ASTM Technical Guidance Committee Meeting

September 17, 1992

Courtyard Marriott - Pittsburgh Airport

The ASTM Technical Guidance Committee meeting was called to order by Chairman Farnsworth at 9:00 A.M. in Board Room B of the Courtyard Marriott Hotel at the Pittsburgh Airport. A copy of the revised agenda is Attachment A. There were 12 voting members and 9 guests present. The attendance roster is Attachment B.

Membership

Chairman Farnsworth reported that there was one membership change; Mr. John Stimson, Jr. of Labeco replaced Mr. Rodney Rich of Labeco as a voting member.

1. Approval of the February 11, 1992 meeting Minutes

Mr. Johnson, holding Mr. Domonkos' proxy, made a motion that the minutes of the February 11, 1992 meeting be approved as reported. The motion was seconded by Mr. Romano and was approved unanimously.

2. Develop proposed criteria for judging whether the results from a single engine sequence test indicate with a certain degree of confidence that an oil does not satisfy the requirements of the applicable performance claims.

Chairman Farnsworth referred to several documents on the history of this agenda item which are contained in Attachment C. It originally began with a letter from Mr. McMillan of MVMA and Mr. Buhlinger of API requesting ASTM to develop a technique to determine that the results from a single engine sequence test, run on a licensed oil, satisfy the performance requirement for that test within a specified confidence level in the applicable minimum performance standard. The requested completion date of this task is January 1, 1993. This topic was discussed at previous TGC meetings, however, there was some confusion as to what the MVMA/API Task Force was requesting, so Chairman Farnsworth contacted Mr. Duffey for clarification. He confirmed that the request was "How can the results of one test be used to determine if an oil does not meet the applicable performance standard with a certain degree of confidence." There was a discussion on what method to use, if there should be multiple testing, and whether it was reasonable to run only one test of a type to determine if an oil does not conform to a specification. Mr. Bendele suggested that ASTM document D 3244 titled "Standards Practice for Utilization of Test Data to Determine Conformance with Specification," be used to resolve this issue.

Mr. Romano made a motion that the Technical Guidance Committee recommend to MVMA that the provisions of D 3244 be used to determine if the results of one engine test indicate that an oil be further tested to determine conformance with the applicable standard, (i.e. parameters for the test run). For clarification, it is recommended that the specification be considered non-critical, as defined in D 3244, in this case and that a probability of error of 5% (95% confidence level) be used. It is further recommended that the r value used be that calculated for the testing laboratory at the pass/fail limit. Mr.

Domonkos seconded the motion. The voting results of the motion were: 10 approved, 0 against, 0 waives. Mr. Domonkos volunteered to write a letter to Mr. Duffey reporting the results of the action taken.

3. CMA Liaison Report

Mr. Oliver reported on the CMA guidelines for judging whether a test method should be included in the CMA Code of Practice. He added that CMA was now looking at the code as an engine test code instead of an engine performance category code. His report (Attachment D) details the acceptance criteria for CMA tests. He stated that there should be a quality control plan for managing parts and fuels which should include a five-year supply. Mr. Oliver stated that at present if a test terminates early, CMA is calling that test operationally invalid.

Mr. Franklin brought up the issue of resolving differences between ASTM and CMA. He suggested a representative from CMA be added to all surveillance panels to alert them of problems. There was a discussion on the need for better communications between CMA and ASTM. Mr. Oliver will inform CMA of these concerns.

Mr. Oliver reported that the CMA Code of Practice had been revised and would be distributed in September.

4. Determine if multiple ratings of a single test should be allowed. If so, how should they be handled in a test report.

Chairman Farnsworth stated that there are instances where tests are being rated more than once and it has caused confusion as to which rating should be included in a test report. He also asked the question, "Should tests be rated more than once?" Mr. Groff displayed an excerpt from "Division 08 Tips Manuals" (Attachment E) which describes the rating practice at Southwest Research Institute. He stated that they have a rating coordinator that does spot checking, however, it was the project engineer's responsibility to ensure that the ratings are accurate. He added that there are requests for reviews of ratings when there is a borderline pass/fail test. He added that there were several instances where there would be re-rating, i.e. if there were parts problems, if a client requested a re-rating, or if the project engineer requested another rating. He stated that the final rating reported in the final test report would be the average of all the ratings. Mr. Johnson stated that ratings were conducted differently in the different test areas. Chairman Farnsworth stated that this was only a recommendation to the surveillance panels and they could adopt different guidelines.

