Test Monitoring Center
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Memo: 01-028

Date: April 10, 2001

TO: Gordon Farnsworth, Chairman, Sequence VE Surveillance Panel

FROM: Richard E. Grundza

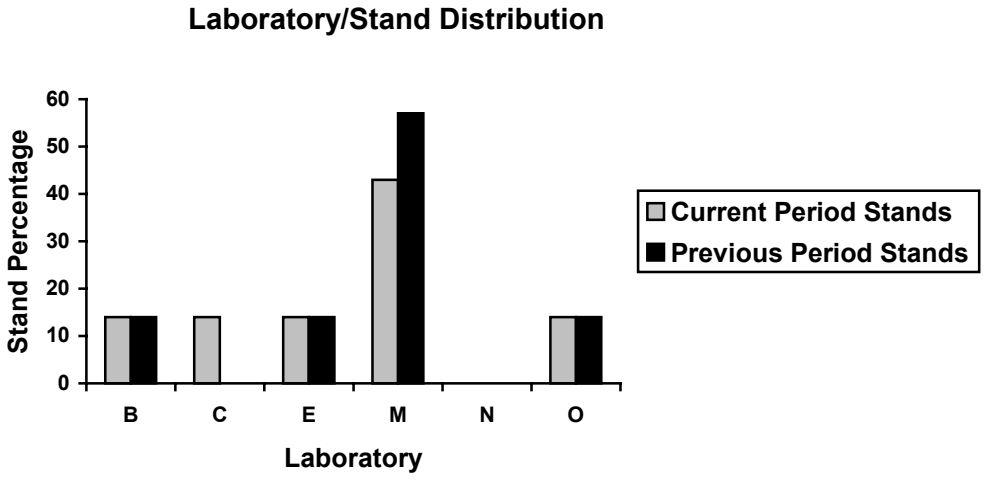
SUBJECT: Sequence VE Reference Test Status from October 1, 2000 through March 31, 2001

The following is a summary of Sequence VE reference tests that were completed during the period October 1, 2000 through March 31, 2001.

Lab/Stand Distribution

	Reporting Data	Calibrated as of 3/31/01
Number of Laboratories	5	3
Number of Stands	7	3

The following chart shows the laboratory/stand distribution:

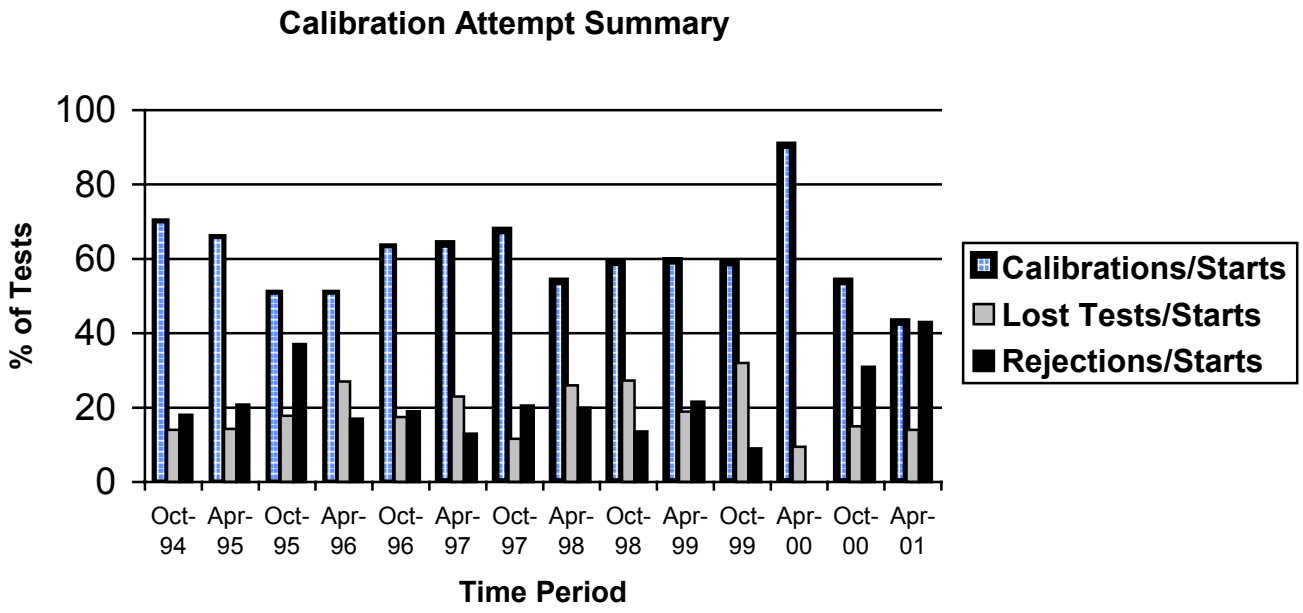


The following summarizes the status of the reference oil tests reported to the TMC:

	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	3
Operationally Valid, Statistically Unacceptable	OC	3
Operationally Valid, Stand Removed from System	MC	1
Total		7

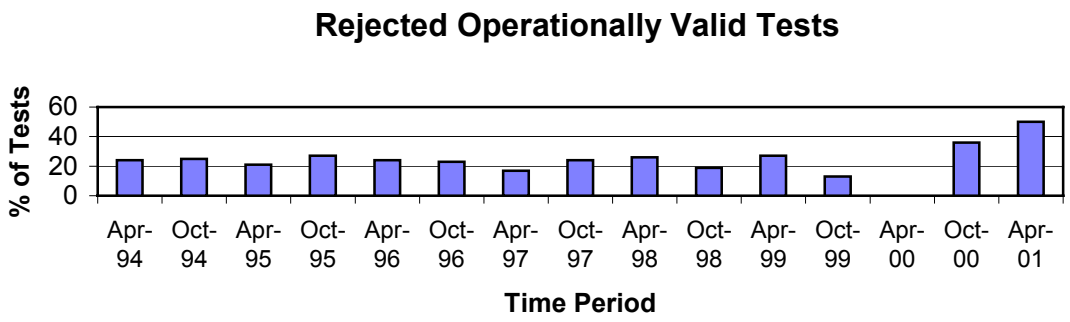
Two of the tests were statistically unacceptable for severe sludge and ACW. The third statistically unacceptable test was due to mild AEV

Calibrations per start, lost tests per start and rejections per start rates are summarized below:



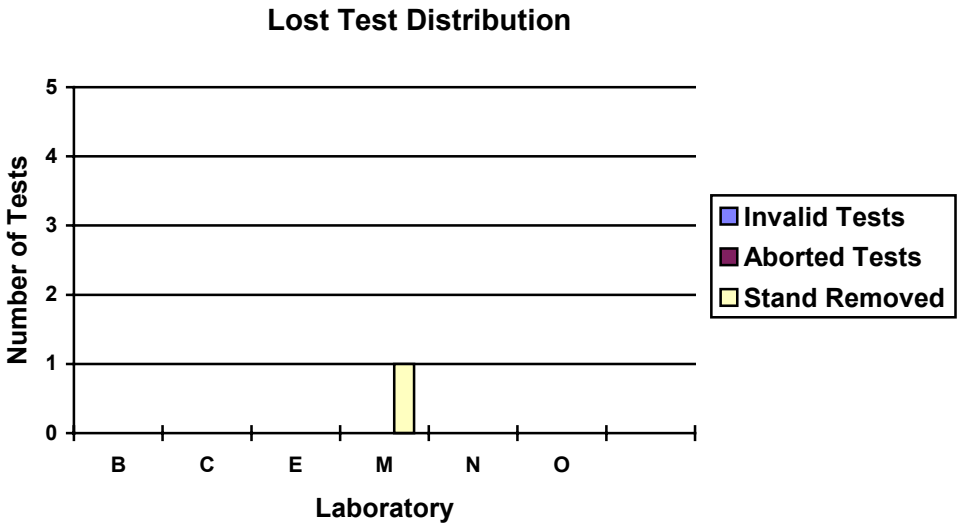
The calibration per start rate has decreased and is much lower than the historical rate. The lost test per start is comparable to the previous period and historical rates. Rejected test per start rate has increased with respect to the previous report period. The lost test per start rate compares favorably with the historical lost test rate, while the rejected test per start is much higher than the historical rate. Only three of the seven starts this period resulted in successful stand calibration.

The following chart shows the percentage of operationally valid tests failing the acceptance criteria:



There were no instances of the application of "Engineering Judgment" in the interpretation of LTMS guidelines during this report period. A total of fourteen LTMS deviations have been granted during the life of the Sequence VE test.

There was one test from which the data was removed from the laboratory control charts, because the stand was abandoned. There were no operationally invalid tests reported during this report period. Aborted and operationally invalid tests by laboratory are summarized with the following chart:



Severity and Precision

Based on the mean delta/s values and pooled standard deviation for the current period, a 95% confidence interval representing severity for the current period is given below in reported units. For RCS, AES, ACW and MCW, calculations were performed in transformed units, then converted to reported units. Pooled s and mean delta/s values for RCS, AES, MCW and ACW are shown in transformed units.

