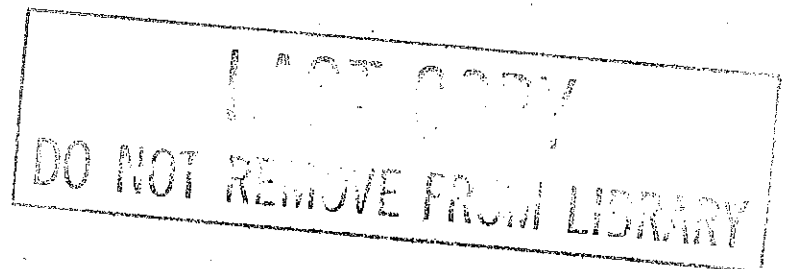


CONTRACT RESEALING OF TRANSVERSE JOINTS
Sealing and Performance of 1963 Maintenance Projects

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In connection with the proposed Statewide Resealing Program, Research Laboratory Division representatives observed cleaning and resealing of joints by three different contractors using five brands of hot-pour rubber-asphalt sealants at nine project locations in April, May, and June 1963. After approximately a year of service, these joints were inspected for possible correlation of contractor's operating procedure with subsequent joint appearance and performance. Pertinent data on the projects and materials are summarized in Table 1. For purposes of this discussion, resealing procedures outlined in the Departmental Specifications are divided into three successive phases:

1. Removal of old sealant
2. Cleaning of joint groove and scarifying of the joint faces
3. Sandblasting, air blowing, caulking, and resealing

Removal of Old Sealant

Department specifications call for plowing old joint sealant and foreign matter from the transverse joint using a plow blade attached to a walking garden tractor. Fig. 1 shows equipment used by the three contractors, indicating that only one complied with this requirement, using a weighted, hand-operated garden tractor. The other two used riding tractors, one with the plow blade mounted on a carriage beneath the tractor and the other with the blade weighted and mounted behind the rear wheels. In both these latter cases, use of a riding tractor resulted in relatively less control over spalling along the joint edge during removal of the old material.

Cleaning Joint Groove and Scarifying Joint Faces

Specifications provide alternatively for either of two methods: use of a routing-refacing machine with a rotary blade followed by use of a power-driven wire brush, or use of a concrete sawing machine with spaced vertical blades. Barton Bros. used a sawing machine with carborundum blades (Fig. 2), Sargent a router and wire brush (Fig. 3), and Young a router and abrasive saw (Fig. 4). It was observed during contractors'

TABLE 1
SUMMARY OF 1963 CONTRACT RESEALING OF TRANSVERSE JOINTS

Contractor	Project Groups	Location	Built	Resealed	Joint Length, lin ft*	Sealant Used
Barton Brothers Co. Hamel, Illinois	Mm 3JS-5C	US 31 between Grand Haven and Holland	NB: 1950 SB: 1958	May 1963	32,065	Meadows hot-pour rubber asphalt
	Mm 3JS-5C	US 131 between I 96 and Grand Rapids East Belt-line	1953	May 1963	5,040	
	Mm 3JS-6A	US 10 between Bay City and Midland	1958	June 1963	38,586	
	Mm 3JS-6C	M 81 between M 47 and Caroline St. in Saginaw	1958	June 1963	8,983	Presstite hot-pour rubber asphalt
	Mm 3JS-6C	M 46 between M 47 and Saginaw	1959	June 1963	22,174	
	Mm JS- 5A	M 66 between I 96 and Barry Co. Line	1947	April 1963	9,148	Allied hot-pour rubber asphalt
Sargent Construction Co. Saginaw, Michigan	Mm JS- 8A	US 127 between Hudson and the State Line	1947, 1949	May-June 1963	12,118	
	Mm 3JS-6B	M 15 between M 81 and Bay City	1955-56	June 1963	19,459	Carey hot-pour rubber asphalt
Ben T. Young Co. Detroit, Michigan	Mm 3JS-5B	US 27 between St. Johns and Ithaca	1956	June 1963	31,376	Servicised hot-pour upgraded rubber asphalt

* Joint lengths shown as let in resealing contracts; at some locations actual resealed joint length was less due to poor condition of some joints.

