

ENGINEERING RESEARCH INSTITUTE
THE UNIVERSITY OF MICHIGAN
ANN ARBOR

Final Report (Appendix I)
TEST DATA FOR ORIGINAL AND
RECOVERED ASPHALT

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Project 2249

THE OHIO OIL COMPANY
FINDLAY, OHIO

May 1957

EXPOSURES

ERI PROJECT 2249

Ohio Oil Company, Findlay, Ohio

Test Results on Composition of Asphalt

Original and Recovered Material

Type of Exposure

Test Exposure	Mat'l Heating		Mix Time Hobart, min	Mixture Heating		Test Conditions
	AGG °F	Asphalt °F		Time, min	Temp, °F	
a	400	300	1	30	350	Cool 45 min, extract and recover AC. M1 to M55.
a ₁	350	300	1	30	325	Cool 45 min, extract and recover AC. ALL tests above 36A.
b	400	300	1	30	350	Air weather 72 hr in laboratory. M1 to M55.
c	Same as b					Air weather 24 hr in laboratory. M1 to M55.
d	Same as b					Air weather 48 hr in laboratory. M1 to M55.
e	Same as b					Heat in force draft 72 hr at 140°F. M1 to M55.
f	Same as b					Heat in force draft 24 hr at 140°F. M1 to M55.
g	Same as b					Heat in force draft 48 hr at 140°F. M1 to M55.
h	350	300	1	90	325	Cool, extract, and recover. Michigan and Minnesota aggregates.
i	Same as h					Intended to be run on Minnesota aggregate. No tests performed.
j	Same as h					Mixture of Michigan aggregate using Garland-Duct-Spot blend.
k	350	300	1	30	350	Loose spread in shallow pan and expose 60 days outdoors.
l	Same as k					Compacted to 4" diameter x 4-1/2" cylinder and exposed 60 days outdoors.
m	350	300	1	30	325	Cool, extract and recover. Michigan aggregate with Garland-Duct-Spot.
n	350	300	1	180	325	Cool, extract and recover. Michigan and Minnesota aggregates with regular test asphalts and special Garland-Duct-Spot blends.

The University of Michigan • Engineering Research Institute

Ohio Oil Company, Findlay, Ohio
Composition of Asphalt—Asphaltenes, Oily Constituents, Resins
Bureau of Mines Method

TABLE I

Test No.	Test Exposure	Type of Asphalt	Source of Asphalt	Type of Aggregate	Weight and Percentage, Original Sample and Component Parts					Tot Wt and % Referred to Orig Sample					
					Orig Wt Grams	Wt Asphtns Grams	Asphtns %	Oily Const Grams	Oily Const %	Wt Resin Grams	Resin %	Revd Wt Grams	+ or - Grams	% of Orig	+ or - % of Orig
C33		OL85-100	Orig		1.3447	0.2555	19.00	0.4777	35.52	0.6214	46.21	1.3546	+0.0099	100.73	+0.73
1C34		OL85-100	Orig		1.3276	0.2537	19.11	0.4529	34.11	0.6615	49.82	1.3681	+0.0405	105.04	+3.04
1C35		OL85-100	Orig		1.3709	0.2590	18.89	0.4874	35.55	0.6687	48.78	1.4151	+0.0442	105.22	+3.22
C36		OT85-100	Orig		1.3598	0.2785	20.54	0.4867	35.89	0.6208	45.79	1.3860	+0.0262	102.22	+2.22
C37		OT85-100	Orig		1.2997	0.2621	20.17	0.4430	34.09	0.5998	46.15	1.3049	+0.0052	100.41	+0.41
C38A		OT85-100	Orig		Test Void. The flask containing the oils was broken in oven at end of standard drying period.										
C38B		OT85-100	Orig		1.3249	0.2719	20.52	0.4568	34.48	0.6181	46.65	1.3468	+0.0219	101.65	+1.65
C39		185-100	Orig		1.3041	0.2483	19.04	0.4996	38.31	0.5676	43.52	1.3155	+0.0114	100.87	+0.87
C40		185-100	Orig		1.2924	0.2491	19.27	0.4540	35.21	0.6042	46.75	1.3073	+0.0149	101.23	+1.23
C41		185-100	Orig		1.2979	0.2517	19.39	0.5107	39.35	0.5952	45.84	1.3376	+0.0597	104.58	+4.58
C42	a	OL85-100	M1	Ottawa	1.2567	0.2891	23.00	0.4298	34.20	0.5603	44.58	1.2791	+0.0224	101.78	+1.78
C43	a	OL85-100	M1	Ottawa	1.3185	0.3084	23.39	0.4680	35.49	0.5750	43.61	1.3514	+0.0329	102.49	+2.49
2C44		Duct Spot	Orig		1.3306	0.2054	15.44	0.4719	35.47	0.6249	46.96	1.3022	-0.0284	97.87	-2.13
Note: After methanol-benzene wash it appeared that some resins remained on the alumina which could not be removed by the solvent.															
C45	a	OL85-100	M2	Ottawa	1.3410	0.3041	22.68	0.4653	34.70	0.5737	42.78	1.3410	+0.0021	100.16	+0.16
C46	a	OL85-100	M2	Ottawa	1.2926	0.2995	23.17	0.4299	32.71	0.5881	45.50	1.3175	+0.0249	101.39	+1.39
C47	a	OL85-100	M5	Ottawa	1.2813	0.2969	23.17	0.4593	35.85	0.5561	43.40	1.3123	+0.0310	102.42	+2.42
C48	a	OL85-100	M5	Ottawa	1.3098	0.3048	23.27	0.4773	36.44	0.5344	40.80	1.3165	+0.0067	100.51	+0.51
2C49	a	OL85-100	M4	Ottawa	1.2928	0.2957	22.87	0.4634	35.84	0.5474	42.34	1.3065	+0.0137	101.05	+1.05
C50		Duct Spot	Orig		0.7031	0.1073	15.26	0.2295	32.65	0.3456	49.15	0.6824	-0.0207	97.06	-2.94
C51	a	185-100	M4	Ottawa	1.2891	0.2939	22.79	0.4982	38.64	0.5465	42.39	1.3586	+0.0495	103.82	+3.82
C52	a	185-100	M5	Ottawa	1.2847	0.2914	22.68	0.4554	35.44	0.5605	43.63	1.3073	+0.0226	101.75	+1.75
C53	a	185-100	M5	Ottawa	1.2655	0.2866	22.64	0.4662	36.83	0.5306	41.93	1.2834	+0.0179	101.40	+1.40
C54	a	185-100	M6	Ottawa	1.2636	0.3011	23.83	0.4663	36.90	0.5392	42.67	1.3066	+0.0430	103.40	+3.40
C55	a	185-100	M6	Ottawa	1.2795	0.3168	24.78	0.4818	37.69	0.5523	42.21	1.3509	+0.0714	105.68	+5.68
C56	a	OT85-100	M7	Ottawa	1.2534	0.3400	27.13	0.4713	37.60	0.4974	39.68	1.3087	+0.0553	104.41	+4.41
C57	a	OT85-100	M7	Ottawa	1.2556	0.3442	27.41	0.4599	36.63	0.5142	40.95	1.3183	+0.0627	104.99	+4.99
2C58		Duct Spot	Orig		1.2629	0.2145	16.98	0.4666	36.93	0.5951	47.11	1.2762	+0.0133	101.02	+1.02
3C59		Garland	Orig		1.2614	0.3003	23.81	0.5791	45.91	0.4618	36.61	1.3412	+0.0798	106.33	+6.33
3C60		Garland	Orig		1.2666	0.2867	22.64	0.6080	48.00	0.4156	32.81	1.3103	+0.0437	103.45	+3.45
4C61		Garland	Orig		1.2576	0.2888	22.96	0.6058	48.17	0.4201	33.40	1.3147	+0.0571	104.53	+4.53
4C62		Garland	Orig		1.2668	0.2853	22.52	0.4874	38.48	0.5275	41.64	1.3002	+0.0334	102.64	+2.64
4C63		Duct Spot	Ht 400°F		1.2736	0.2018	15.84	0.4345	34.04	0.6353	49.88	1.2716	-0.0020	99.76	-0.24
4C64		Duct Spot	Ht 400°F		1.2546	0.1993	15.08	0.3882	30.94	0.6470	51.57	1.2345	-0.0201	98.39	-1.61
3C65		Garland	Orig		1.2808	0.2897	22.62	0.4752	37.10	0.5463	42.66	1.3112	+0.0304	102.38	+2.38
C66	a	OT85-100	M8	Ottawa	1.2817	0.3308	25.81	0.4402	34.35	0.5236	40.85	1.2946	+0.0129	101.01	+1.01
C67	a	OT85-100	M8	Ottawa	1.2551	0.3172	25.27	0.4058	32.22	0.5497	43.80	1.2727	+0.0176	101.40	+1.40
3C68		Garland	Orig		1.2750	0.2805	22.00	0.5374	42.15	0.5000	39.22	1.3179	+0.0429	103.36	+3.36
4C69		Duct Spot	Ht 400°F		1.2591	0.1947	15.46	0.4779	37.96	0.5799	45.74	1.2485	-0.0106	99.16	-0.84
4C70		Garland	Orig		1.2604	0.2935	23.29	0.5337	43.14	0.4656	36.78	1.3008	+0.0404	103.21	+3.21
C71	a	OT85-100	M9	Ottawa	1.2577	0.3056	24.30	0.4935	39.24	0.4865	38.68	1.2856	+0.0279	102.22	+2.22
C72	a	OT85-100	M9	Ottawa	1.2609	0.3054	24.22	0.4806	38.12	0.5009	39.73	1.2869	+0.0260	102.07	+2.07
C73	a	OL85-100	M10	Local	1.2601	0.2902	23.03	0.5389	45.42	0.4489	35.62	1.2776	+0.0175	101.38	+1.38
C74	a	OL85-100	M10	Local	1.2532	0.2927	23.36	0.4616	36.83	0.5350	42.69	1.2893	+0.0361	102.88	+2.88
C75	a1	OL85-100	M5GA	Minn.	1.2651	0.3142	24.84	0.3922	31.00	0.5782	45.78	1.2846	+0.0195	101.54	+1.54
C76	a1	OL85-100	M57A	Minn.	1.2610	0.2996	23.76	0.3748	29.72	0.5951	47.19	1.2695	+0.0085	100.67	+0.67
C77	Asphalt	6% Duct-Spot Garland	Lab-Mix Mat'l		1.2811	0.2793	21.80	0.5257	41.04	0.5017	39.16	1.3067	+0.0256	102.00	+2.00
C78	Asphalt	9% Duct-Spot Garland	Lab-Mix Mat'l		1.2585	0.2739	21.76	0.5074	40.40	0.5167	41.06	1.2980	+0.0395	103.14	+3.14
C79	a1	OL85-100	M58A	Minn.	1.2621	0.2716	21.52	0.4524	35.85	0.5684	45.04	1.2924	+0.0303	102.40	+2.40
C80	b	OL85-100	M11	Local	1.2500	0.2993	23.94	0.4410	35.28	0.5466	43.73	1.2869	+0.0369	102.95	+2.95
C81	c	OL85-100	M12	Local	1.2592	0.3050	24.22	0.4350	34.55	0.5350	42.49	1.2750	+0.0158	101.25	+1.25
C82	a1	OL85-100	M59A	Mich.	1.2505	0.2702	21.61	0.5074	40.58	0.5159	41.26	1.2935	+0.0430	103.44	+3.44
C83	a1	OL85-100	M40A	Mich.	1.2571	0.2800	22.47	0.4744	37.74	0.5373	42.74	1.2917	+0.0346	102.75	+2.75
C84	a1	OL85-100	M41A	Mich.	1.2777	0.2658	20.80	0.5005	39.17	0.5371	42.04	1.3034	+0.0297	102.00	+2.00
C85	a1	OT85-100	M42A	Mich.	1.2561	0.2978	23.71	0.5036	40.49	0.5087	40.50	1.3101	+0.0540	104.30	+4.30
C86	d	OL85-100	M13	Local	1.2624	0.3093	24.50	0.5175	40.99	0.4763	37.73	1.3031	+0.0407	103.22	+3.22
C87	d	OL85-100	M13	Local	1.2746	0.3054	23.96	0.4565	35.82	0.5344	41.93	1.2963	+0.0217	101.70	+1.70
C88	a1	OT85-100	M43A	Mich.	1.2576	0.2840	22.58	0.4376	34.80	0.5666	45.05	1.2882	+0.0306	102.43	+2.43
C89	a1	OT85-100	M44A	Mich.	1.2604	0.2874	22.95	0.5046	40.30	0.5061	40.50	1.2981	+0.0377	102.99	+2.99
C90	a1	185-100	M45A	Mich.	1.2568	0.2679	21.42	0.4975	39.77	0.5254	42.01	1.2908	+0.0340	102.71	+2.71
C91	a1	185-100	M46A	Mich.	1.2503	0.2680	21.51	0.5673	45.37	0.4429	35.42	1.2782	+0.0279	102.23	+2.23
C92	e	OL85-100	M14	Local	1.2548	0.3003	23.93	0.4465	35.50	0.5335	42.52	1.2803	+0.0255	102.03	+2.03
C93	e	OL85-100	M14	Local	1.2517	0.2963	23.67	0.4372	34.28	0.5506	43.99	1.2841	+0.0324	102.59	+2.59
C94	f	OL85-100	M15	Local	1.2588	0.3148	25.01	0.4322	34.33	0.5456	43.34	1.2986	+0.0338	102.69	+2.69
C95	f	OL85-100	M15	Local	1.2584	0.3103	24.66	0.4420	35.12	0.5190	41.24	1.2713	+0.0129	101.03	+1.03
C96	a1	OT85-100	M49A	Minn.	1.2592	0.2884	23.07	0.4306	34.44	0.5520	44.15	1.2710	+0.0288	101.66	+1.66
C97	a1	OT85-100	M48A	Minn.	1.2540	0.2885	23.01	0.4633	36.95	0.5393	43.01	1.2911	+0.0371	102.96	+2.96
C98	a1	OT85-100	M47A	Minn.	1.2606	0.2909	23.08	0.4453	35.32	0.5518	43.77	1.2880	+0.0274	102.17	+2.17
C99	a1	185-100	M50A	Minn.	1.2557	0.2566	20.43	0.4744	37.78	0.5500	43.80	1.2810	+0.0253	102.01	+2.01
C100	g	OL85-100	M16	Local	1.2548	0.2841	22.64	0.4799	38.25	0.5149					

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Ohio Oil Company, Findlay, Ohio
Composition of Asphalt—Asphaltenes, Oily Constituents, Resins
Bureau of Mines Method

TABLE I
(Concluded)

Test No.	Test Exposure	Type of Asphalt	Source of Asphalt	Type of Aggregate	Weight and Percentage, Original Sample and Component Parts								Tot Wt and % Referred to Orig Sample			
					Orig Wt Grams	Wt Asphtns Grams	Asphtns %	Oily Const Grams	Oily Const %	Wt Resin Grams	Resin %	Revd Wt Grams	+ or - Grams	% of Orig	+ or - % Orig	
C113	j	9% Duct-Spot Garland	61C	Mich.	1.2581	0.3348	26.61	0.5693	45.25	0.3698	29.39	1.2739	+0.0158	101.25	+1.25	
C114	b	OL85-100	M11	Local	1.2518	0.3422	27.34	0.4353	34.65	0.5514	44.05	1.3274	+0.0756	106.04	+6.04	
C115	c	OL85-100	M12	Local	1.2568	0.3165	25.18	0.4285	34.09	0.5581	44.41	1.3031	+0.0465	103.68	+3.68	
C116	g	OL85-100	M16	Local	1.2587	0.2971	23.60	0.4780	37.98	0.5384	42.77	1.3135	+0.0548	104.35	+4.35	
C117	n	9% Duct-Spot Garland	62C	Mich.	1.2544	0.3656	29.15	0.4800	38.26	0.4359	34.75	1.2815	+0.0271	102.16	+2.16	
C118	n	OL85-100	63D	Mich.	1.2514	0.3516	28.10	0.4119	32.92	0.5399	43.14	1.3034	+0.0520	104.16	+4.16	
C119	n	OL85-100	64D	Mich.	1.2504	0.3903	31.21	0.3871	30.96	0.5109	40.86	1.2885	+0.0579	103.03	+3.03	
C120	m	12% Duct-Spot Garland	65A	Mich.	1.2512	0.3050	24.38	0.5331	42.61	0.4504	36.00	1.2885	+0.0373	102.99	+2.99	
C121	b	OL85-100	M18	Local	1.2571	0.2812	22.37	0.4899	38.97	0.5137	40.86	1.2848	+0.0277	102.20	+2.20	
C122	d	OL85-100	M18	Local	1.2591	0.2830	22.48	0.5098	40.17	0.4974	39.50	1.2862	+0.0271	102.15	+2.15	
C123	j	12% Duct-Spot Garland	66B	Mich.	1.2572	0.3444	27.39	0.5158	41.03	0.4168	33.15	1.2770	+0.0198	101.57	+1.57	
C124	d	L85-100	M20	Local	1.2547	0.2881	22.96	0.4872	38.83	0.5065	40.36	1.2818	+0.0271	102.15	+2.15	
C125	d	L85-100	M20	Local	1.2592	0.2834	22.58	0.5145	40.99	0.4943	39.38	1.2922	+0.0370	102.95	+2.95	
C126	g	L85-100	M23	Local	1.2533	0.2916	23.27	0.4937	39.39	0.4990	39.81	1.2843	+0.0310	102.47	+2.47	
C127	g	L85-100	M23	Local	1.2534	0.2959	23.57	0.4916	39.16	0.4876	38.84	1.2751	+0.0197	101.57	+1.57	
C128	f	L85-100	M24	Local	1.2568	0.2813	22.38	0.5281	42.02	0.4764	37.91	1.2858	+0.0290	102.31	+2.31	
C129	f	L85-100	M24	Local	1.2548	0.2846	22.68	0.4365	34.79	0.5741	45.75	1.2952	+0.0404	103.22	+3.22	
C130	e	L85-100	M25	Local	1.2525	0.3370	26.91	0.4903	39.15	0.4981	39.77	1.3254	+0.0729	105.83	+5.83	
C131	e	L85-100	M25	Local	1.2512	0.2977	23.79	0.4976	39.77	0.4823	38.55	1.2776	+0.0264	102.11	+2.11	
C132	n	12% Duct-Spot Garland	M67D	Mich.	1.2579	0.3969	31.55	0.4702	37.38	0.4091	32.52	1.2762	+0.0185	101.45	+1.45	
C133	k	OL85-100	M36E	Minn.	1.2538	0.4682	37.34	0.4105	32.74	0.3908	31.17	1.2695	+0.0157	101.25	+1.25	
C134	l	OL85-100	M36F	Minn.	1.2577	0.3135	24.93	0.4531	36.03	0.5368	42.68	1.3034	+0.0457	103.64	+3.64	
C135	k	OL85-100	M37E	Minn.	1.2571	0.4972	39.54	0.3921	31.19	0.3788	30.13	1.2681	+0.0110	100.86	+0.86	
C136	l	OL85-100	M37F	Minn.	1.2535	0.2954	23.57	0.4816	38.42	0.5019	40.04	1.2789	+0.0244	102.03	+2.03	
C137	k	OL85-100	M38E	Minn.	1.2545	0.3126	24.92	0.4321	34.44	0.5387	42.94	1.2834	+0.0289	102.30	+2.30	
C138	l	OL85-100	M38F	Minn.	1.2502	0.2770	22.16	0.4677	37.41	0.5298	42.38	1.2745	+0.0243	101.95	+1.95	
C139	k	OL85-100	M39E	Mich.	1.2530	0.3233	25.80	0.4439	35.43	0.5015	40.02	1.2687	+0.0150	101.25	+1.25	
C140	l	OL85-100	M39F	Mich.	1.2526	0.2779	22.19	0.4831	38.57	0.5027	40.13	1.2637	+0.0103	100.89	+0.89	
C141	k	OL85-100	M40E	Mich.	1.2534	0.3056	24.38	0.4621	36.87	0.4986	39.78	1.2663	+0.0129	101.03	+1.03	
C142	l	OL85-100	M40F	Mich.	1.2531	0.2721	21.71	0.4782	38.16	0.5232	41.75	1.2735	+0.0204	101.62	+1.62	
C143	j	12% Duct-Spot Garland	Blend	Orig MTL	1.2567	0.2789	22.19	0.5447	43.34	0.4468	35.55	1.2704	+0.0137	101.08	+1.08	
C144	k	OL85-100	M41E	Mich.	1.2578	0.3299	26.23	0.4517	35.91	0.5002	39.77	1.2818	+0.0240	101.91	+1.91	
C145	l	OL85-100	M41F	Mich.	1.2505	0.2851	22.80	0.5138	41.10	0.4739	37.90	1.2728	+0.0223	101.80	+1.80	
C146	k	OL85-100	M42E	Mich.	1.2551	0.3354	26.72	0.5140	40.95	0.4210	33.54	1.2704	+0.0153	101.21	+1.21	
C147	l	OL85-100	M42F	Mich.	1.2553	0.2983	23.76	0.5266	44.02	0.4470	35.61	1.2797	+0.0246	103.39	+3.39	
C148	k	OL85-100	M43E	Mich.	1.2544	0.3429	27.34	0.4912	39.16	0.4440	35.40	1.2781	+0.0237	101.90	+1.90	
C149	l	OL85-100	M43F	Mich.	1.2562	0.3069	24.43	0.5768	45.92	0.4041	32.17	1.2804	+0.0316	102.52	+2.52	
C150	k	OL85-100	M44E	Mich.	1.2524	0.3484	27.82	0.5191	41.45	0.4129	32.97	1.2804	+0.0280	102.24	+2.24	
C151	l	OL85-100	M44F	Mich.	1.2558	0.3018	24.03	0.5026	40.02	0.4739	37.74	1.2783	+0.0225	101.79	+1.79	
C152	k	L85-100	M45E	Mich.	1.2550	0.3115	24.82	0.4390	34.98	0.5216	41.56	1.2721	+0.0171	101.36	+1.36	
C153	l	L85-100	M45F	Mich.	1.2510	0.2770	22.14	0.4701	37.58	0.5332	42.62	1.2803	+0.0293	102.34	+2.34	
C154	k	L85-100	M46E	Mich.	1.2519	0.3126	24.97	0.4942	39.48	0.4732	37.80	1.2800	+0.0281	102.25	+2.25	
C155	l	L85-100	M46F	Mich.	1.2515	0.2793	22.32	0.4945	39.51	0.4957	39.61	1.2695	+0.0180	101.44	+1.44	
C156	k	OL85-100	M47E	Minn.	1.2529	0.3364	26.86	0.4455	35.56	0.5032	40.16	1.2851	+0.0322	102.57	+2.57	
C157	l	OL85-100	M47F	Minn.	1.2545	0.3039	24.22	0.4801	38.27	0.4932	39.24	1.2763	+0.0218	101.73	+1.73	
C158	k	OL85-100	M48E	Minn.	1.2570	0.3317	26.38	0.5371	42.72	0.4118	32.76	1.2806	+0.0236	101.86	+1.86	
C159	l	OL85-100	M48F	Minn.	1.2577	0.3111	24.74	0.5226	41.55	0.4690	37.29	1.3027	+0.0450	103.58	+3.58	
C160	k	OL85-100	M49E	Minn.	1.2510	0.3434	27.45	0.5331	42.61	0.4201	33.58	1.2966	+0.0456	103.64	+3.64	
C161	l	OL85-100	M49F	Minn.	1.2525	*	*	*	*	*	*	*	*	*	*	
C162	k	L85-100	M50E	Minn.	1.2546	0.3008	23.98	0.6296	50.18	0.3477	27.71	1.2781	+0.0235	101.87	+1.87	
C163	l	OL85-100	M49F	Minn.	1.2515	0.3001	23.98	0.5193	41.49	0.4728	37.78	1.2922	+0.0407	103.25	+3.25	
C164	k	L85-100	M51E	Minn.	1.2515	0.3517	28.10	0.5034	40.22	0.4105	32.80	1.2656	+0.0141	101.12	+1.12	
C165	k	L85-100	M52E	Minn.	1.2510	0.3036	24.27	0.5171	41.33	0.4621	36.93	1.2828	+0.0318	102.34	+2.34	
C166	l	L85-100	M51F	Minn.	1.2500	0.2625	21.00	0.6201	49.61	0.4088	32.70	1.2914	+0.0414	103.30	+3.30	
C167	l	L85-100	M50F	Minn.	1.2549	0.2784	22.19	0.5114	40.75	0.5022	40.02	1.2920	+0.0371	102.96	+2.96	
C168	k	L85-100	M52F	Minn.	1.2572	0.2768	22.02	0.5612	44.64	0.4684	37.26	1.3064	+0.0492	103.92	+3.92	
C169	l	L85-100	M53E	Mich.	1.2533	0.3166	25.26	0.5210	41.57	0.4525	36.10	1.2901	+0.0368	102.93	+2.93	
C170	b	L85-100	M26	Local Sand	1.2520	0.2925	23.36	0.4900	39.14	0.5160	41.21	1.2985	+0.0465	103.71	+3.71	
C171	a	L85-100	M27	Local Sand	1.2548	0.2938	23.41	0.5100	40.64	0.5009	39.92	1.3047	+0.0499	103.97	+3.97	
C172	l	L85-100	M53F	Mich.	1.2521	0.2724	21.76	0.4791	38.26	0.5214	41.64	1.2729	+0.0208	101.66	+1.66	
C173	n	OL85-100	M58D	Minn.	1.2532	0.3872	30.90	0.4407	35.17	0.4507	35.96	1.2786	+0.0254	102.03	+2.03	

