

Ohio DOT 2016 PG Binder Round Robin Results

	ODOT A	ODOT B	LAB #1	LAB #2	LAB #3	LAB #4	LAB #5	LAB #6	LAB #7	LAB #8A	LAB #8B	LAB #9	LAB #10A	LAB #10B	LAB #10C	LAB #11	LAB #12	LAB #13
Rotational Viscosity	1.700		1.665	1.670	1.612	1.755	1.737	0.164	1.750							1.788	1.755	1.668
Penetration	58		58	52	58	56	60	47	58							56	58	60
Pass/Fail Temp. - Original	80.9		81.0	79.8	81.9		81.4	80.6	76.0		81.6		81.1			81.6	81.6	
Pass/Fail Temp. - RTFO	79.8		79.4	78.8	79.6		79.7	81.1	76.0							79.7	79.7	
Pass/Fail Temp. - PAV	19.6		19.3	18.5	16.0		19.9	17.5	22.0							19.1	18.6	
Pass/Fail Temp. - m-value	-27.0		-27.1	-26.7	-26.8			-24.0	-27.7							-27.5		
Pass/Fail Temp. - Est. Stiff	-29.6		-29.4	-30.2	-30.8			-24.0	-29.6							-30.3		
Complex Modulus @ 70°C	2.28		2.22	2.06	2.38	2.27	2.29	2.20	2.21	2.36	2.36	2.49	2.33			2.27	2.29	2.25
Phase Angle	64.2		64.6	64.4	64.2	64.1	64.0	64.5	64.2	64.5	64.6	64.2	64.4			64.3	64.1	64.6
Original DSR	2.53		2.46	2.28	2.64	2.52	2.54	2.44	2.45	2.62	2.62	2.76	2.59			2.52	2.55	2.49
Complex Modulus @ 70°C	4.22		4.41	4.18	4.39		4.50	4.87	4.37							4.41	4.55	4.33
Phase Angle	60.8		61.3	61.0	61.0		60.9	60.4	61.0							60.8	60.8	61.2
RTFO DSR	4.81		5.02	4.78	5.02		5.15	5.60	5.00							5.05	5.21	4.76
Mass Change %	-0.081		-0.099	-0.111	-0.065		-0.086	-0.075	-0.086							-0.052	-0.065	-0.054
Elastic Recovery	80.5		81.0	82.5	81.0		82.5	77.5	79.2							83.0		82.5
PAV With VDO																		
Phase Angle	45.6		45.8	45.6	46.0		46.3	45.0	45.2							45.6	46.1	
PAV DSR	2330		2450	2215	2127		2650	2049	2598							2463	2250	
Estimated Stiff @ -12°C	120		122	114	114		100	112	108							114	114	
Estimated Stiff @ -18°C	248		254	232	240		224	220	242							230	226	
m-value @ -12°C	0.340		0.339	0.335	0.342		0.348	0.334	0.336							0.334	0.338	
m-value @ -18°C	0.292		0.293	0.290	0.289		0.300	0.298	0.297							0.297	0.301	
E.R. DSR - Original	68.40		67.20	56.80														
E.R. DSR - RTFO	63.80		63.70	52.30														
MSCR at 64 °C on Original																		
Avg % Recovery @ 3.2 kPa	84.92		84.68	84.41	85.30		84.81	85.04	84.93							83.29	86.18	86.79
Jnr @ 3.2 kPa	0.20		0.22	0.25	0.20		0.22	0.21	0.21							0.22	0.19	0.19
% Diff. between Jnr	54.37		54.05	50.32	119.50		78.74	68.52	8.18							-1.56	6.28	16.68
MSCR at 64 °C on RTFO																		
Avg % Recovery @ 3.2 kPa	80.35		76.36	77.13	81.60		83.35	78.14	78.05							77.39	78.86	79.42
Jnr @ 3.2 kPa	0.14		0.16	0.16	0.12		0.15	0.13	0.15							0.15	0.14	0.15
% Diff. between Jnr	36.98		47.67	43.13	72.50		43.36	47.95	5.13							4.72	50.02	1.02