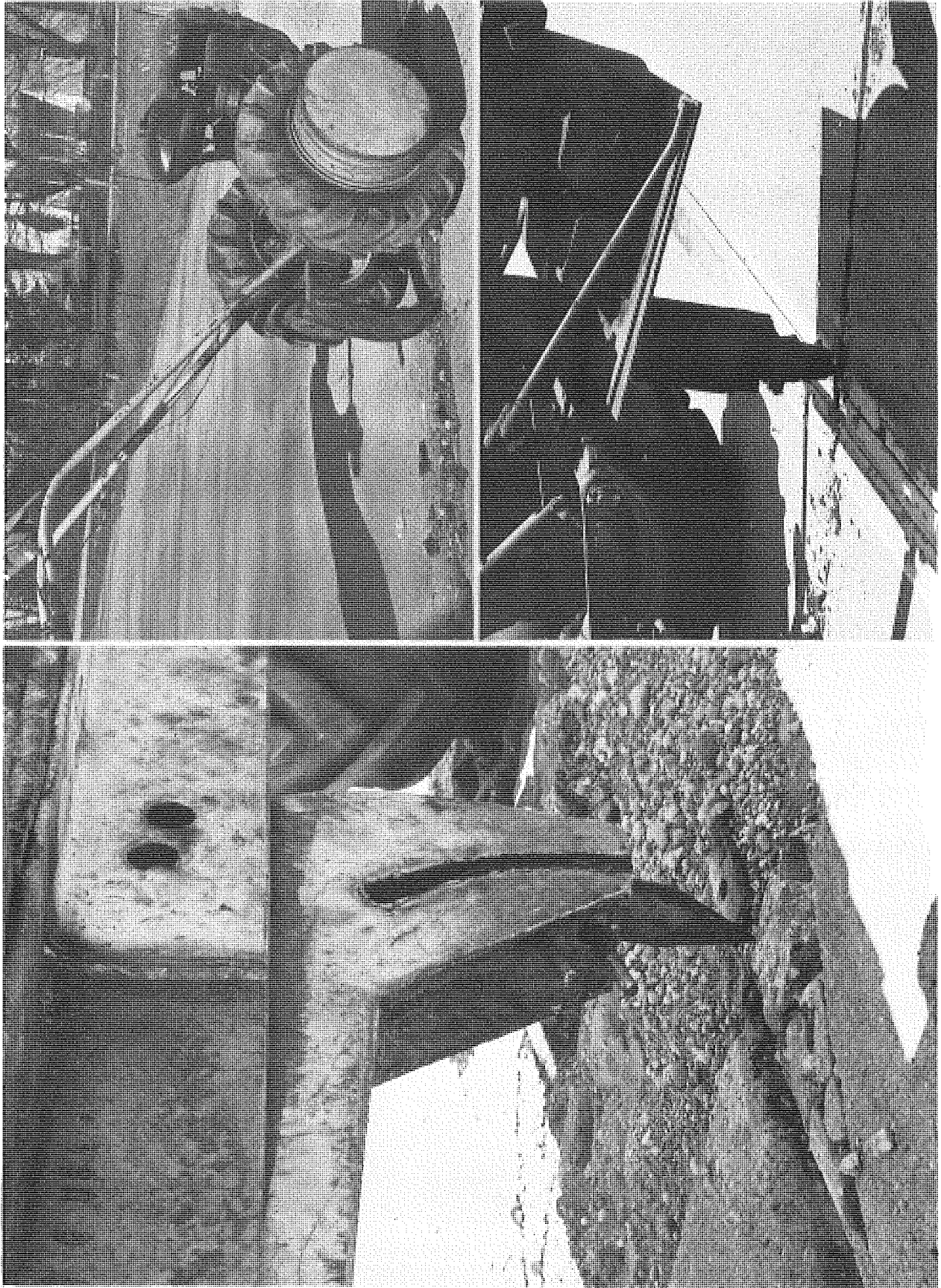


Figure 1. Equipment used to remove old sealant included blade mounted beneath riding tractor (left, Barton), weighted garden tractor (top right, Sargent), and blade mounted behind tractor (bottom right, Young).



Figure 2. Barton's only mechanical operation in cleaning joint groove and scarifying joint faces was concrete saw containing spaced vertical carborundum blades.



Figure 3. Sargent used Windsor router (top) for routing and scarifying, and then cleaned further with rotating wire brush (bottom).



Figure 4. Young also used Windsor router (left) and then scarified with an abrasive saw (right).

operations that the combination of router and brush generally proved to be superior to the concrete saw for cleaning and scarifying the joint faces.

Sandblasting, Air Blowing, Caulking, and Resealing

Specifications call for sandblasting the vertical joint faces and the pavement surface for 1 in. each side of the joint, using compressed air to blow out dust and sand left by sandblasting, caulking the joint groove with jute or oakum, and then resealing. The three contractors used similar equipment in sandblasting (Fig. 5) and in air blowing. Barton used rope and Sargent jute for caulking, but Young was observed at all joints to proceed directly from air blowing to resealing. In resealing, Barton used a truck-mounted melter-applicator (Fig. 6), and the other two contractors used similar trailer-mounted melter-applicators (Fig. 7). All three contractors had Berry Melter-Applicators, the newest and most modern type in use.

Comparison of Contractors' Methods

Barton resealed at five locations, where most pavement was about 5 years old. In most cases, Barton's joint grooves appeared to be in good condition after removal of the old sealer, except for a few corner breaks. Sargent worked at two locations where the joints were about 15 years old, and were badly spalled, cracked, and faulted. In many cases these joints were considered too poor to merit resealing. Young operated at two locations where joints were 7 or 8 years old, and intermediate in condition in comparison to the good and poor joints encountered by the other two contractors.

Barton generally worked fastest, as a result of good joint groove conditions and use of the quicker of the two alternate cleaning procedures. Sargent's equipment was almost new at the start of operations, and was used by an efficient crew which appeared to be doing a satisfactory job, although their operations were slow, reflecting the poor joint groove conditions encountered from the beginning of their work. Young's methods were intermediate in speed, just as the grooves involved were intermediate in condition. It should be noted that on one of Young's two projects, a special upgraded hot-pour rubber-asphalt sealant was installed experimentally.