*Test stopped because the oils would not pass through alumina during their removal with pentane. Test C165 is a repeat of this test.

EXPOSURES

ERI PROJECT 2249

Ohio Oil Company, Findlay, Ohio

Test Results on Composition of Asphalt

Original and Recovered Material

Type of Exposure

Test Exposure	Mat'l Heating		Mix Time Hobart, min	Time, min	Mixture Heating		Test Conditions
	AGG °F	Asphalt °F			Temp, °F	Type of Oven	
a	400	300	1	30	350	F. Draft	Cool 45 min, extract and recover AC. MI to M55.
a ₁	350	300	1	30	325	F. Draft	Cool 45 min, extract and recover AC. ALL tests above 36A.
b	400	300	1	30	350	F. Draft	Air weather 72 hr in laboratory. MI to M55.
c	Same as b						Air weather 24 hr in laboratory. MI to M55.
d	Same as b						Air weather 48 hr in laboratory. MI to M55.
e	Same as b						Heat in force draft 72 hr at 140°F. MI to M55.
f	Same as b						Heat in force draft 24 hr at 140°F. MI to M55.
g	Same as b						Heat in force draft 48 hr at 140°F. MI to M55.
h	350	300	1	90	325	F. Draft	Cool, extract, and recover. Michigan and Minnesota aggregates.
i	Same as h						Intended to be run on Minnesota aggregate. No tests performed.
j	Same as h						Mixture of Michigan aggregate using Garland-Duct-Spot blend.
k	350	300	1	30	350	F. Draft	Loose spread in shallow pan and expose 60 days outdoors.
l	Same as k						Compacted to 4" diameter x 4-1/2" cylinder and exposed 60 days outdoors.
m	350	300	1	30	325	F. Draft	Cool, extract and recover. Michigan aggregate with Garland-Duct-Spot.
n	350	300	1	180	325	F. Draft	Cool, extract and recover. Michigan and Minnesota aggregates with regular test asphalts and special Garland-Duct-Spot blends.

EXPOSURES

ERI PROJECT 2249

Ohio Oil Company, Findlay, Ohio

Test Results on Composition of Asphalt

Original and Recovered Material

Type of Exposure

Test Exposure	Mat'l Heating Agg °F	Mix Time Hobart, min	Mixture Heating		Test Conditions
			Time, min	Temp, °F	
a	400	1	30	350	Cool 45 min, extract and recover AC. M1 to M55.
a ₁	350	1	30	325	Cool 45 min, extract and recover AC. All tests above 36A.
b	400	1	30	350	Air weather 72 hr in laboratory. M1 to M55.
c	Same as b				Air weather 24 hr in laboratory. M1 to M55.
d	Same as b				Air weather 48 hr in laboratory. M1 to M55.
e	Same as b				Heat in force draft 72 hr at 140°F. M1 to M55.
f	Same as b				Heat in force draft 24 hr at 140°F. M1 to M55.
g	Same as b				Heat in force draft 48 hr at 140°F. M1 to M55.
h	350	1	90	325	Cool, extract, and recover. Michigan and Minnesota aggregates.
i	Same as h				Intended to be run on Minnesota aggregate. No tests performed.
j	Same as h				Mixture of Michigan aggregate using Garland-Duct-Spot blend.
k	350	1	30	350	Loose spread in shallow pan and expose 60 days outdoors.
l	Same as k				Compacted to 4" diameter x 4-1/2" cylinder and exposed 60 days outdoors.
m	350	1	30	325	Cool, extract and recover. Michigan aggregate with Garland-Duct-Spot.
n	350	1	180	325	Cool, extract and recover. Michigan and Minnesota aggregates with regular test asphalts and special Garland-Duct-Spot blends.

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Ohio Oil Company
Percent Change in Composition and Properties of Asphalt Related to Exposure Conditions
Included data presented on graph no. 1

TABLE III

A.C.	Composition						Physical Properties									
	% Asphtns	% Oils	% Resin	O/A	R/A	R/O	Penet	Duct	Sp Gr	% L on H	Pen Res	Soft Pt °F	Soft Pt/RmRatio	% Ash	Skelly '33' Spot	Xylene Spot
Original Asphalt																
Orig O.L.	18.57	34.27	47.16	1.846	2.540	1.376	83	150+	1.024	0.00	75	115.34	1.390	0.078	Neg	Neg
Orig L.	18.82	36.79	44.39	1.955	2.359	1.207	95	150+	1.018	0.00	88	114.26	1.205	0.055	Neg	Neg
Orig O.T.	20.12	34.34	45.54	1.707	2.263	1.326	86	150+	1.027	0.030	75	113.18	1.316		Neg	Neg
Ottawa Sand Aggregate																
O.L. (a)	22.75	34.47	42.78	1.515	1.881	1.241	47	150+	1.025	0.085	42	123.08	2.619		Neg	Neg
% Change	+22.51	+0.58	-9.29	-17.93	-25.94	-9.81	-43.37	0.0	+0.10		-44.00	+6.71	+88.42			
L. (a)	22.62	35.87	41.51	1.586	1.835	1.157	59	150+	1.020	0.091	52	122.00	2.068		Neg	Neg
% Change	+20.19	-2.50	-6.49	-18.87	-22.21	-4.14	-37.89	0.0	+0.20		-40.91	+6.77	+71.90			
O.T. (a)	25.02	35.42	39.56	1.416	1.581	1.117	45	150+	1.032	0.077	40	126.68	2.815		Neg	Neg
% Change	+24.35	+3.15	-13.13	-17.05	-30.14	-15.76	-47.67	0.0	+0.49		+46.67	+11.93	+113.91			
Local Sand Aggregate																
O.L. (a)	22.71	38.96	38.33	1.716	1.688	0.984	53	150+	1.027	0.070	44	124.88	2.356		Neg	Neg
% Change	+22.29	+13.69	-18.74	-7.0	-33.54	-28.49	-36.15	0.0	+0.29		-41.33	+8.27	+69.50			
L. (a)	22.52	39.08	38.39	1.735	1.705	0.982	76	150+	1.022	0.044	66	118.94	1.565		Neg	Neg
% Change	+19.66	+6.22	-13.52	-11.25	-27.72	-18.64	-20.0	0.0	+0.39		-25.0	+4.10	+30.09			
O.T. (a)							46	150+	1.035	0.077	42	127.22	2.766	0.088	S1 Pos	Neg
% Change							-46.51	0.0	+0.78		+156.67	-44.0	+110.18			
O.L. (b)	23.26	34.27	42.48	1.473	1.826	1.239	47	150+	1.030	0.036	47	126.32	2.688		Neg	S1 Pos
% Change	+25.26	0.00	-9.92	-20.21	-28.11	-9.96	-43.37	0.0	+0.59		-37.33	+9.52	+93.98			
L. (b)	22.53	37.74	39.74	1.675	1.764	1.053	68	150+	1.022	0.044	60	121.82	1.791		Neg	Neg
% Change	+19.71	+2.58	-10.48	-14.32	-25.22	-12.76	-28.42	0.0	+0.39		-31.82	+6.62	+48.88			
O.T. (b)							47	150+	1.032	0.072	42	125.42	2.669		Neg	Neg
% Change							-45.35	0.0	+0.49		+140.0	-44.0	+102.81			
O.L. (c)	23.92	34.12	41.96	1.426	1.754	1.230	45	150+	1.031	0.054	38	128.30	2.851		Neg	Neg
% Change	+28.81	-0.44	-11.03	-22.75	-30.95	-10.61	-45.78	0.0	+0.68		-49.33	+11.24	+105.11			
L. (c)							68	150+	1.022	0.058	60	122.36	1.799	0.072	Neg	Neg
% Change							-28.42	0.0	+0.39		-31.82	+7.09	+49.54	+105.71		
O.T. (c)																
% Change																
O.L. (d)	23.65	37.47	38.89	1.584	1.644	1.038	43	150+	1.030	0.057	41	128.84	2.996		Neg	Neg
% Change	+12.74	+9.34	-17.54	-14.19	-35.28	-24.56	-48.19	0.0	+0.59		-45.33	+11.70	+115.54			
L. (d)	22.20	38.92	38.88	1.753	1.751	0.999	67	150+	1.018	0.048	58	122.00	1.821		Neg	Neg
% Change	+17.96	+5.79	-12.48	-10.33	-25.77	-27.40	-29.48	0.0	0.0		-34.09	+6.77	+51.37			
O.T. (d)							40	150+	1.036	0.071	40	131.56	3.284	1.06	S1 Pos	Neg
% Change							-53.49	0.0	+0.88		+136.67	-46.67	+16.24	+149.54		
O.L. (e)	23.26	34.46	41.52	1.481	1.817	1.227	43	150+	1.029	0.078	37	125.42	2.917		Neg	Neg
% Change	+25.26	+0.55	-11.96	-19.77	-28.46	-10.83	-48.19	0.0	+0.49		-50.67	+8.74	+109.86			
L. (e)	24.39	37.95	37.66	1.556	1.544	0.992	55	150+	1.024	0.040	49	124.88	2.271		Neg	Neg
% Change	+29.60	+3.15	-15.16	-20.41	-34.55	-17.81	-42.11	0.0	+0.58		-44.31	+9.29	+88.78			
O.T. (e)																
% Change																
O.L. (f)	24.38	34.09	41.52	1.398	1.703	1.218	39	150+	1.031	0.054	33	128.84	3.304		Neg	Neg
% Change	+31.29	-0.53	-11.96	-24.27	-32.95	-11.48	-53.01	0.0	+0.68		-56.0	+11.70	+137.70			
L. (f)	21.90	37.37	40.70	1.704	1.856	1.089	70	150+	1.023	0.036	61	121.46	1.735		Neg	Neg
% Change	+16.52	+1.58	-8.31	-12.84	-21.32	-9.78	-26.32	0.0	+0.49		-30.68	+6.30	+44.22			
O.T. (f)																
% Change																
O.L. (g)	22.21	37.52	40.26	1.689	1.812	1.073	52	150+	1.028	0.040	45	120.20	2.312		Neg	Trace
% Change	+11.96	+9.48	-14.63	-8.50	-28.66	-22.02	-37.35	0.0	+0.39		-40.0	+4.21	+66.33			
L. (g)	22.96	38.50	38.55	1.677	1.679	1.001	65	150+	1.029	0.048	56	122.54	1.885		Neg	Neg
% Change	+22.00	+4.65	-13.16	-14.22	-28.85	-17.07	-31.58	0.0	+1.08		-36.36	+7.25	+56.69			
O.T. (g)							47	150+	1.037	0.068	44	127.22	2.707	1.08	S1 Pos	Neg
% Change							-45.35	0.0	+0.97		-41.33	+12.40	+105.70			
Michigan Aggregate																
O.L. (a ₁)	20.98	38.12	40.90	1.817	1.949	1.073	58	150+	1.026			119.66	2.063	1.11	Neg	Neg
% Change	+11.30	+11.23	-13.27	-1.57	-23.27	-22.02	-30.12	0.0	+0.20			+3.75	+48.42	+42.31		
L. (a ₁)	20.99	40.02	38.99	1.907	1.858	0.974	76	150+	1.019			114.08	1.501	0.33	Neg	Neg
% Change	+11.53	+8.78	-2.46	-21.24	-19.30	-20.00	0.0	+0.10				-0.16	+24.77	+942.85		
O.T. (a ₁)	22.31	37.10	40.58	1.663	1.819	1.094	55	150+	1.031			118.22	2.149	0.64	Neg	Neg
% Change	+10.88	+8.04	-10.89	-2.58	-19.62	-17.50	-36.05	0.0	+0.39			+4.45	+63.30			
O.L. (h)	23.37	35.69	40.95	1.527	1.752	1.147	38	150+	1.025			129.56	3.409	0.12	Neg	Neg
% Change	+25.85	+4.14	-13.17	-17.28	-31.02	-16.64	-54.22	0.0	+0.10			+12.33	+145.25	+53.85		
L. (h)	21.54	33.84	44.62	1.571	2.072	1.318	56	150+	1.021			122.00	2.179	0.20	Neg	Neg
% Change	+14.45	-8.02	+0.52	-19.64	-12.17	+9.20	-41.05	0.0	+0.29			+6.77	+81.13	+571.43		
O.T. (h)	24.84	36.34	38.82	1.463	1.563	1.068	40	150+	1.032			127.40	3.185	0.21	Neg	Neg
% Change	+23.46	+5.82	-14.76	-14.79	-30.93	-19.46	-53.49	0.0	+0.49			+12.56	+142.02			
O.L. (i)	26.98	31.60	41.42	1.172	1.536	1.172	24	19	1.028			141.98	5.916	0.19	S1 Pos	Neg
% Change	+45.29	-7.79	-12.17	-36.51	-39.53	-14.85	-71.08	-87.33	+0.39			+23.10	+325.61	+243.59		
L. (i)	No Test Made															
O.T. (i)																
% Change																
O.L. (j)	30.30	30.04	39.66	0.991	1.309	1.320	19	7	1.039			158.18	8.325	0.15	Pos	Neg
% Change	+49.40	-12.52	-12.91	-41.94	-42.16	-0.45	-77.91	-95.82	+1.17			+39.76	+532.60			
L. (j)	25.48	34.99	39.53	1.373	1.551	1.130	31	150+	1.034			135.86	4.383	0.42	Trace	Neg
% Change	+37.21	+2.10	-16.18	-25.62	-38.94	-17.88	-62.65	0.0	+0.98			+17.79	+215.32	+538.46		
O.L. (k)	24.13	36.49	39.37	1.512	1.632	1.079	33	150+	1.031			135.14	4.095	0.246	Neg	Neg
% Change	+29.94	+6.48	-16.52	-18.09	-35.75	-21.58	-60.24	0.0	+0.68			+17.17	+194.60	+315.38		
O.L. (k)	25.74	35.24	39.02	1.369	1.516	1.107	32	150+	1.031			136.04	4.251	0.382	Neg	Neg
% Change	+38.61	+2.83	-17.78	-25.84	-40.31	-19.55	-61.45	0.0	+0.68			+17.95	+205.83	+489.74		
L. (k)	24.49	34.51	41.00	1.409	1.674	1.188	41	150+	1.024			132.98	3.243	0.017	Neg	Neg
% Change	+30.13	-6.20	-7.64	-27.93	-29.04	-1.57	-56.84	0.0	+0.59			+16.38				

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Ohio Oil Company, Findlay, Ohio
 Percent Change in Composition and Properties of Asphalt Related to Exposure Conditions
 Included data presented on graph no. 1

TABLE III
 (Concluded)

