Service Engineering Bulletin

AUSTRALIA engine TECHNICAL

SB021

Surface Finish

Each new generation of engines is lighter in weight, uses more exotic materials and processes, has higher horsepower output, increased fuel efficiency and lower emissions than the previous one. To achieve all these outcomes, component designs are highly engineered and manufactured to very tight tolerances. One of the secrets to a successful engine rebuild is the ability to machine within these tolerances in the workshop. Some of the most critical yet least regulated machining specifications for engines are the various surface finishes. Crankshaft journals, cylinder bore, cylinder block surface and cylinder head surface finish are arguably the most important. Surface finish is determined by the condition of the machine used, the speeds and feeds selected, the tooling used, component setup and operator skill. Surface finish can only be accurately measured with a surface texture analyser/roughness tester and all workshops should regularly check the crankshaft journal, cylinder bore, cylinder head surface and cylinder block surface finishes they are producing to ensure they are achieving the required specifications.

Engine manufacturers typically specify surface finish with either Ra or Rz values, and Rt readings can be helpful in problem solving. These values are measured in millionths of an inch (10^{-6} inches, µ or microns) or millionths of a meter (10^{-6} m, µm or micrometers), where 1 µm = 39.4 µ.

Ra (arithmetic mean deviation of profile) is the most commonly used specification for a surface finish. It is defined as the arithmetic average of the deviation of the surface irregularities from the mean depth.

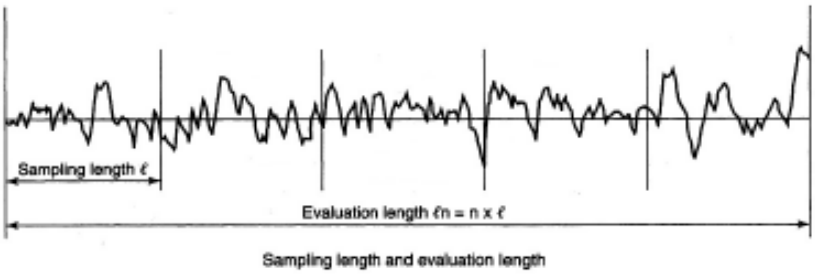

Figure 1. Sample of a surface texture profile

Rz JIS/ISO (ten-point height of irregularities) is defined as the sum of the mean height of the five highest profile peaks and the mean depth of the five deepest profile valleys measured from a line parallel to the mean line. This is the best method for short surfaces.

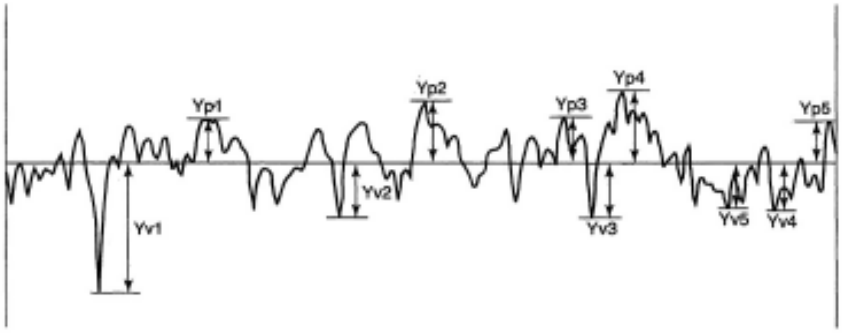

Figure 2. Rz JIS / ISO method

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Rz DIN/ANSI (maximum height of profile) is defined as the average value of the height difference between the highest peak and deepest valley within each of 5 sampling lengths (i.e. the evaluation length divided into five equal lengths).

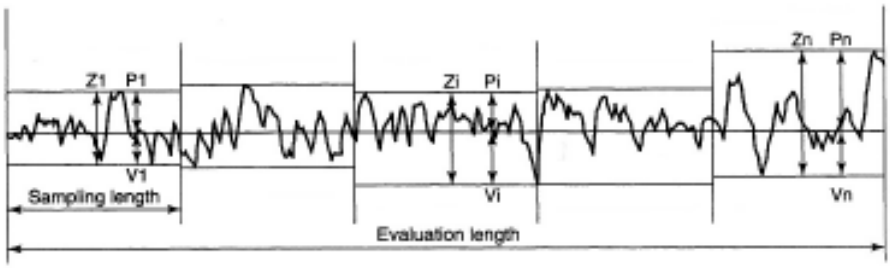

Figure 3. Rz DIN / ANSI method

Rt (total height of profile) is defined as the distance from the highest peak to the deepest valley over the evaluation length. While rarely specified, Rt readings are useful for determining honing problems. If Rt is much more than 10 times Ra, there is either a honing problem or a plateau-honed surface.

For standard honing finishes, it is possible to convert Ra values to *approximate* values in other parameters. The formulae is: Ra x Parameter Factor (Table 1) = Alternate Parameter
e.g. 1.0 µm (micrometer) Ra x 7.6 (Rz ISO Factor) = 7.6 µm Rz

Parameter	Factor
Rt	8.7
Rz DIN / ANSI	7.2
Rz JIS / ISO	7.6
Rmax	8.0
Rp	3.6
Rpm	2.9
RMS	1.1

Table 1. Parameter Conversion Factors

For further details on surface finish, refer to:

SB016 Cylinder Bore Finish
SB022 Plateau Honing
SB023 Semi-finished Vs. Finished Thin Wall Dry Liners
SB024 Cylinder Block and Cylinder Head Surface Finish
SB025 Crankshaft Journal Finish