Variable	Pooled s All Oils	Mean Delta/s	Confidence Interval	Based on	Delta in Reported Units
RCS	0.447	-0.655	3.97 - 7.42	7.0	-1.35
AES	0.765	-0.818	5.48 – 9.11	9.0	-0.90
APV	0.038	-0.063	6.46 – 6.54	6.5	0.00
AEV	0.126	0.382	4.92 – 5.18	5.0	0.05
ACW	3.038	1.064	131.0 - 317.6	130	84.0
MCW	4.109	0.599	311.2 – 689.7	380	102

The mean Δ/s for this period shows AES (-0.818), RCS (-0.655), MCW (0.599) and ACW (1.064) were severe, AEV (0.382) was mild, and APV (-0.063) was on or near target. Figures 1 through 6 are current industry severity and precision EWMA control charts and plots of summations Δ/s for RCS, AES, APV, AEV, MCW and ACW. Figures 7 through 9 compare the pooled standard deviation of the current period with previous periods.

RCS severity began the period in action alarm. Subsequent tests caused the industry charts to return to the warning level and then clear for three tests, before sounding a warning alarm at the end of the period. The alarm at the beginning period was caused by a severe (-2.653 Δ/s) result from one lab. The alarm goes to a warning level and subsequently clear after results closer to target are reported. A severity warning alarm occurs at the end of the period when a result –2.551 Δ/s from target is reported. This test was from a lab other than the lab reporting the -2.653 Δ/s result at the beginning of the period. RCS precision was in control the entire period. The summation Δ/s plot shows RCS having a severe trend at the beginning of the period, moderating towards the middle of the period.

As with the RCS control chart, AES began this period in severity EWMA action alarm, went to warning alarm, and then cleared for three tests before ending the period in warning alarm. The alarm at the beginning of the period was the result of a test –2.945 Δ/s from target, which followed a similarly severe result run by the same laboratory at the end of the last report period. The alarm clears when additional results, closer to target, are reported. A warning alarm sounds at the end of the period, which was caused by a result –2.916 Δ/s from target. This result was from a lab other than the one reporting severe results at the end of last report period and the beginning of this period. AES precision chart was in control for the period. The summation Δ/s plot shows that with the exception of the last test, severity was on or near target.

The APV severity and precision EWMA charts were in control the entire period. The summation Δ/s shows on or near target results for the period.

AEV severity was in control for the period. AEV precision began the period in control but sounded two precision EWMA warning alarms at the end of the period. The alarm may be lab related, based on a result from one lab which was –1.538 Δ/s from target, which was preceded by a result from a different lab which was 0.801Δ/s and followed by a result from a third lab which was 0.787 Δ/s from target. The lab reporting the severe result has typically been severe on varnish, having a severity adjustment in effect. The summation Δ/s plot shows severity on or near target for most of the period.

The charts for MCW severity and precision were in control the entire period. The summation Δ/s plot shows a severe trend for most of the period.

Industry control charts for ACW severity began the period in action alarm, clearing for four tests and finally sounding a warning alarm at the end of the period. Industry precision has been in warning or action alarm the entire period. Severity and precision problems appear to have been caused by two severe results from two labs. At the beginning of the period, one lab reported a result which was 4.622 □/s from target. The following four results were within ± one standard deviation of target. The last test reported was 2.597 □/s from target. The summation Δ/s plot shows a severe trend for most of the period.

Pooled precision estimates show AES and RCS precision are directionally improved with respect to the previous period and are not significantly different than historical estimates. Precision for AEV and APV has improved significantly with respect to the previous period and historical estimates. ACW and MCW are directionally poorer when compared to the previous period, but have not degraded significantly with respect to the previous period and historical estimates.

Fuels and Reference Oils

Reference oil quantities available at the laboratories and TMC, as well as estimated life of these oils, is tabulated below.

Oil	TMC Inventory, in gallons	TMC Inventory, in tests	Laboratory Inventory, in tests	Estimated life
925-3	227	75	6	3+ years
927	9	3	1	< 1 year
927-1	152	50	10	3+ years
930	281	93	4	3+ years
930-1	265	88	0	3+ years
1006	1573	524	3	2+ years

Note: Oil 1006 is used across multiple test areas, TMC inventory represents total amount of that oil on hand.

Information Letters

Information Letter 01-1 was issued on January 15, 2001. This information letter revised temperature measurement sensor calibration frequency to prior to a calibration attempt.

Information Memos

The following memos were issued by the TMC during this period.

Memo	Date	Subject
00-130	10/4/00	Sequence VE Semi-Annual Report

The following table compares the standard deviation used in the LTMS for severity adjustment calculations, which is a pooled estimate of precision based on oils 930 and 1002, with the current and historical pooled precision of the oils 1002, 1006 and 930.

Parameter	Severity Adjustment Standard Deviation (n = 43)	Historical Pooled Standard Deviation, Oils 930, 1006 and 1002 (n =324)	Current Period Pooled Standard Deviation, Oils 930, 1006 and 1002 (n = 3)
AES	0.594	0.701	0.471
RCS	0.528	0.588	0.076
AEV	0.239	0.264	0.177
APV	0.213	0.253	0.050
ACW	2.318	2.583	0.486
MCW	3.155	3.866	0.235

Summary

Calibration per start rate has decreased with respect to the previous period and historical rates. The rejected test per start has increased with respect to the previous period and historical rates. The lost test per start rate compares favorably with the previous period and historical rates. Precision, when compared to the previous period, is directionally better for AES and RCS and comparable to historical estimates. AEV and APV precision has improved significantly with respect to both the previous period and historical rates. ACW and MCW precision are directionally poorer when compared with the previous period and are not significantly different than historical estimates. AES, ACW, RCS and MCW trended severe this period. AEV was mild and APV was on or near target for severity. The severe results appear to lab related, occurring at the beginning and end of the report period.

Attachments

c: Sequence VE Surveillance Panel
ftp://www.tmc.astm.cmri.cmu.edu/docs/gas/sequencev/semiannualreports/ve-4-2001
J. L. Zalar
F. M. Farber

Listing of Tables and Figures Included as Part of This Report to the Sequence VE Surveillance Panel

Table 1 summarizes the mean and range of results, by oil, of all operationally valid reference oil tests reported to the TMC, through March 31, 2001, in transformed and reported units, where applicable.

Table 2 summarizes the mean and range of results, by oil, of all operationally valid reference oil tests reported to the TMC from October 1, 2000 through March 31, 2001, in transformed and reported units, where applicable.

Table 3 summarizes the mean and range of individual varnish part results, by oil, of all operationally valid dual plug reference oil tests reported to the TMC through March 31, 2001.

Table 4 summarizes the mean and range of individual sludge part results, by oil, of all operationally valid dual plug reference oil tests reported to the TMC through March 31, 2001.

Table 5 is the Sequence VE Industry Timeline

Figures 1 through 6 are the Industry control charts for the dual plug head results for AES, RCS, APV, AEV, ACW and MCW.

Figures 7 through 9 compare the pooled standard deviation of the dual plug head results for this ASTM reporting period with previous ASTM reporting periods, for AES and RCS, AEV and APV, and ACW and MCW, respectively.