A.C.	Composition						Physical Properties									
	% Asphtns	% Oils	% Resin	O/A	R/A	R/O	Penet	Duct	Sp Gr	% L on H	Pen Res	Soft Pt °F	Soft Pt/ Pen Ratio	% Ash	Skelly "G" Spot	Xylene Spot
Michigan Aggregate (continued)																
O.L. (1)	22.40	40.37	37.23	1.802	1.662	0.922	48	150+	1.026			126.32	2.632	0.332	Neg	Neg
% Change	+20.62	+17.80	-21.07	-2.38	-34.57	-32.99	-42.17	0.0	+0.20			+9.52	+89.35	+325.64		
L. (1)	21.64	36.72	41.65	1.697	1.925	1.334	66	150+	1.019			121.28	1.858	0.005	Neg	Neg
% Change	+14.98	-0.19	-6.17	-13.20	-18.40	-6.05	-30.53	0.0	+0.10			+6.14	+52.78	-85.71		
L. (1)	22.00	38.95	39.05	1.770	1.775	1.003	66	150+	1.019			122.36	1.854	0.014	Neg	Neg
% Change	+16.90	+5.87	-12.03	-9.46	-24.76	-16.90	-30.53	0.0	+0.10			+7.09	+54.11	-60.0		
L. (1)	21.40	37.64	40.96	1.759	1.914	1.088	58	150+	1.021			123.62	2.131	0.004	Neg	Neg
% Change	+11.37	+2.31	-7.73	-10.03	-18.86	-9.86	-38.95	0.0	+0.29			+8.19	+77.14	-88.57		
O.T. (1)	22.98	42.58	34.44	1.853	1.499	0.809	51	150+	1.033			123.62	2.424	0.042	Neg	Neg
% Change	+14.21	+24.00	-24.37	+8.55	-33.76	-38.99	-40.70	0.0	+0.39			+9.22	+84.19			
O.T. (1)	23.85	44.79	31.38	1.880	1.336	0.701	48	150+	1.034			127.94	2.665	0.079	Neg	Neg
% Change	+18.44	+30.44	-31.09	+10.13	-40.96	-47.13	-44.19	0.0	+0.49			+13.04	+102.51			
O.T. (1)	23.61	39.32	37.07	1.666	1.570	0.943	50	150+	1.032			127.04	2.541	0.009	Sl Pos	Neg
% Change	+17.35	+14.50	-18.60	-2.40	-30.62	-28.88	-41.86	0.0	+0.29			+12.25	+93.09			
Orig Gar 9% Duct	21.10	39.09	39.81	1.853	1.886	1.018	91	150+	1.031	0.058	78	109.77	1.206	0.09	Neg	Neg
Gar 9% Duct (m)	22.89	34.16	42.95	1.492	1.876	1.257	63	150+	1.036			116.78	1.854	0.26	Pos	Neg
% Change	+8.48	-12.61	+7.89	-19.48	-0.53	+23.48	-30.77	0.0	+0.48			+6.39	+53.73	+288.89		
Gar 9% Duct (j)	26.28	44.69	29.03	1.700	1.105	0.650	35	150+	1.040			129.02	3.686	0.25	Pos	Neg
% Change	+24.55	+14.33	-27.08	-8.26	-41.41	-36.15	-61.54	0.0	+0.87			+17.54	+205.64	+277.78		
Gar 9% Duct (n)	28.53	37.46	34.01	1.313	1.192	0.908	28	18	1.042			140.00	5.000	0.41	Pos	Neg
% Change	+35.21	-4.17	-14.57	-29.14	-36.80	-10.81	-69.23	-88.0	+1.07			+27.54	+314.59	+455.56		
Orig Gar 12% Duct	21.95	42.88	35.17	1.935	1.602	0.820	93	150+	1.032	0.082	81	109.04	1.172	0.04	Neg	Neg
Gar 12% Duct (m)	23.67	41.37	34.96	1.748	1.477	0.845	54	150+	1.036			126.14	2.336	0.18	Pos	Neg
% Change	+7.84	-3.52	-0.60	-9.66	-7.80	+3.05	-41.94	0.0	+0.39			+13.68	+99.32	+450.0		
Gar 12% Duct (j)	26.97	40.39	32.64	1.498	1.210	0.808	34	150+	1.039			136.58	4.017	0.32	Pos	Neg
% Change	+22.87	-5.81	-7.19	-22.58	-24.57	-1.46	-63.44	0.0	+0.68			+25.26	+242.75	+800.0		
Gar 12% Duct (n)	31.10	36.84	32.06	1.185	1.031	0.870	23	8	1.043			160.16	6.963	0.16	Pos	Neg
% Change	+41.69	-14.09	-8.84	-38.76	-35.64	+6.10	-75.27	-94.67	+1.07			+46.88	+494.11	+400.0		
Minnesota Aggregate																
O.L. (a ₁)	23.02	31.70	45.28	1.377	1.967	1.428	46	150+	1.027			126.14	2.742	0.15	Neg	Neg
% Change	+23.96	-7.50	-3.99	-25.41	-22.56	+3.78	-44.58	0.0	+0.29			+9.36	+97.27	+92.31		
L. (a ₁)	22.23	36.67	41.10	1.649	1.846	1.121	73	150+	1.018			127.58	1.748	0.12	Neg	Neg
% Change	+19.77	-0.33	-7.41	-15.64	-21.74	-7.13	-23.16	0.0	0.0			+11.66	+45.30	+242.86		
O.T. (a ₁)	22.54	34.78	42.68	1.543	1.893	1.227	53	150+	1.030			122.00	2.302	0.28	Neg	Neg
% Change	+12.03	+1.28	-6.28	-9.61	-16.35	-7.47	-38.37	0.0	+0.29			+7.79	+74.92			
O.L. (h)	25.35	33.66	41.00	1.328	1.617	1.216	30	93	1.028			132.08	4.403	0.21	Neg	Neg
% Change	+36.51	-1.78	-13.06	-28.06	-36.34	-11.63	-63.86	-38.00	+0.39			+14.51	+216.76	+169.23		
L. (h)	24.58	38.07	37.35	1.549	1.519	0.981	41	123	1.022			129.20	3.154	0.15	Neg	Neg
% Change	+30.61	+3.48	-15.86	-20.77	-35.61	-18.72	-56.84	-18.00	+0.39			+13.08	+162.18	+328.57		
O.T. (h)	25.46	33.33	41.21	1.309	1.619	1.236	32	150+	1.034			131.54	4.111	0.10	Neg	Neg
% Change	+26.54	-2.94	-9.51	-23.32	-28.46	-6.79	-62.79	0.0	+0.68			+16.22	+212.39			
O.L. (n)	30.28	34.47	35.25	1.138	1.164	1.023	19	6	1.034			162.86	8.572	0.004	Pos	Neg
% Change	+63.06	+0.58	-25.25	-38.35	-54.17	-25.65	-77.11	-96.0	+0.98			+41.20	+516.69	-94.87		
L. (n)	27						9	1.022				151.52	5.612	0.002	Neg	Neg
% Change							-71.58	-94.0	+0.39			+32.61	+366.50	-94.29		
O.T. (n)	27						27	52	1.034			139.82	5.179	0.003	Sl Pos	Neg
% Change							-68.60	-65.33	+0.68			+23.54	+293.54			
O.L. (k) ¹	36.88	32.34	30.78	0.877	0.835	0.952	9	3	1.038			201.92	22.436	0.15	Pos	Neg
% Change ²	+98.60	-1.78	-34.73	-52.49	-67.13	-30.81	-89.16	-98.00	+1.37			+75.07	+1514.10	+92.31		
O.L. (k) ¹	39.21	30.92	29.87	0.789	0.762	0.966	5	2	1.041			212.00	42.400	0.12	Neg	Neg
% Change ²	+111.15	-9.78	-36.66	-57.26	-70.00	-29.80	-93.98	-98.66	+1.66			+83.80	+2950.36	+53.85		
O.L. (k) ³	25.14	33.67	41.97	1.382	1.723	1.247	33	150+	1.027			132.80	4.024	0.18	Neg	Neg
% Change	+35.38	-1.75	-11.01	-25.14	-32.17	-9.37	-60.24	0.0	+0.29			+15.14	+189.50	+130.77		
L. (k)	23.53	49.26	27.20	2.093	1.156	0.532	44	150+	1.021			129.38	2.940	0.011	Neg	Neg
% Change	+25.03	+33.90	-38.72	+7.06	-51.0	-54.27	-53.68	0.0	+0.29			+13.23	+144.39	-68.57		
L. (k)	27.79	39.78	32.44	1.431	1.167	0.815	28	13	1.025			146.12	5.219	0.110	Neg	Neg
% Change	+47.66	+8.13	-26.92	-27.80	-50.53	-32.48	-70.53	-91.33	+0.69			+27.88	+333.83	+214.29		
L. (k)	23.67	40.31	36.02	1.703	1.522	0.894	45	150+	1.021			128.84	2.863	0.077	Trace	Neg
% Change	+25.77	+9.57	-18.86	-12.89	-35.48	-25.93	-52.63	0.0	+0.29			+12.76	+136.91	+120.00		
O.T. (k)	26.18	34.67	39.16	1.324	1.496	1.130	29	2	1.035			136.40	4.703	0.047	Neg	Neg
% Change	+30.12	+0.96	-14.01	-22.44	-33.89	-14.78	-66.28	-98.67	+0.78			+20.52	+257.37			
O.T. (k)	25.90	41.94	32.16	1.619	1.242	0.767	31	150+	1.036			132.98	4.290	0.016	Neg	Neg
% Change	+28.73	+22.13	-29.38	-5.16	-45.12	-42.16	-63.95	0.0	+0.88			+17.49	+225.99			
O.T. (k)	26.48	41.12	32.40	1.533	1.224	0.788	31	150+	1.035			131.72	4.249	0.047	Neg	Neg
% Change	+31.61	+19.74	-28.85	-9.02	-45.91	-40.57	-63.95	0.0	+0.78			+16.38	+222.87			
O.L. (1) ¹	24.05	34.76	41.18	1.445	1.712	1.185	35	150+	1.024			130.82	3.738	0.22	Neg	Neg
% Change ⁴	+29.51	+1.43	-12.68	-21.72	-32.60	-13.88	-57.83	0.0	0.0			+13.42	+168.92	+282.05		
O.L. (1) ¹	23.10	37.66	39.24	1.630	1.699	1.042	38	150+	1.026			135.14	3.556	0.41	Sl Pos	Neg
% Change ⁴	+24.39	+9.89	-16.79	-11.70	-33.11	-24.27	-54.22	0.0	+0.20			+17.17	+155.83	+425.64		
O.L. (1) ³	21.73	36.70	41.57	1.688	1.913	1.133	44	150+	1.026			128.12	2.912	0.13	Trace	Neg
% Change ⁴	+17.02	+7.09	-11.85	-8.56	-24.69	-17.66	-46.99	0.0	+0.20			+11.08	+109.50	+66.67		
L. (1)	21.55	39.58	38.87	1.837	1.804	0.982	63	150+	1.021			120.74	1.917	0.016	Neg	Neg
% Change	+14.51	+7.58	-12.44	-6.04	-23.53	-18.64	-33.68	0.0	+0.20			+5.67	+59.35	-54.29		
L. (1)	20.33	48.02	31.66	2.362	1.557	0.659	56	150+</								

EXPOSURES

ERI PROJECT 2249

Ohio Oil Company, Findlay, Ohio

Percentage Change in Composition and Properties of Asphalt as Related to Exposure

Type of Exposure of Asphalt

Test Exposure	Mat'l Heating Asphalt		Mix Time Hobart,		Mixture Heating		Test Conditions
	°F	°F	min	min	Time, min	Temp, °F	
a	400	300	1	30	30	350	Cool 45 min, extract and recover AC. Ml to M55.
a ₁	350	300	1	30	30	325	Cool 45 min, extract and recover AC. All tests above 36A.
b	400	300	1	30	30	350	Air weather 72 hr in laboratory. Ml to M55.
c	Same as b						Air weather 24 hr in laboratory. Ml to M55.
d	Same as b						Air weather 48 hr in laboratory. Ml to M55.
e	Same as b						Heat in force draft 72 hr at 140°F. Ml to M55.
f	Same as b						Heat in force draft 24 hr at 140°F. Ml to M55.
g	Same as b						Heat in force draft 48 hr at 140°F. Ml to M55.
h	350	300	1	90	90	325	Cool, extract, and recover. Michigan and Minnesota aggregates.
i	Same as h						Intended to be run on Minnesota aggregate. No tests performed.
j	Same as h						Mixture of Michigan aggregate using Garland-Duct-Spot blend.
k	350	300	1	30	30	350	Loose spread in shallow pan and expose 60 days outdoors.
l	Same as k						Compacted to 4" diameter x 4-1/2" cylinder and exposed 60 days outdoors.
m	350	300	1	30	30	325	Cool, extract and recover. Michigan aggregate with Garland-Duct-Spot.
n	350	300	1	180	180	325	Cool, extract and recover. Michigan and Minnesota aggregates with regular test asphalts and special Garland-Duct-Spot blends.

**E.R.I. Project 2249 Ohio Oil Company, Findlay Ohio
Percent Change In Composition And Properties As Related To Exposure**

Special Study Of Garland Asphalt, Duct.spot, And Blends

Original Material Test Data

% Astn	Oils	Resin	O/A	R/A	R/O	Scale	Penet	Scale	Duct	Scale	Sp.Gr	%	LonH	Penet		S.Pt/Pan		% Ash	Skally S	Spot	Xylene
														Resid	Fahr	Sft Pt	Scale				
100						100	160	150		1.05	0.10	161	100	200	10.0	10			Pos		
80						80	120	90		1.04	0.08	161	80	160	8.0	0.8			S.Pos		
60						60	90	60		1.03	0.06	161	60	120	6.0	0.6					
40						40	60	40		1.02	0.04	161	40	80	4.0	0.4			Datum		
20						20	30	20		1.01	0.02	161	20	40	2.0	0.2					
0						0	0	0		1.00	0.00	161	0	0	0	0			Neg		

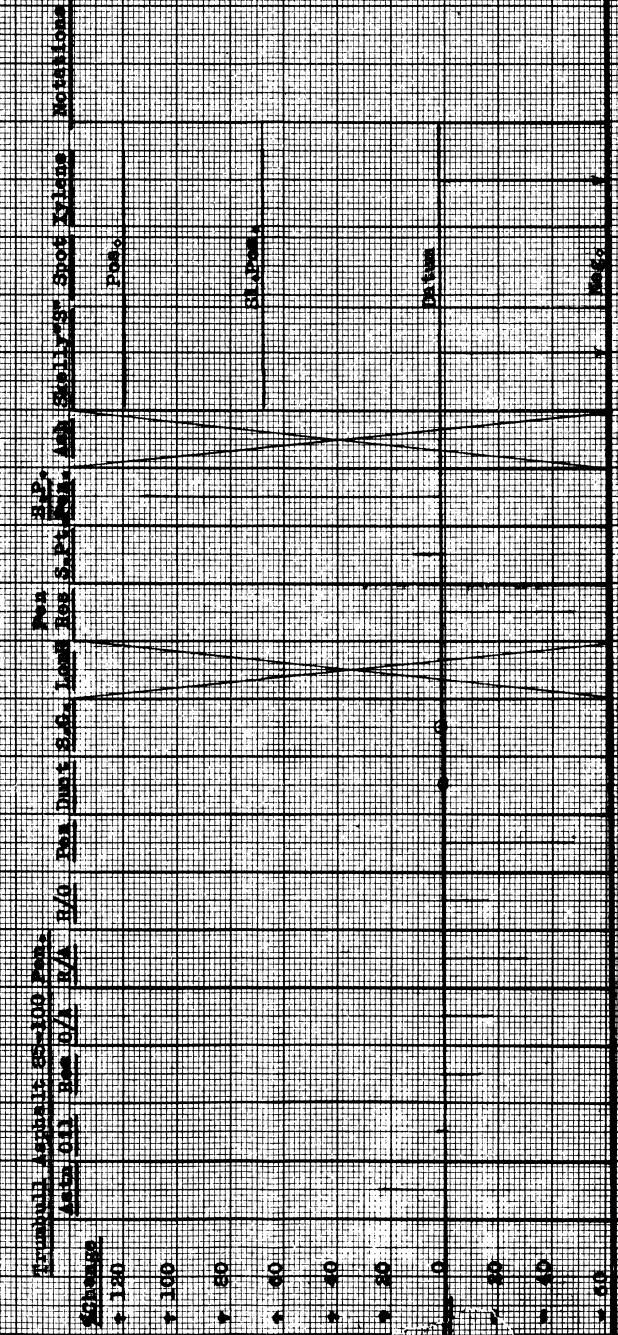
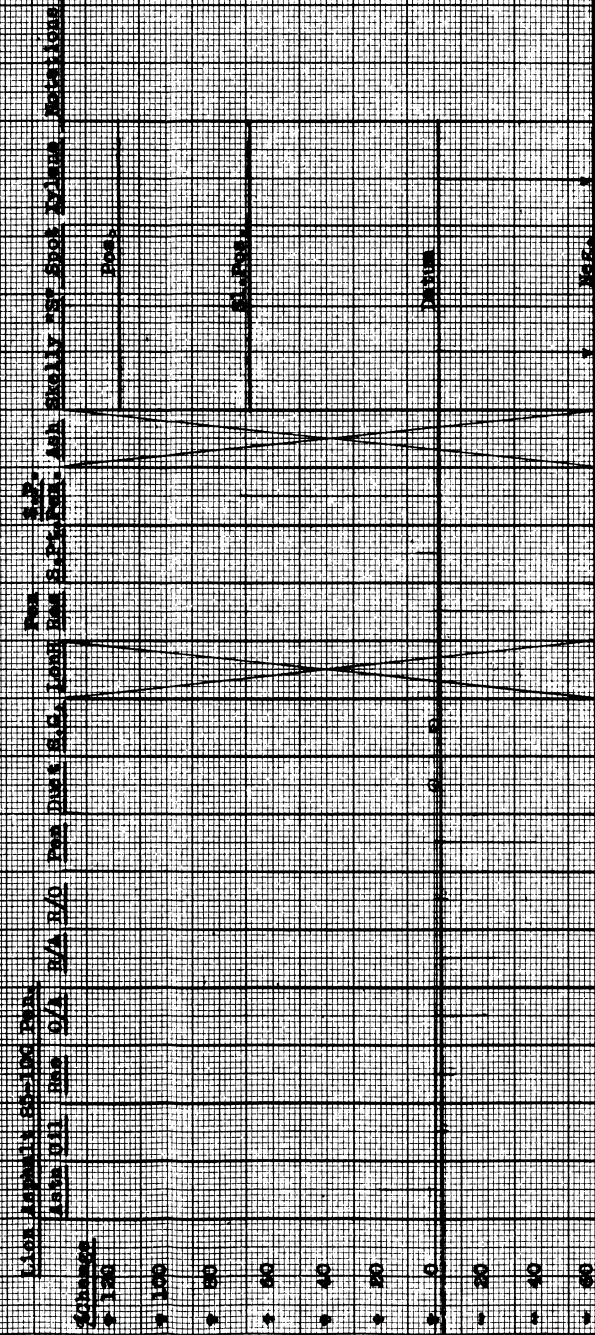
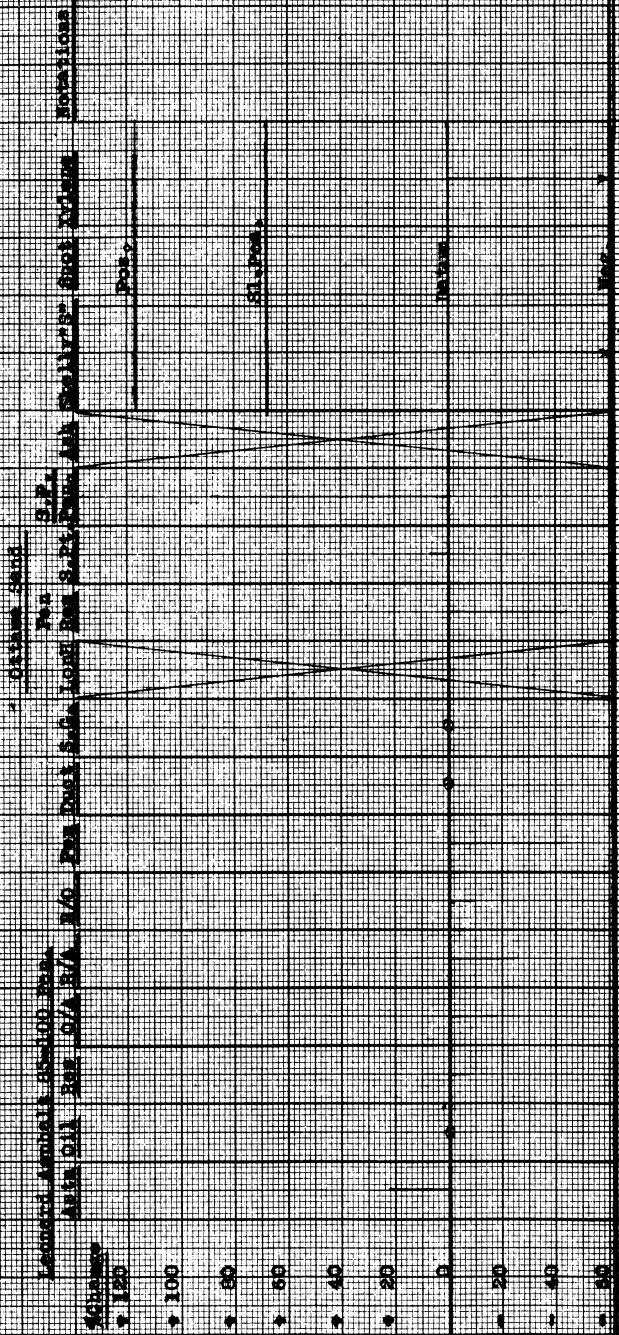
Recovered Blends 9% & 12% Duct.spot With Garland Asphalt After (m),(j), & (n) Exposure

% Change	Astns	Oils	Resin	O/A	R/A	R/O	Penet	Duct	Sp.Gr	LonH	Resid	Sft Pt	S.Pt/Pan Ratio	Ash	Skally S	Spot	Xylene
120													12069	12069			
100													12430	12430	Pos		
80													12150	12150			
60													12020	12020			
40															SI Pos		
20																	
0															Datum		
20																	
40																	
60																	
80																	
100															Neg		

NOTE:
 9% Duct.spot - Garland Road Blend
 12% " " " " " "
 G - Garland asphalt, DS - Duct.spot
 9% D.S. - Duct.spot Garland Blend
 12% D.S. - " " " " " "

APR 2006 ON Y. H. CO. RESS 3 JANUARY
 2/2004 Rev. 1.00 2/2004 Rev. 1.00 2/2004 Rev. 1.00
 A. J. U. M. 30AM

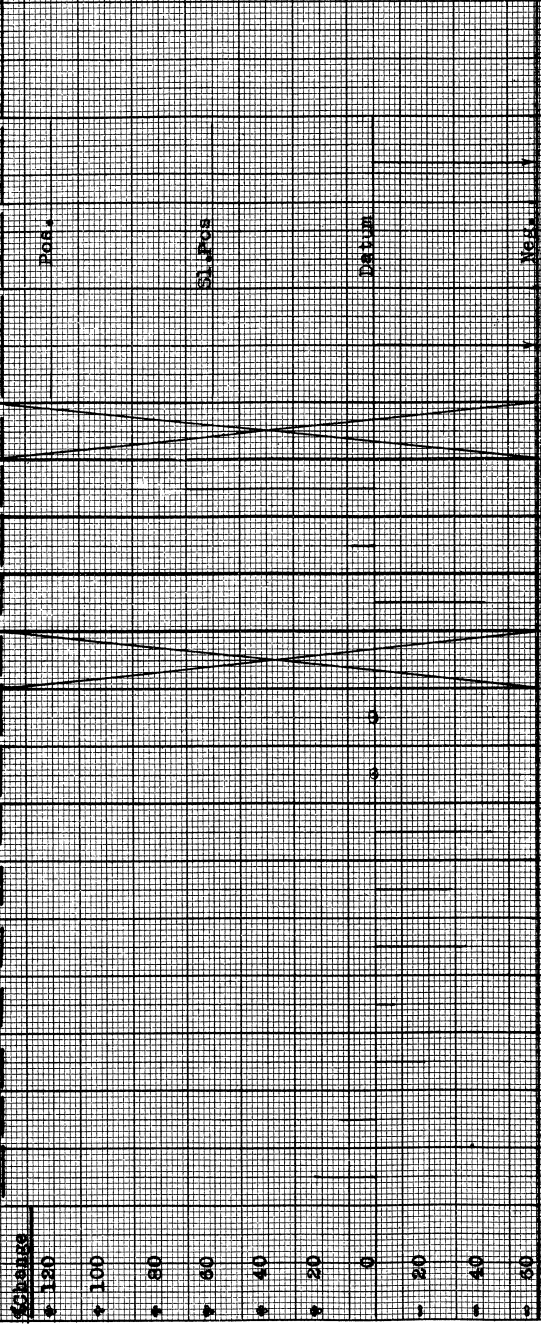
E.B.I. Profeta 25400 Ohio Oil Company, Findlay Ohio.
 Percent Change in Composition and Properties of Asphalts As Related to Exposure
 Laboratory No. 507-5508-Sub 1



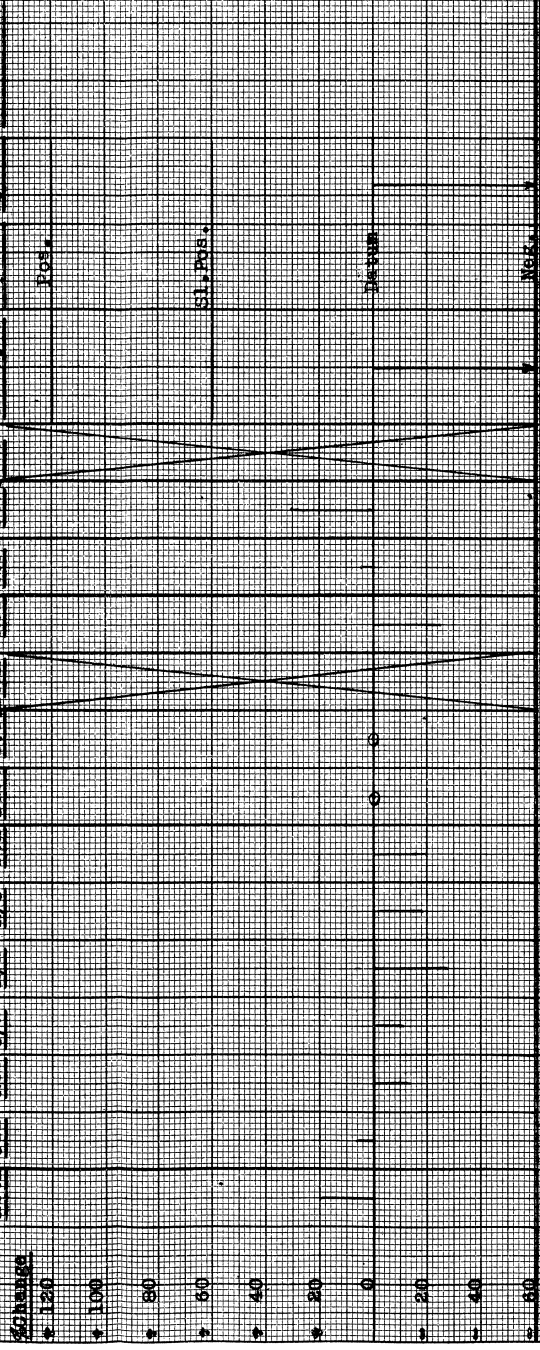
R.R.I. Project 2849-Ohio Oil Company, Findlay Ohio.
Percent Change in Composition and Properties of Asphalt As Related to Exposure.

