

# ICON RESEARCH LTD

## Indicated Power Versus Shaft Power

We are often asked why the Doctor system shows higher power figures than are seen on the output meter of an electric generator or a torque meter on a propeller shaft. The difference is due to losses in the engine and transmission system. This note explains these losses that reduce efficiency, often referred to as the difference between indicated power and shaft power.

*Indicated Power* is what we measure with the Doctor system. This is the actual power produced in the cylinders. However, some of this power is used by the engine itself in driving pumps and cams. Additionally, power is lost due to friction within the engine, together with heat losses. The power produced at the shaft, known as *Shaft Power*, is therefore reduced.

To put some approximate numbers to these losses, the most efficient 4-stroke engines can be expected to show about 12.5% loss, and usually the loss is worse than that. On a 2-stroke a figure of 7% is what might be expected but at lower loads you will lose more. However, modern common rail engines are showing improvements in efficiency and, when new, can be as low as 4.5 to 5%.

The MCR (Maximum Continuous Rating) figure quoted for an engine is the power that the engine can produce continuously, and so equates to shaft power. Icon's Version 6 software allows engine losses to be entered into the engine parameter definitions, so the relationship between MCR and Maximum Indicated Rated Power can be adjusted. The differences between MCR and Max Indicated Power are the losses figures as discussed earlier. Remember, however, that losses will increase as the engine operates at loads further away from MCR.

On auxiliary engines driving electric generators, there will be a difference between the engine Indicated Power and the electrical output power figure read from the generator power meter (usually in kW). Here the total losses are the sum of the engine and the generator losses. The generator loss is at least 2% and usually somewhat more – note that the generator power factor can come into play as well. So, taking the losses on a 4-stroke engine together with generator losses, and operating a little way off MCR, typical losses in the order of 17% can be expected. For example, in the case of an auxiliary engine driving a generator showing indicated power in the cylinders in the region of 890kW, the output power from the generator might be around 740kW. This sounds like a lot but is quite normal. In fact, it is not unusual to see 20% or more difference between indicated power and what you see as generated power.

As can be seen, it is difficult to be precise on the topic of engine losses, but hopefully this note gives an idea of what might be expected.