

A REPORT ON
VIRGINIA SPECIFICATIONS FOR PENETRATION ASPHALT CEMENTS

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(A Cooperative Organization Sponsored Jointly by the Virginia
Department of Highways and the University of Virginia)

Charlottesville, Virginia

September 1970

VHRC 70-R14

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INTRODUCTION

Mr. A. K. Hunsberger, in his letter of March 18, 1970, concerning the properties of petroleum products, stated that the asphalts currently supplied seem to cause loss of life in bituminous materials in a shorter period of time than was experienced in the past.

With the development of technology, the manufacture of petroleum products will continue to undergo changes likely to affect the chemistry of the residue from the crude oil. The users of asphalt for road purposes, therefore, need to frame their specifications such that whatever changes occur in the manufacture of petroleum products, the asphalt they receive will meet their requirements.

The Virginia specifications for penetration asphalt cements as revised for the 1970 Road and Bridge Specifications are the same as the AASHO M20-63 specifications, with a very minor modification in the solubility test. The tests required in this specification are as follows: Penetration; flash point; ductility; solubility; ash percent; loss on heating; penetration and ductility of residue on thin film oven test (1/8 in. film); and spot test.

PURPOSE

The object of this report is to consider how to classify asphalt cements and what tests and what values should be specified for them.

CLASSIFICATION OF ASPHALTS

The need for grading asphalts according to viscosity in order to minimize temperature susceptibility differences between asphalts has been realized and many states have changed from a penetration classification to viscosity classification. The interim AASHO M226-70I specifications are viscosity graded. In view of this change and looking toward a progressive asphalt specification it is recommended that the Virginia specifications be viscosity graded too.

TEST METHODS AND VALUES

For the purpose of a functional evaluation the items of interest are the physical properties of asphalt (1) for construction, and (2) for durability.

Tests for Construction

To control the heating, mixing, and laying of asphalt or asphaltic mixes, the physical tests obviously needed are as follows:

- (a) Viscosity at mixing temperature.
- (b) Flash point.
- (c) Cohesiveness, or brittleness fracture, as represented by the ductility test.

Viscosity Test

In the past, viscosity has been assumed to be represented by a penetration test at 77°F, 100 g, 5 sec. by Virginia and other highway departments. However, recent investigations have determined the need for additional viscosity tests at 275°F and/or 140°F as well.

About eleven states now specify viscosity tests at 275°F and 140°F in addition to the penetration test (77°F, 100 g, and 5 sec.), and three states have specifications based on viscosity values only. Among the neighboring states, Pennsylvania specifies viscosity tests at 275° and 140°F in addition to determinations of the minimum and maximum penetration values at 77°F. Delaware changed its specifications on June 1, 1970, and now uses viscosity tests at 140°F and 275°F, but does not require penetration tests. The interim AASHO specification for asphalt cement viscosity graded at 140°F (see Table I*) provides for viscosity tests at 140°F and 275°F and a minimum penetration value at 77°F.

Mr. R. G. Bremner, Materials Engineer, reported in 1969 results of viscosity tests at 140°F and 275°F and penetration tests at 77°F of varying asphalt grades from different sources. The results of these tests are shown in Figures 1 and 2. Figure 1 shows the viscosity at 140°F versus the viscosity at 275°F.

* All tables and figures are appended.

Figure 2 shows the viscosity at 140°F versus penetration. In these figures lines ab show the minimum values of viscosity at 275°F and the penetration at 77°F recommended in the new AASHO specifications.

Based on Mr. Bremner's data and specifications given by other states, the authors feel that the AASHO specifications could permit acceptance of inferior asphalts. It was therefore, thought desirable to reduce the large variability provided by the proposed AASHO specifications. Using the new AASHO specification as a basis but incorporating values from Bremner's work and the Pennsylvania Highway Department Specification, the following two changes have been made in the proposed AASHO specifications for use in Virginia.

- (1) An increase in the minimum values of viscosity at 275°F. The minimum recommended values for the proposed Virginia specifications (Table II) are about 30 percent higher than those in the new AASHO specification. Comparing these values with the Pennsylvania Specifications for AC-20 as one example, the value of 280 recommended for Virginia is still lower than that of Pennsylvania by 20Cs. Lines pq in Figure 1 show the minimum values of viscosity at 275°F.
- (2) Because of Virginia's lack of experience with viscosity grading it would seem prudent to retain some reasonably strong ties to the traditional penetration tests. It is therefore, felt necessary to specify the minimum and maximum values of penetration during what may prove to be a transition period. Lines pq and rs in Figure 2 show the minimum and maximum values of penetration for the proposed Virginia Specifications. As seen from Figure 2 these values are met by the asphalts reported by Mr. Bremner, and are also compatible with those of the Pennsylvania Department of Highways.

