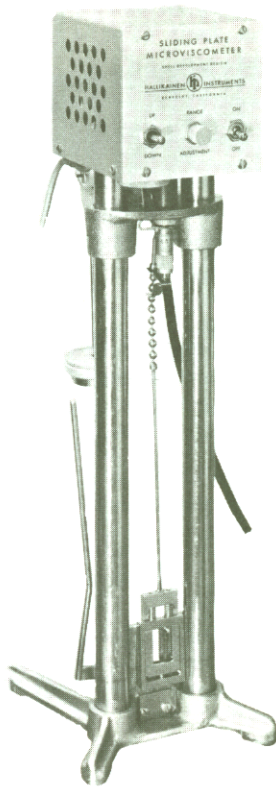


SLIDING PLATE MICROVISCOMETER

(Shell Development Co. Design)

for determining ASPHALT VISCOSITY
ASPHALT DURABILITY



Model 1113

DESCRIPTION

The SLIDING PLATE MICROVISCOMETER combines the simplicity of the classical concept of viscosity—shearing a sample between two parallel flat plates—with the sensitivity and accuracy of an electronic circuit for measuring movement. It is a precise and versatile instrument for determining viscosity in absolute units and is suitable for penetration-grade asphalts, liquid asphalts and other viscous materials. This MICROVISCOMETER has a range of one thousand to one hundred billion poise. At freezing temperatures this permits measuring the viscosity of all products from Grade 1 liquid asphalts to 40/50 penetration paving asphalts. At 77°F the range is from Grade 3 liquid asphalts to zero penetration paving asphalts. Since the shear rate may be accurately determined, it is equally applicable to materials having Newtonian or non-Newtonian flow properties.

The MICROVISCOMETER is designed for operation in constant-temperature water baths normally used for testing asphaltic materials. By using it in baths of different temperature, the viscosity-temperature characteristics of asphalt may be determined directly.

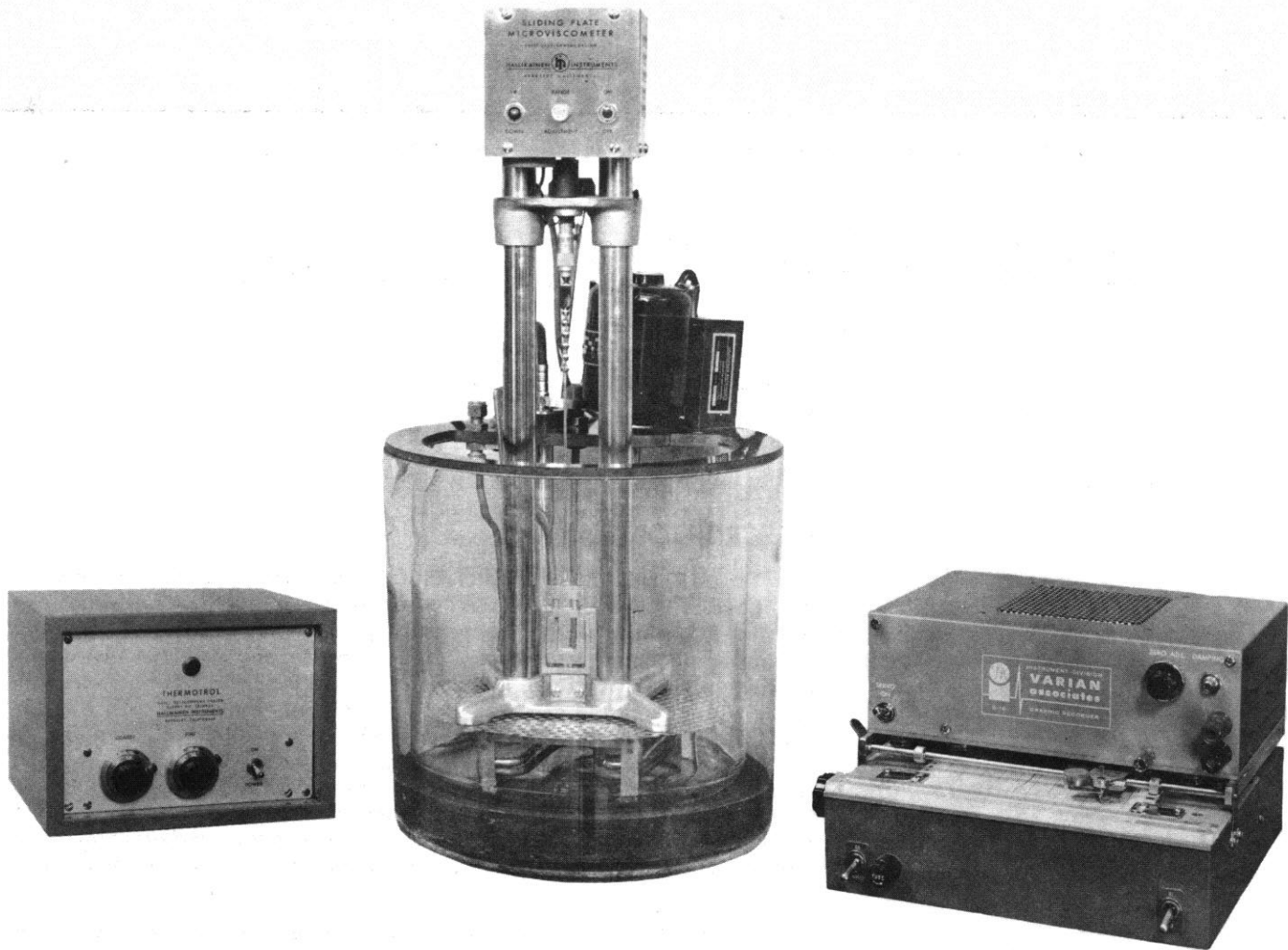
The MICROVISCOMETER consists of two polished glass plates between which is placed a thin layer of the sample. This thin layer is made by pressing a warmed drop of the sample between the plates. The film thickness used in the MICROVISCOMETER normally is in the range from about 10 microns to 200 microns. Homogeneity of the film is determined by observing the uniformity of color in transmitted light. Thickness of the film is determined by weighing on an analytical balance or by use of Model 1147 FILM FORMER. By means of quickly operated spring clamps, one of the glass plates is clamped to the MICROVISCOMETER frame and the other to the loading device. It is not necessary for the operator to put his hands in the water of the constant-temperature bath to do this. The sample will reach the test temperature within two minutes

