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Standard Test Method for Obtaining Char Density Profile of Ablative Materials by Machining and Weighing[1]

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INTRODUCTION

The ablation characteristics of charring materials must be well known in order to design the material for a specific set of environmental conditions. The char density profile and the environmental conditions under which it was formed can provide useful information about the ablation performance.

A method of obtaining the char density profile from a charred sample of material is described in the following sections. Some chars are very friable and are easily broken before they can be measured. Other chars are relatively strong and can be handled with ease. The type of char density profile measurement described in this method is applicable if the char is strong enough to be machined without breaking.

1. Scope

1.1 This test method covers the determination of the char density profile of a charred ablator that can be used with the following limitations:

1.1.1 The local surface imperfections must be removed, and the char must be able to be machined off in a plane parallel to the char-virgin material interface before the density profiles can be determined.

1.1.2 The char must be strong enough to withstand the machining and handling techniques employed.

1.1.3 The material should have orderly density variations. The total thickness of the char and degradation zone must be larger than the machining thicknesses required.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Summary of Test Method

2.1 Density variation throughout a charred ablator material is determined by successively measuring, machining, and weighing a sample of known size to obtain the density of the material removed by machining.

3. Apparatus

3.1 The apparatus required for this method includes a laboratory balance capable of measuring to the nearest 0.0001 g, and a machining technique capable of removing material in increments as small as 0.025 mm (0.001 in.). For example, flat specimens can be machined with a surface grinder using a medium fine grit ceramic grinding wheel of a soft grade dressed to the proper contour. Cylindrical specimens can be mounted in a lathe and the char can be removed with a sharp carbide or diamond tip tool.

4. Sampling

4.1 The charred sample selected for machining and weighing should be taken from a representative section of the ablated specimen where the environmental conditions are well known, and where the surface is parallel to the char-virgin material interface. Where large sections are available, this condition is usually met. For small samples which have been exposed to varying environmental conditions along the length of the sample, the sample size will be smaller.

5. Test Specimens

5.1 A typical specimen size obtained from a channel, pipe flow, or rocket motor section may be 12.7 by 12.7 mm (0.5 by 0.5 in.), or 12.7 mm (0.5 in.) in diameter. The sample thickness is determined by the available thickness of material. Smaller or larger samples can be used depending upon the accuracy, weighing apparatus, and specimen size. Larger samples reduce edge effects. Excess virgin material should be eliminated, if possible.

5.2 The specimen is rough-cut out of the ablated section, and then machined so as to make the sides perpendicular and the front surface parallel to the char-virgin interface as shown in Fig. 1.

5.3 For simplicity and ease of handling, the base of the sample (the backface or side opposite the charred surface) may

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