Other Tests

No change is needed in the flash point test and no improvements have been developed for the ductility test, hence both of these tests should be continued as part of the Virginia specifications. The other tests, i. e. solubility in trichlorethene, ash percent and spot tests as specified in the 1970 Virginia Specifications should be retained.

The proposed Virginia Specifications for the above mentioned tests are given in Table II.

Tests for Durability

For durability testing the properties at the following two stages need to be considered.

- (a) Stage one — The physical properties of the asphalt immediately after it is placed in the road are the ones that determine the potential service the pavement may furnish.
- (b) Stage two — The rate of deterioration in the physical properties of the asphalt during the period of aging determine the life of the asphalt pavement. Investigations carried out by the Research Council during the last few years have shown that cracks may be caused by a combination of aging and low temperatures. The penetration and ductility values of asphalt from surface courses in these investigations have been found to be below 10 and 30 respectively.

For stage one the accelerated laboratory tests so far developed are the thin film oven test (1/8 in. film), the rolling thin film oven test, and the oxidation test. The thin film test is a time proven test and has been adopted by almost all states who also use determinations of (a) penetration and/or (b) ductility of the residue. In the Virginia Road and Bridge Specifications (1970) these tests are specified and will provide a good estimate for this stage. It is, however, recommended that in addition, viscosity of the residue obtained from the thin film oven test (1/8 in. film) be specified for the evaluation of the first stage in Virginia. The reason for the recommendation of this additional test is that for the viscosity evaluation there is a trend away from the penetration test to the direct viscosity tests. Further, this direct viscosity test has been provided in the proposed AASHO specifications (see Table I).

Since the functional properties of asphalt are the ones of interest, penetration and viscosity tests are both recommended for the proposed specifications and their values are given in Table II.

Temperature cracks which apparently have caused a great deal of pavement distress, are a result of a combination of aging and low temperature, and thus any tests considered for stage two should consider both long time aging and low temperature. At this time Virginia has no experience with any test for either condition. The modified thin film oven test may be a suitable test for predicting long time aging. This test and low temperature tests are therefore discussed below under proposed tests.

PROPOSED TESTS

Many experiments have been carried out to develop a suitable test for low temperatures, but no very satisfactory ones have been found. Some states have specified penetration and viscosity tests for temperatures lower than 77°F; i. e. at 60 or 39.2°F. Delaware specifies viscosity at 60°F.

It is proposed that in order to develop background information on the above two conditions the following tests be carried out as time, personnel and funds permit to evaluate the rate of deterioration of asphalt:

1. Thin film oven test
 - (a) Penetration, 39.2°F, 200 gms, 2 min.
specify minimum value for AC-5, AC-10 and AC-20
2. Modified thin film oven test
 - (a) Viscosity, 140°F, poises
specify maximum values for AC-5, AC-10 and AC-20
 - (b) Penetration (100 gms, 5 sec.) and/or ductility
specify minimum values for AC-5, AC-10 and AC-20
 - (c) Penetration, 39.2°F, 200 gms, 2 min.
specify minimum values for AC-5, AC-10 and AC-20

REQUIREMENTS FOR A SPECIFICATION FOR
 ASPHALT CEMENT - VISCOSITY GRADED AT 140°F

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AASHO Designation: M-226-70 I

Test	Viscosity Grade											
	AC-5		AC-10		AC-20		AC-40					
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, 140°F, poises	500+100		1000+200		2000+400		4000+8000					
Viscosity, 275, Cs	110	—	150	—	210	—	300	—				
Penetration, 77°F, 100 g, 5 sec.	120	—	70	—	40	—	20	—				
Flash Point, COC, F	350	—	425	—	450	—	450	—				
Solubility in trichlorethylene, percent	99.0	—	99.0	—	99.0	—	99.0	—				
Tests on residue from Thin-film oven test:												
Viscosity, 140°F, poises	—	2000	—	4000	—	8000	—	16000				
Ductility, 77°F 5 Cm per min., cm	100	—	50	—	20	—	10	—				
Spot test (When and as specified. See Note 1 with:												
Standard naphtha solvent												
Naphtha-Xylene-solvent,												
percent Xylene												
Heptane-Xylene solvent,												
percent Xylene												