after being placed in the bath. The pulling force is applied through a simple balance beam pivoted on agate bearings and polished steel knife edges. This design permits extreme sensitivity while allowing a range in loads from 0.1 gram to 10 kilograms.

An electronic circuit is used to follow the movement of the glass plate by controlling a simple servo motor. This drives an insulated micrometer and causes it to maintain a high resistance contact with a flag attached to the movable glass plate assembly. The effect of contact pressure in the following mechanism is unmeasurable over the range of viscosities covered.

Movement of the glass plate may be measured directly by reading the micrometer as a function of time, thus making the instrument complete by itself. For greater convenience, however, it has also been designed to permit recording the displacement of the glass plate on a millivolt recorder. This allows the operator to do other work while the test is in progress and provides a permanent graphical record of the test.

Although any potentiometer type millivolt recorder with proper range may be used, the instrument generally has been used with a Varian Model G-10 Graphic Recorder modified by Hallikainen. With the recorder, 0.5 mm displacement of the glass plates is magnified to a 5-inch movement in the chart. Normally a movement of 0.1 mm is all that is needed for one viscosity determination. Measurements at four different shear rates can therefore be made in one chart width. If the movement is greater than this, the recording pen automatically moves to the other edge of the chart and continues its trace. Complete viscosity measurements of an 85/100 penetration asphalt may be made at four different shear rates at 77°F in less than fifteen minutes.



VISCOSITY-TEMPERATURE CHARACTERISTICS OF ASPHALT

The SLIDING PLATE MICROVISCOMETER may be used in a constant-temperature bath at whatever temperature it is desired to measure viscosity. Since the viscosity in absolute units may be readily determined at two or more temperatures, it is an ideal instrument for measuring the viscosity-temperature characteristics of asphalt. The same identical sample may be run at different temperatures.

ASPHALT DURABILITY

A method of measuring asphalt durability was described in the prize-winning paper "Microfilm Durability Test for Asphalt" by Griffin, Miles and Penther of Shell Development Company, PROCEEDINGS OF THE ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS, 24, p. 31, 1955.

In this test the viscosity of the asphalt is determined before and after aging in a very thin film of about 5 microns thickness. The SLIDING PLATE MICROVISCOMETER is the instrument designed to measure viscosity in that test. The only additional equipment needed in making the microfilm durability test is a set of aging plates (available separately) and an oven capable of maintaining a temperature of 225°F and equipped with a rotating shelf.