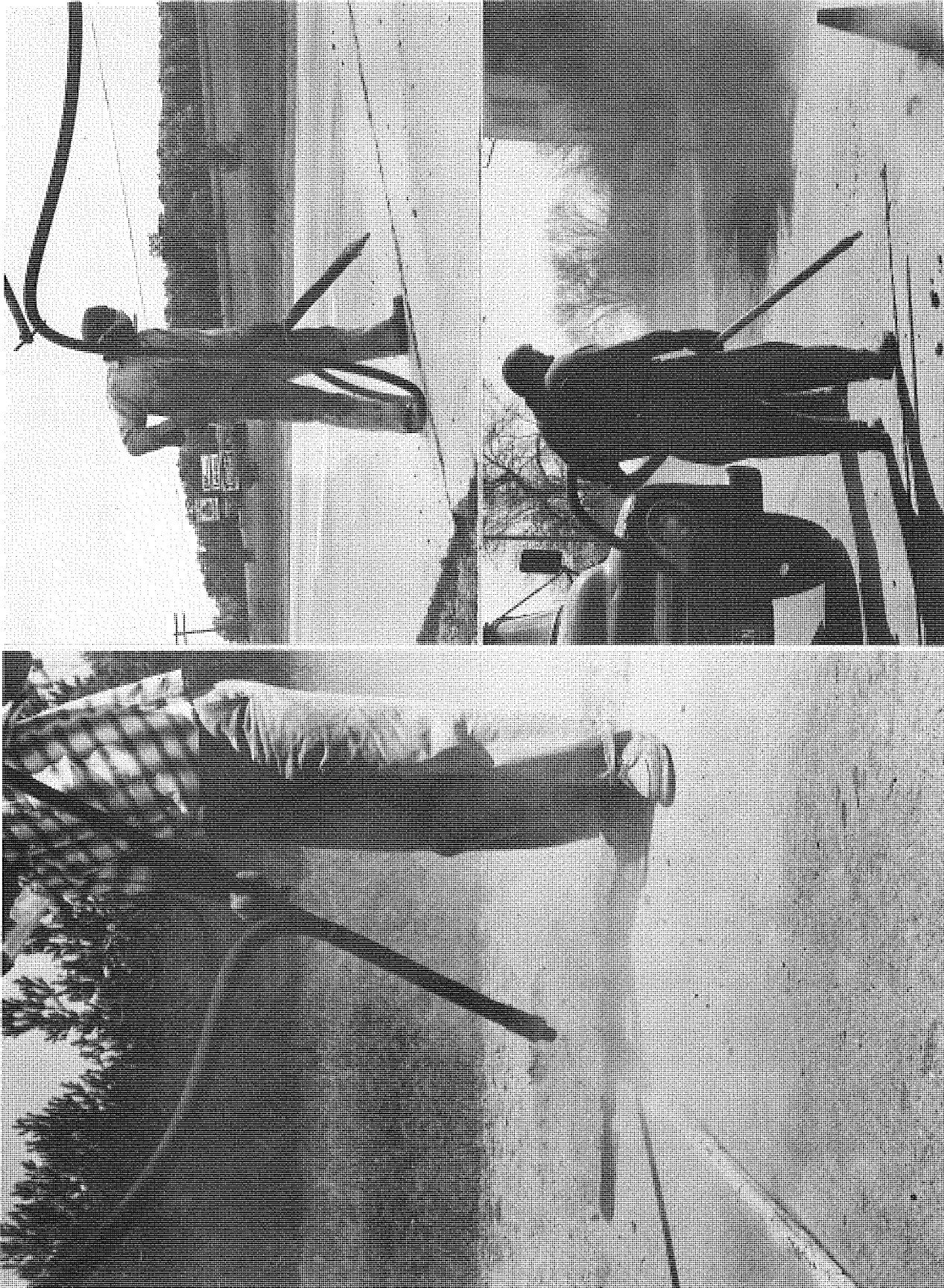


Figure 5. Sandblasting by Barton (left), Sargent (top right), and Young (bottom right).



Figure 6. Barton used truck-mounted melter-applicator.

