

APPENDIX I—BUNSEN BURNER APPARATUS AND EQUIPMENT DETAILS

I.1. SCOPE

I.1.1 APPLICABILITY

This test apparatus is intended for use in determining the resistance of materials to a Bunsen burner flame.

I.2. DEFINITIONS

I.2.1 IGNITION TIME

Ignition time is the length of time the burner flame is applied to the sample.

I.2.2 FLAME TIME

Flame time is the time in seconds that the sample continues to flame after the burner flame is removed from beneath the sample.

I.2.3 DRIP FLAME TIME

Drip flame time is the time in seconds that any flaming material continues to flame after falling from the sample to the floor of the chamber.

I.2.4 BURN LENGTH

Burn length is the distance from the original sample edge to the farthest evidence of damage to the test sample due to that area's combustion.

I.3. TEST APPARATUS

I.3.1 TEST CABINET

Tests must be conducted in a draft-free cabinet or other enclosure acceptable to the Federal Aviation Administration (FAA). The test cabinet must have a viewing window set up such that both sides of the sample can be observed during testing. Using a mirror to observe the back of the sample is allowed. It is suggested that the cabinet be located inside an exhaust hood to facilitate clearing the cabinet of smoke after each test. Stainless-steel or other corrosion-resistant metal at least 0.04 inches thick (1 mm) must be used for the bottom surface of the chamber or enclosure.

NOTE: Draft-free implies a condition of no air currents in a closed in space. The cabinet should not be air-tight though, so as not to suffocate the flame. One way of determining whether the cabinet is draft free is to place a smoldering and smoking material, such as a lighted cigarette, in the test cabinet, then closing the door and observing the behavior of the smoke for signs of drafts.

NOTE: The entire inside back wall of the chamber may be painted flat black to facilitate viewing of the test sample, and a mirror may be located on the inside back surface to facilitate observation of the hidden surfaces.

NOTE: Suitable test cabinets of the type described are manufactured by Marlin Engineering of Bellingham, WA; Deatak Testing Instruments of McHenry, IL; and Atlas Material Testing Solutions of Mount Prospect, IL.

I.3.3 BURNER

The burner must be a Bunsen or Tirrill type. The burner must have a 0.375-inch (10-mm) inside diameter barrel. A Tirrill burner is equipped with a needle valve located at the bottom of the burner barrel to adjust the gas flow rate and, thereby, adjust the flame height. If using a Bunsen burner, there must be a means of regulating the gas flow (e.g. a needle valve) to achieve the flame height, and all aspirating holes at the bottom of the burner must be closed. Either burner should have a 0.036+0.0002/-0.0003-inch orifice. The burner base is marked for natural gas. There must be a means provided to move the burner into and out of test position when the cabinet door is closed. An example Bunsen burner is shown in figure I-1.

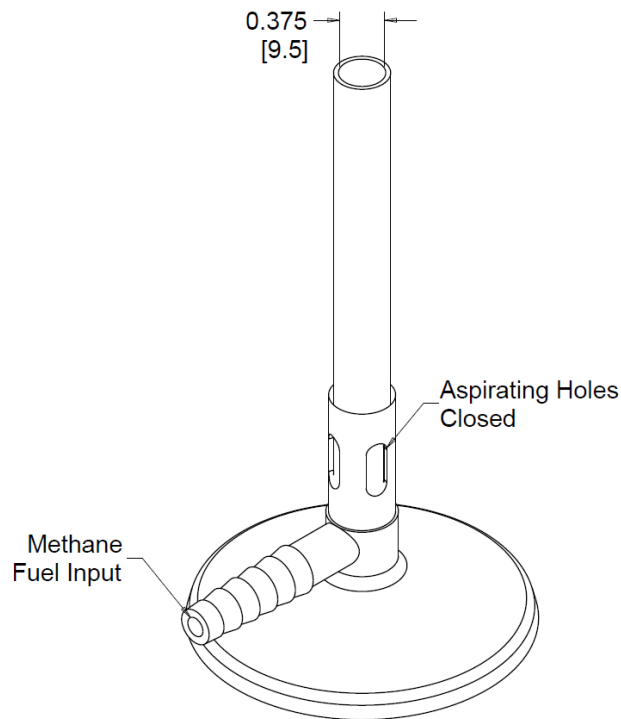


Figure I-1. A Bunsen burner example with aspirating holes closed

NOTE: Natural gas is marked on the base of the burner. This is because natural gas is composed of more than 90% methane and there is no orifice size specific to methane. Humboldt Company is one manufacturer of the Bunsen and Tirrill burners. They are located in Schiller Park, Illinois and their phone number is (800) 544-7220. Other manufacturers and distributors of the burners may be found on the Internet.