CURING RATE OF CUTBACKS

The curing rate of all types of cutbacks and slow-curing road oils may be determined by exposing a thin film of material at a selected temperature and measuring increase in viscosity with time.

MEASURING THE VISCOSITY OF ASPHALT IN A PAVEMENT

Since only a very small quantity of asphalt is needed for a viscosity measurement, it is possible to simplify the method of asphalt recovery from a pavement. After dissolving a small section of pavement in benzene, a portion of the extract is centrifuged, a glass plate is dipped in the extract, and the solvent is evaporated in an inert atmosphere in the dark at room temperature. The asphalt is then scraped off the glass plate and placed on the viscosity plates for the usual viscosity measurement.

VISCOSITY OF RESINS, PLASTICS & OTHER VISCOUS MATERIALS

The instrument may be used for measuring the viscosity of resins, plastics and other viscous materials which will adhere to the glass sample plates. Uniformity of thickness of thick films which are not transparent may be checked by use of a dial comparator or by use of Model 1147 FILM FORMER.

SPECIFICATIONS

SLIDING PLATE MICROVISCOMETER

The MICROVISCOMETER is a precision instrument designed both for routine operation and research use. All metal parts which go in the water are nickel-plated or made of stainless steel. The complete electronic circuit and servo motor is housed in the box at the top of the stand and is fused for safety. Overall height of the instrument is 21 inches.

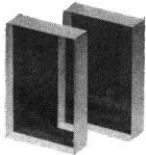
The micrometer on the instrument is graduated in millimeters and reads directly in microns. A range adjustment is provided on the face plate of the MICROVISCOMETER so that each division on the recording chart will correspond exactly to a 5 micron movement of the glass plate. This facilitates calculation of viscosity by means of a nomograph which is included with complete operating instructions.

The MICROVISCOMETER is supplied with one pair of viscosity plates, a set of weights from 1 to 1000 grams; for 115 volt, 60 cycle AC. For 220 volt an external transformer is supplied. Can be used at 50 cycle without modification.

SLIDING PLATE MICROVISCOMETER ACCESSORIES

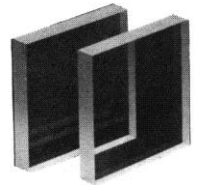
VISCOSITY PLATES—IU-403

The viscosity plates are made of polished flat Pyrex glass, 20 mm by 30 mm in size and 0.240-inch thick with squared edges. They are supplied in matched pairs.



AGING PLATES—IU-404

The aging plates for use in making the microfilm durability test for asphalt are made of polished flat Pyrex glass, 40 mm by 40 mm in size and 0.240-inch thick with squared edges. They are supplied in matched pairs.



WATER BATH—MODEL 1141



This bath has been specifically designed for the MICROVISCOMETER. It consists of two glass jars, one within the other. The inner jar has a capacity of 2½ gallons. The top of the bath is made of Bakelite with a cut-out large enough to permit insertion of the MICROVISCOMETER in the bath. The MICROVISCOMETER rests on a stainless steel plate. Suspended from the Bakelite top is an electrical heating unit and a cooling coil. A motor-driven stirrer equipped with an impeller is mounted on the Bakelite top. The bath is designed as standard equipment for operation at 115 volts 60 cycles AC; modification can be made for other power supplies at extra charge.

TEMPERATURE CONTROL FOR WATER BATH



We recommend for temperature control of the water bath either a Hallikainen-Shell THERMOTROL Temperature Controller or a Hallikainen-Shell RESISTOTROL Temperature Controller. The selection of either one would depend upon the degree of accuracy desired. The THERMOTROL incorporates proportional and reset control features, thereby providing for much closer bath temperature control than might be obtained by the RESISTOTROL Temperature Controller. The RESISTOTROL incorporates "on-off" control only.



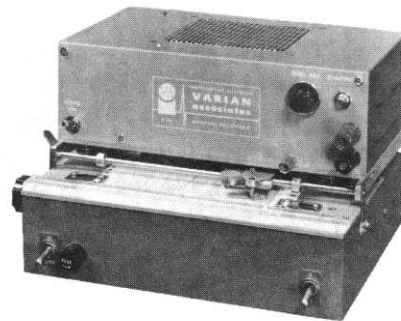
The THERMOTROL is capable of controlling the water bath to $\pm 0.01^{\circ}\text{C}$, and the RESISTOTROL to $\pm 0.1^{\circ}\text{C}$. With either of these controllers, a Hallikainen Model 1080 Resistance Thermometer would be used as the primary element in the water bath.