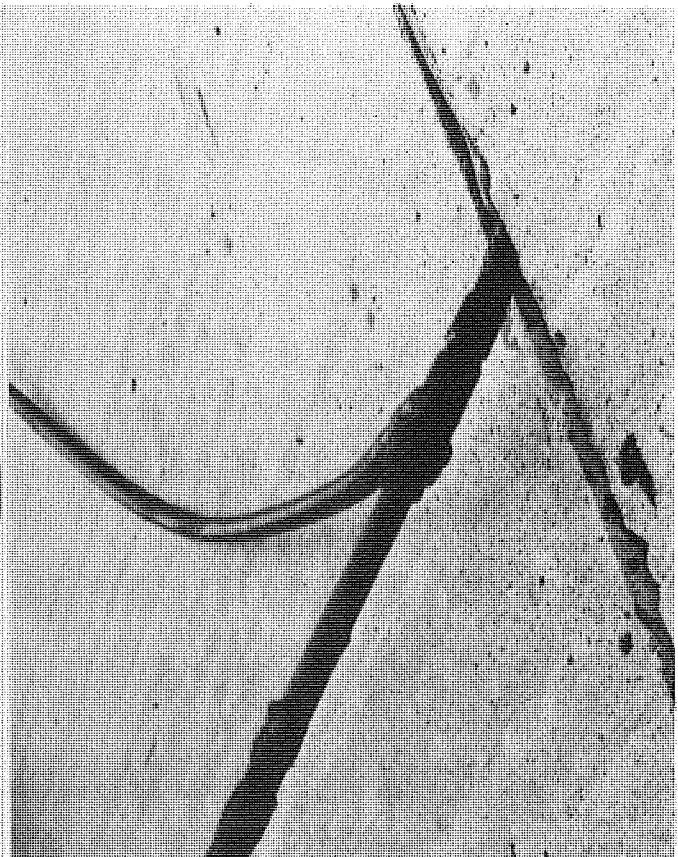
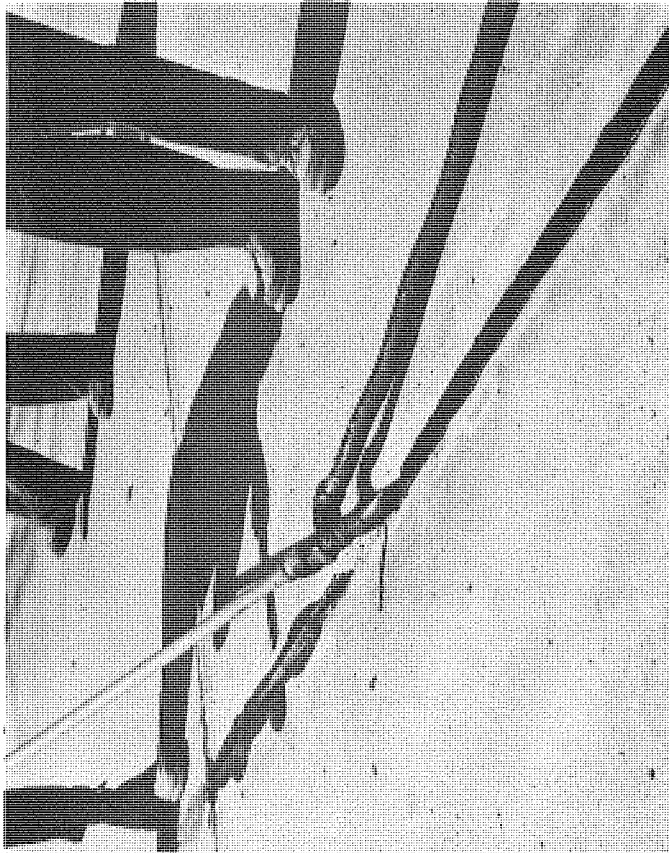


Figure 7. Both Sargent (top left) and Young used trailer-mounted melter-applicators; application by Sargent shown at top right and Young at bottom left. Note good lepping of sealant at tip of Sargent joint (top right).

Performance Evaluation Ratings

Many factors influence performance of a joint sealant in a resealed joint groove. Five of the more critical factors are: condition of the joint groove after removal of old sealant, cleaning of the joint groove prior to resealing, temperature at time of sealing, installation workmanship, and joint sealant quality.

1. Since resealing necessarily involves pavements with several years of service, the joint grooves are generally spalled, and frequently corner breaks have occurred. As a result the cleaned joint groove in many cases may vary from the original 1/2 in. width to as much as 4 in. at points along its length. Thus, the volume of joint sealant is increased, which may seriously affect sealant stresses.

2. Removal of the old sealant and subsequent cleaning operations must ensure clean joint side walls free of loose foreign material. Otherwise, proper adhesion of the sealer cannot be expected.

3. Ambient temperature at the time of sealing affects the amount of the sealer installed, and thus whether at other temperatures, the joint will appear to be over- or underfilled. For example, joint grooves sealed at extremely high ambient temperature (joint closed) will appear underfilled at lower temperatures, and joint grooves sealed at low temperatures (joints open) will appear overfilled at higher temperatures.

4. The resealing crew should have sufficient experience in operating their equipment to ensure proper installation temperature of the sealant, because improper melting temperatures change sealant properties so that satisfactory performance cannot be expected. Good workmanship and judgment are necessary to obtain a joint groove filled to a proper level with respect to joint width.

5. The quality of a joint sealant greatly affects its adhesion and cohesion characteristics.

With these five factors in mind, a system was developed for evaluation of sealant performance, based on sealant ductility, appearance, dirt infiltration, and type of failure. Ductility was classified as resilient, plastic, or hard. Appearance was rated normal, wrinkled, or cracked. Location of dirt infiltration was noted with respect to joint faces, sealant cracks, or sealant center fold. Sealant failures were identified as adhesive or cohesive.

By rating joints in terms of these characteristics, it was possible to group their performance into four broad categories defined as follows:

Good-to-excellent— where the sealer was resilient or plastic, and appeared normal.

Fair-to-good— where the sealer had any of the ductility characteristics, appeared wrinkled and/or cracked, with or without dirt infiltration.