Exposure (a). See Graph Sheet 1.
Local Sand

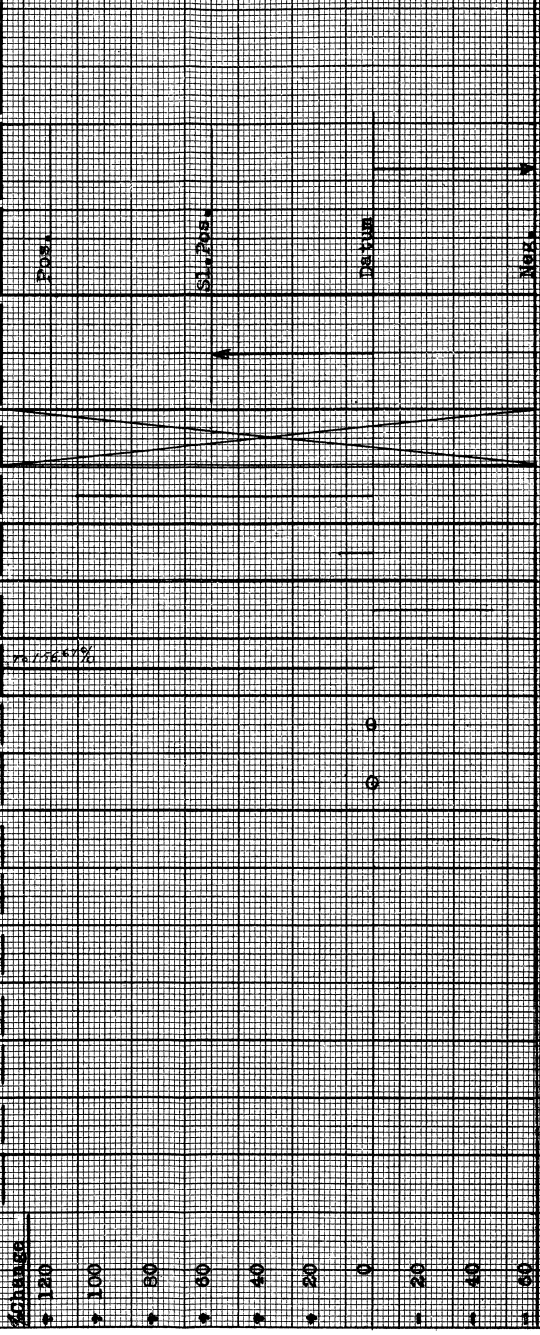
Leonard Asphalt 65-100 Pen.
Asph Oil Res 0/A R/A B/O Pen Duct S.C. Lond Res S.P. Pen Ash Skellysol Spot Xylene Notations



Lion Asphalt 65-100 Pen.
Asph Oil Res 0/A R/A B/O Pen Duct S.C. Lond Res S.P. Pen Ash Skellysol Spot Xylene Notations.

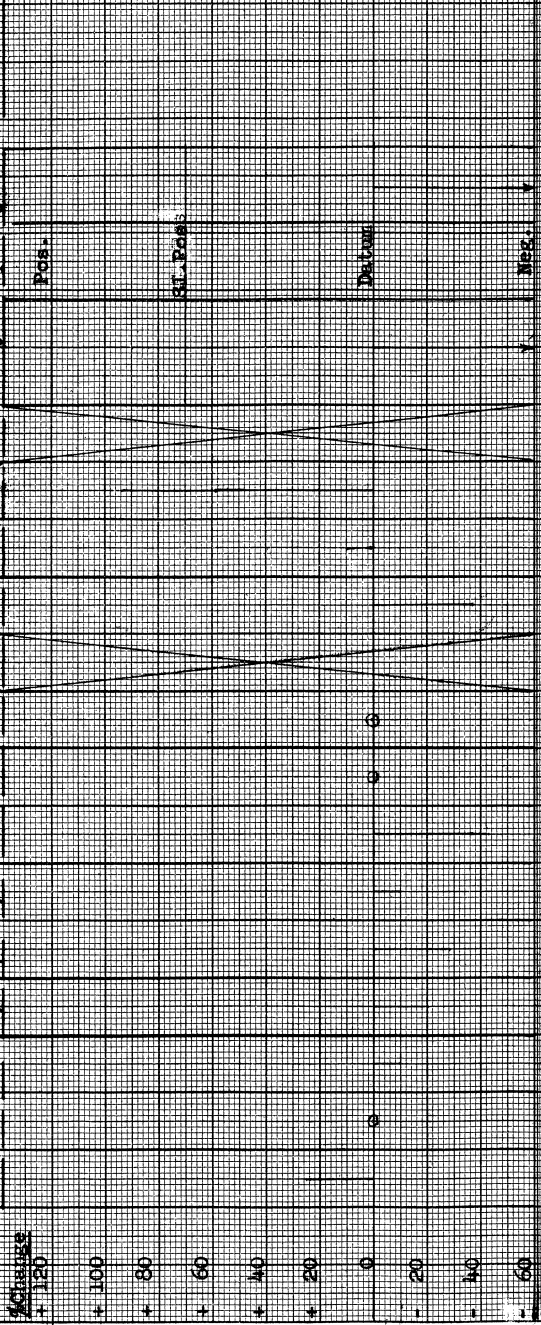


Franklin Asphalt 65-100 Pen.
Asph Oil Res 0/A R/A B/O Pen Duct S.C. Lond Res S.P. Pen Ash Skellysol Spot Xylene Notations

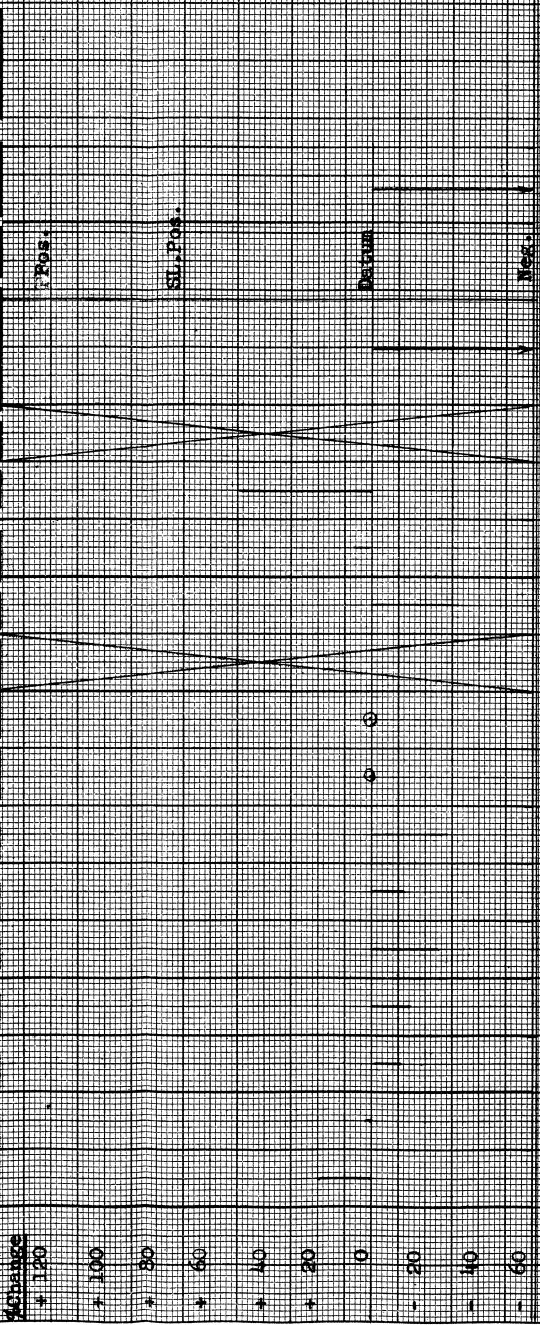


R.R.I. Project 2249 - Ohio Oil Company, Findlay, Ohio
 Percent Change in Composition and Properties of Asphalt As Related To Exposure
 Exposure (%) See Graph Sheet 1.

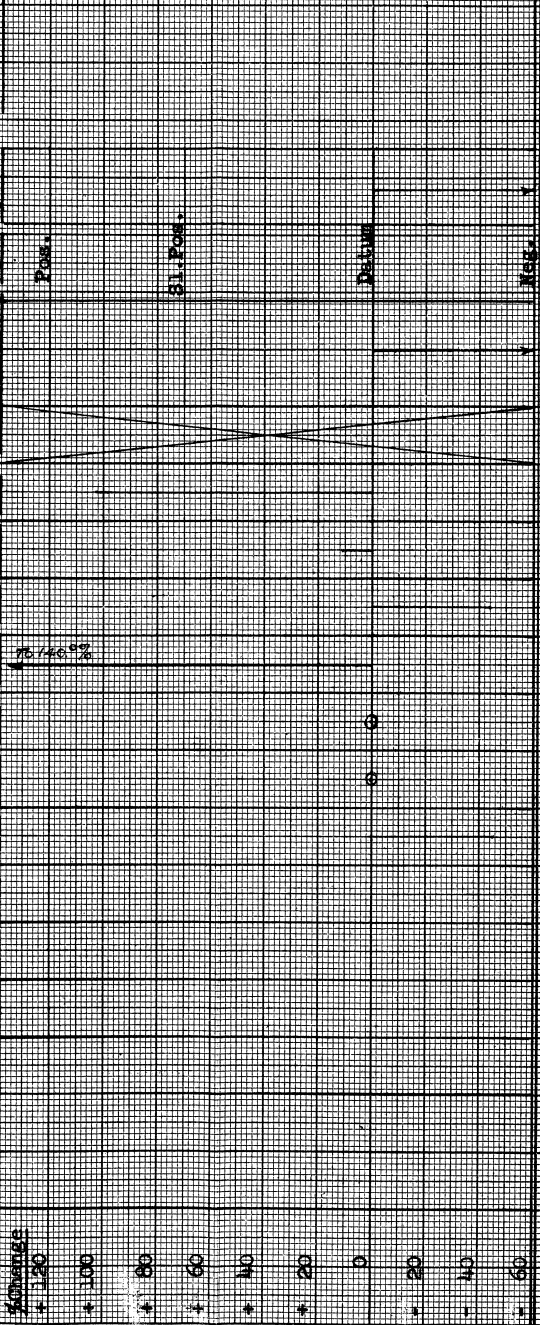
Leonard Asphalt 85-100 Pen.
 Ash/Oil Res O/A R/A R/O Pen Dust S.G. Loss Res S.P.F. Pen Ash Skelly'S' Spot Xylene Notations



Lion Asphalt 85-100 Pen.
 Ash/Oil Res O/A R/A R/O Pen Dust S.G. Loss Res S.P.F. Pen Ash Skelly'S' Spot Xylene Notations



Trumbull Asphalt 85-100 Pen.
 Ash/Oil Res O/A R/A R/O Pen Dust S.G. Loss Res S.P.F. Pen Ash Skelly'S' Spot Xylene Notations



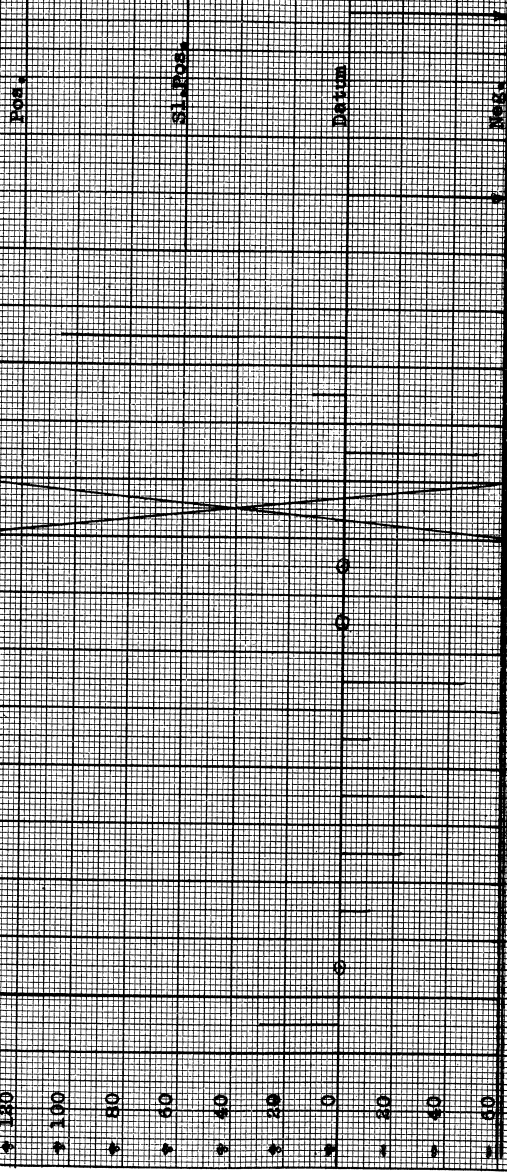
E.B.P. Project 2249 - Ohio Oil Company, Findlay Ohio.
Percent Change in Compression and Properties of Asphalt As Related to Expansion.
Exposure (3), See Graph Sheet 1.

Local Sand

Leonard Asphalt 85-100 Pen.

Asph Oil Res 0.7A R/A R/O Pen Dual S.G. Load Res S.P. Pen Ash Shell 1.57 Spot Xylene Notations

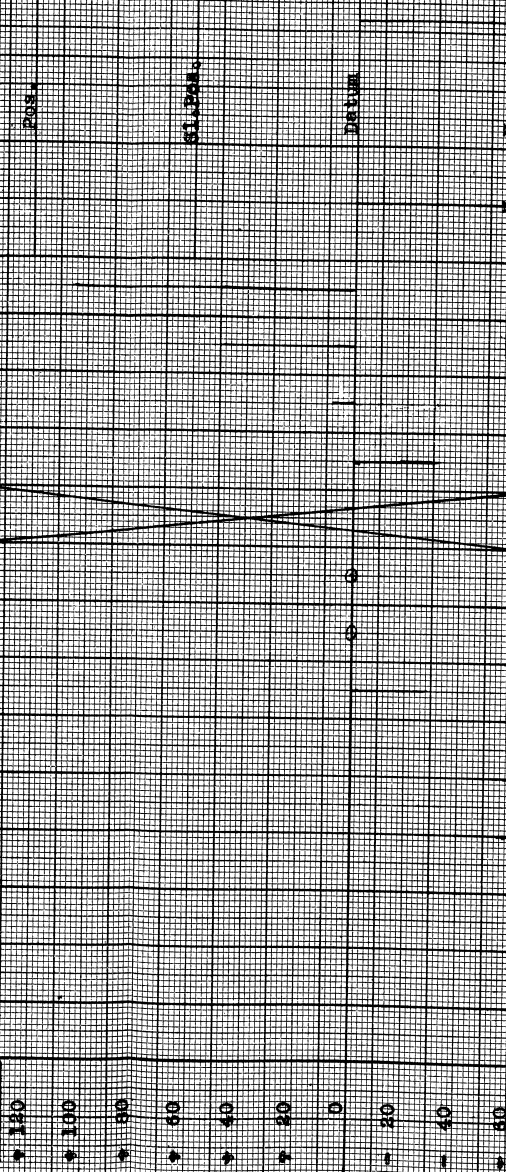
Distance
+ 120
+ 100
+ 80
+ 60
+ 40
+ 20
0
- 20
- 40
- 60



Lion Asphalt 85-100 Pen.

Asph Oil Res 0.7A R/A R/O Pen Dual S.G. Load Res S.P. Pen Ash Shell 1.57 Spot Xylene Notations

Distance
+ 120
+ 100
+ 80
+ 60
+ 40
+ 20
0
- 20
- 40
- 60



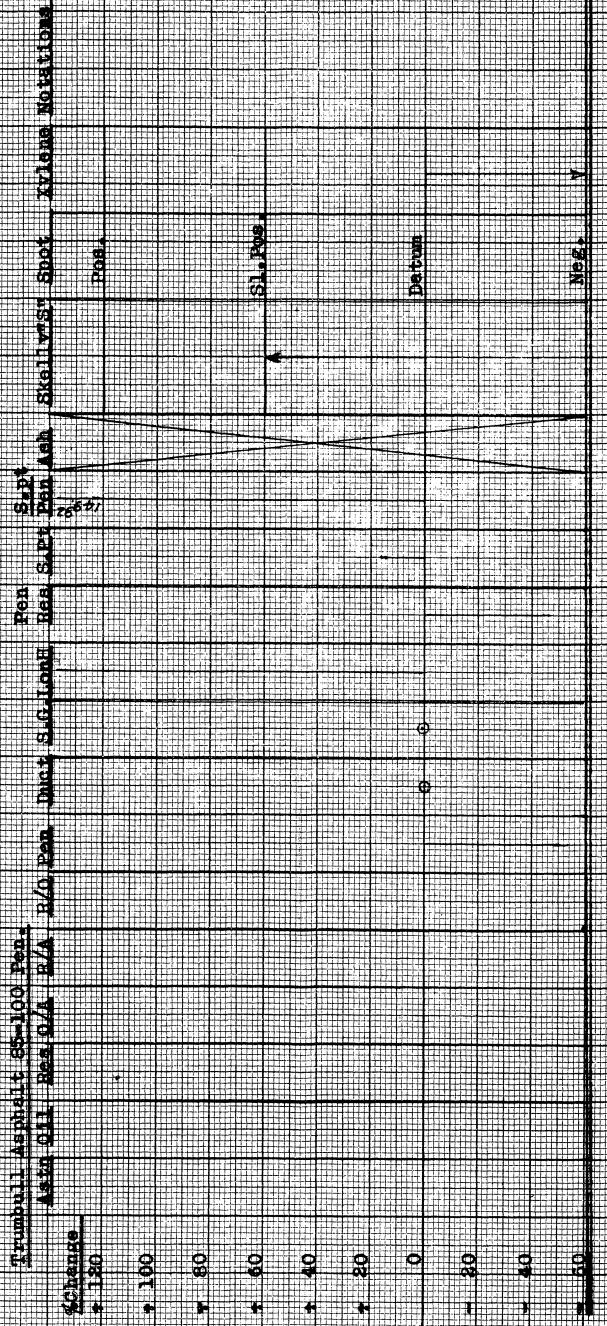
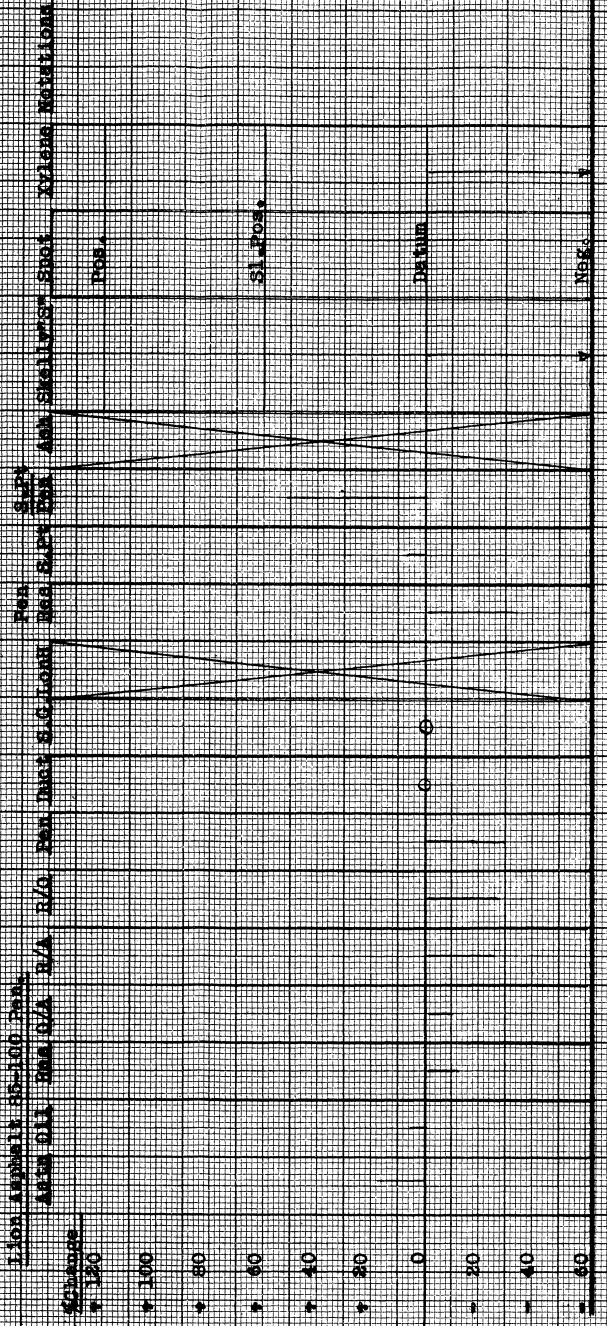
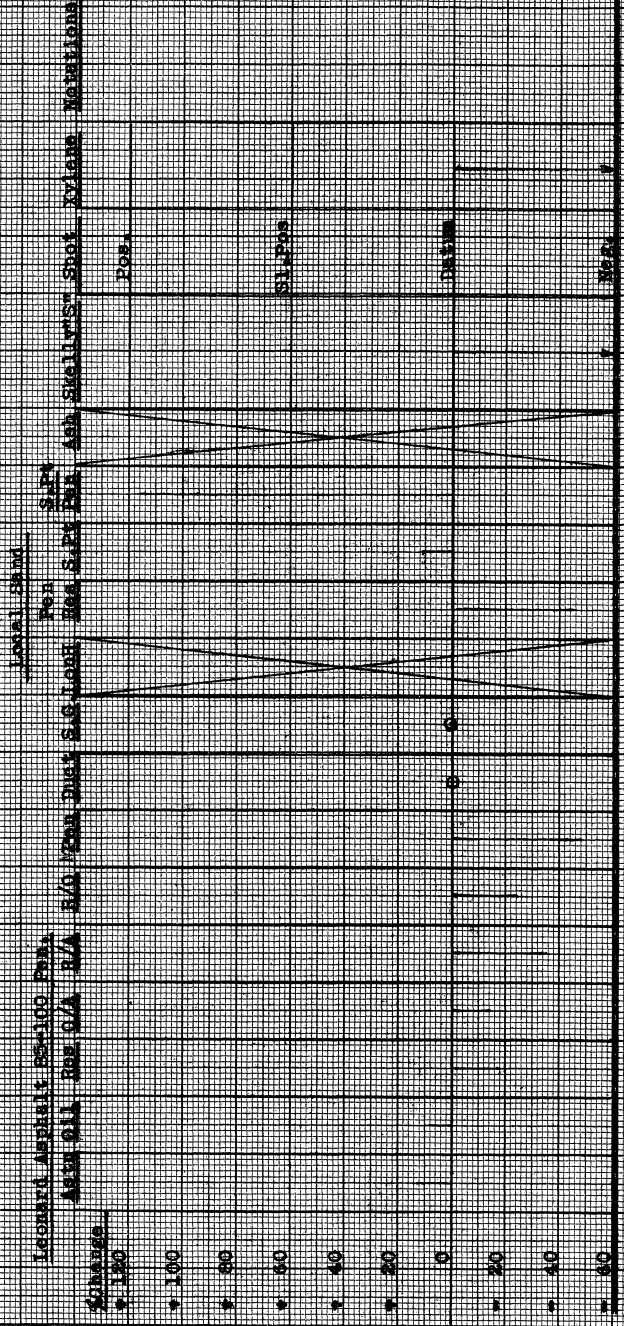
Trumbull Asphalt 85-100 Pen.