For details on the THERMOTROL or RESISTOTROL, ask for the brochures describing and illustrating each of these instruments.

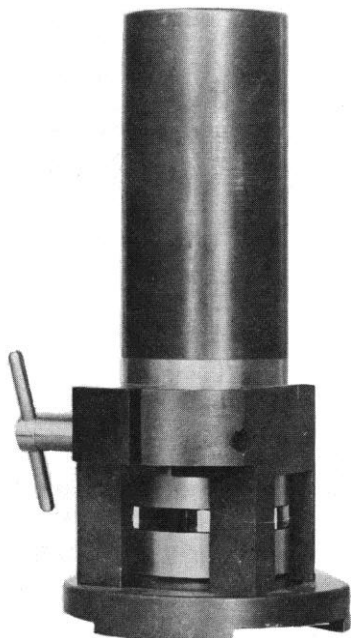
VARIAN G-10 RECORDER

Varian Model G-10 Graphic Recorder is an all-purpose portable laboratory millivolt recorder. For use with the MICROVISCOMETER it is furnished with one roll of chart paper. For convenience, the standard Varian recorder is modified by Hallikainen Instruments.

Standard instrument is for operation at 115 volt, 60 cycle; can be supplied for other voltages and frequencies at extra charge.

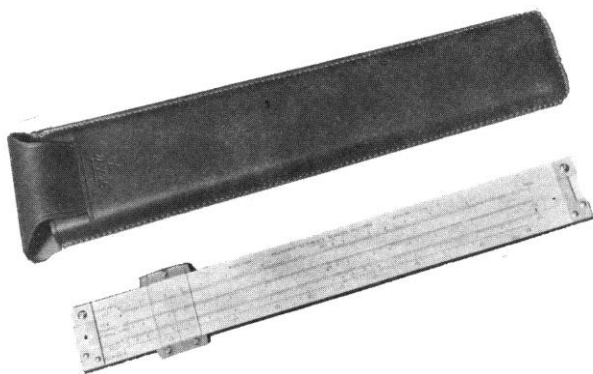


FILM FORMER—MODEL 1147



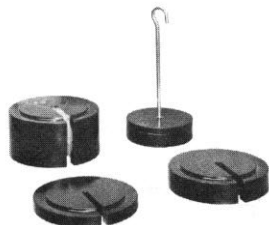
The FILM FORMER has been developed to eliminate the need for weighing samples to assure uniform thickness. The FILM FORMER consists of a base with a flat ground surface onto which is placed an adjustable weight with a ground surface. The viscosity plates are placed between these ground surfaces. In operation, one of the viscosity plates is placed on the base and a thickness gauge corresponding to the thickness of the sample desired is placed upon it. Over the thickness gauge is placed the second glass plate. The weight is then set upon the base so that its ground face is in contact with the upper glass plate. With the ground face of the weight in contact with the glass plate, the legs of the weight must rest on the base, and if they do not, then the adjustment of the weight is made to permit the legs to touch the base. The weight, upper glass plate, and thickness gauge are then removed. The sample is applied to the lower glass plate. The upper glass plate is placed on the sample and the weight is replaced on the base. As the weight descends, it forces excess sample from between the plates so that when the weight has dropped into place, the proper amount is left between the glass plates. The adjustability of the legs on the weight make it possible to apply thicknesses of samples over a wide range. The FILM FORMER is manufactured of stainless steel.

SLIDE RULE—MODEL 1149



To eliminate the need for referring to nomographs and the need for calculation of mathematical equations, Model 1149 SLIDE RULE has been developed with the cooperation of Shell Development Company. The SLIDE RULE is of the usual type except for the scales which are provided for special use with the MICROVISCOMETER. Data obtained in a test involving the slope or angle of a curve on the chart of the recorder, the film thickness, and the amount of weights used are applied to the proper scales on the slide rule and the answer in viscosity (poise) is readily obtained.

SPECIAL HEAVY WEIGHTS—1 TO 10 KG.



The set of weights supplied with the MICROVISCOMETER as standard equipment range from a minimum individual weight of 1 gram to a maximum individual weight of 500 grams with the entire set totalling 1100 grams. For measuring asphalts with viscosities ranging considerably higher than those which the standard set will accommodate, we have designed special weights as illustrated at the left. These are 1000, 2000, and 5000 gram weights with the maximum total to be applied to the instrument restricted to 10,000 grams. These special heavy weights with their weight hanger are available at an extra charge.