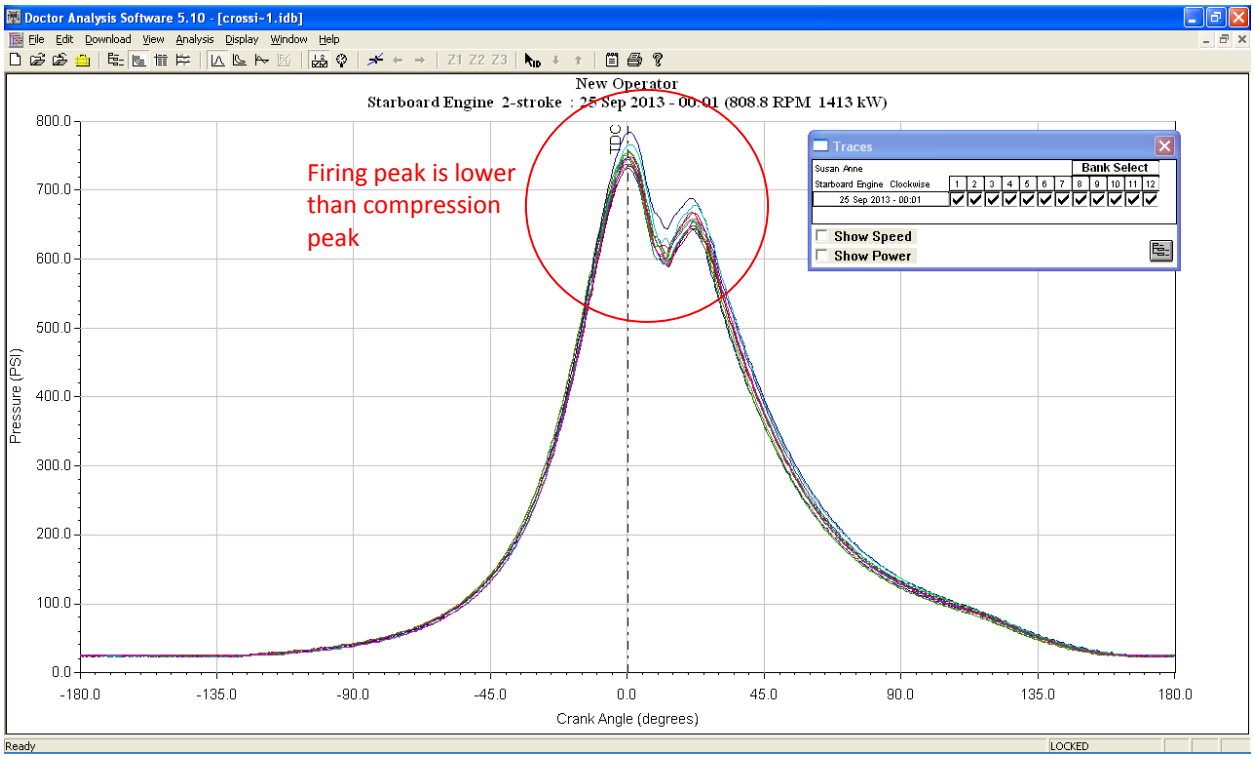
Figure 1: 'Classic' Traces



Often two distinct peaks can be seen as on the trace on the first picture. This is typical of a 2-stroke engine with slightly delayed firing. The first peak (Pcomp) is at TDC and the second peak, usually higher and often referred to as Pmax, is a few degrees later. The second trace is typical of a 4-stroke auxiliary engine where earlier firing means that the pressure rise is almost continuous past TDC towards Pmax.

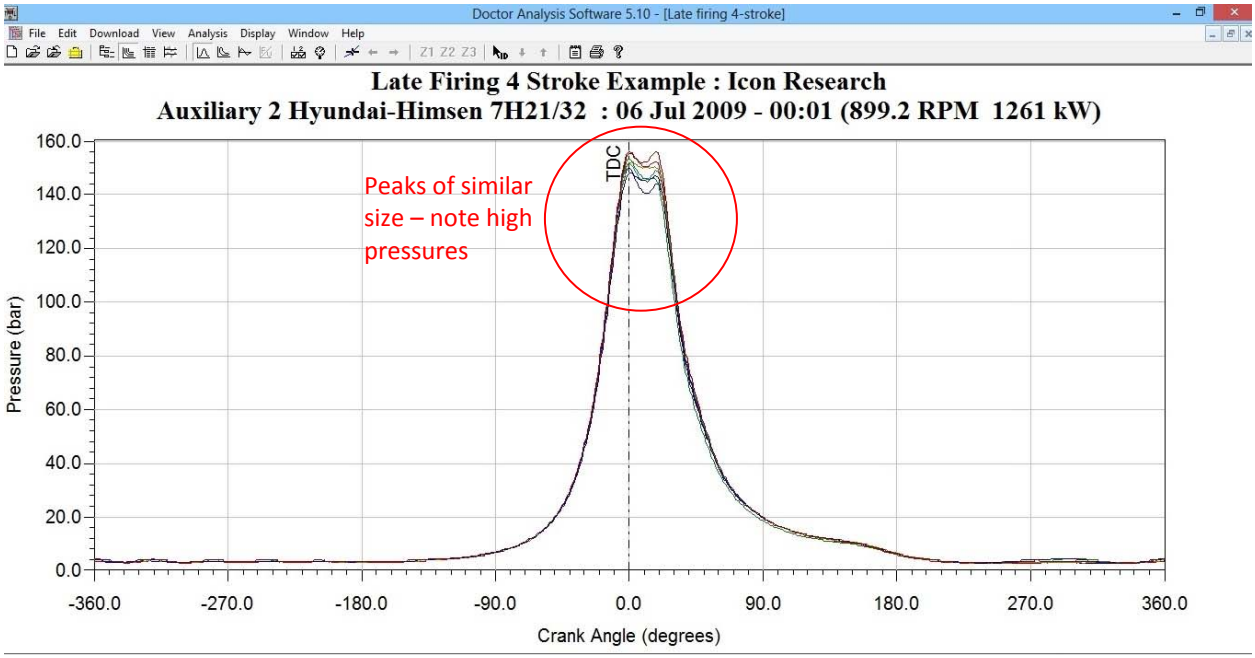
In late firing engines, two peaks can again be seen. However, in some cases, the firing peak may be lower than the compression peak and this can be confusing as the graphs can seem to be back to front. They aren't of course but it does take getting used to. Figure 2 shows a late firing 2-stroke engine with lower firing pressure.

Figure 2: Late Firing 2-stroke



Sometimes firing is closer to the now very high compression peak, and a flatter top to the graphs is the result, and in some cases can be almost flat topped. Figure 3 below shows a late firing 4-stroke engine where the compression and firing peaks are almost the same, resulting in what appears to be a flat top.

Figure 3: Late Firing 4-stroke



So, if late firing reduces NOx emissions, is this not a good strategy to follow? As always, it is a compromise. The primary downside of late firing is increased fuel consumption ie. the engine is not operating at its highest efficiency. Late firing can also result in higher exhaust gas temperatures and we have heard of exhaust gas temperature alarms being triggered by very late firing engines.

In the case of late firing engines, the Doctor program may have difficulty in identifying the actual ignition points and manual identification may be necessary for the diagnostic analysis to work correctly.