TABLE 1
SEQUENCE VE DUAL PLUG HEAD
ALL OPERATIONALLY VALID DATA
DATE COMPLETED ENDING MARCH 31, 2001

OIL CODE	TEST PARAMETER	N	MEAN	s	REPORTED RANGE
1002	RCS (-1(LN(9.65-RCS)))	122	-0.505	.516	-1.637 TO 0.734
	RCS (MERITS*)		7.992		4.510 TO 9.170
	AES (-1(LN(9.65-AES)))		0.367	.603	-1.244 TO 1.427
	AES (MERITS*)		8.957		6.180 TO 9.410
	Avg. Pist. Varnish		7.104	.222	6.620 TO 7.570
	Avg. Eng. Varnish		5.590	.272	4.230 TO 6.290
	MCW (Square Root)		14.09	3.22	4.243 TO 19.31
	MCW (micrometres*)		198.5		18.00 TO 373.0
	ACW (Square Root)		9.649	2.42	3.633 TO 15.21
	ACW (micrometres*)		93.09		13.20 TO 231.4
1006	RCS (-1(LN(9.65-RCS)))	54	-0.011	.738	-1.954 TO 1.022
	RCS (MERITS*)		8.639		2.590 TO 9.290
	AES (-1(LN(9.65-AES)))		0.602	.890	-1.792 TO 1.661
	AES (MERITS*)		9.103		3.650 TO 9.460
	Avg. Pist. Varnish		6.949	.271	6.460 TO 7.590
	Avg. Eng. Varnish		5.509	.247	4.940 TO 6.060
	MCW (Square Root)		9.023	4.36	4.359 TO 18.06
	MCW (micrometres*)		81.42		19.00 TO 326.0
	ACW (Square Root)		6.760	3.04	3.033 TO 13.55
	ACW (micrometres*)		45.70		9.200 TO 183.5
925-2	RCS (-1(LN(9.65-RCS)))	9	-1.452	.192	-1.658 TO -1.102
	RCS (MERITS*)		5.380		4.400 TO 6.640
	AES (-1(LN(9.65-AES)))		-0.426	.357	-0.944 TO 0.174
	AES (MERITS*)		8.119		7.080 TO 8.810
	Avg. Pist. Varnish		6.546	.184	6.300 TO 6.900
	Avg. Eng. Varnish		4.477	.227	4.160 TO 4.840
	MCW (Square Root)		6.367	3.37	3.162 TO 12.04
	MCW (micrometres*)		40.54		10.00 TO 145.0
	ACW (Square Root)		4.330	1.39	2.530 TO 6.411
	ACW (micrometres*)		18.75		6.400 TO 41.10
925-3	RCS (-1(LN(9.65-RCS)))	144	-1.215	.334	-2.194 TO -0.182
	RCS (MERITS*)		6.281		0.680 TO 8.450
	AES (-1(LN(9.65-AES)))		-0.443	.528	-1.959 TO 0.916
	AES (MERITS*)		8.093		2.560 TO 9.250
	Avg. Pist. Varnish		6.565	.222	5.730 TO 7.100
	Avg. Eng. Varnish		4.088	.276	3.580 TO 4.950
	MCW (Square Root)		6.531	3.10	2.236 TO 16.85
	MCW (micrometres*)		42.65		5.000 TO 284.0
	ACW (Square Root)		4.830	1.79	2.025 TO 12.28
	ACW (micrometres*)		23.33		4.100 TO 150.9
926-1	RCS (-1(LN(9.65-RCS)))	8	0.476	.469	-0.385 TO 1.050
	RCS (MERITS*)		9.029		8.180 TO 9.300
	AES (-1(LN(9.65-AES)))		1.280	.473	0.301 TO 1.772
	AES (MERITS*)		9.372		8.910 TO 9.480
	Avg. Pist. Varnish		6.963	.154	6.650 TO 7.160
	Avg. Eng. Varnish		5.570	.190	5.230 TO 5.850
	MCW (Square Root)		13.04	4.13	5.745 TO 17.89
	MCW (micrometres*)		169.9		33.00 TO 320.0
	ACW (Square Root)		8.091	2.75	4.648 TO 12.76
	ACW (micrometres*)		65.47		21.60 TO 162.8

TABLE 1
SEQUENCE VE DUAL PLUG HEAD
ALL OPERATIONALLY VALID DATA
DATE COMPLETED ENDING MARCH 31, 2001

OIL CODE	TEST PARAMETER	N	MEAN	s	REPORTED RANGE
927	RCS (-1(LN(9.65-RCS)))	22	-1.583	.489	-2.128 TO -0.049
	RCS (MERITS*)		4.781		1.250 TO 8.600
	AES (-1(LN(9.65-AES)))		-0.907	.744	-1.739 TO 0.916
	AES (MERITS*)		7.174		3.960 TO 9.250
	Avg. Pist. Varnish		6.780	.338	6.150 TO 7.600
	Avg. Eng. Varnish		4.994	.250	4.490 TO 5.510
	MCW (Square Root)		19.02	2.98	8.000 TO 21.73
	MCW (micrometres*)		361.6		64.00 TO 472.0
	ACW (Square Root)		13.55	2.77	5.523 TO 16.75
	ACW (micrometres*)		183.6		30.50 TO 280.4
927-1	RCS (-1(LN(9.65-RCS)))	7	-1.832	.170	-1.981 TO -1.509
	RCS (MERITS*)		3.403		2.400 TO 5.130
	AES (-1(LN(9.65-AES)))		-1.275	.258	-1.537 TO -0.820
	AES (MERITS*)		6.071		5.000 TO 7.380
	Avg. Pist. Varnish		6.991	.214	6.580 TO 7.200
	Avg. Eng. Varnish		5.023	.276	4.500 TO 5.270
	MCW (Square Root)		19.32	1.24	17.92 TO 21.70
	MCW (micrometres*)		373.4		321.0 TO 471.0
	ACW (Square Root)		14.24	.990	13.07 TO 15.83
	ACW (micrometres*)		202.9		170.9 TO 250.7
930	RCS (-1(LN(9.65-RCS)))	151	-0.285	.590	-1.920 TO 1.609
	RCS (MERITS*)		8.320		2.830 TO 9.450
	AES (-1(LN(9.65-AES)))		0.345	.706	-1.656 TO 1.470
	AES (MERITS*)		8.942		4.410 TO 9.420
	Avg. Pist. Varnish		6.993	.268	5.950 TO 7.820
	Avg. Eng. Varnish		4.846	.261	4.130 TO 5.700
	MCW (Square Root)		9.813	4.21	3.464 TO 20.07
	MCW (micrometres*)		96.30		12.00 TO 403.0
	ACW (Square Root)		6.858	2.58	2.470 TO 15.78
	ACW (micrometres*)		47.04		6.100 TO 248.9

* CALCULATED IN TRANSFORMED UNITS AND CONVERTED BACK TO REPORTED UNITS

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TABLE 2
SEQUENCE VE DUAL PLUG HEAD
ALL OPERATIONALLY VALID DATA
DATA FROM OCTOBER 1, 2000 THROUGH MARCH 31, 2001

OIL CODE	TEST PARAMETER	N	MEAN	s	REPORTED RANGE
1006	RCS (-1(LN(9.65-RCS)))	2	0.767	.076	0.713 TO 0.821
	RCS (MERITS*)		9.186		9.160 TO 9.210
	AES (-1(LN(9.65-AES)))		1.327	.471	0.994 TO 1.661
	AES (MERITS*)		9.385		9.280 TO 9.460
	Avg. Pist. Varnish		6.885	.049	6.850 TO 6.920
	Avg. Eng. Varnish		5.735	.177	5.610 TO 5.860
	MCW (Square Root)		5.998	.236	5.831 TO 6.164
	MCW (micrometres*)		35.97		34.00 TO 38.00
	ACW (Square Root)		4.656	.486	4.313 TO 5.000
	ACW (micrometres*)		21.68		18.60 TO 25.00
925-3	RCS (-1(LN(9.65-RCS)))	2	-1.750	.628	-2.194 TO -1.306
	RCS (MERITS*)		3.897		0.680 TO 5.960
	AES (-1(LN(9.65-AES)))		-1.270	.973	-1.959 TO -0.582
	AES (MERITS*)		6.088		2.560 TO 7.860
	Avg. Pist. Varnish		6.335	.021	6.320 TO 6.350
	Avg. Eng. Varnish		4.265	.021	4.250 TO 4.280
	MCW (Square Root)		11.39	5.81	7.280 TO 15.49
	MCW (micrometres*)		129.6		53.00 TO 240.0
	ACW (Square Root)		9.044	4.27	6.025 TO 12.06
	ACW (micrometres*)		81.79		36.30 TO 145.5
927-1	RCS (-1(LN(9.65-RCS)))	1	-1.954	.	-1.954 TO -1.954
	RCS (MERITS*)		2.590		2.590 TO 2.590
	AES (-1(LN(9.65-AES)))		-1.418	.	-1.418 TO -1.418
	AES (MERITS*)		5.520		5.520 TO 5.520
	Avg. Pist. Varnish		7.120	.	7.120 TO 7.120
	Avg. Eng. Varnish		4.500	.	4.500 TO 4.500
	MCW (Square Root)		21.70	.	21.70 TO 21.70
	MCW (micrometres*)		471.0		471.0 TO 471.0
	ACW (Square Root)		14.39	.	14.39 TO 14.39
	ACW (micrometres*)		207.0		207.0 TO 207.0
930	RCS (-1(LN(9.65-RCS)))	1	-1.351	.	-1.351 TO -1.351
	RCS (MERITS*)		5.790		5.790 TO 5.790
	AES (-1(LN(9.65-AES)))		-1.044	.	-1.044 TO -1.044
	AES (MERITS*)		6.810		6.810 TO 6.810
	Avg. Pist. Varnish		7.290	.	7.290 TO 7.290
	Avg. Eng. Varnish		4.860	.	4.860 TO 4.860
	MCW (Square Root)		20.07	.	20.07 TO 20.07
	MCW (micrometres*)		403.0		403.0 TO 403.0
	ACW (Square Root)		13.45	.	13.45 TO 13.45
	ACW (micrometres*)		180.8		180.8 TO 180.8