Between 1 & 2 Std. Dev

Greater than 2 Std Dev

Ohio DOT 2016 PG Binder

	LAB #14	LAB #15	LAB #16	LAB #17	LAB #18A	LAB #18B	LAB #19	LAB #20	LAB #21	LAB #22	LAB #23	LAB #24	LAB #25	LAB #26	LAB #27	LAB #28	LAB #29	LAB #30
Rotational Viscosity	1.825	1.697		1.760	1.690	1.483	1.568	1.748	1.666	1.677	1.809	1.734	1.892		1.678	1.686	1.670	1.665
Penetration	55	59		58			53	57	58	55	56	56	59		55	56	58	59
Pass/Fail Temp. - Original	80.3	80.6	81.1	80.9	81.4		79.6	80.8	80.5	81.3	80.8	80.6	80.9		84.3	82.0	81.5	78.1
Pass/Fail Temp. - RTFO	79.5	78.8		79.1			76.9	79.4	79.6	79.1	78.8	78.5	79.9		79.5	82.0	79.5	79.4
Pass/Fail Temp. - PAV	19.3	17.7		19.0			19.2	18.5	19.2	18.5	19.4	18.4	19.5		19.3	16.0	18.1	19.3
Pass/Fail Temp. - m-value	-26.5	-29.3		-28.4			-27.4	-26.7	-27.3	-28.0	-26.8	-28.0	-26.8		-26.9		-28.4	-29.4
Pass/Fail Temp. - Est. Stiff	-30.4	-27.6		-31.0			-29.7	-32.4	-29.6	-29.6	-30.8	-29.8			-29.5		-29.9	-29.9
Complex Modulus @ 70°C	2.08	2.22	2.28	2.21	2.30	2.37	2.13	2.17	2.12	2.19	2.37	2.16	2.27		2.57	2.23	2.25	2.21
Phase Angle	64.2	64.3	64.4	64.5	64.1	64.0	64.5	64.4	64.3	64.5	64.3	64.3	64.2		61.8	64.2	64.0	64.3
Original DSR	2.31	2.46	2.53	2.48	2.60	2.64	2.36	2.41	2.36	2.42	2.63	2.40	2.52		2.92	2.47	2.51	2.45
Complex Modulus @ 70°C	4.39	4.29		4.32			4.02	4.37	4.49	4.08	4.14	4.05	4.22		4.56	4.03	4.23	4.39
Phase Angle	60.6	61.1		61.1			61.1	61.0	60.8	61.2	61.0	61.3	61.0		60.4	61.2	60.5	60.7
RTFO DSR	5.04	4.90		4.92			4.59	5.00	5.15	4.66	4.73	4.62	4.83		5.24	4.60	4.86	5.04
Mass Change %	-0.070	-0.078		-0.110			-0.102	-0.083	-0.099	-0.089	-0.048	-0.124	-0.135		-0.083	-0.103	-0.078	-0.058
Elastic Recovery	85.0	80.0		79.0					80.0	80.0	82.0	80.0	81.0		82.0	81.0	82.5	82.5
PAV With VDO																		
Phase Angle	45.2	46.4		46.2			46.0	46.5	46.3	46.9	45.1	47.2	45.6		45.6	47.1	45.8	46.3
PAV DSR	2480	2020		2390			2670	2225	2430	2230	2534	2170	2589		2501	2203	2180	2450
Estimated Stiff @ -12°C	125	120		107			107	112	117	109	113	112	128		118	112	114	112
Estimated Stiff @ -18°C	250	255		236			238	220	246	242	240	239	261		248	238	248	248
m-value @ -12°C	0.335	0.333		0.348			0.339	0.340	0.344	0.349	0.336	0.338	0.332		0.343	0.353	0.342	0.342
m-value @ -18°C	0.288	0.298		0.303			0.296	0.289	0.294	0.300	0.291	0.300	0.292		0.290	0.298	0.303	0.299
E.R. DSR - Original	67.00	92.10		68.87				66.10				66.90			66.80			72.50
E.R. DSR - RTFO	62.90	84.20		66.81				64.80				66.80			62.30			67.90
MSCR at 64 °C on Original																		
Avg % Recovery @ 3.2 kPa	82.17	86.49		82.38			88.59	82.53	85.45	84.64	83.31	84.61	90.85		84.70	88.02	84.70	86.21
Jnr @ 3.2 kPa	0.28	0.20		0.27			0.17	0.26	0.21	0.23	0.24	0.20	0.14		0.22	0.17	0.23	0.21
% Diff. between Jnr	62.84	78.04		59.66			9.79	58.04	65.95	58.52	0.09	65.40	-43.27		63.09	125.72	40.40	77.69
MSCR at 64 °C on RTFO																		
Avg % Recovery @ 3.2 kPa	76.18	77.98		78.90			80.05	76.16	77.41	78.08	78.46	81.22	80.13		78.22	84.06	79.03	80.32
Jnr @ 3.2 kPa	0.17	0.15		0.14			0.15	0.16	0.15	0.16	0.16	0.10	0.14		0.14	0.11	0.15	0.12
% Diff. between Jnr	41.68	45.08		50.32			3.89	32.88	47.01	42.99	7.98	49.80	-2.34		48.81	69.96	45.42	56.64