Poor-to-fair — where the sealer had any or all the characteristics of a "fair-to-good" joint, but up to 25 percent of the total lineal feet of seal partially or totally failed in adhesion at the joint groove side walls, or up to 25 percent of the sealant partially or totally failed in cohesion.

Failed— where 25 to 100 percent of the sealant had failed in adhesion or cohesion.

Because of the large number of joints included in this study (170,000 lin ft of seal) 100-percent inspection seemed impractical. Therefore, for each project a representative number of randomly selected joints were chosen for close observation. To eliminate the influence of joint groove condition, which varied greatly because of the relatively large age differential among the projects, only joint grooves free of spalls and corner breaks were selected for inspection. To obtain joints representing a complete range of sealing conditions, each project was divided roughly into thirds (end, middle, end) with about the same number of joints studied in each third.

Results of Performance Survey

The first performance survey of the nine resealing projects was conducted in March 1964, after approximately a year of service. The joints selected for these inspections were rated independently by two observers using the evaluation system just described. Results were compared and in case of disagreement, the observers made a second examination of the joint in question to adjust their two ratings for closer resemblance to the existing condition.

A total of 130 joints were rated, representing 3120 lin ft of sealant. In addition, a general survey was performed on each project to ensure that the condition of the sample joints was typical of all joints. Results of

the inspection are summarized in Table 2, and selected joints are illustrated in Figs. 8 through 11. On the basis of this survey and assuming no variation in sealant quality, the percentages of joints in four performance categories would be as follows:

Contractor	Good to Excellent	Fair to Good	Poor to Fair	Failed
Barton	79	21	--	--
Sargent	19	62	19	--
Young	8	56	11	25

Discussion

Based on the quality percentages just listed, which assume relative equality of the five sealants and thus principally reflect the workmanship of each contractor, it appears that projects sealed by Barton Bros. are performing best, those of Ben T. Young poorest, and those of Sargent Construction are intermediate in quality. The relatively poor performance of 19 percent of the Sargent joints and 36 percent of Young's can probably be attributed to one or more of the following causes:

1. Premature adhesion or cohesion failure due to poor sealant quality (although all five products used meet current specifications).
2. Improper caulking or absence of caulking beneath the sealant, allowing flow of the material into the plane-of-weakness crack and establishing a poor shape factor.
3. Inadequate cleaning at the time of sealing.
4. Overheating of sealant in the melter.
5. Not filling joint grooves to a proper level to allow for subsequent joint movement.

Observations of each contractor's workmanship during resealing indicated adequate performance by the Barton and Sargent crews, suggesting that poor performance of the Sargent joints might be due to sealant quality. In the case of the Young projects, omission of caulking beneath

TABLE 2
SUMMARY OF PERFORMANCE OF INSPECTED RESEALED JOINTS
Figures for Number of Joints Exhibiting Characteristics Indicated

Contractor	Project	Total Joints Surveyed	Sealant Ductility			Sealant Appearance(a)			Dirt Infiltration(b)(c)			Sealant Failure, percent of length			
			Resilient	Plastic	Hard	Normal	Wrinkled	Cracked	At Joint Faces	In Sealant Cracks	In Sealant Center Fold	Adhesion		Cohesion	
												0-25	25-100		0-25
															0-25
Meadows	US 31	26	0	0	10	16	16	5	12	10	0	0	0	0	0
	US 131	5	0	0	5	0	0	0	0	0	0	0	0	0	0
Barton	US 10	20	0	20	0	20	0	0	0	0	0	0	0	0	0
	M 81	8	0	0	8	0	0	0	0	0	0	0	0	0	0
	M 46	19	0	0	19	0	0	0	0	0	0	0	0	0	0
Sargent	M 66	7	0	0	3	4	0	0	0	0	0	1	0	0	0
	US 127	9	0	9	0	3	6	0	0	0	0	2	0	0	0
Young	M 15	16	7	9	0	3	7	6	7	6	0	4	6	0	3
	US 27	20	20	0	0	0	20	20	0	20	0	0	0	0	0

(a) Sealant in a single joint may be both wrinkled and cracked.

(b) Dirt may have infiltrated sealant in a single joint at one, two, or all three locations indicated.

(c) Gravel shoulder on all projects except M 81 (curbs) and M 46 (whole length curbs or sealed shoulders).

