Devices & Services Co.

D&S Technical Note 81-2


## MEASUREMENT OF EMITTANCE OF CYLINDRICAL SURFACES

The model AE Emissometer is designed to measure the emittance of flat surfaces in comparison to a standard sample. Special measurement techniques are required for any surface with a differing geometry. In this note we describe an adapter that can be made for cylindrical surfaces, and a method of making measurements.

Figure 1 shows an adapter for a 1 1/2" diameter tube. Notice that the aperture through which the detector views the tube is small enough so that the surface appears "flatter" to the detector. This is necessary because of geometric effects on the radiation exchange between the detector and the surface, that, for example would cause a diffuse and a specular sample with the same emittance to read differently.

For larger tubes the aperture can be made larger, to increase the view factor to the sample, which increases the detector output. For smaller tubes, it may be necessary to put three grooves side by side, see Figure 2, so that the surface appears flat to the detector.

In order to make accurate measurements, some means must be provided to maintain the temperature of the sample and the adapting collar close to that of the standard when it is being measured. A heat sink is used for flat samples, and a similar arrangement could be used for the tube samples. Alternative measurement techniques have been described in Devices and Services TN 79-17 for cases where the surface temperature cannot be maintained. It is important that the collar temperature be the same as the sample and the standard, since the detector views radiation coming from the collar as well as the sample. For controlling the temperature and limiting the radiation exchange between the detector and the adapter, aluminum is a good material to use.

In addition to temperature, the orientation of the sample relative to the detector is very important. This occurs because the detector response is not uniform over the area. There are two areas of low emittance that provide the temperature difference and therefore the output voltage that corresponds to emittance. For repeatable results these detector areas must be lined up with the tube at the same orientation each time. Line up marks should be put on both the Emissometer and the adapting collar.

Finally, calibration of the Emissometer must be made on the same tube diameter as the samples to be measured. You need at least one low and one high emittance standard. For the low standard you can use aluminum foil wrapped around and bonded to the tube, and for the high emittance standard a black paint can be applied to a sample of the tube. The emittance of the two materials must first be measured on flat samples so that a calibration curve for the cylindrical surface can be generated. It is recommended that a third intermediate emittance sample be prepared to insure the linearity of emittance versus voltage output. Some metallic paints have emittance in the 0.40 to 0.60 range. Again first measure the emittance of the paint on a flat sample in the usual manner.

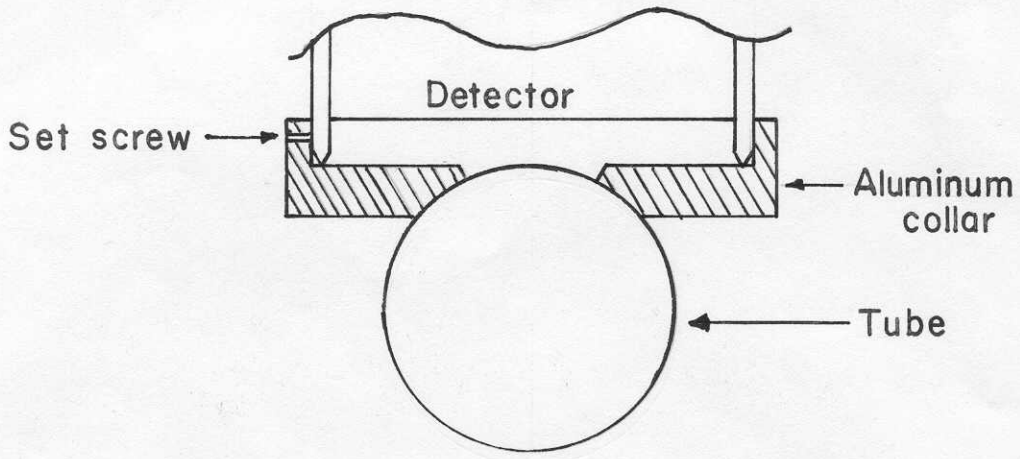


FIGURE 1

Emissometer Collar for a 1-½" Tube

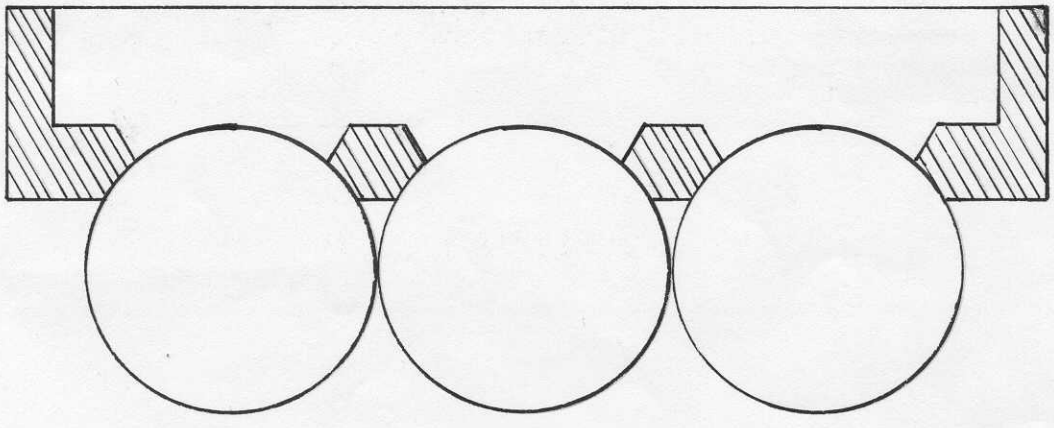

FIGURE 2

Collar for Small Diameter Tubes