

How is the efficiency of a fan determined?

April 2012

ErP
legislation

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Application of ErP for a ducted axial fan

From Regulation 327/2011, a ducted axial flow fan must achieve an efficiency grade of N50 to meet ErP 2013 and an efficiency grade of N58 to meet ErP 2015. See Tables 1 and 2 below

Table 1. First tier minimum energy efficiency requirements for fans

Fan types	Measurement category (A-D)	Efficiency category (static or total)	Power range P in kW	Target energy efficiency	Efficiency grade
Axial fan	A, C	static	$0.125 \leq P \leq 10$	$\eta_{\text{target}} = 4.56 \cdot \ln(P) - 6.33 + N$	36
			$10 < P \leq 500$	$\eta_{\text{target}} = 0.78 \cdot \ln(P) - 1.88 + N$	
Axial fan	B, D	total	$0.125 \leq P \leq 10$	$\eta_{\text{target}} = 2.74 \cdot \ln(P) - 6.33 + N$	50
			$10 < P \leq 500$	$\eta_{\text{target}} = 0.78 \cdot \ln(P) - 1.88 + N$	

Table 2. Second tier minimum energy efficiency requirements for fans

Fan types	Measurement category (A-D)	Efficiency category (static or total)	Power range P in kW	Target energy efficiency	Efficiency grade
Axial fan	A, C	Static	$0.125 \leq P \leq 10$	$\eta_{\text{target}} = 4.56 \cdot \ln(P) - 6.33 + N$	40
			$10 < P \leq 500$	$\eta_{\text{target}} = 0.78 \cdot \ln(P) - 1.88 + N$	
Axial fan	B, D	Total	$0.125 \leq P \leq 10$	$\eta_{\text{target}} = 2.74 \cdot \ln(P) - 6.33 + N$	58
			$10 < P \leq 500$	$\eta_{\text{target}} = 0.78 \cdot \ln(P) - 1.88 + N$	

This introduces a number of issues to UK fan users who are used to working in static pressure, fan shaft power and static efficiency which ignores the efficiency of the motor. Fan manufacturers and users will have to consider the overall efficiency based on the electrical input power and consider total pressure for ducted applications. The total pressure is the sum of the static pressure and the dynamic pressure which takes into account the swirl velocity of the air after it leaves the impeller. The overall efficiency based on motor input power is the product of the motor efficiency and the total efficiency (or static efficiency depending on the measurement category), resulting in a lower overall efficiency figure. This is best illustrated graphically per the example in Figures 1, 2 & 3.

Fig 1

Fig 2

Fig 3

From the graphs it can be seen that the maximum overall efficiency is 63.9% at a volume flow rate of 6.69m³/s and a motor input power of 2.64kW. Using the formula from Table 1 this gives an FMEG value of N66 and exceeds the ErP 2015 requirements.