Between 1 & 2 Std. Dev

Greater than 2 Std Dev

Ohio DOT 2016 PG Binder												
	LAB #31	LAB #32	LAB #33	LAB #34	LAB #35	LAB #36	AVG	2 STD DEV	1 STD DEV	STD DEV	1 STD DEV	2 STD DEV
Rotational Viscosity	1.750		1.639	1.737		1.613	1.6533	1.0880	1.3707	0.2826	1.9359	2.2185
Penetration			55	50		59	56.379	50.398	53.388	2.990	59.369	62.359
Pass/Fail Temp. - Original			81.0	80.6		81.1	80.832	78.200	79.516	1.316	82.148	83.464
Pass/Fail Temp. - RTFO			79.3	79.1		78.9	79.274	77.120	78.197	1.077	80.351	81.428
Pass/Fail Temp. - PAV			18.6	18.7		16.5	18.682	16.234	17.458	1.224	19.906	21.130
Pass/Fail Temp. - m-value			-27.5	-29.9		-27.1	-27.443	-29.799	-28.621	1.178	-26.266	-25.088
Pass/Fail Temp. - Est. Stiff			-30.4	-26.9		-30.0	-29.514	-32.841	-31.177	1.663	-27.850	-26.187
Complex Modulus @ 70°C	2.42	2.29	2.16	2.32		2.22	2.265	2.056	2.160	0.105	2.370	2.474
Phase Angle	64.0	64.0	64.2	64.3		64.6	64.224	63.337	63.781	0.444	64.668	65.112
Original DSR	2.69	2.55	2.40	2.58		2.46	2.518	2.272	2.395	0.123	2.641	2.764
Complex Modulus @ 70°C			4.22	4.27		4.03	4.309	3.926	4.117	0.191	4.500	4.691
Phase Angle			60.9	61.0		61.8	60.959	60.372	60.666	0.293	61.253	61.546
RTFO DSR			4.83	4.89		4.57	4.921	4.459	4.690	0.231	5.152	5.383
Mass Change %			-0.071	-0.097		-0.072	-0.084	-0.127	-0.106	0.021	-0.063	-0.042
Elastic Recovery			80.0	78.3		79.0	80.917	77.523	79.220	1.697	82.614	84.311
PAV With VDO												
Phase Angle			45.5	45.4		46.5	45.954	44.779	45.367	0.587	46.541	47.128
PAV DSR			2410	2572		1835	2346.962	1929.274	2138.118	208.844	2555.805	2764.649
Estimated Stiff @ -12°C			112	111		108	113.654	101.888	107.771	5.883	119.537	125.420
Estimated Stiff @ -18°C			232	237		252	240.231	219.041	229.636	10.595	250.826	261.421
m-value @ -12°C			0.345	0.339		0.340	0.340	0.330	0.335	0.005	0.345	0.351
m-value @ -18°C			0.296	0.291		0.293	0.295	0.286	0.291	0.004	0.300	0.304
E.R. DSR - Original				68.90			69.234	53.060	61.147	8.087	77.321	85.408
E.R. DSR - RTFO				68.90			65.855	51.498	58.677	7.179	73.034	80.213
MSCR at 64 °C on Original												
Avg % Recovery @ 3.2 kPa			85.36	86.00		87.80	85.339	81.522	83.430	1.909	87.248	89.157
Jnr @ 3.2 kPa			0.22	0.19		0.19	0.212	0.152	0.182	0.030	0.242	0.273
% Diff. between Jnr			8.18	26.28		5.07	45.059	-30.344	7.357	37.701	82.760	120.462
MSCR at 64 °C on RTFO												
Avg % Recovery @ 3.2 kPa			78.63	79.76		78.87	79.041	75.210	77.125	1.916	80.957	82.872
Jnr @ 3.2 kPa			0.15	0.13		0.16	0.144	0.111	0.127	0.017	0.160	0.177
% Diff. between Jnr			5.67	68.69		0.91	35.847	-9.851	12.998	22.849	58.696	81.545

Between 1 & 2 Std. Dev
Greater than 2 Std Dev