* CALCULATED IN TRANSFORMED UNITS AND CONVERTED BACK TO REPORTED UNITS

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SEQUENCE VE DUAL PLUG
ALL OPERATIONALLY VALID DATA
DATA REPORTED THROUGH MARCH 31, 2001

OIL CODE	VARNISH PART	N	MEAN	s	REPORTED RANGE
1002	AVERAGE PISTON	122	7.104	.222	6.620 TO 7.570
	ROCKER ARM COVER		3.594	.659	2.250 TO 5.540
	CAMSHAFT BAFFLE		7.197	.567	5.170 TO 8.550
	CYLINDER WALL (BRT)		2.916	.661	2.140 TO 8.290
	OIL PAN		7.175	.604	4.020 TO 8.520
1006	AVERAGE PISTON	54	6.949	.271	6.460 TO 7.590
	ROCKER ARM COVER		3.312	.727	1.720 TO 4.650
	CAMSHAFT BAFFLE		7.200	.387	5.890 TO 8.130
	CYLINDER WALL (BRT)		2.906	.311	2.300 TO 3.640
	OIL PAN		7.157	.482	5.380 TO 8.140
925-2	AVERAGE PISTON	9	6.546	.184	6.300 TO 6.900
	ROCKER ARM COVER		3.452	.642	2.280 TO 4.380
	CAMSHAFT BAFFLE		3.679	.810	2.330 TO 4.840
	CYLINDER WALL (BRT)		3.098	.147	2.880 TO 3.290
	OIL PAN		5.613	.295	5.310 TO 6.320
925-3	AVERAGE PISTON	144	6.565	.222	5.730 TO 7.100
	ROCKER ARM COVER		2.457	.577	1.410 TO 4.660
	CAMSHAFT BAFFLE		3.048	.873	1.380 TO 6.150
	CYLINDER WALL (BRT)		3.018	.385	2.240 TO 5.920
	OIL PAN		5.345	.411	4.400 TO 6.360
926-1	AVERAGE PISTON	8	6.963	.154	6.650 TO 7.160
	ROCKER ARM COVER		4.144	.638	3.400 TO 5.080
	CAMSHAFT BAFFLE		7.036	.642	6.120 TO 7.810
	CYLINDER WALL (BRT)		2.713	.270	2.280 TO 3.090
	OIL PAN		6.990	.574	6.280 TO 7.720
927	AVERAGE PISTON	22	6.780	.338	6.150 TO 7.600
	ROCKER ARM COVER		3.409	.792	2.080 TO 5.480
	CAMSHAFT BAFFLE		5.875	.811	3.870 TO 7.270
	CYLINDER WALL (BRT)		2.658	.396	1.940 TO 3.380
	OIL PAN		6.229	.461	5.460 TO 7.100
927-1	AVERAGE PISTON	7	6.991	.214	6.580 TO 7.200
	ROCKER ARM COVER		3.703	.673	2.670 TO 4.780
	CAMSHAFT BAFFLE		5.946	.467	5.350 TO 6.630
	CYLINDER WALL (BRT)		2.503	.415	1.810 TO 2.950
	OIL PAN		5.970	.655	4.830 TO 6.680
930	AVERAGE PISTON	151	6.993	.268	5.950 TO 7.820
	ROCKER ARM COVER		3.158	.707	1.780 TO 5.300
	CAMSHAFT BAFFLE		5.320	.689	3.370 TO 7.390
	CYLINDER WALL (BRT)		2.815	.407	1.920 TO 4.420
	OIL PAN		5.941	.572	4.650 TO 8.160

SEQUENCE VE DUAL PLUG
ALL OPERATIONALLY VALID DATA
DATA REPORTED THROUGH MARCH 31, 2001

OIL CODE	SLUDGE PART	N	MEAN (MERITS*)	s	REPORTED RANGE
1002	ROCKER ARM COVER	122	-.716 (7.954)	.424	4.51 TO 9.17
	CAMSHAFT BAFFLE		0.099 (9.094)	.405	6.19 TO 9.45
	FRONT SEAL HOUSING		0.589 (9.445)	.405	7.90 TO 9.75
	OIL PAN		-.099 (8.896)	.535	5.71 TO 9.50
	VALVE DECK		0.061 (9.059)	.620	3.60 TO 9.59
	UNDERSIDE OF BLOCK		0.242 (9.215)	.452	6.90 TO 9.65
1006	ROCKER ARM COVER	54	-.353 (8.577)	.584	2.59 TO 9.29
	CAMSHAFT BAFFLE		0.084 (9.081)	.640	4.23 TO 9.56
	FRONT SEAL HOUSING		0.554 (9.425)	.685	3.04 TO 9.75
	OIL PAN		-.000 (9.000)	.659	4.50 TO 9.51
	VALVE DECK		-.013 (8.987)	.763	1.30 TO 9.60
	UNDERSIDE OF BLOCK		0.270 (9.236)	.596	5.99 TO 9.67
925-2	ROCKER ARM COVER	9	-1.53 (5.375)	.176	4.40 TO 6.64
	CAMSHAFT BAFFLE		-.781 (7.817)	.637	4.97 TO 9.16
	FRONT SEAL HOUSING		-.313 (8.632)	.490	7.55 TO 9.25
	OIL PAN		-.091 (8.905)	.230	8.26 TO 9.16
	VALVE DECK		0.093 (9.089)	.652	6.77 TO 9.47
	UNDERSIDE OF BLOCK		0.406 (9.334)	.244	8.95 TO 9.53
925-3	ROCKER ARM COVER	144	-1.32 (6.263)	.300	0.68 TO 8.45
	CAMSHAFT BAFFLE		-.912 (7.510)	.598	2.06 TO 9.31
	FRONT SEAL HOUSING		-.454 (8.426)	.619	2.06 TO 9.72
	OIL PAN		-.346 (8.586)	.518	2.80 TO 9.48
	VALVE DECK		-.229 (8.743)	.604	0.39 TO 9.59
	UNDERSIDE OF BLOCK		0.220 (9.198)	.508	4.65 TO 9.65
926-1	ROCKER ARM COVER	8	0.008 (9.008)	.311	8.18 TO 9.30
	CAMSHAFT BAFFLE		0.486 (9.385)	.304	8.76 TO 9.51
	FRONT SEAL HOUSING		0.879 (9.585)	.346	9.30 TO 9.75
	OIL PAN		0.372 (9.311)	.302	8.66 TO 9.50
	VALVE DECK		0.663 (9.485)	.190	9.29 TO 9.60
	UNDERSIDE OF BLOCK		0.515 (9.402)	.114	9.25 TO 9.50
927	ROCKER ARM COVER	22	-1.66 (4.733)	.439	1.25 TO 8.60
	CAMSHAFT BAFFLE		-.875 (7.601)	.692	5.42 TO 9.53
	FRONT SEAL HOUSING		-.783 (7.812)	.892	1.28 TO 9.70
	OIL PAN		-.954 (7.404)	.619	4.58 TO 9.36
	VALVE DECK		-.883 (7.582)	.879	3.00 TO 9.35
	UNDERSIDE OF BLOCK		-.694 (7.999)	.647	4.90 TO 9.43
927-1	ROCKER ARM COVER	7	-1.89 (3.398)	.160	2.40 TO 5.13
	CAMSHAFT BAFFLE		-1.19 (6.714)	.143	6.07 TO 7.40
	FRONT SEAL HOUSING		-1.18 (6.740)	.623	2.64 TO 8.20
	OIL PAN		-1.20 (6.686)	.373	5.38 TO 8.33
	VALVE DECK		-1.40 (5.940)	.291	3.91 TO 7.54
	UNDERSIDE OF BLOCK		-.940 (7.440)	.220	6.77 TO 8.32

SEQUENCE VE DUAL PLUG
ALL OPERATIONALLY VALID DATA
DATA REPORTED THROUGH MARCH 31, 2000

OIL CODE	SLUDGE PART	N	MEAN	(MERITS*)	s	REPORTED RANGE
930	ROCKER ARM COVER	151	-.547	(8.273)	.465	2.83 TO 9.45
	CAMSHAFT BAFFLE		-.060	(8.938)	.557	4.10 TO 9.53
	FRONT SEAL HOUSING		0.343	(9.290)	.557	5.26 TO 9.70
	OIL PAN		-.164	(8.822)	.592	3.69 TO 9.50
	VALVE DECK		-.023	(8.977)	.643	2.83 TO 9.59
	UNDERSIDE OF BLOCK		0.207	(9.187)	.524	5.81 TO 9.63