I.3.3.1 Burner Fuel

A diffusion flame using methane gas of 99% certified purity (CP) must be used (i.e., without adding air through the aspirating holes at the bottom of the burner barrel).

I.3.3.2 Plumbing for Gas Supply

A control valve system with a delivery rate designed to furnish gas to the burner under a pressure of 2.5 ± 0.25 psi (17 ± 2 kPa) at the burner inlet must be installed between the gas supply and the burner. If using a Bunsen burner, a needle valve needs to be placed between the fuel pressure regulator and burner inlet to control the flame height.

NOTE: A phenomenon that some labs have experienced is a sharp decrease in flame temperature after about three-fourths of the gas originally in the cylinder has been used. This has occurred primarily in labs that have single-stage regulators on their gas cylinders. Single-stage regulators differ from two-stage regulators in that control of the discharge pressure is not as accurate. Few designs should maintain constant or near constant discharge pressures over the full range of cylinder pressures. Therefore, it is necessary to make adjustments periodically to allow for decreasing inlet pressures. Even the slightest drop in pressure should affect the flow rate of gas through the burner orifice. This, in turn, should cause temperature variation. By using a two-stage regulator or adjusting pressure on a single-stage regulator, as the cylinder gets low, this problem can essentially be eliminated.

I.3.3.3 Flame Height Indicator

A flame height indicator may be used to aid in setting the height of the flame. The flame height is set to 1.5 inches (38 mm) for all Bunsen burner tests, except the 60-degree wire test in which the flame height is set to 3 inches (76 mm). It is suggested to fabricate a flame height indicator similar to the one shown in figure I-2. When using methane as the burner fuel, it is desirable to have two prongs for measuring the flame height—one prong to indicate the height of the inner cone of the flame and one prong to indicate the height of the tip of the flame. For methane, it has been determined that the proper flame profile is achieved when the tip of the flame is 1.5 inches (38 mm) long and the height of the inner cone is 0.875 inch (22 mm). When the tip of the flame is 3 inches (76 mm) long, the height of the inner cone is 1 inch (25 mm). The tip of the methane flame is blue, transparent, and difficult to see. It is more easily seen if there is no light on the flame, as in a darkened room. However, the inner cone of the flame is more visible and easily seen.

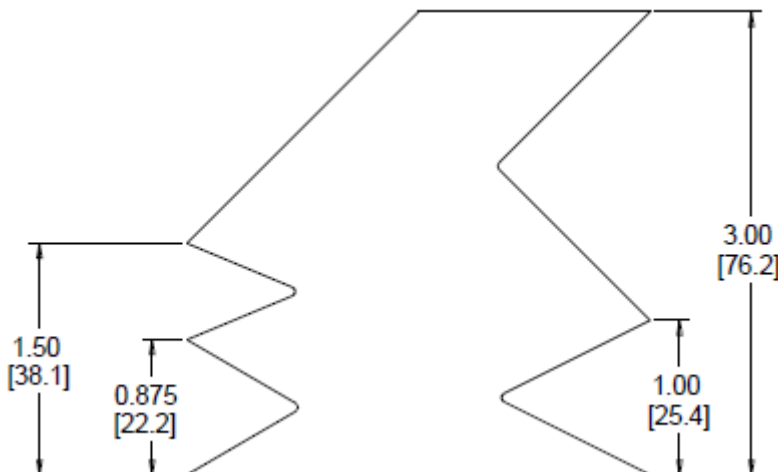


Figure I-2. An example flame height indicator

I.4. INSTRUMENTATION

I.4.1 TIMING DEVICE

A stopwatch or other device, accurate to within ± 1 second per 8 hours (± 3 sec/day), must be used to measure the time of application of the burner flame (ignition time), the flame time, and the drip flame time.

I.4.2 RULER

A ruler or scale graduated to the nearest 0.1 inch (2.5 mm) must be used to measure the burn length.