Asph Oil Res 0.7A R/A R/O Pen Dual S.G. Load Res S.P. Pen Ash Shell 1.57 Spot Xylene Notations.

Distance
+ 120
+ 100
+ 80
+ 60
+ 40
+ 20
0
- 20
- 40
- 60



S.P.L. Project 2243 Ohio Oil Company, Findlay Ohio.
 Percent Change in Compaction and Properties of Asphalt As Related to Exposure.
 Exposure (All See Drsh) Sheet 1.



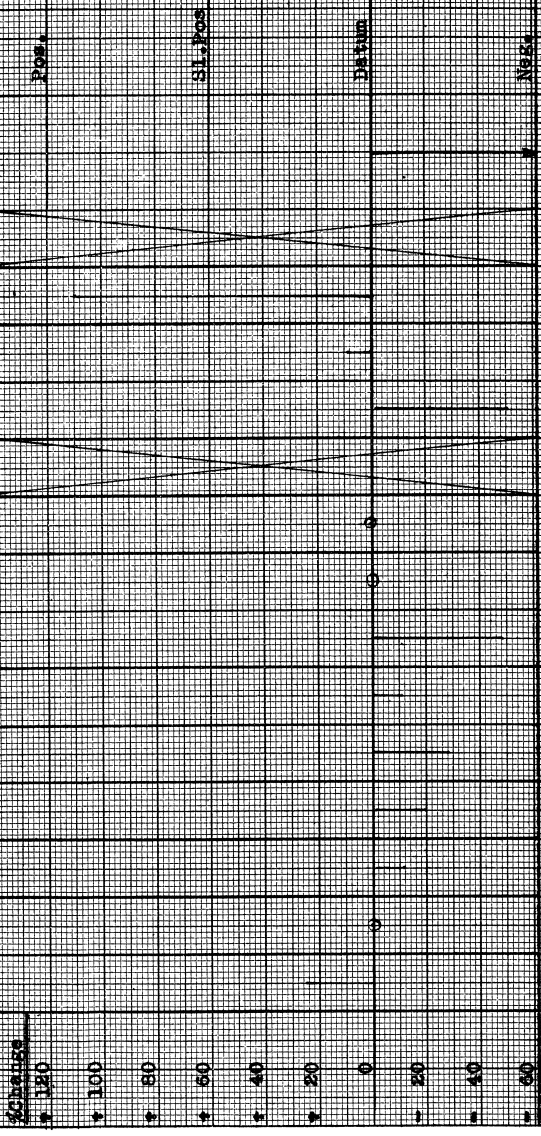
R.R.1. Project 2249, Ohio Oil Company, Findley, Ohio.
 Percent Change in Composition and Properties of Asphalt As Related to Exposure.

Exposure (h), See Graph Sheet 1.

Leaded Sand

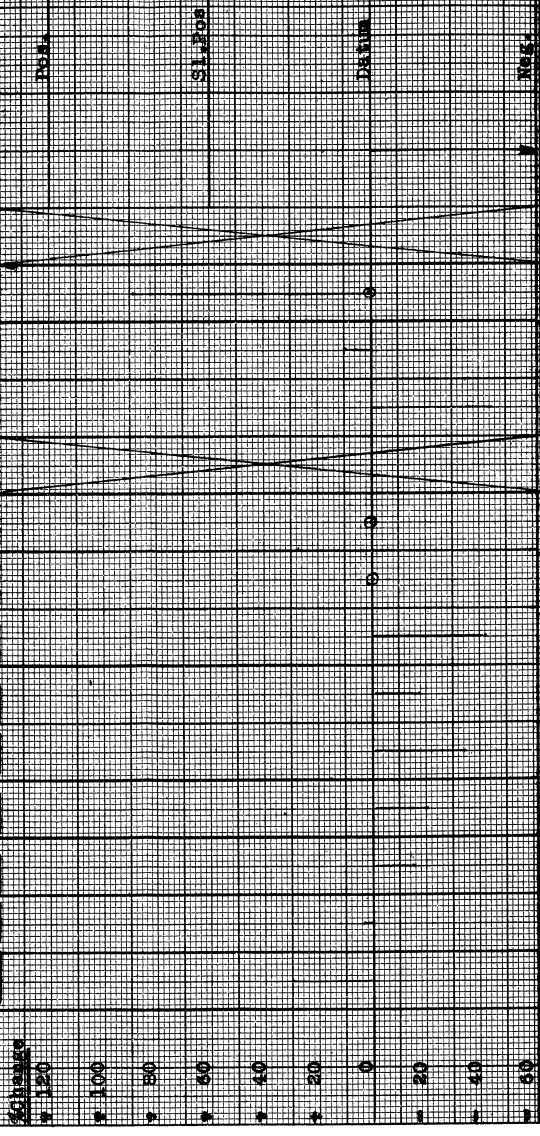
Leeward Asphalt 55-100 Pen.

Asph. Oil Res. O/A R/A R/O Pen. Dust S.G. Lead Res. S.Pt. Pen. Ash Skellysol. Sol. Xylene Notations



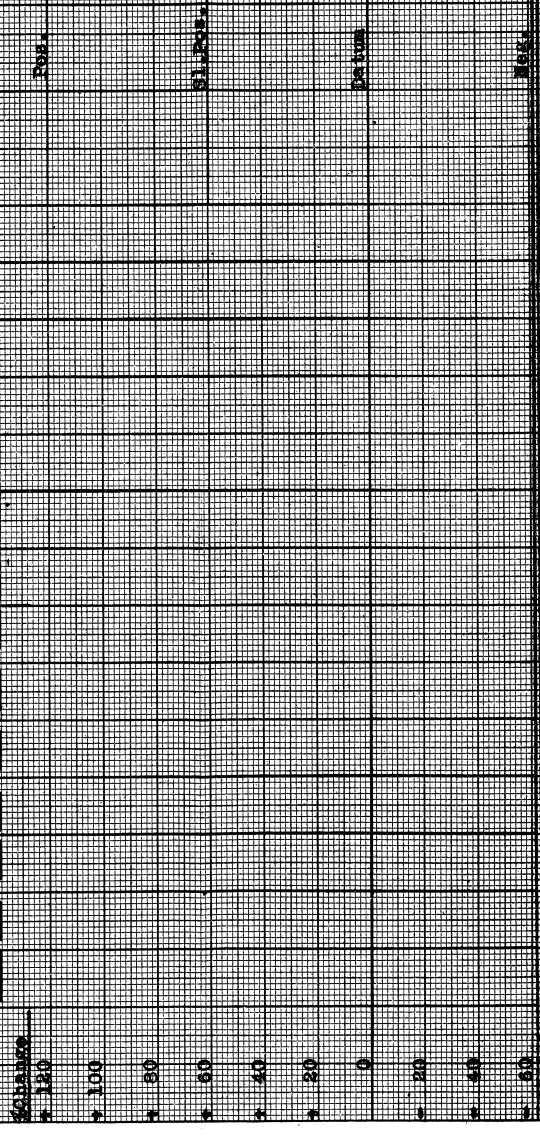
Lion Asphalt 55-100 Pen.

Asph. Oil Res. O/A R/A R/O Pen. Dust S.G. Lead Res. S.Pt. Pen. Ash Skellysol. Sol. Xylene Notations

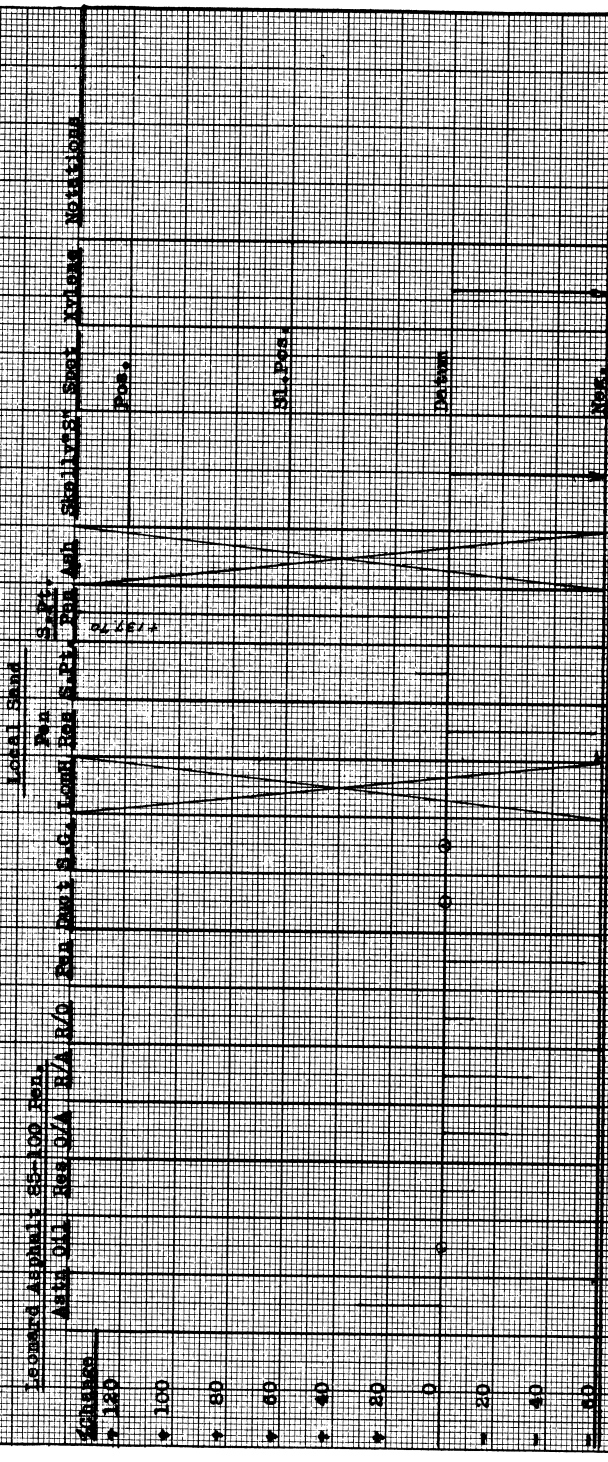


Fremont Asphalt 55-100 Pen.

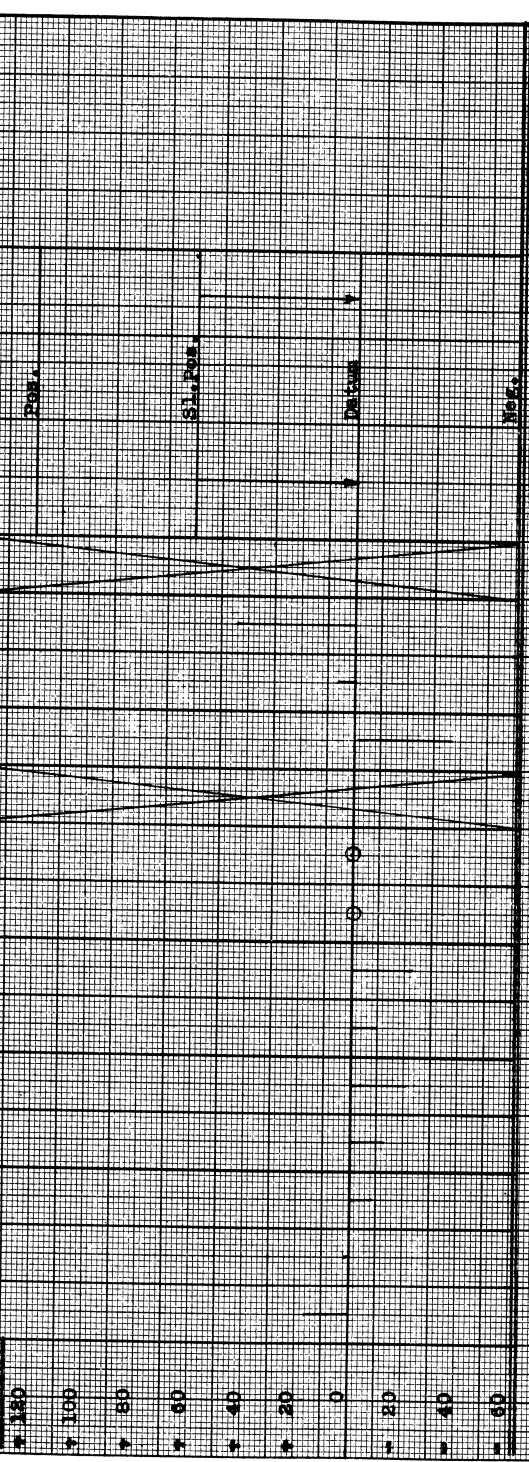
Asph. Oil Res. O/A R/A R/O Pen. Dust S.G. Lead Res. S.Pt. Pen. Ash Skellysol. Sol. Xylene Notations



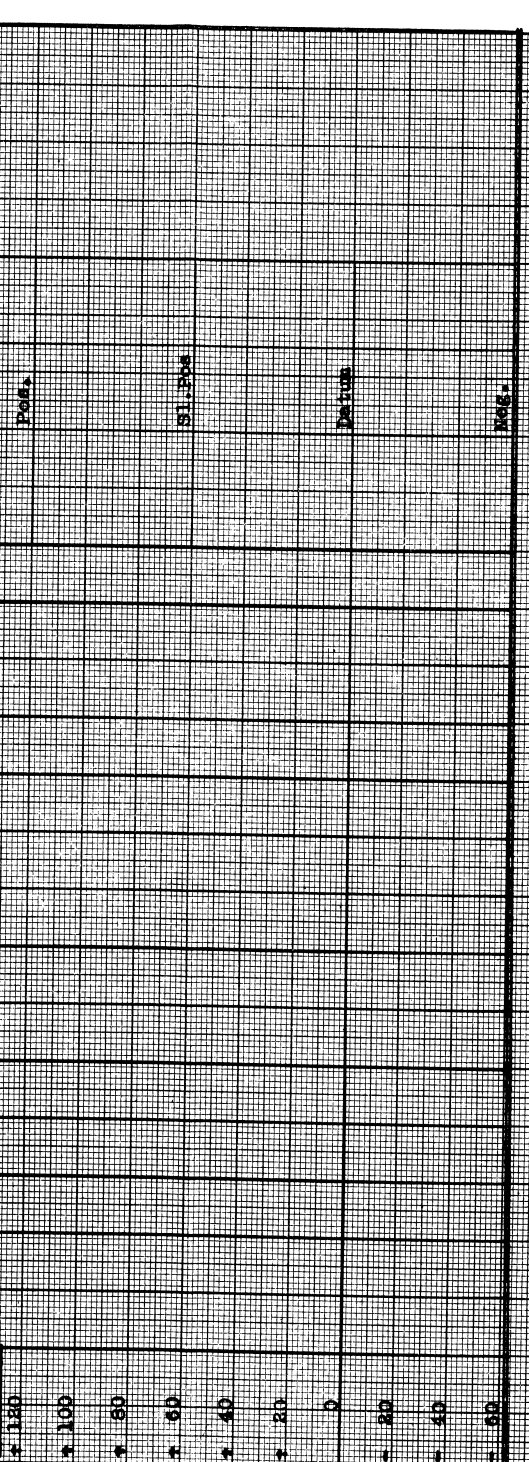
Leonard Asphalt 55-100 Pen.
Asph. Oil Res. 0/A R/A R/D Pen. Test S.C. Temp. Res. S.Pi. Pen. Ash. Shelliness. Swell. Volume. Notations.



Wilson Asphalt 55-100 Pen.
Asph. Oil Res. 0/A R/A R/D Pen. Test S.C. Temp. Res. S.Pi. Pen. Ash. Shelliness. Swell. Volume. Notations.



Fremont Asphalt 55-100 Pen.
Asph. Oil Res. 0/A R/A R/D Pen. Test S.C. Temp. Res. S.Pi. Pen. Ash. Shelliness. Swell. Volume. Notations.



Local Band
 S.B.L. Project's 23420 Ohio Oil Company, Findlay Ohio.
 Percent Change in Composition and Properties of Asphalt as Related to Exposure
 Pressure (e). See Graph Sheet 1.