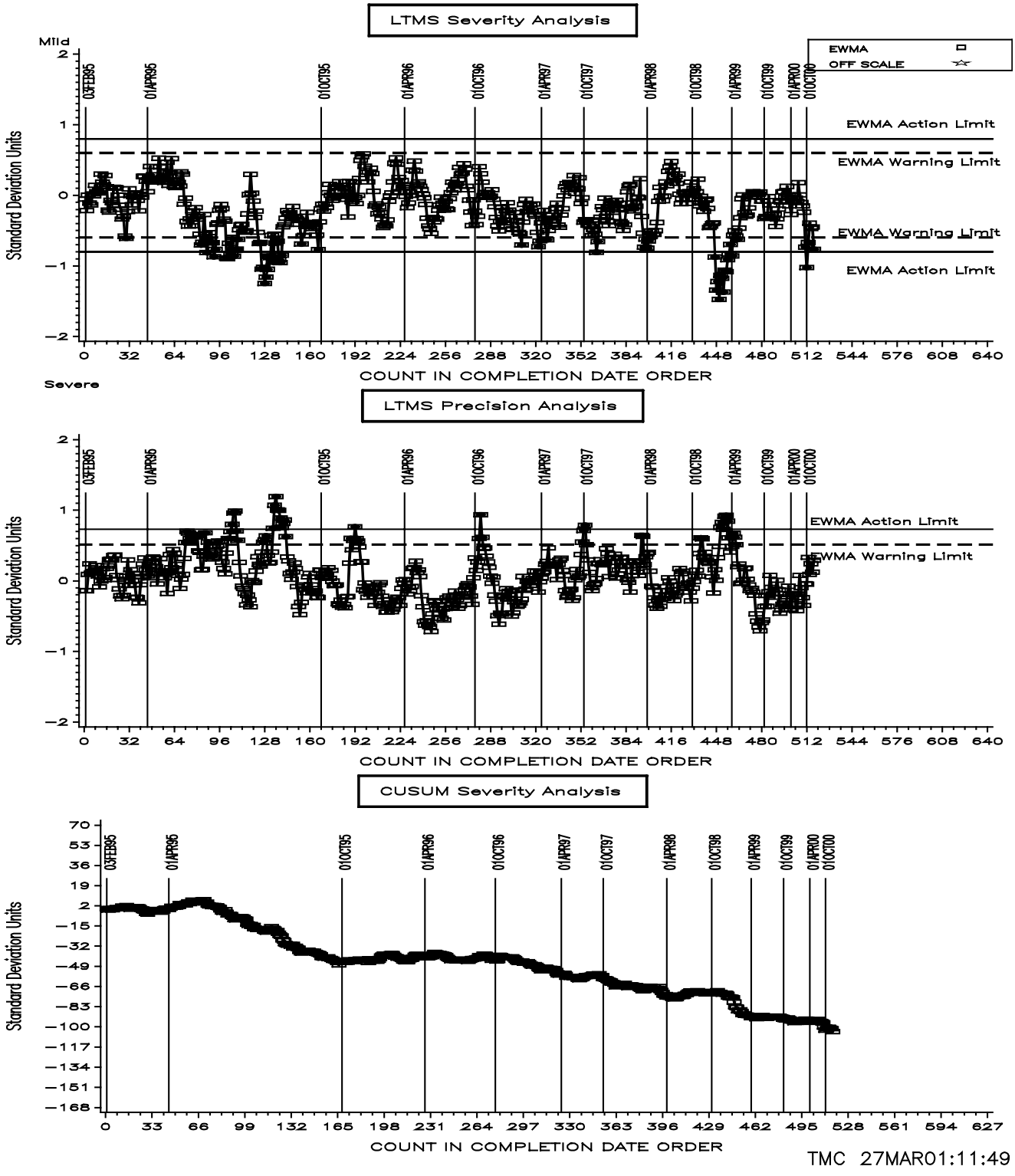
Table 5
Sequence VE Industry Timeline

19950201	95-3	Start of Dual Plug VE Testing
19950515		Targets For Oil 925-3 and 930 Updated
19950523	95-5	Sludge Rating Sites Revised on Cylinder Head
19950523	95-5	Oxygen limits in test method were incorrect
19950524	95-4	AEV Correction Factor Approved (Candidates only)
19950601		Targets For Oil 1002 and 930 Updated
19950901		Reground followers introduced.
19960901	95-5	Data dictionary version 19950530 implemented
19951003		Targets for 1002; 925-3 and 930 Updated
19951101	95-6	Increased Aliphatic naphtha concentration to 50%
19951101	95-6	Added requirements to change honing oil & filter 1/15 Hrs
19951101	95-6	Changed cylinder head calibration rig calibration requirements
19951101	95-6	Allowed Torque to Yield bolts to be used twice
19951101	95-6	Corrected errors in footnote 14 and renumbered footnotes
19960101	95-7	Instituted program to monitor test fuel stored at labs
19951003	95-7	Revised pooled s for severity adjustment calculations
19960515	96-2	Implemented industry correction factors for ACW and MCW
19960901	96-1	Standard orifice mount; clean orifice daily; standard correction calculation
19960901	96-1	Revised stage 1 to 2 RAC temperature Ramp
19960901	96-1	Calibration Frequency Changes and requirements
19960901	96-1	Specified Follower Installation Tool
19960901	96-1	Coolant Flush Cart Calibration
19960901	96-1	Pre-lube engine when downtime exceeds 8 hours
19960901	96-1	Require the use of OHTA-007-1 adapter
19960901	96-1	Required use of lifter fill chamber for VE lifters
19960901	96-1	Standardized separator height at 5.5±0.25 in
19960901	96-1	Standardized sample probe distance 2.75±0.25" from exh man flange
19960901	96-1	Required pressurized engine coolant system at 10 psig
19960901	96-1	Specified engine coolant out temperature measurement at 1"
19960901	96-1	Clarified what is a shutdown and reporting requirements
19960901	96-1	Deleted retention requirements for excess oil at oil leveling
19960901	96-1	Corrected errors; footnote 2; table 3; section 9.3.1 and Fig A3.25
19961001	96-2	Forms and Data Dictionary Change, Version 19960726
19961001	96-2	Added requirement to identify sampling technique used for sampling of lab fuel supply
19961119	97-1	Humidity Calibration Requirements Added
19961119	97-1	Clean Blowby Orifice weekly
19970101	97-1	Changed AFR probe location
19970310	97-2	Changed Cam Wear measurements (Avg, Max and individual lobes) to micrometres
19970310	97-2	Forms and data dictionary changes to accompany wear measurement units, Version 19970130
19970429	97-3	Corrected typo errors in 8.3.5, 9.3.2 and 13.2.2.1. Changed Nalcool to Pencool 2000
19970820	97-4	Added requirements to flow test fuel injectors, prior to each test
19970820	97-4	Changed calibration frequency for fuel flow measurement device from every 3rd test to every reference
19971124	97-5	Changed field length for DELACW and DELMCW, Moved notes 29 and 31 into text of procedure
19971118	97-6	Allowed removal of piston staining and deleted Annex A13.
19980611	98-1	Machining of 0.5 mm pistons, Calibration frequency Changes
19980709		Test Target Update, Reference oil 1006 (N=20)
19980611	99-1	Machining of 0.5 mm pistons, Calibration frequency Changes
19990224		Test Target Update, Reference oil 1006 (N=30)
19990615	99-2	Added Procedure for re-using cylinder heads, deleted requirement to identify cams with lobes <50C
19991216	99-3	Revised method to allow use of non-kit parts obtained from Ford Dealers, for other than parts listed in the Origin of Significant Parts Sheet (Form A7.12)
20000916	00-1	Revised definitions to match D02.B Glossary of Terms and Their Definitions
20010115	01-1	Revised calibration frequency for temperature sensors.