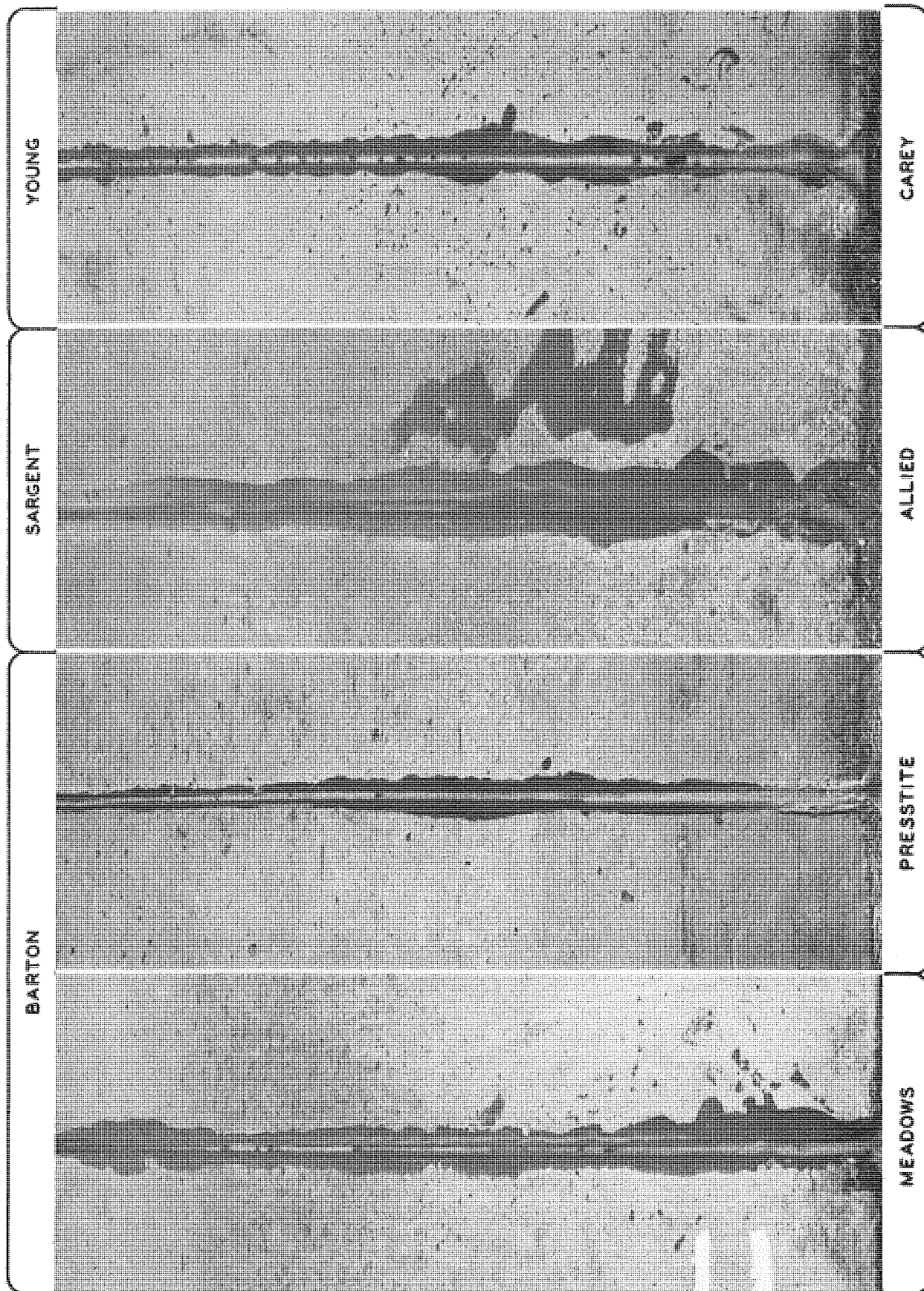


Figure 8. Typical joints rated "good-to-excellent".