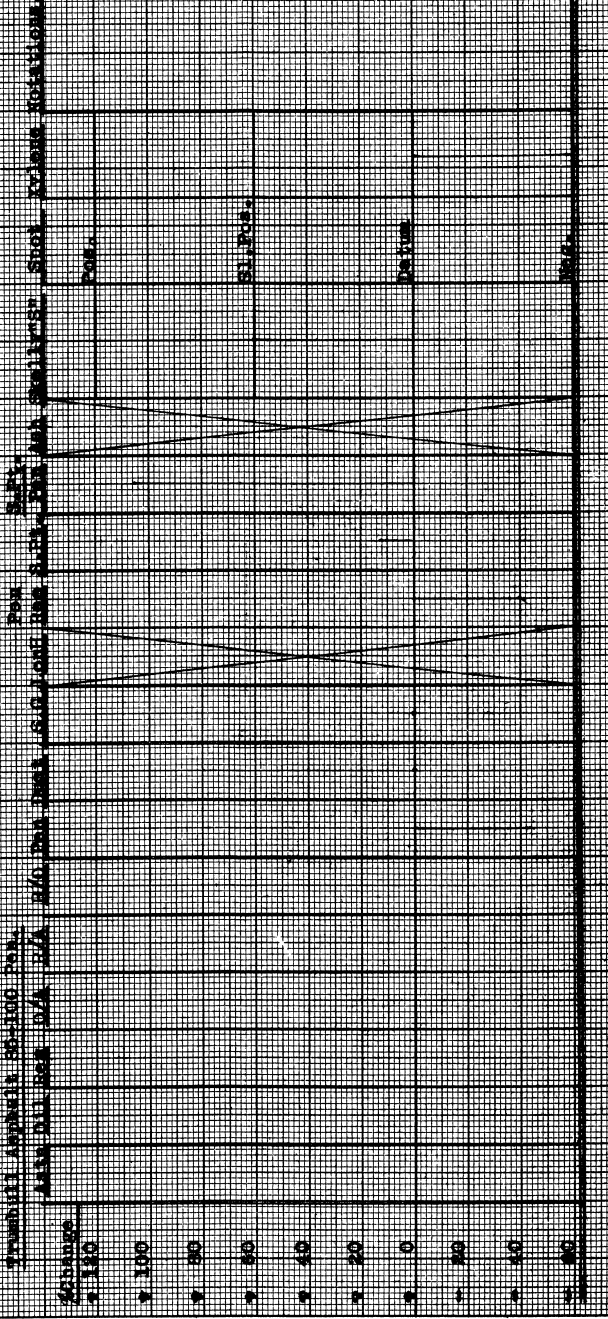
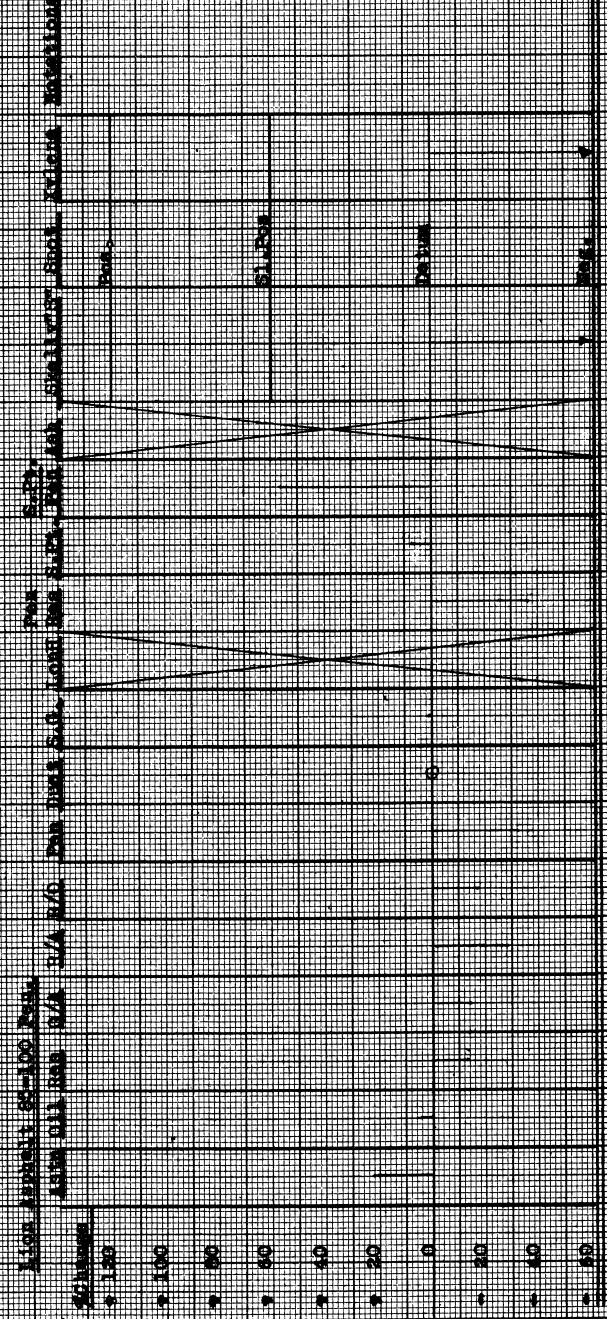
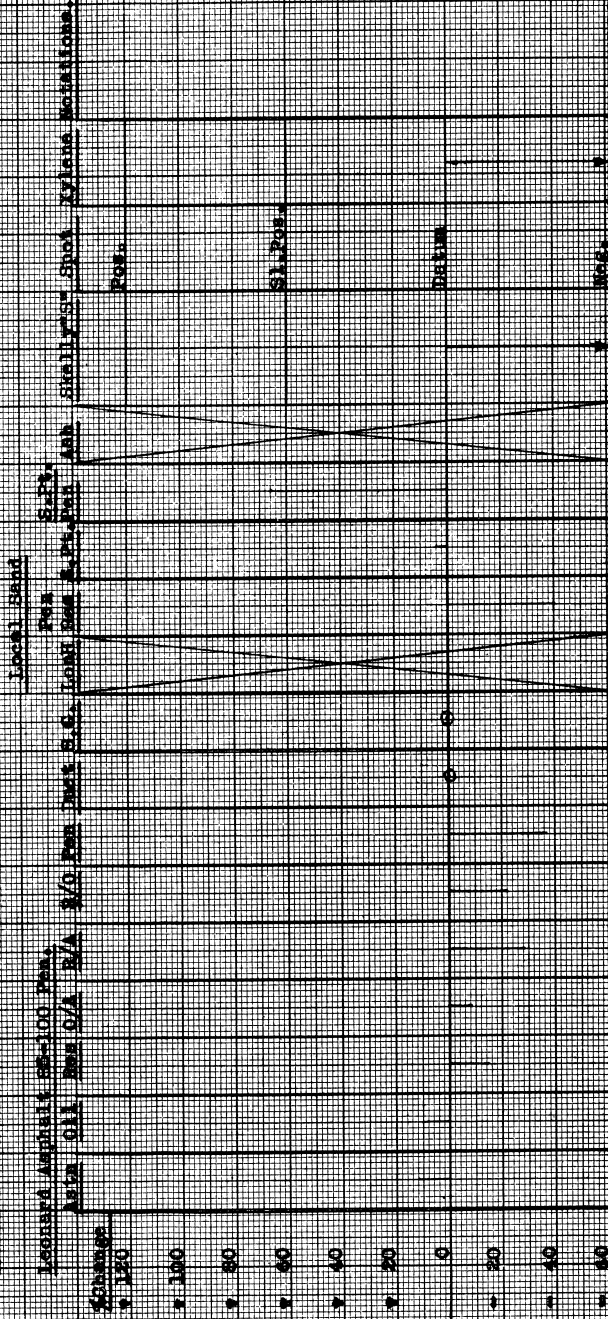
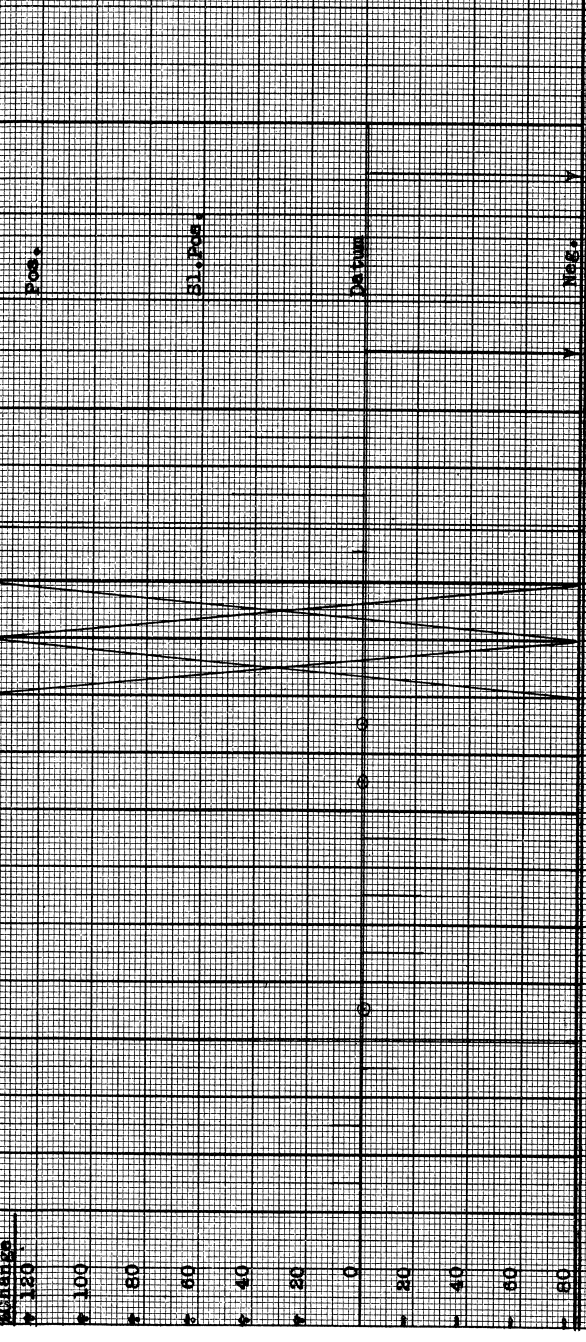
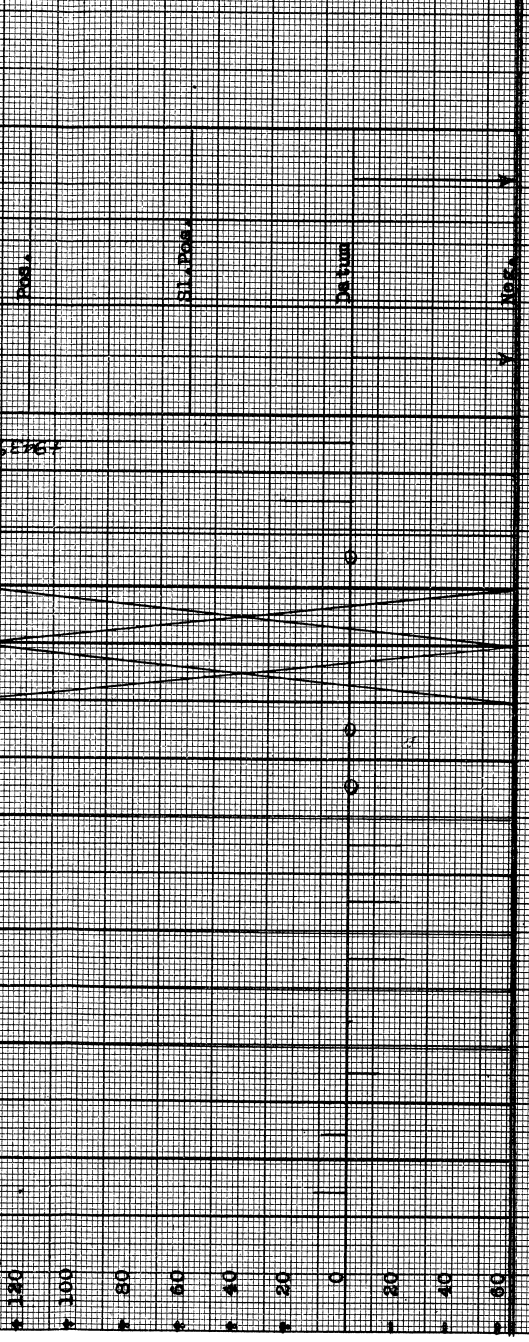


Fig. 1, Project 2240 - Ohio Oil Company, Findlay Ohio.
Permit Change in Composition and Properties of Asphalt as Related to Exposure.
Exposure (a) - See Graph Sheet 1.

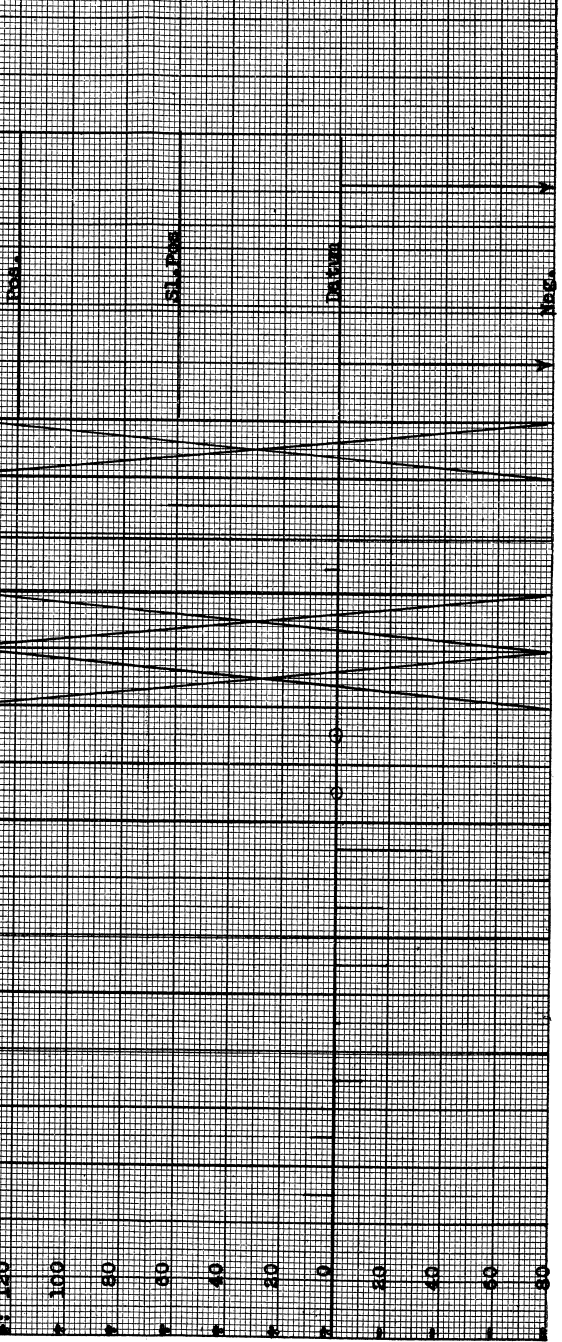
Leonard Asphalt 55-100 Per.
Asph. Oil Res. 0/A B/A R/O Per. Test S.C. Low Res. 0/A B/A Ash Shell 1/8" Sph. 1/16" Notations



Lion Asphalt 55-100 Per.
Asph. Oil Res. 0/A B/A R/O Per. Test S.C. Low Res. 0/A B/A Ash Shell 1/8" Sph. 1/16" Notations



Trumbull Asphalt 65-100 Per.
Asph. Oil Res. 0/A B/A R/O Per. Test S.C. Low Res. 0/A B/A Ash Shell 1/8" Sph. 1/16" Notations

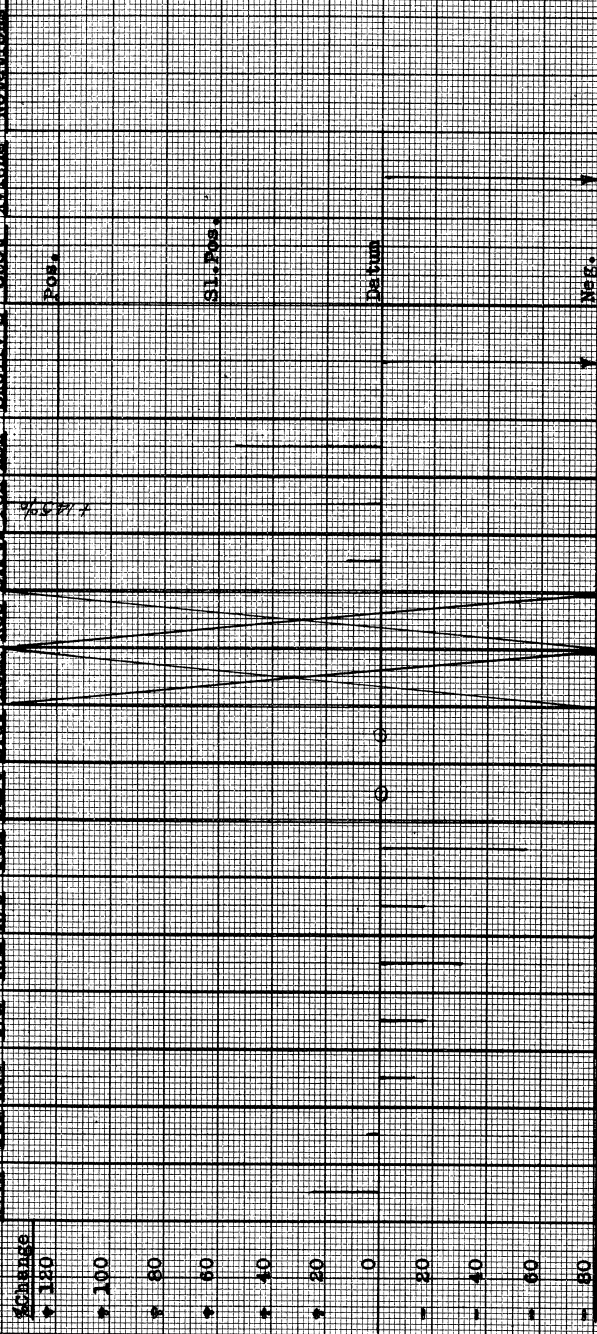


A.R.I. Project 2242 Ohio Oil Company Findley Ohio.
 Percent Change In Combustion And Properties Of Asphalt As Related To Exposure.

Exposure (h). See Graph Sheet A.

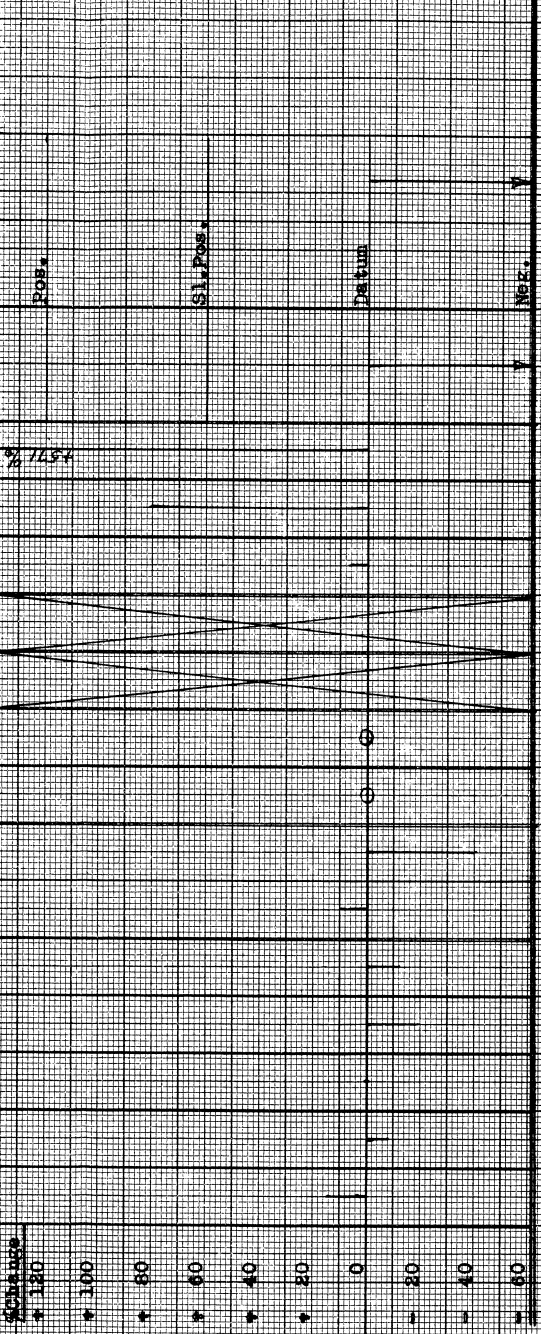
Michigan Aggregate

Leonard Asphalt 55-100 Pen.
 Ash Oil Res O/A B/A B/O Pen Dust S.G. Loss Res S.Pt. Pen Ash Skellyvis Spot Xylene Notations



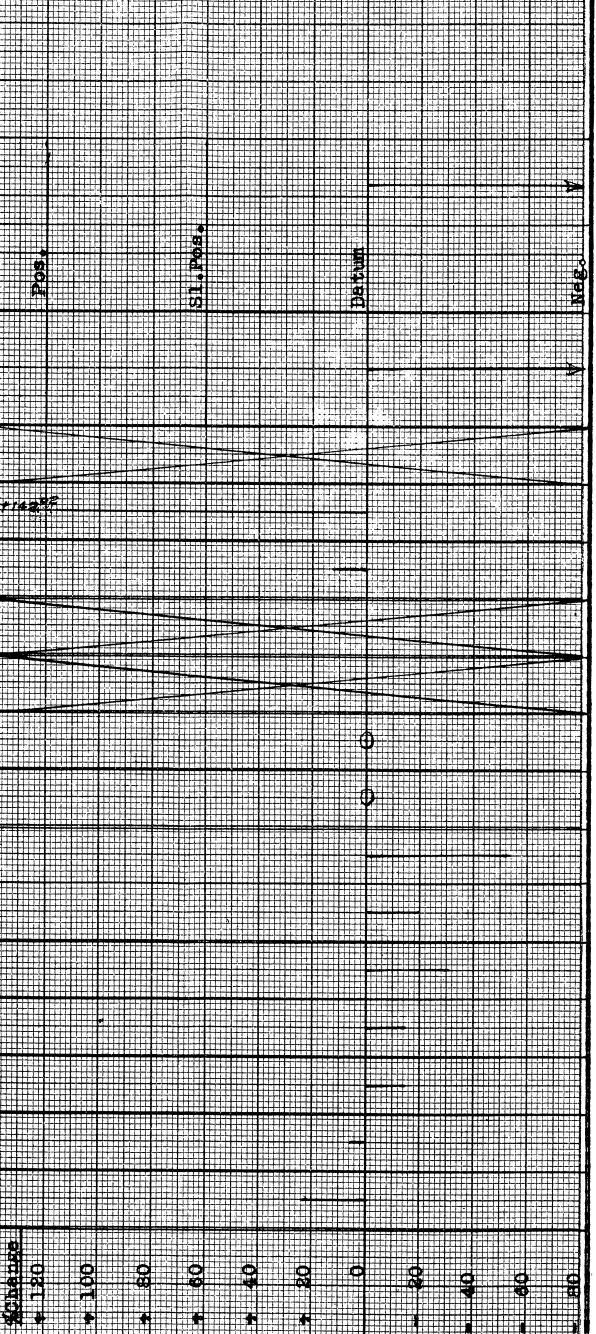
Lion Asphalt 55-100 Pen.

Ash Oil Res O/A B/A B/O Pen Dust S.G. Loss Res S.Pt. Pen Ash Skellyvis Spot Xylene Notations.