Mr. Romano made a motion that for tests which are in the LTMS, consensus ratings are allowed within a lab and, where implemented, will be noted on the rating sheet with reason why. The reported rating will be the original rating or the consensus rating only. Any independent re-rating will be included in the supplemental section of the test report for informational purposes only. The motion was seconded by Mr. Bergin. Voting results of the motion were: approved 9, against 2, waives 0.

5. Establish a "quality process" flow plan, including success criteria, for new test development to assure that tests meet Industry expectations.

Chairman Farnsworth stated that several members of the TGC thought it would be adviseable to have a flow plan to use in the development of new tests for ASTM. Chairman Farnsworth's draft of a flow plan, Attachment F, was discussed. It included all significant test development steps from determining if a new test is needed through to final procedure approval. Mr. Johnson suggested a small working group get together and work out the details and standardize the format. Mr. Franklin stated that when new tests are proposed to Subcommittee B they are accompanied by a Research Report which defines the development process and the data that was used to justify the test. He suggested that this flow plan could be used as the outline for the research report. Chairman Farnsworth appointed Mr. Guinther as the Chairman of the Task Force Group and Messrs. Johnson, Larsen and himself to develop and submit a report to the TGC members before November. It was the concensus of the TGC that the report be letter balloted within the Technical Guidance Committee and taken to the Test Monitoring Board meeting in December for action, if the ballot is positive. Chairman Farnsworth asked members and guests to forward any comments they had on the subject to Mr. Guinther.

6. Develop a recommendation for handling test results with MTAC from tests that terminate early due to oil degradation.

If a laboratory stops a test without the client requesting it because of some problem, Chairman Farnsworth stated, the CMA ~~would consider~~ these tests operationally invalid. The problem is how to handle the data, and could this be a loophole for labs to not report data. Mr. Oliver stated that CMA is training independent auditors from seven companies who will audit the laboratories yearly to see if they comply with the code. It was felt that labs stop tests without client request so few times that it may not be a problem. Mr. Oliver was asked to inform CMA to check the data and let the TGC know if this is a problem.

7. Data Acquisition Task Force

Mr. Bendele brought to the attention of the members that at the September 1991 TGC meeting Data Acquisition was discussed and the surveillance panels were asked to make revisions to the original Data Acquisition Research Report. It was reported that a few of the surveillance panels had begun to revise the document. Chairman Farnsworth asked that the surveillance panels already working on the revision share their study as a framework for the other surveillance panels to use in developing a data acquisition system that would meet each surveillance panel's need.

8. "SG" reference oil "gimmie tests"

Mr. Bendele reported that there was a movement to introduce an SG oil into the system in approximately six test areas. Since gimmie tests are run to provide data for these test areas and they are costly to labs, Mr. Bendele suggested that there might be funds in the TMC budget to help defray the costs to the laboratories. Chairman Farnsworth suggested that the costs may be made up by increasing the cost of reference oils. Mr. Boschert stated that he had already begun studying the possibility of increasing reference oil fees and that the subject would be on the agenda at the Administrative Guidance

Committee meeting on October 6, 1992. The AGC will study the raising of fees and make a recommendation to the TMB meeting in December. Chairman Farnsworth stated that larger batches of reference oils should be blended. Mr. Franklin suggested modifying the normal reference periods and having all labs run the oil during the same time period. Data could be generated in a shorter period of time thereby reducing costs to Industry. It was the concensus of the group that Dr. Zalar talk with the labs, work out a system and put the oil into the system. Chairman Farnsworth asked that he report to the surveillance panel meetings in November. Mr. Shoffner stated that CMA would need to agree to this proposal. Mr. Oliver stated that he would be meeting shortly with CMA and would be able to give an answer by October 15, 1992.