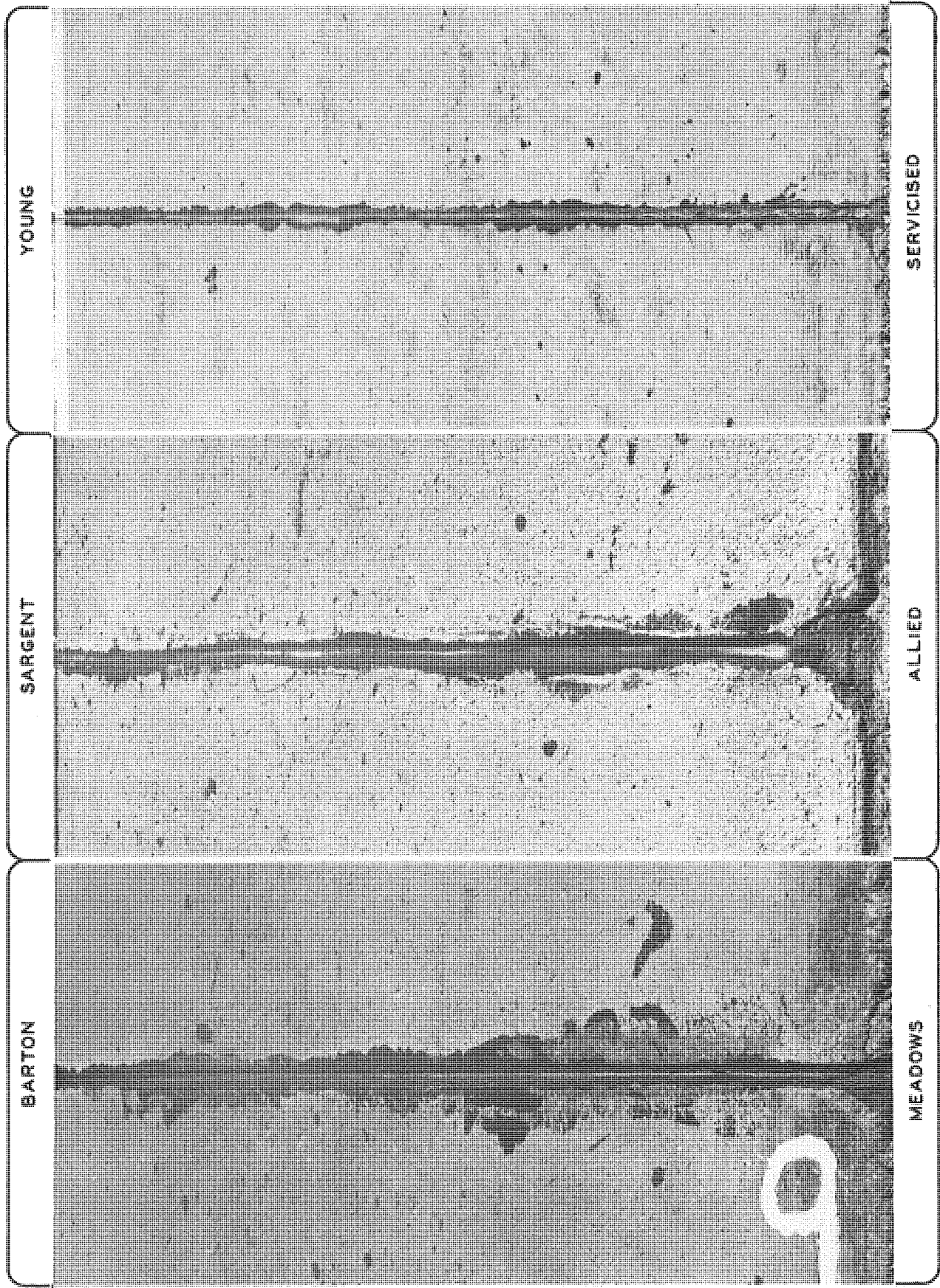


Figure 9. Typical joints rated "fair-to-good" because of some sealant wrinkling or cracking, or some dirt infiltration.

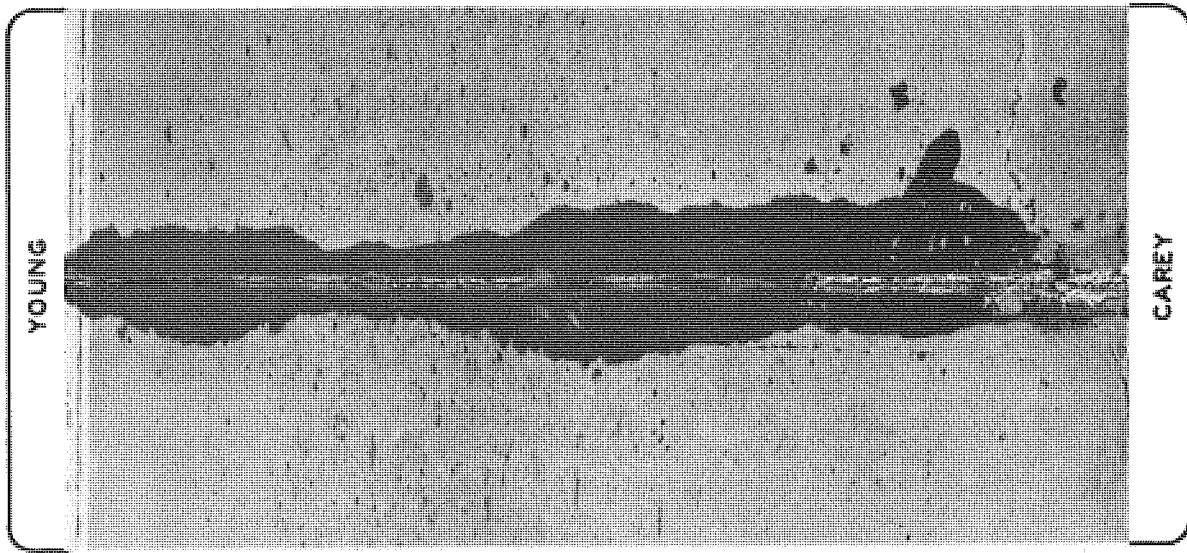


Figure 11. One-fourth of Young's joints had failed, with loss of adhesion or cohesion along 25 to 100 percent of the groove length.