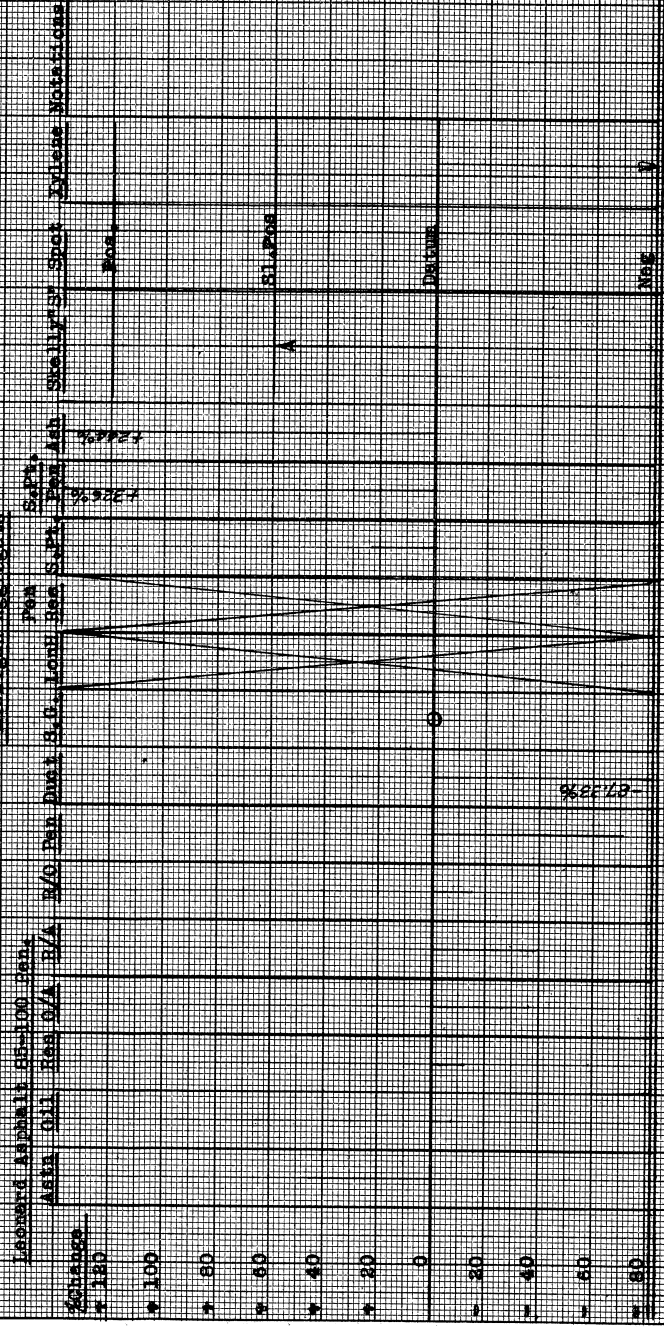
Trumbull Asphalt 55-100 Pen.

Ash Oil Res O/A B/A B/O Pen Dust S.G. Loss Res S.Pt. Pen Ash Skellyvis Spot Xylene Notations

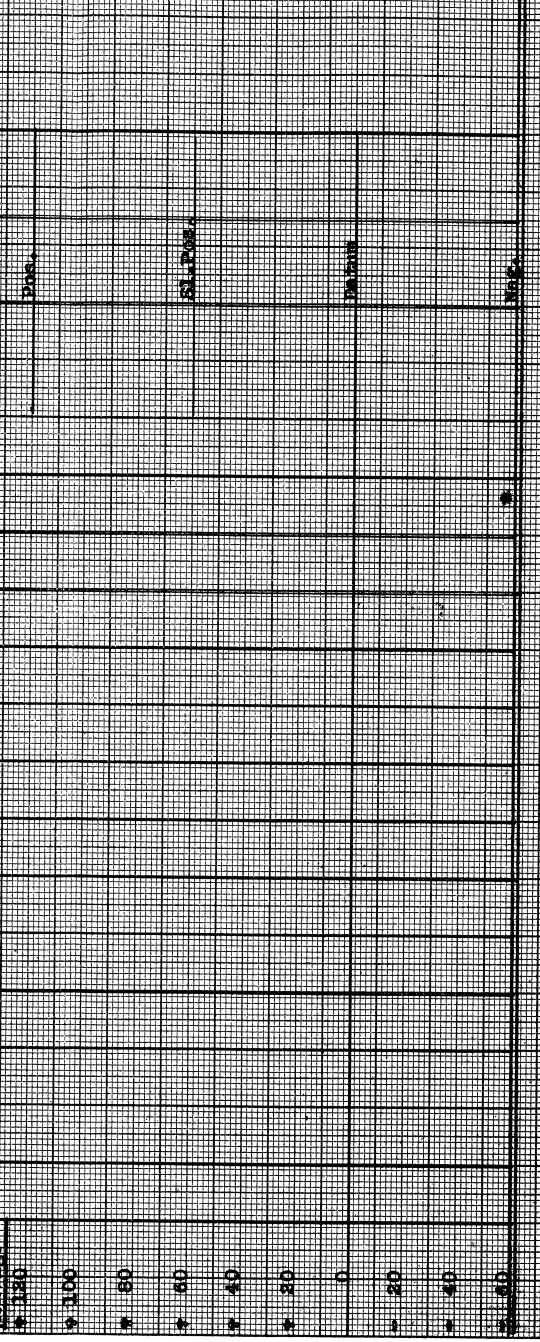


Subj. Project 2240- Ohio Oil Company, Findlay Ohio.
 Percent Change in Composition and Properties of Asphalt in Relation to Exposure
 Exposure (All. See Graph Sheet 1)

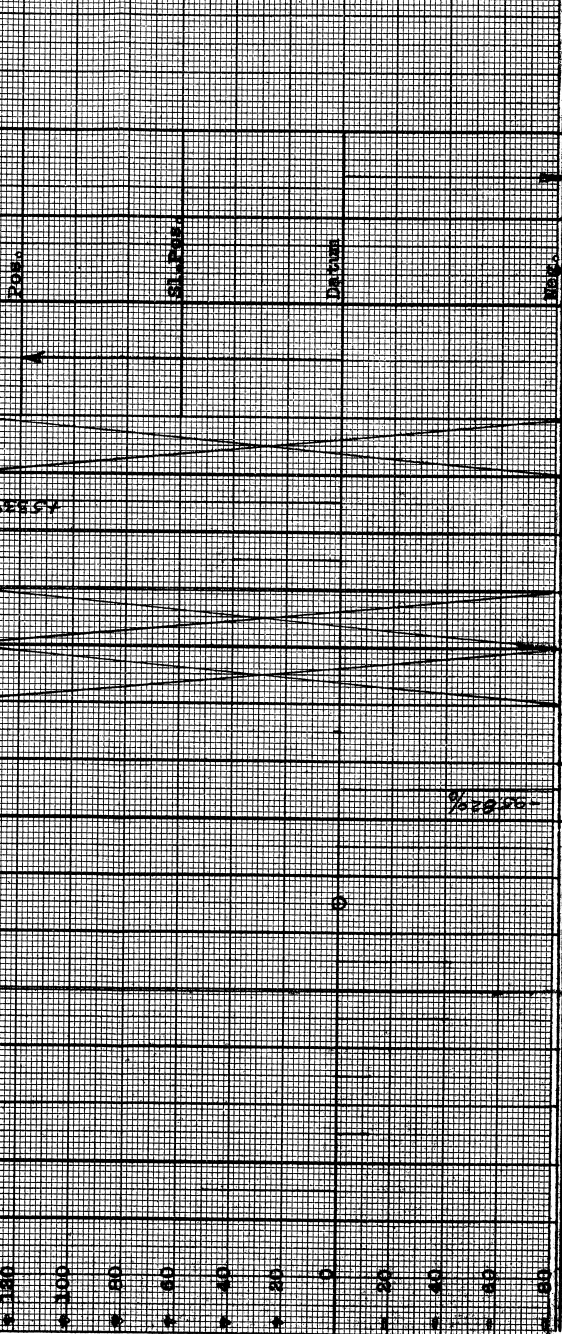
Michigan Asphalts



Lion Asphalt 65-100 Pen.
 Asph. Res. 0.1% B/A 1/0 Pen. Dust 5.0. Loss. Res. S.P.T. Pen. Ash Shelliness Spot. Xylene Notations.

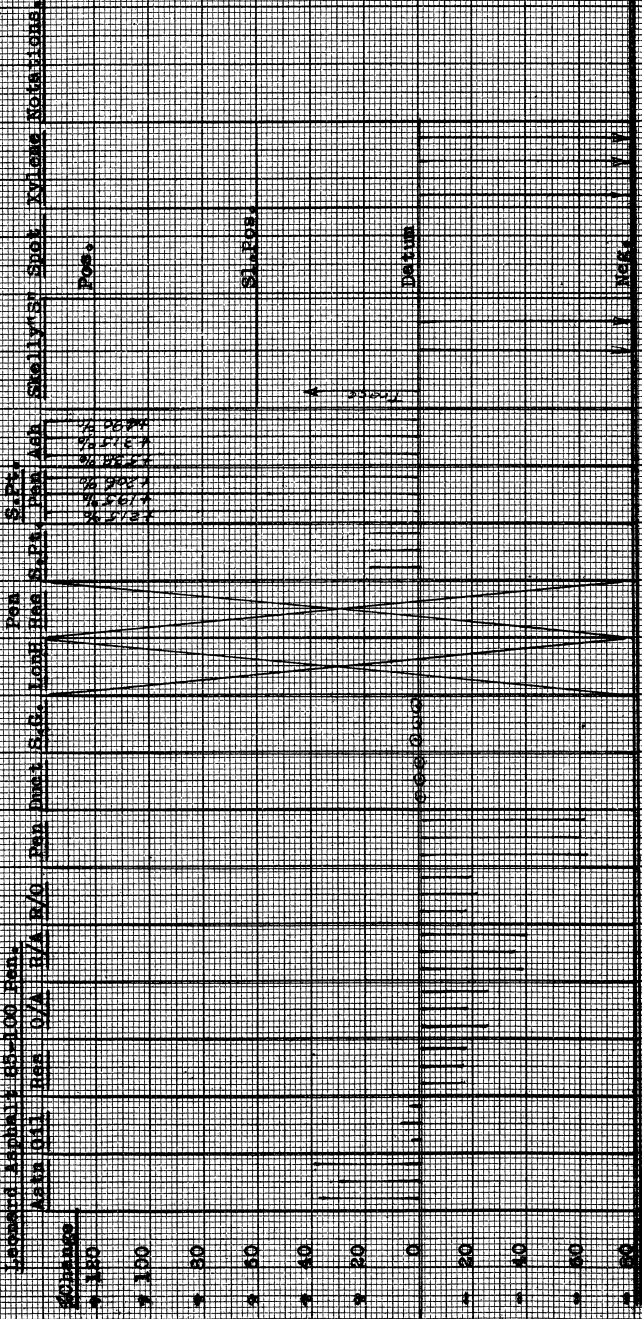


Trumbull Asphalt 65-100 Pen.
 Asph. Res. 0.1% B/A 1/0 Pen. Dust 5.0. Loss. Res. S.P.T. Pen. Ash Shelliness Spot. Xylene Notations.

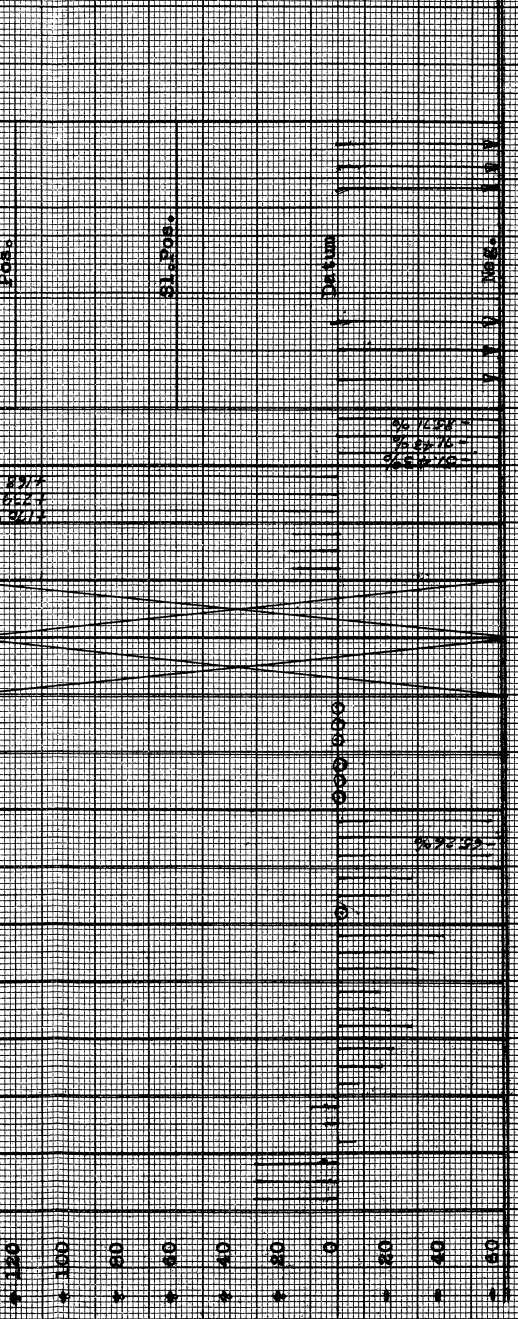


Shelly, Product 8840 - Oil Company, Findlay Ohio
 Patent Discharge in Composition and Preparation of Asphalt as Held and to be Prepared
 Pressure (k) - See Graph Sheet 1

Michigan Aggregate



Lion Asphalt 85-100 Pen.
 Ash Oil Res 0.75 R/A R/O Pen. Dust S.C. Low Res S.P. Pen. Ash Shelly 85-100 Spot Indene Notation



Trumbull Asphalt 85-100 Pen.
 Ash Oil Res 0.75 R/A R/O Pen. Dust S.C. Low Res S.P. Pen. Ash Shelly 85-100 Spot Indene Notation

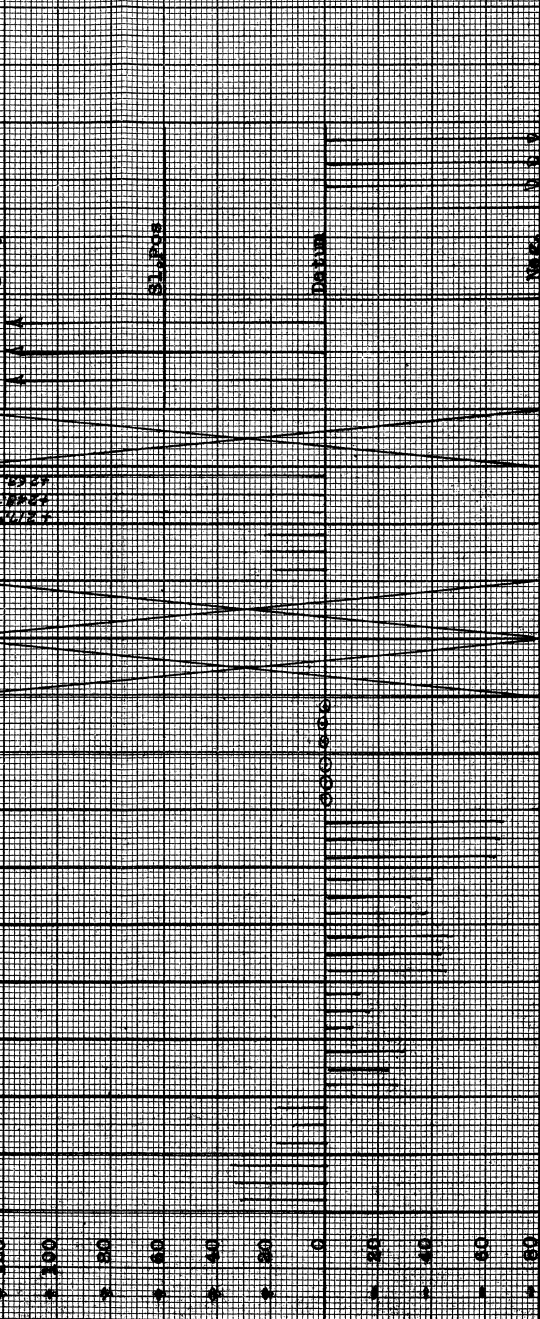


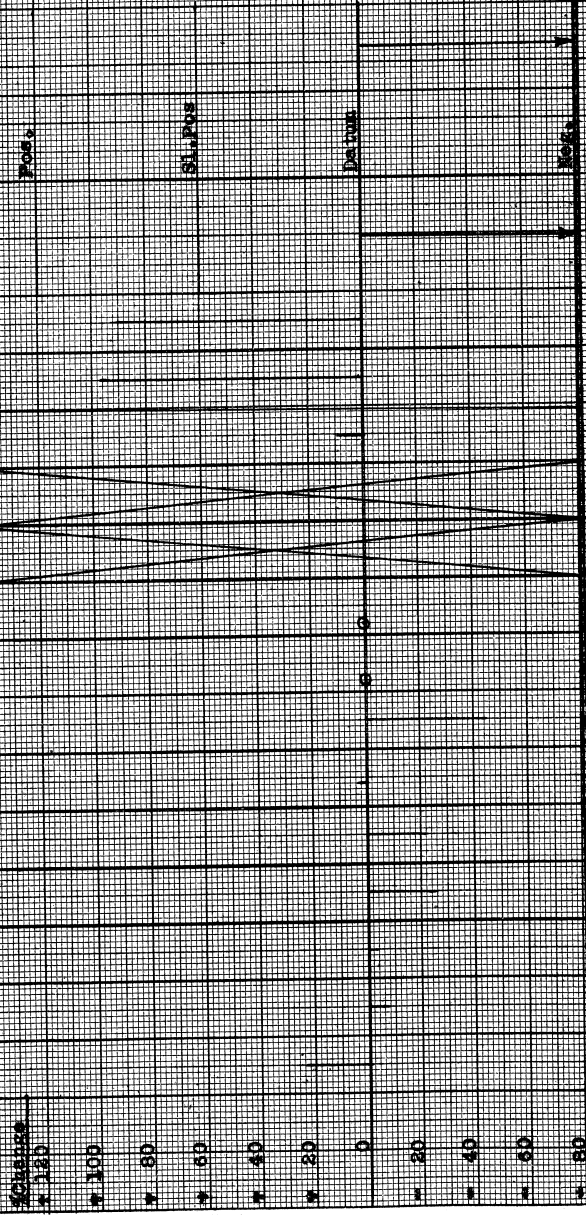
Exhibit Project 2249- Ohio Oil Company, Finley Ohio.
 Percent Change in Composition and Properties of Asphalt As Related to Exposure

Exposure (a) Sea Drunk Street

Michigan Aggregate

Legend Asphalt 65-100 Pen. 8/0 Pen Dual S.G. Loss Res S.P.T. Pen Ash Shelliness Bulk Volume Retention.

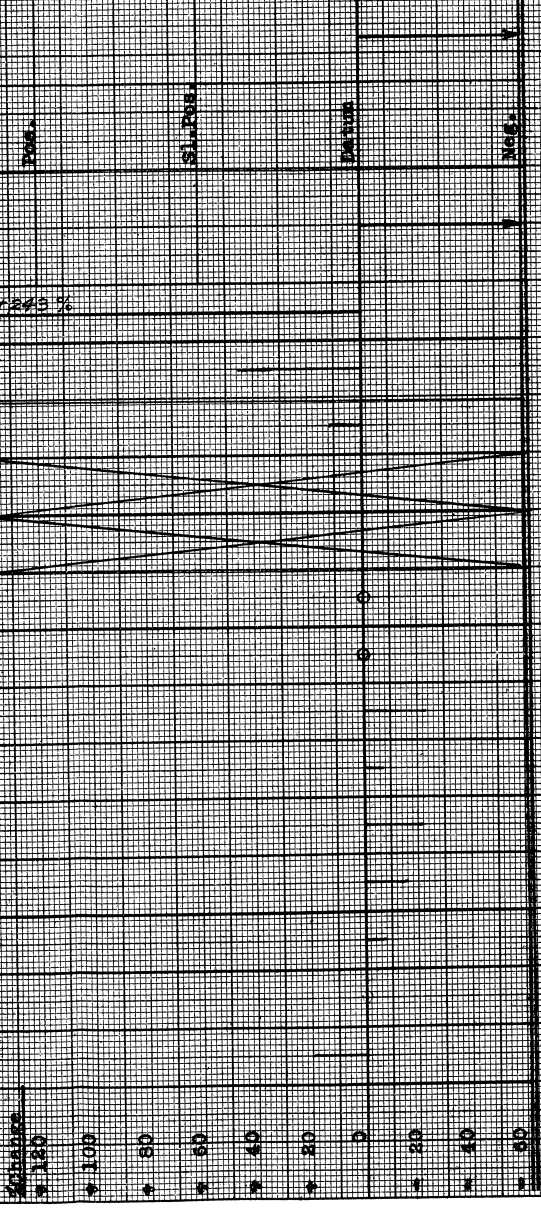
Asphalt 65-100 Pen. 8/0 Pen Dual S.G. Loss Res S.P.T. Pen Ash Shelliness Bulk Volume Retention.



Exposure (b) Sea Drunk Street

Legend Asphalt 65-100 Pen. 8/0 Pen Dual S.G. Loss Res S.P.T. Pen Ash Shelliness Bulk Volume Retention.