Negative for all grades

Negative for all grades

Negative for all grades

Note. 1. — Same as Note 1 in AASHO Spec. M20-19

Test	VISCOSITY GRADE											
	AC-5		AC-10		AC-20		AC-40					
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, 140°F, poises	500±100		1000±200		2000±400		4000±800					
Viscosity, 275, Cs	150	—	200	—	280	—	400	—				
Penetration, 77°F, 100 g, 5 sec.	150	300	80	150	60	120	40	70				
Flash Point, COC, F	350	—	425	—	450	—	450	—				
Solubility in trichlorethylene, percent	99.0	—	99.0	—	99.0	—	99.0	—				
Tests on residue from Thin-film oven test:												
Viscosity, 140°F, poises	—	2000	—	4000	—	8000	—	1600				
Penetration 77°F, 100 g, 5 cm % of Original	45	—	50	—	50	—	55	—				
Ductility, 77°F 5 Cm per min., cm	100	—	50	—	20	—	10	—				
Spot test (When and as specified. See Note 1 with:												
Standard naphatha solvent	Negative for all grades											
Naphatha-Xylene-solvent, _____percent Xylene	Negative for all grades											
Heptane-Xylene solvent, _____percent Xylene	Negative for all grades											

Note 1. — Same as Note 1 in AASHO Spec. M20-19

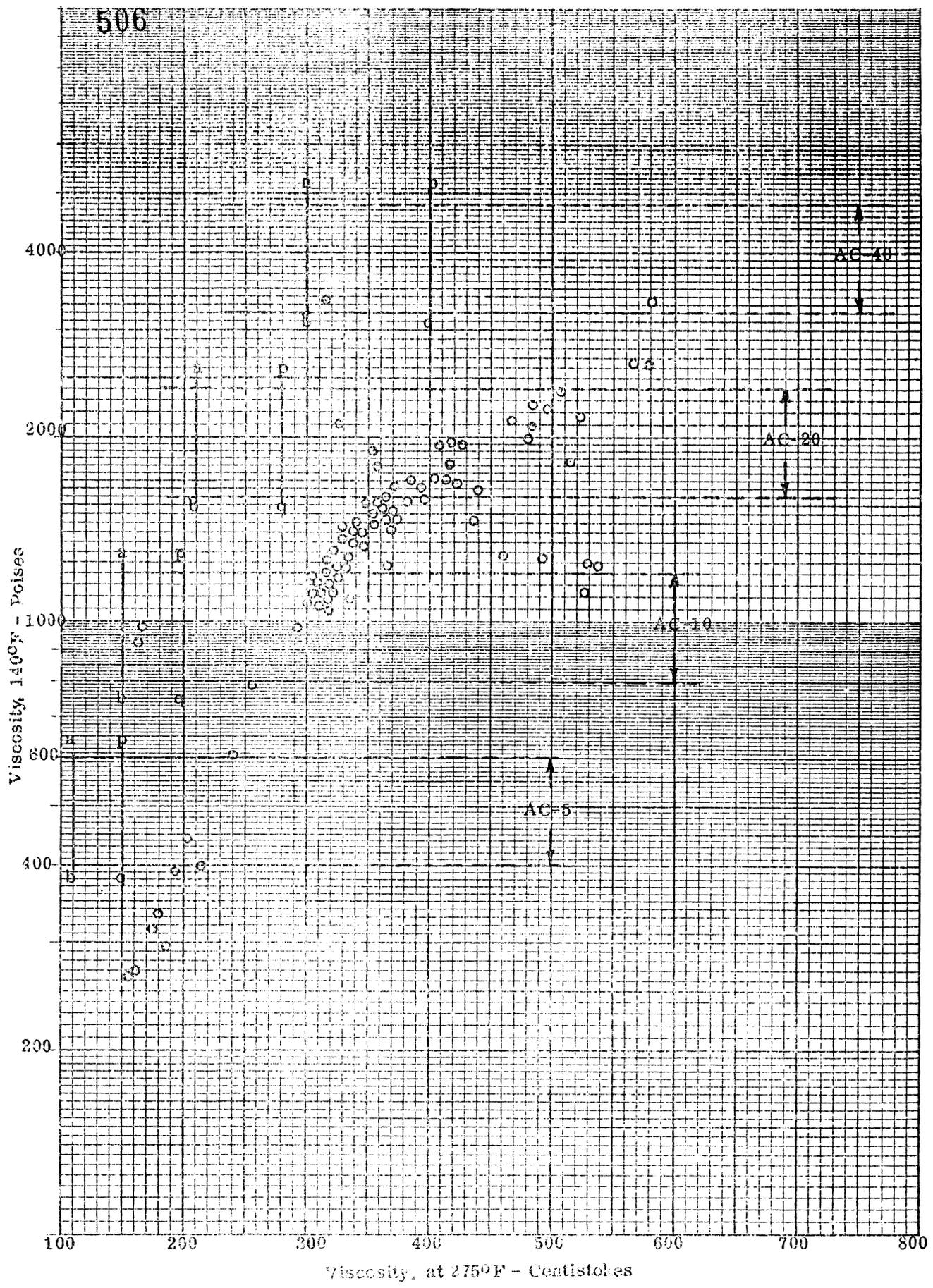


Figure 1. Viscosity at 140°F versus viscosity at 275°F.