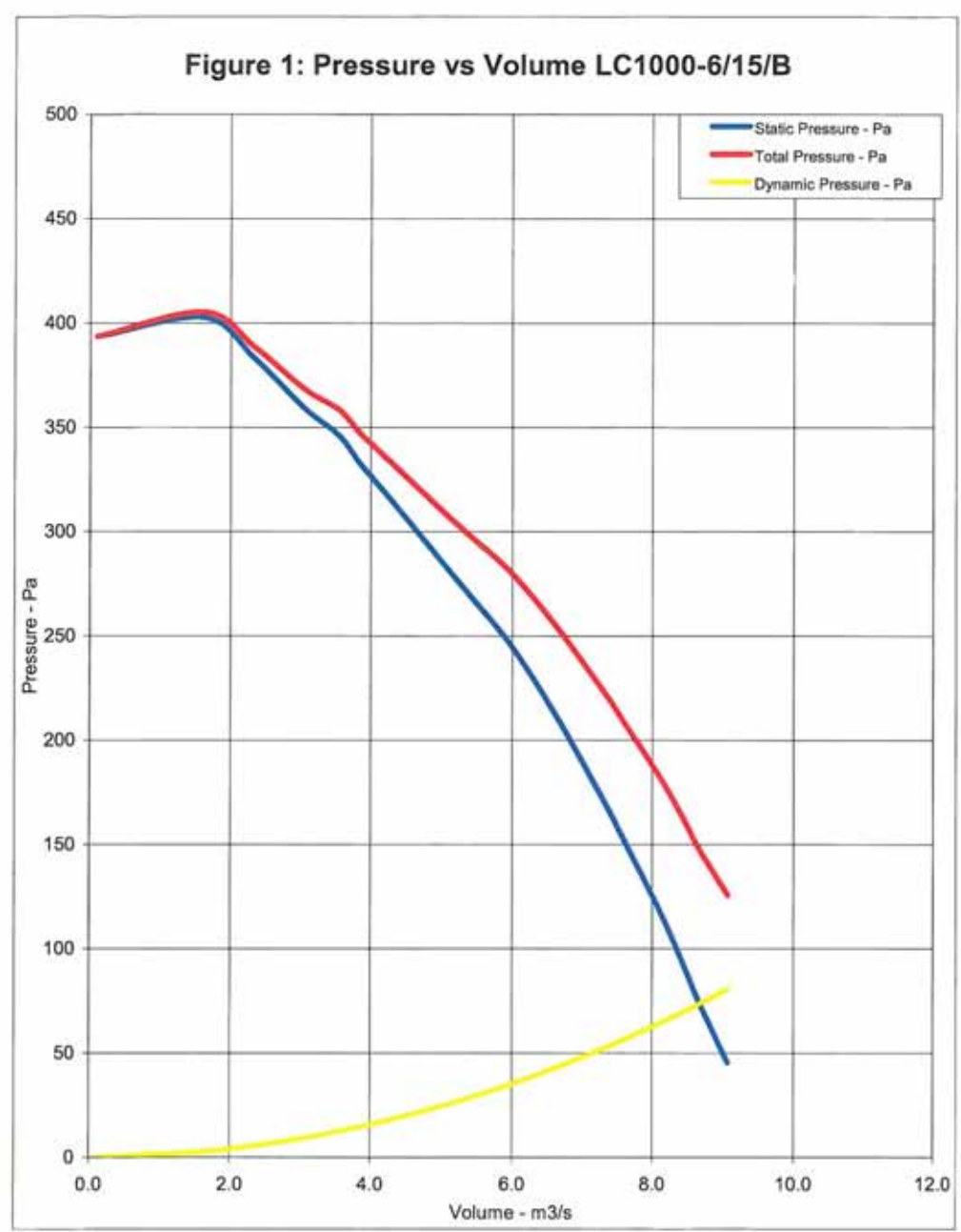


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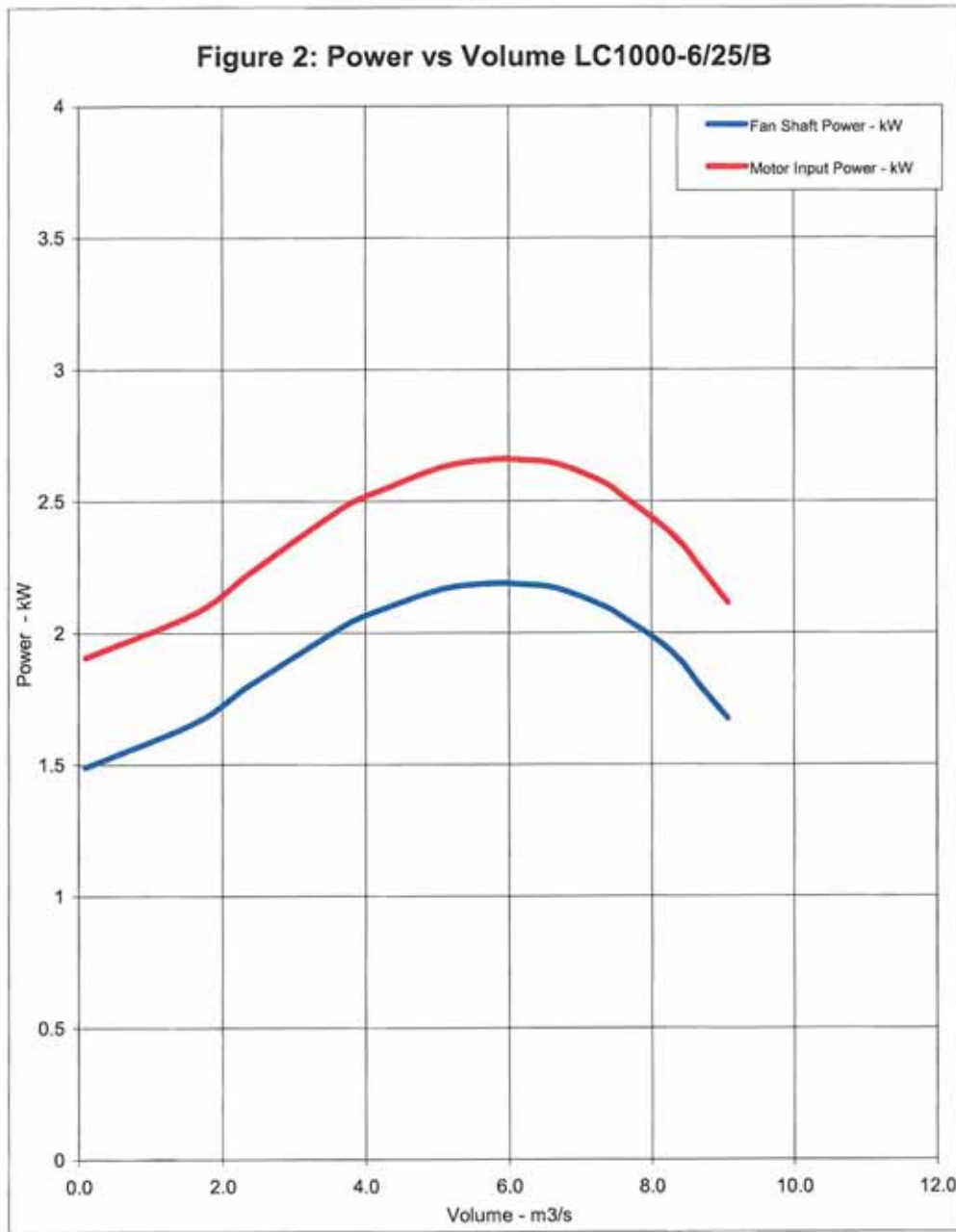