SEQUENCE VE INDUSTRY OPERATIONALLY VALID DATA

Rocker Cover Sludge — Merits

Figure 1



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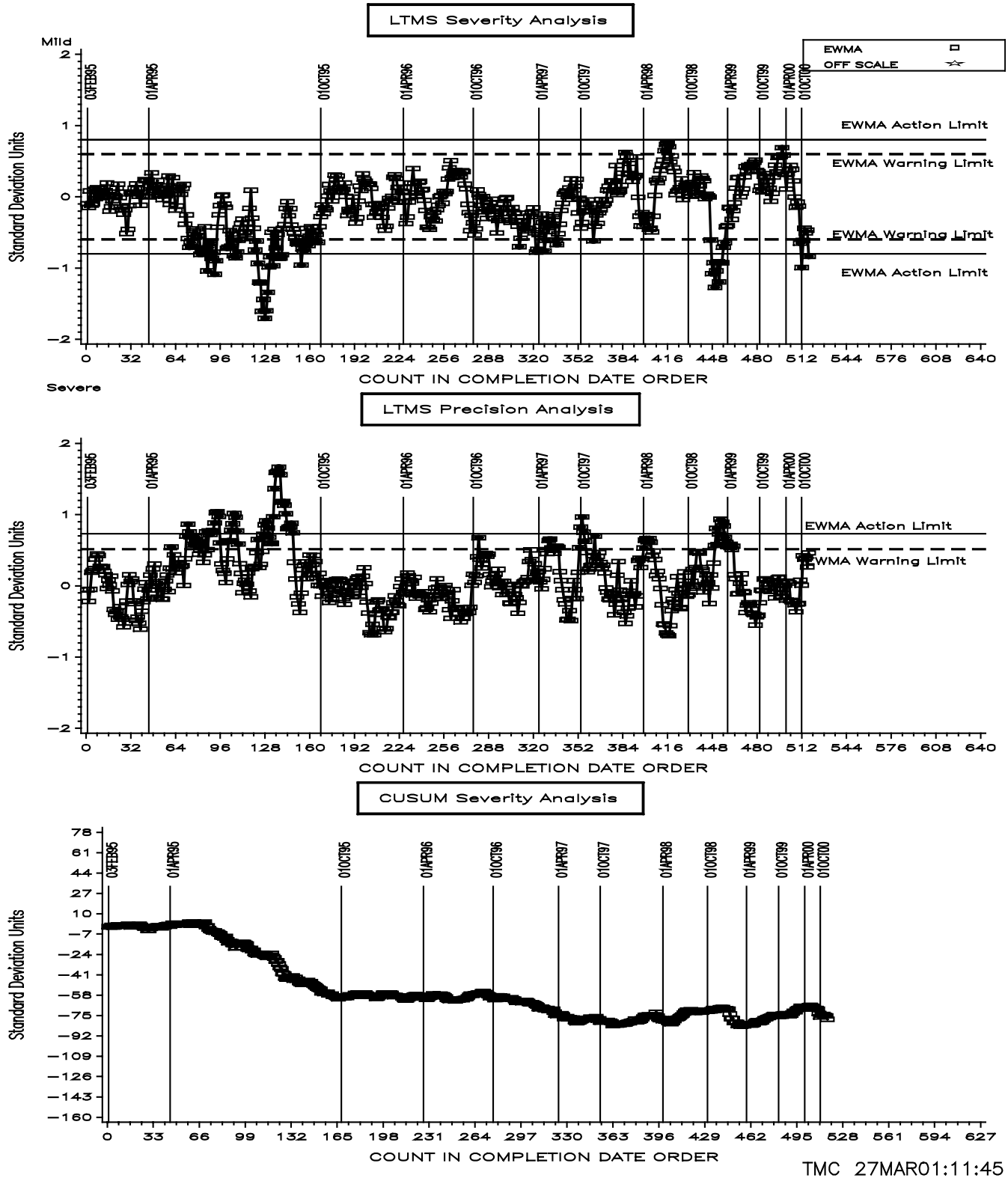
SEQUENCE VE INDUSTRY OPERATIONALLY VALID DATA

Average Engine Sludge — Merits

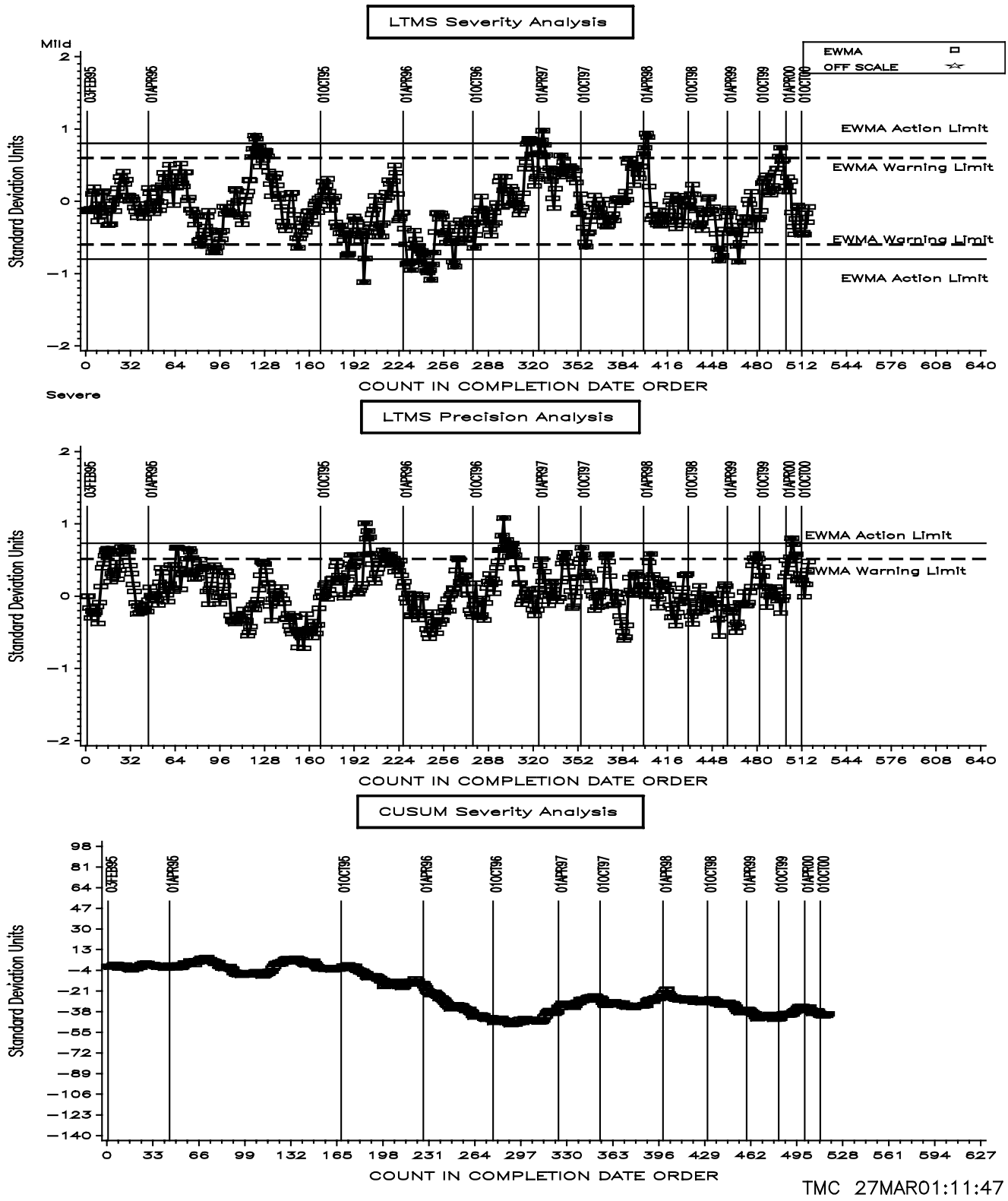
Figure 2



SEQUENCE VE INDUSTRY OPERATIONALLY VALID DATA

Average Piston Varnish — Merits

Figure 3



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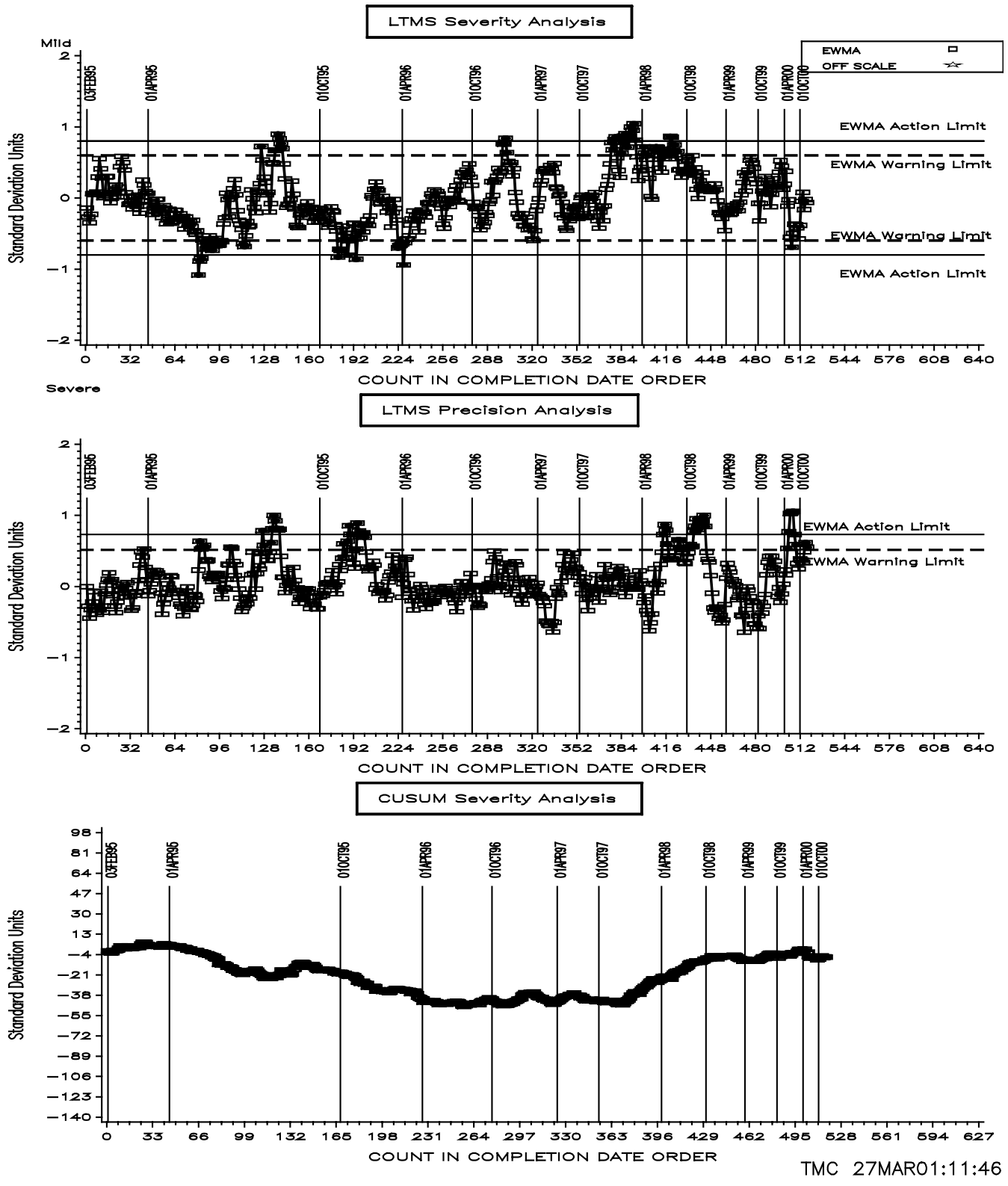
SEQUENCE VE INDUSTRY OPERATIONALLY VALID DATA