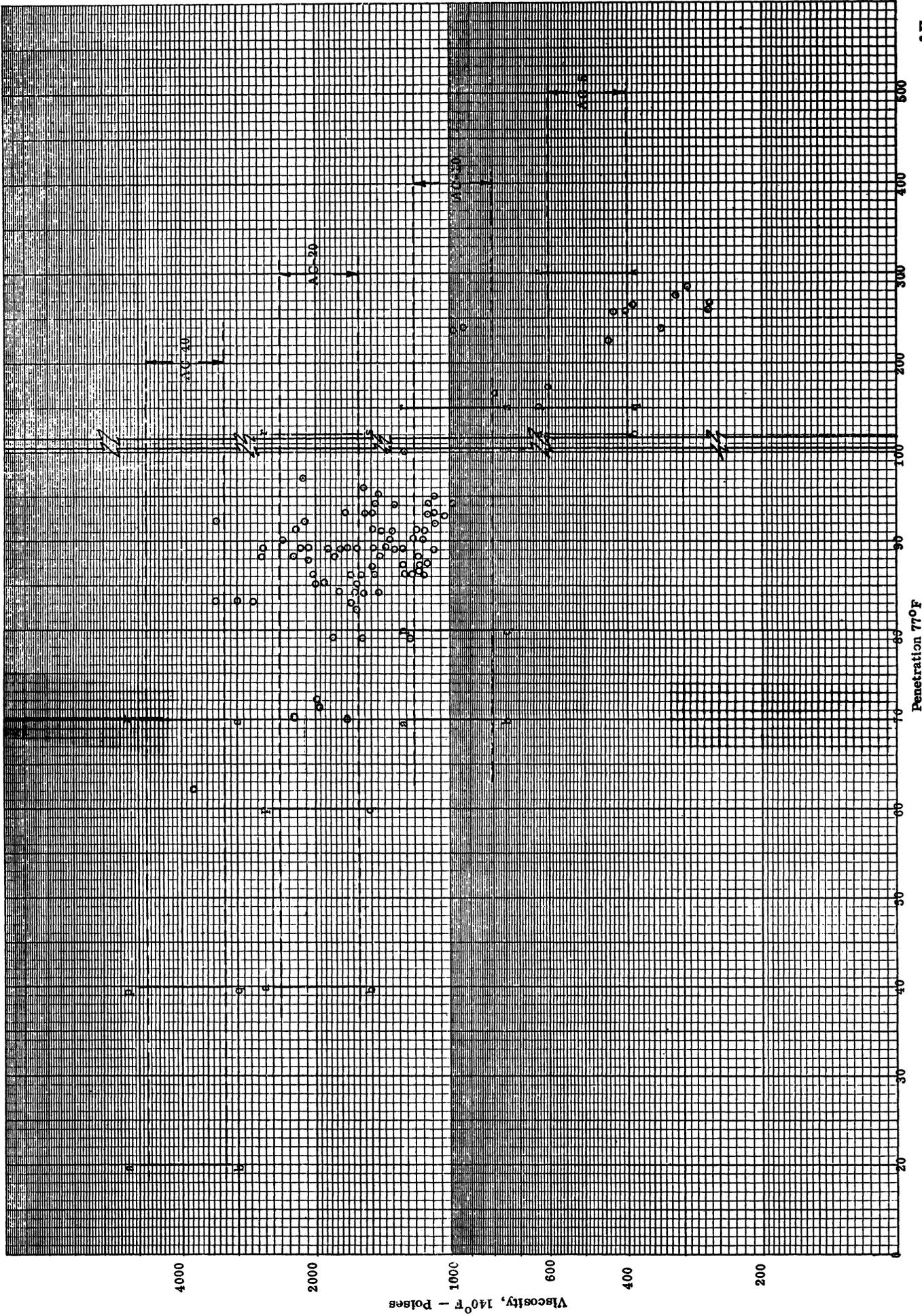


Figure 2. Penetration versus viscosity.