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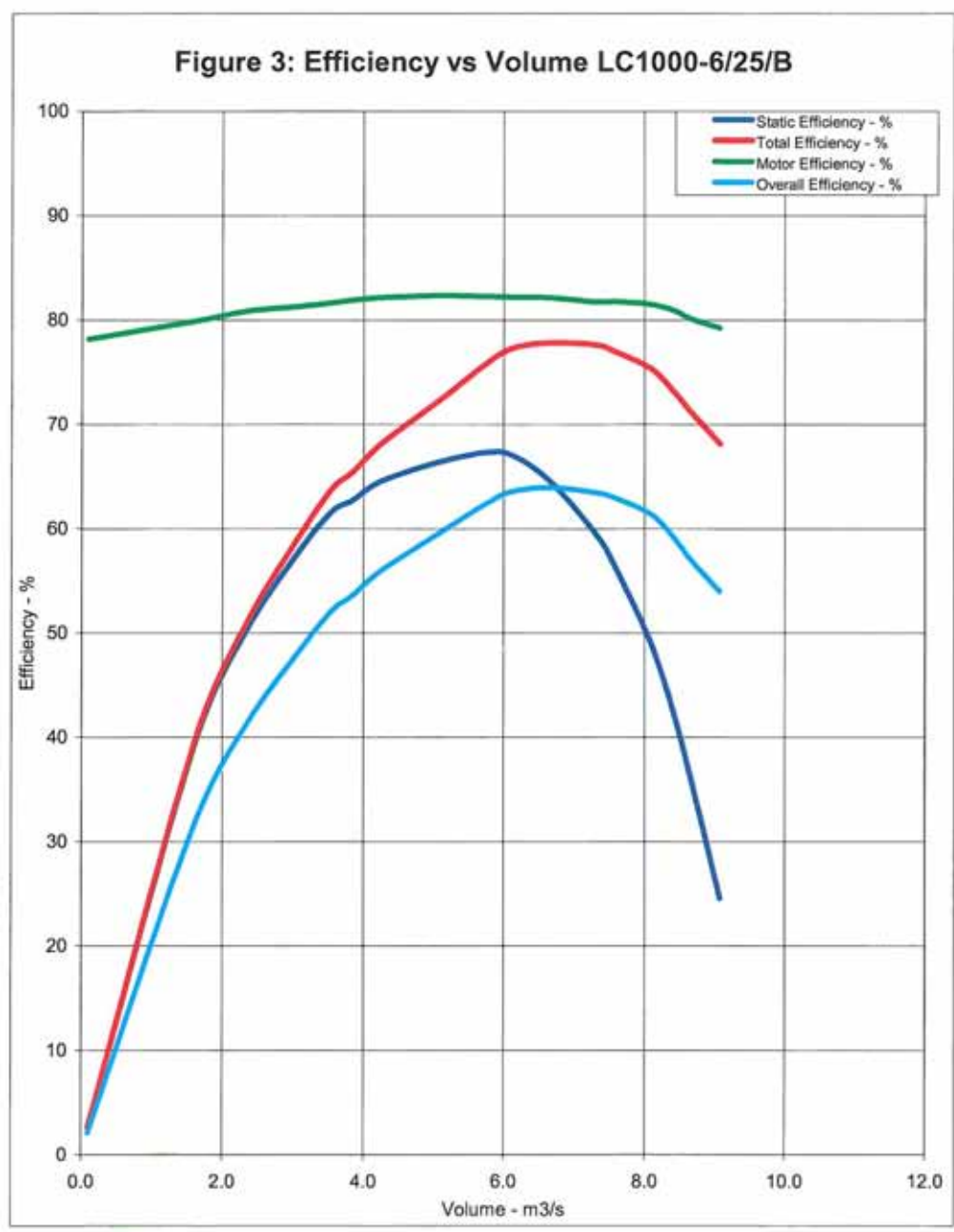


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