Average Engine Varnish — Merits

Figure 4



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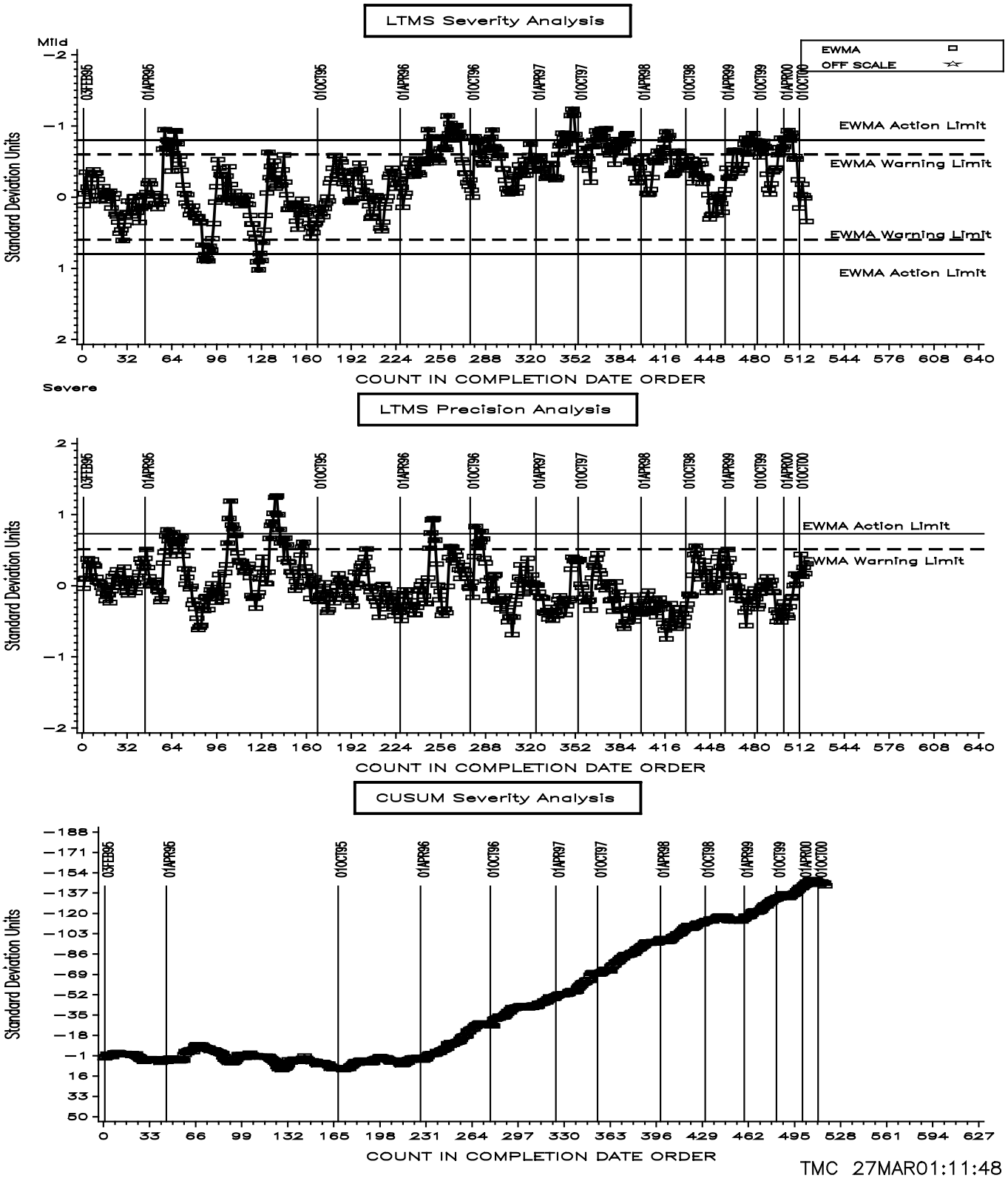
SEQUENCE VE INDUSTRY OPERATIONALLY VALID DATA

Maximum Camshaft Wear (Micrometers)

Figure 5



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SEQUENCE VE INDUSTRY OPERATIONALLY VALID DATA

Average Camshaft Wear (Micrometers)