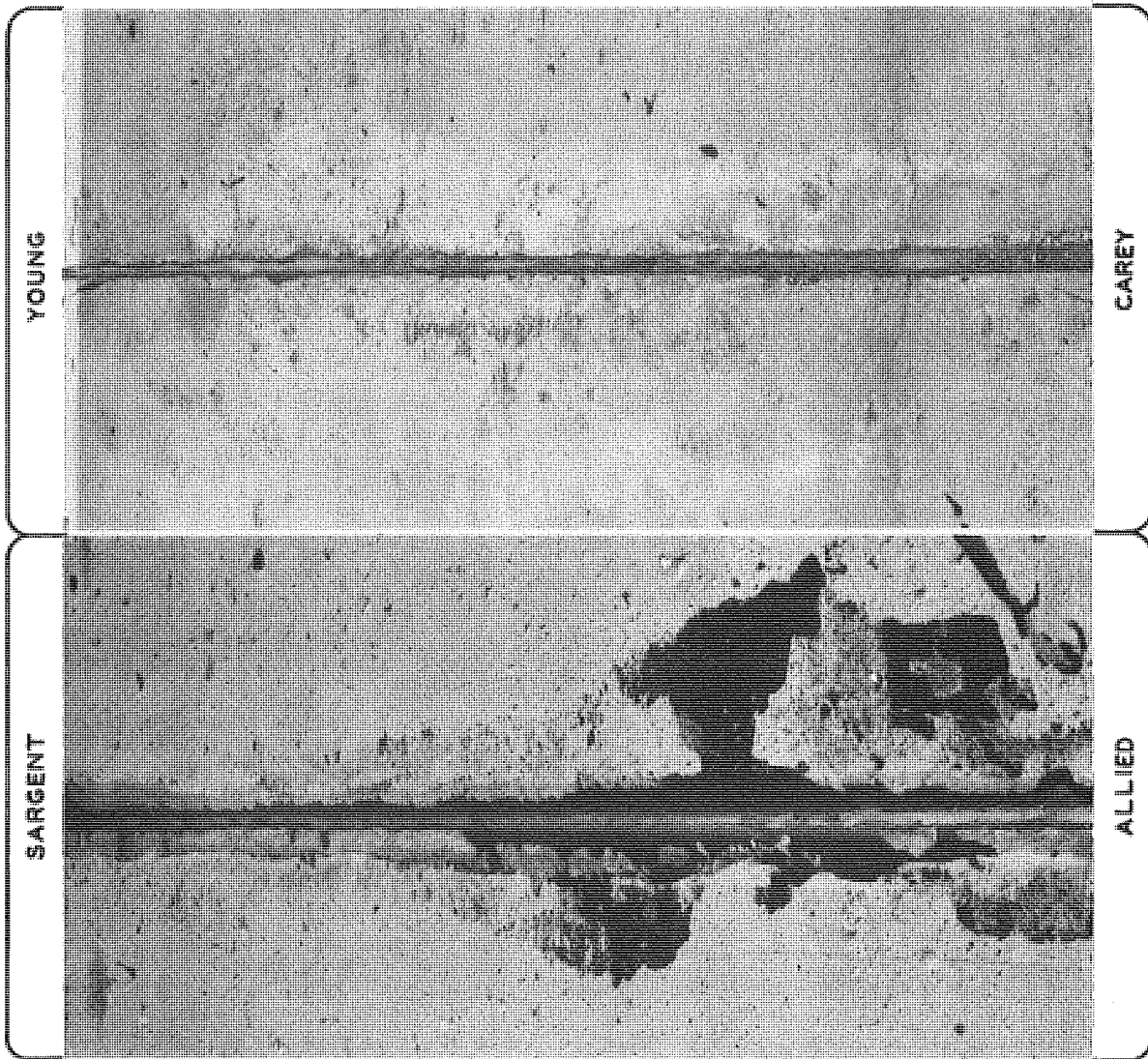


Figure 10. Typical joints rated "poor-to-fair" because of sealant wrinkling, cracking, dirt infiltration, or loss of adhesion or cohesion along up to 25 percent of the groove length.

the sealant was noticed; also, because of the poor appearance of the sealant material on Young's US 27 project, several samples were tested for flow with results indicating overheating at the time of resealing.

Although factors of workmanship and sealant quality cannot be separated in a sealant performance evaluation, it is possible to rate performance of the five sealant products as follows, assuming equal contractor workmanship and drawing on the survey data:

Meadows and Presstite - good

Allied and Servicised - fair

Carey - poor

Samples of Carey sealant extracted from the resealed joints were also tested, but results indicated no overheating. It may be concluded, then, that this material is generally of poorer quality than the other four sealants.

Dirt infiltration into a sealant affects duration of the period during which that material can provide an effective seal, since the dirt becomes intermixed due to the kneading action of tires and to fold-in by joint movement. Thus, once a joint seal surface has cracked, wrinkled, folded, or partially failed in adhesion or cohesion, seal failure is hastened by tracking of dirt from the shoulders or deposition of windblown dirt on the joint. Of the nine resealing projects, seven had gravel shoulders and the other two were curbed or had sealed shoulders. Although these latter two were among Barton's five projects, the relative amount of tracked or blown dirt would be less significant at this early stage of performance (providing that installation was well done and that the material is in good condition) than later in the sealant's service when cracking or other failure permits infiltration. Thus, while shoulder conditions may affect a poorly sealed joint or an inferior sealant early in service life, eventually most joints become vulnerable to infiltration regardless of initial condition. Similarly, once the joint does become vulnerable, sufficient dirt to permit infiltration is present in most environments regardless of shoulder composition.

The survey data further indicate that pavement age at the time of resealing has relatively little effect on sealant performance, provided that the joint grooves have sound side walls, are free of large spalls and corner breaks, and of course are "working" joints. Thus, the survey underscores the fact that selection of pavements for resealing cannot be

based entirely on age, but that joint and joint groove conditions should be a paramount consideration. The criteria for projecting pavement life, based on known sufficiency rating methods, could possibly be used to determine whether resealing of a pavement is desirable from structural or economic points of view.

In conclusion, satisfactory contract resealing can be obtained on pavements where joints are "working" and faces are sound, provided that specification procedures are followed during the work, and that a good sealant material is used.