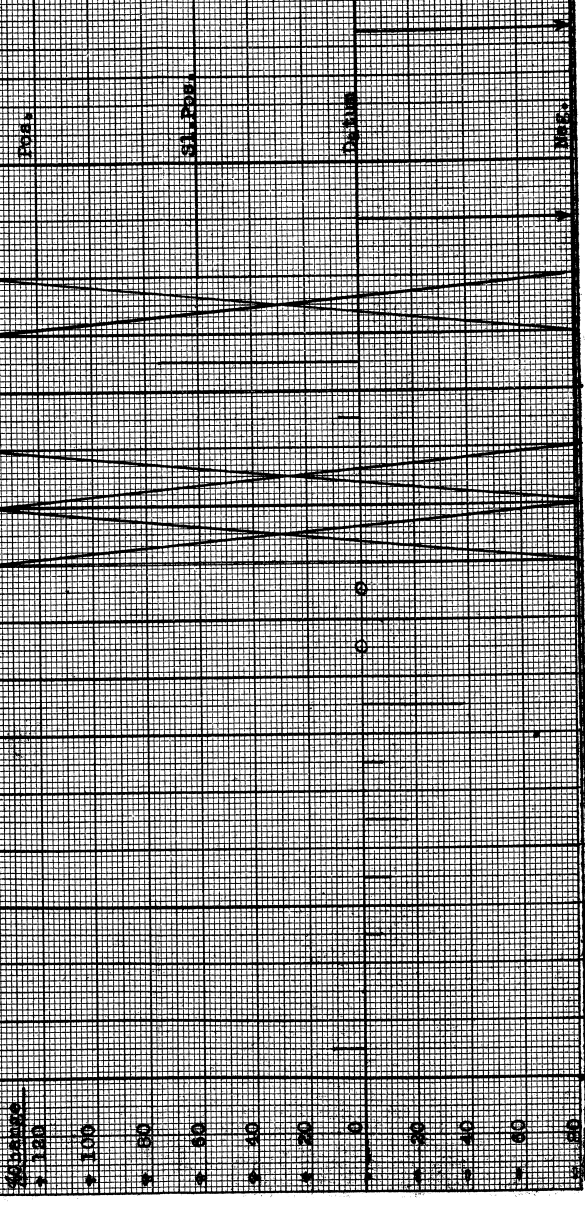
Asphalt 65-100 Pen. 8/0 Pen Dual S.G. Loss Res S.P.T. Pen Ash Shelliness Bulk Volume Retention.



Exposure (c) Sea Drunk Street

Legend Asphalt 65-100 Pen. 8/0 Pen Dual S.G. Loss Res S.P.T. Pen Ash Shelliness Bulk Volume Retention.

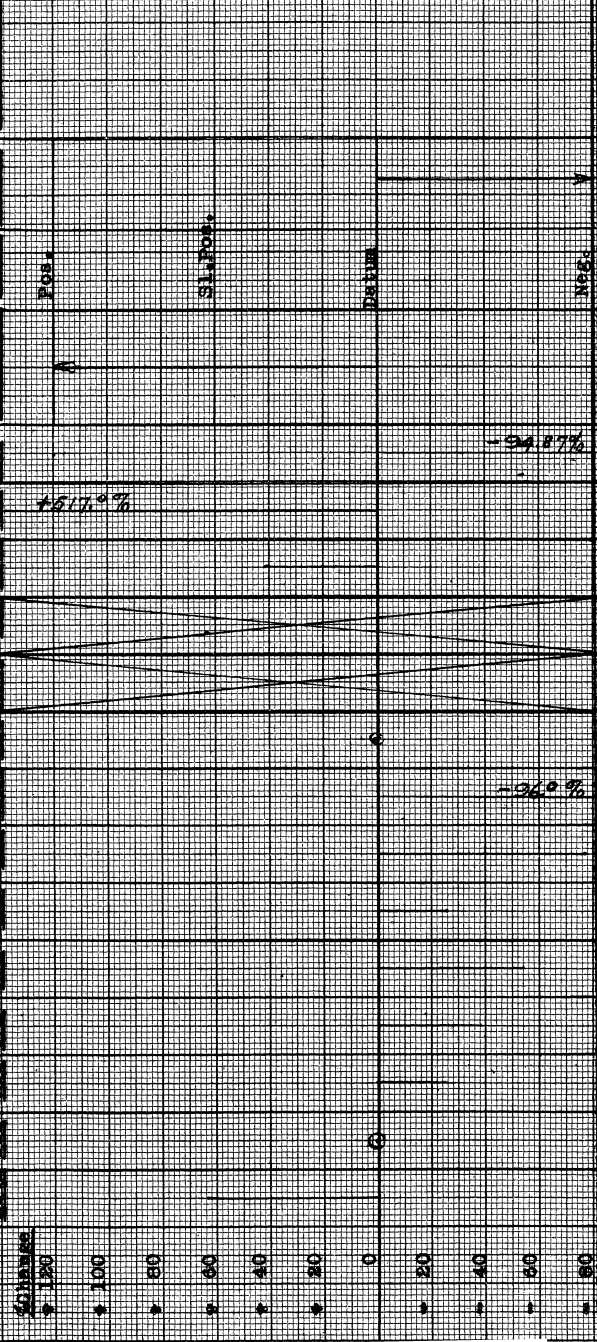
Asphalt 65-100 Pen. 8/0 Pen Dual S.G. Loss Res S.P.T. Pen Ash Shelliness Bulk Volume Retention.



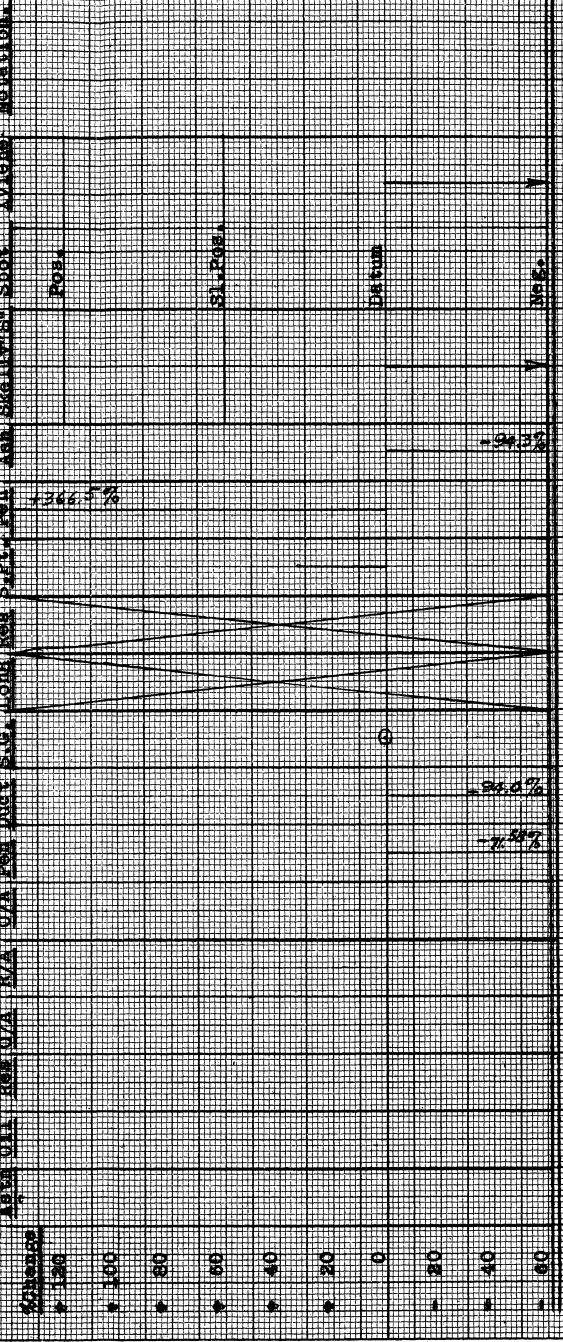
W. Paul, President 2249 Ohio Oil Company, Findlay Ohio.
 Percent Change in Composition and Properties of Asphalt As Related To Exposure.
 Exposure (in) See Graph Sheet 1.

Minnesota Aggregate

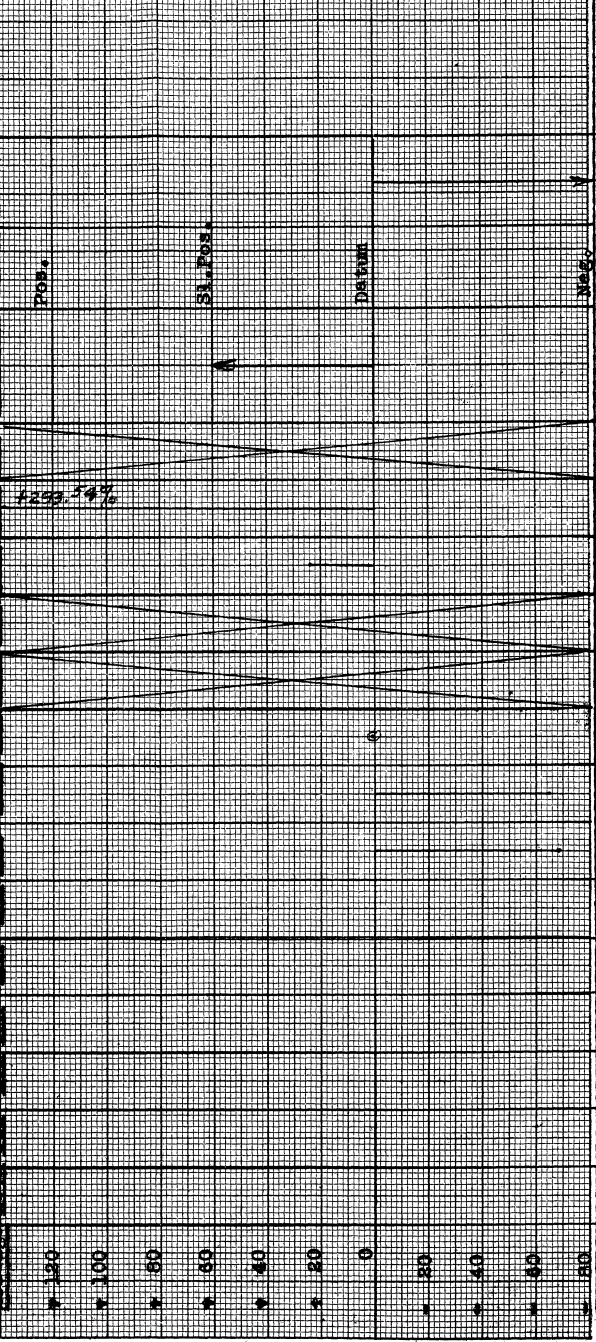
Leonard Asphalt 85-100 Pen.
 Ash Oil Res. 0.7% S.A. 11.0 Pen. Dust S.G. 1.041 Res. S.P.L. 7.0 Ash Shellings Spot. Xylene Notations.



Lion Asphalt 85-100 Pen.
 Ash Oil Res. 0.7% S.A. 11.0 Pen. Dust S.G. 1.041 Res. S.P.L. 7.0 Ash Shellings Spot. Xylene Notations.

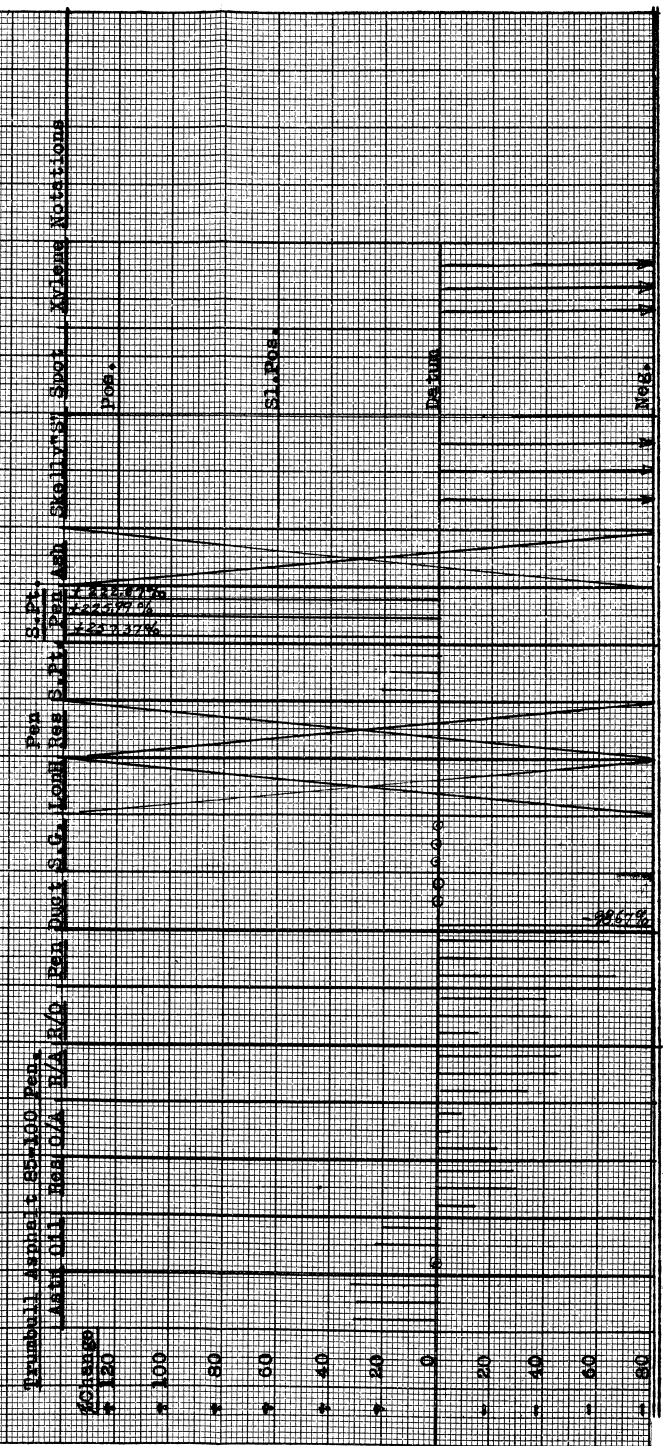
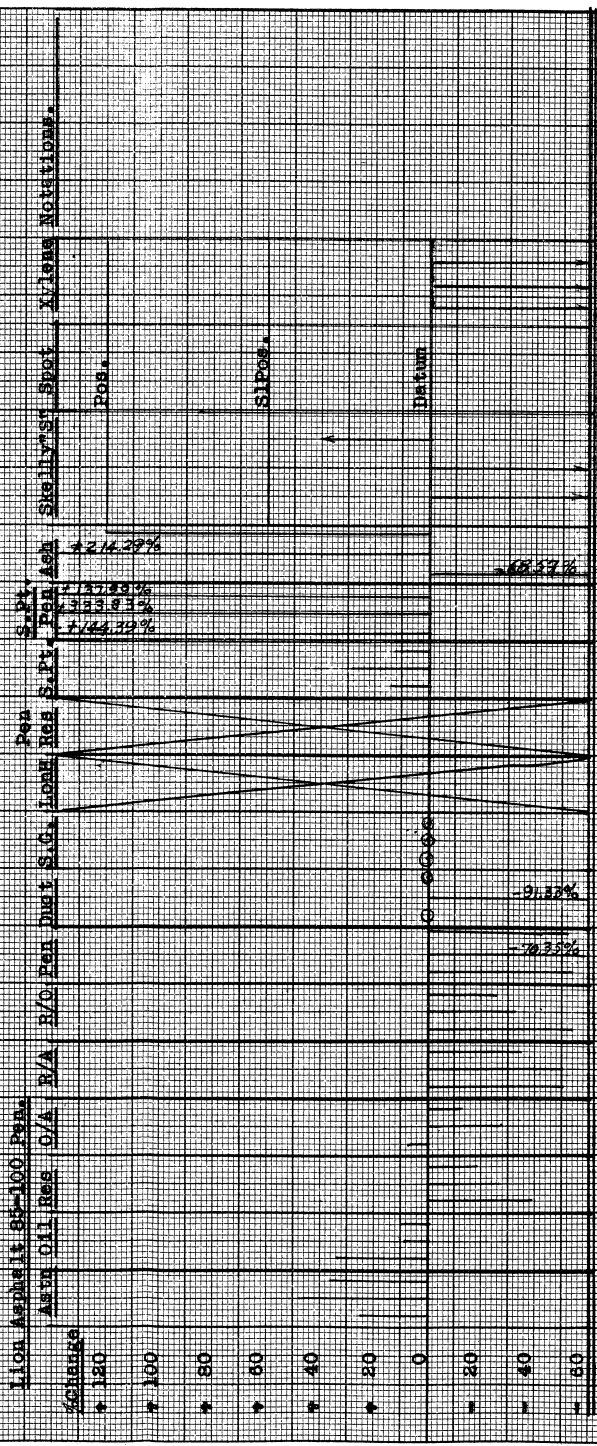
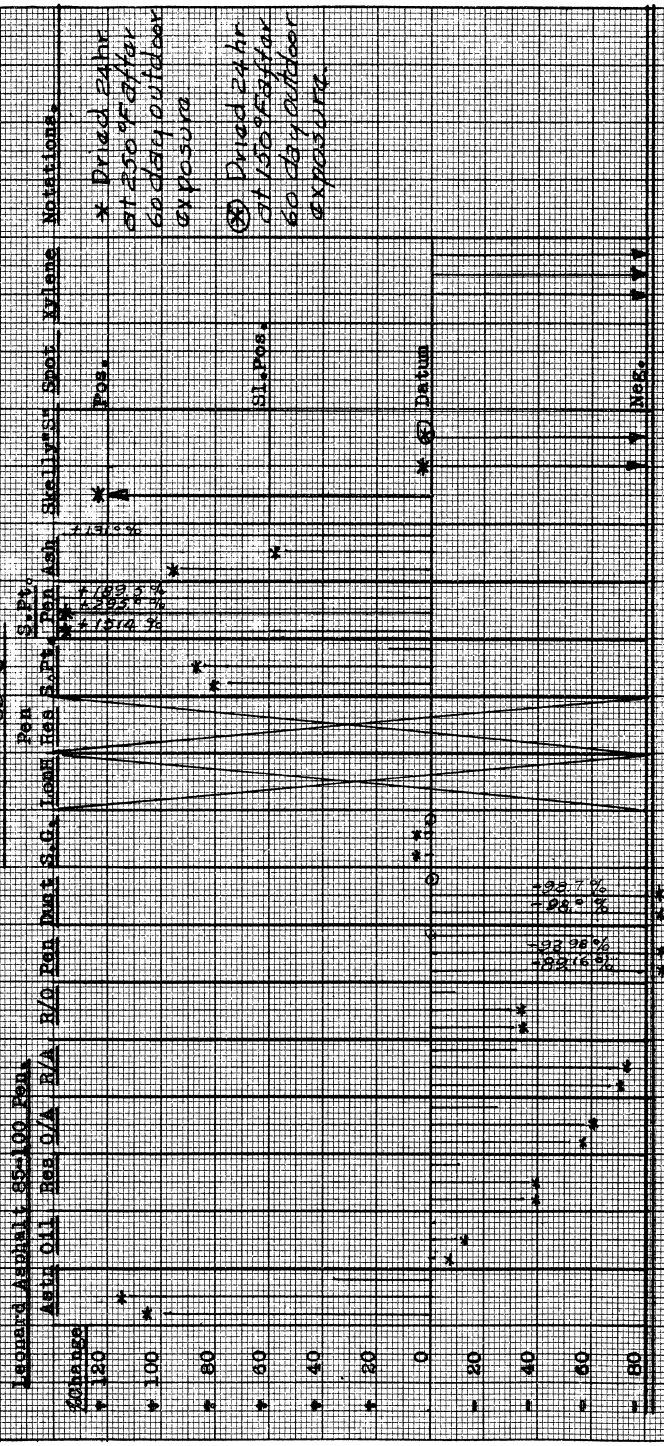


Fremont Asphalt 85-100 Pen.
 Ash Oil Res. 0.7% S.A. 11.0 Pen. Dust S.G. 1.041 Res. S.P.L. 7.0 Ash Shellings Spot. Xylene Notations.



E.F.I. Project 2249 - Ohio Oil Company, Findlay Ohio
 Percent Change in Composition and Properties of Asphalt as Related to Exposure,
 Exposure (K), See Graph Sheet 1.

Minnesota Aggregate



E.R.I. Project 2849- Ohio Oil Company, Findlay Ohio.

Special Test Series. Percent change from Original for recovered Leonard, Lion and Trumbull asphalt from mixtures with original and re-used Michigan and Minnesota aggregate after (a) exposure.

Leonard Asphalt 85-100 Pen.

Penet. Soft. Pt. S. Pt./Penet. Ratio

77%
15924
1524
1524

Original

Minnesota Aggregate

Shelly Xylene Spot 10%XY 15%XY 20%XY 25%XY 30%XY 35%XY Notations

Pos.

Sl. Pos.
Trace
Ring
Datum

Change	60%	40%	20%	00%	20%	40%	60%	80%	100%
Penet.									
Soft.									
Pt.									
S. Pt.									
Penet.									
Ratio									
Original									
Minnesota Aggregate									
Shelly Xylene Spot									
10%XY									
15%XY									
20%XY									
25%XY									
30%XY									
35%XY									
Notations									
Pos.									
Sl. Pos.									
Trace									
Ring									
Datum									
Ref.									

Lion Asphalt 85-100 Pen.

Penet. Soft. Pt. S. Pt./Penet. Ratio

77%
1324
1264
1264

Original

Minnesota Aggregate

Shelly Xylene Spot 10%XY 15%XY 20%XY 25%XY 30%XY 35%XY Notations

Pos.

Sl. Pos.
Trace
Ring
Datum

Change	60%	40%	20%	00%	20%	40%	60%	80%	100%
Penet.									
Soft.									
Pt.									
S. Pt.									
Penet.									
Ratio									
Original									
Minnesota Aggregate									
Shelly Xylene Spot									
10%XY									
15%XY									
20%XY									
25%XY									
30%XY									
35%XY									
Notations									
Pos.									
Sl. Pos.									
Trace									
Ring									
Datum									
Ref.									

Trumbull Asphalt 85-100 Pen.

Penet. Soft. Pt. S. Pt./Penet. Ratio

77%
15924
1524
1524

Original

Minnesota Aggregate

Shelly Xylene Spot 10%XY 15%XY 20%XY 25%XY 30%XY 35%XY Notations

Pos.

Sl. Pos.
Trace
Ring
Datum

Change	60%	40%	20%	00%	20%	40%	60%	80%	100%
Penet.									
Soft.									
Pt.									
S. Pt.									
Penet.									
Ratio									
Original									
Minnesota Aggregate									
Shelly Xylene Spot									
10%XY									
15%XY									
20%XY									
25%XY									
30%XY									
35%XY									
Notations									
Pos.									
Sl. Pos.									
Trace									
Ring									
Datum									
Ref.									