Figure 6

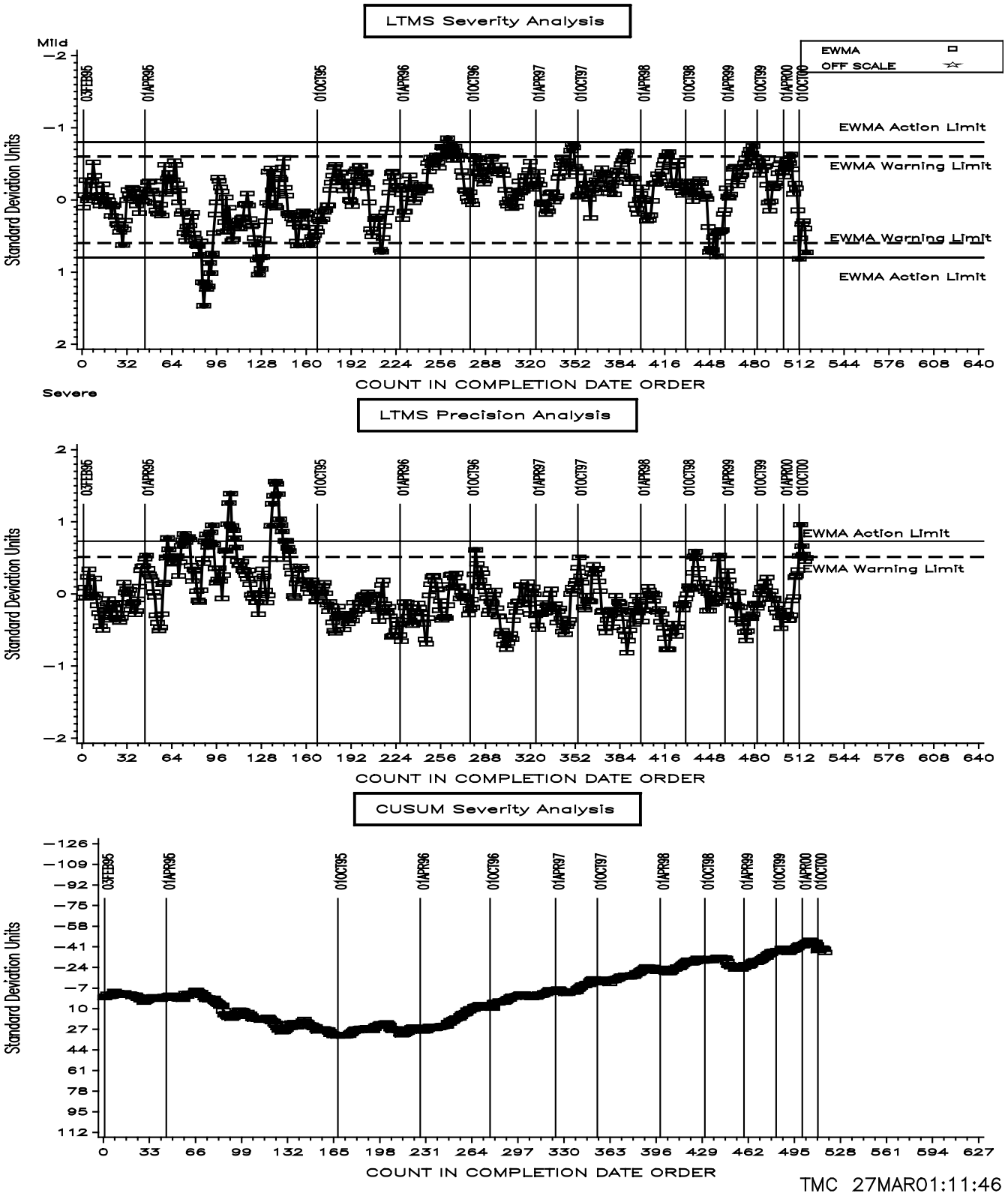

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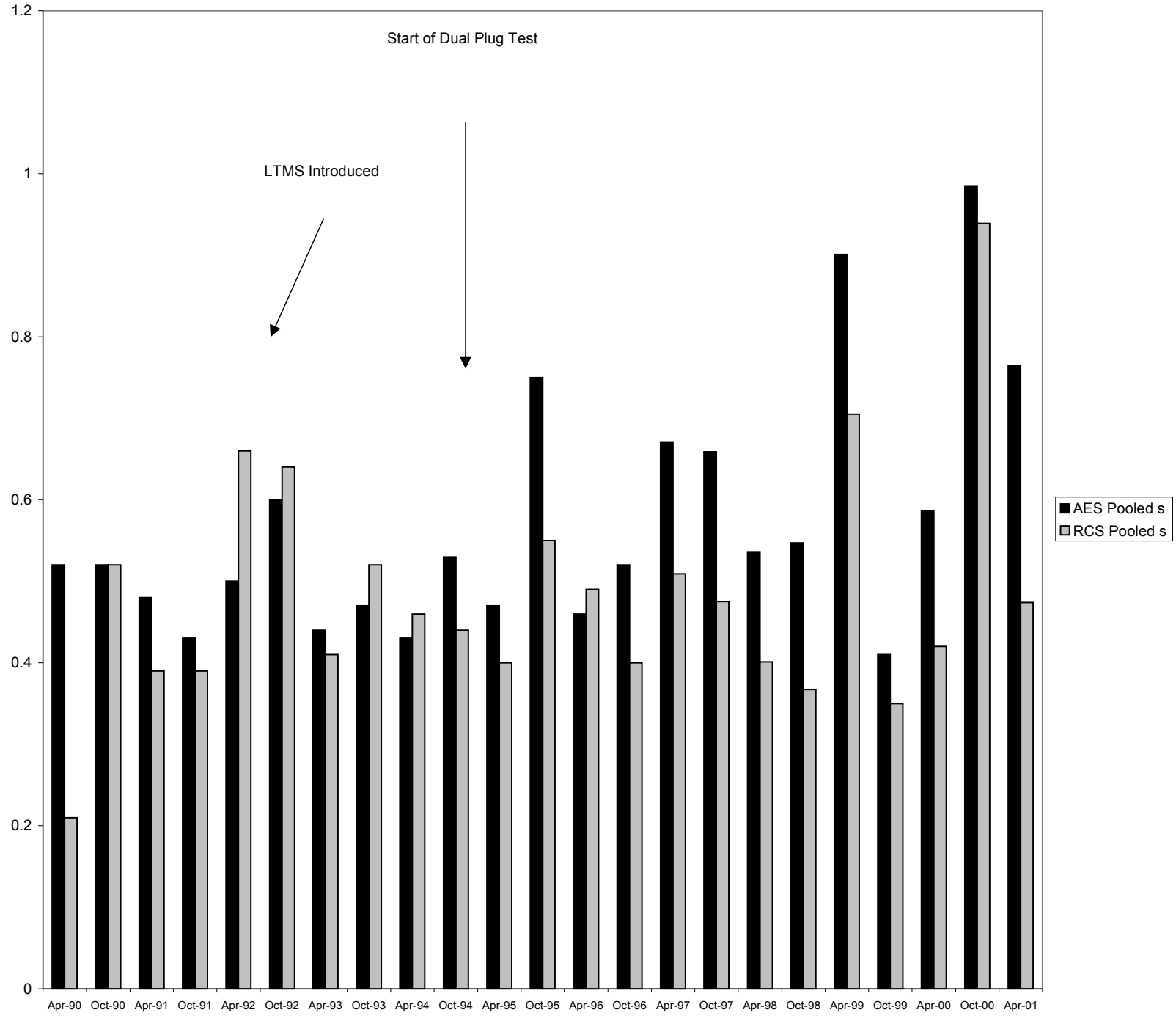
Figure 7

Summary of AES and RCS Pooled s Value By ASTM Report Period



Summary of AEV and APV Pooled s Values by ASTM Report Period

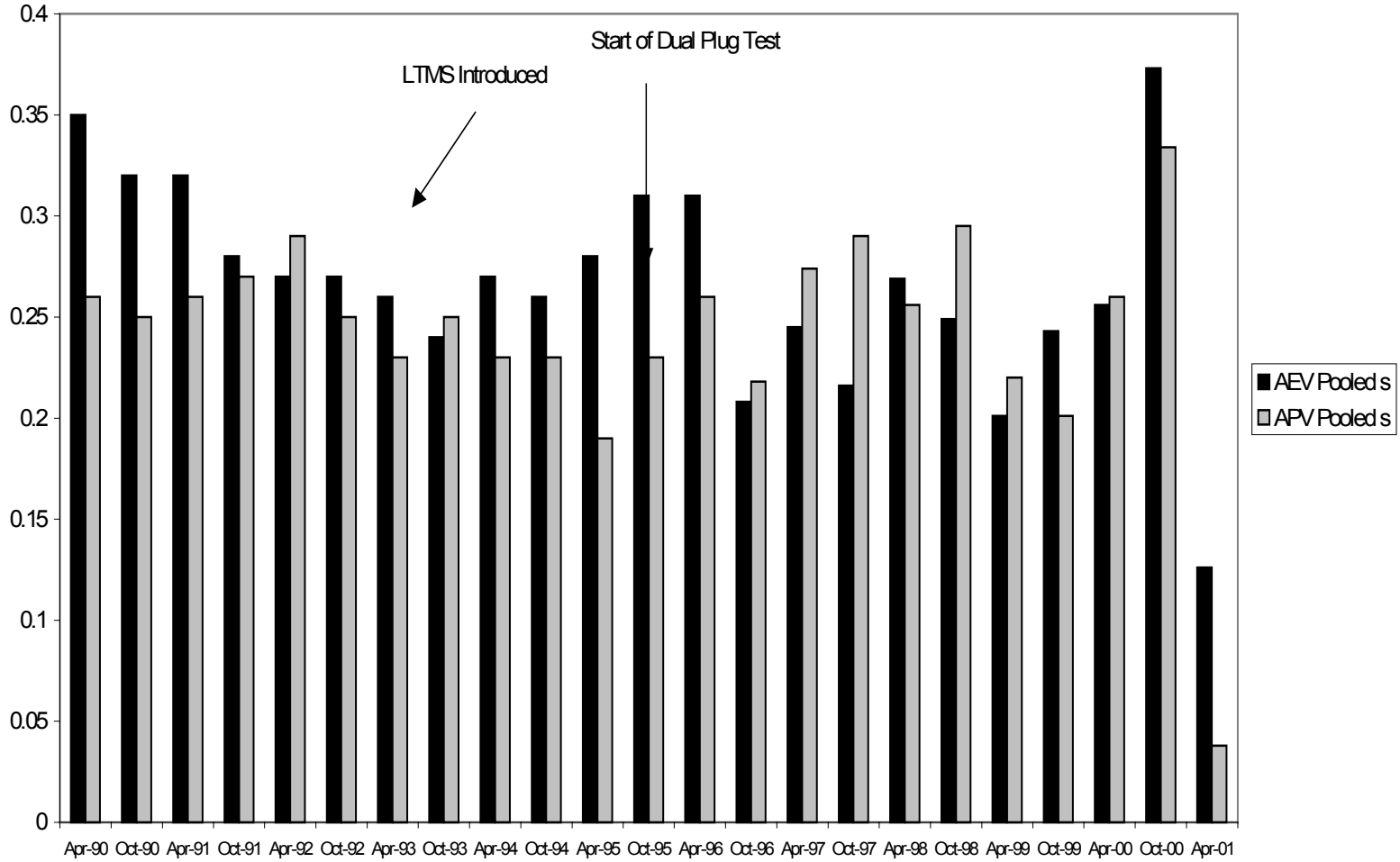


Figure 9

Summary of ACW and MCW Pooled s Values by ASTM Report Period