9. Old Business

Out of Control Ballot

Mr. Guinther distributed a copy of the ballot on Out of Control Tests, Attachment H, which had received negative votes. He added that this document incorporated all the positive and negative comments which had been received on the previous ballot and that the changes which were made were underlined. Mr. Guinther will send this ballot to Mr. Dable for issuance.

10. New Business

The Meeting Schedule for ASTM Surveillance Panel Meetings in November.

Mr. Franklin distributed copies of the ASTM Surveillance Panel meeting schedule (Attachment F) which will be held in St. Louis, Missouri from November 16-19, 1992.

Adjournment

The next meeting will be at the call of the Chairman. The meeting was adjourned at 4:25 P.M.

Respectfully submitted,

Grace E. Berriker

Grace E. Berriker
Acting Secretary
ASTM Technical Guidance Committee

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Attachments

ATTACHMENT A

AGENDA

ASTM TECHNICAL GUIDANCE COMMITTEE

SEPTEMBER 17, 1992

1. Approval of Meeting Minutes: February 11, 1992

2. Develop proposed criteria for judging whether the results from a single engine sequence test indicate, with a certain degree of confidence, that an oil does not satisfy the requirements of the applicable performance claims.

4. ~~6.~~ Determine if multiple ratings of a single test should be allowed. If so, how should they be handled in a test report.

6. ~~4.~~ Develop a recommendation for handling test results within MTAC from tests that terminate early due to oil degradation,

   Ex. - IIIE high oxidation
   - VE loss of oil pressure due to sludge.

5. Establish a "quality process" flow plan, including success criteria, for new test development to assure that tests meet industry expectations.

3. ~~5.~~ Receive CMA liaison report

7. Data acquisition task force

8. "SG" reference oil "gimmie tests"

9. Old business
   - Calibration/ Metrology Task Force

10. New business
    - ASTM meeting schedule for November

ATTACHMENT B

TECHNICAL GUIDANCE COMMITTEE MEETING

September 17, 1992

Courtyard Marriott/Pittsburgh Airport
Pittsburgh, PA

ATTENDANCE ROSTER

Name	Company and Address	Phone No.	Present
Members:			
Stephen P. Bergin	General Motors Research Fuels and Lubricants Dept. 12 Mile and Mound Roads Warren, MI 48090-9057	(313) 986-1923	SPB
G. E. Callis	Chevron Res. and Tech. Company 100 Chevron Way Richmond, CA 94802-0627	(415) 620-4625	____
Carmen Cusano	Cummins Engine Company Box 3005, Mail Code 50160 1900 McKinley Avenue Columbus, IN 47202-3005	(812) 377-7127	CMC
B. D. Domonkos	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092	(216) 943-4200	B.D.D.
Gordon R. Farnsworth Chairman	Exxon Chemical Company P.O. Box 536 Linden, NJ 07036	(908) 474-3351	GRF
Walter P. Groff	Southwest Research Inst. 6200 Culebra Road San Antonio, TX 78284	(512) 684-5111	WPG
Greg H. Guinther	Ethyl Petroleum Additives ~~125 Lafayette Avenue~~ 1531 Kosciusko St. Louis, MO 63104 St Louis, MO 63104	(314) 259-~~5305~~ 5368	GHG
Allen C. Hahn	Caterpillar, Inc. TC-L Engr. G.O., Test & Eval. 100 N.E. Adams St. Peoria, IL 61629	(309) 578-3617	____
Daniel H. Heath	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092	(216) 943-4200	DHH

Name	Company and Address	Phone No.	Present
Members:			
Danny E. Larkin	Detroit Diesel Allison 13400 W. Outer Drive K-15 Detroit, MI 48239-4001	(313) 592-5730	_____
Lawrence T. Murphy	Mack Trucks, Inc. 1999 Pennsylvania Avenue Hagerstown, MD 21740	(301) 790-5815	_____
Jim E. Larson	Ethyl Petroleum Add. Div. 125 Lafayette St. St. Louis, MO 63104	(314) 259-5280	JEL
Ron Romano	Ford Motor Company EEE Bldg., D-145 (Box 44) 21500 Oakwood Blvd. Dearborn, MI 48121-2053	(313) 322-6522	RR
John Stimson, Jr.	Labeco 156 E. Harrison St. Mooresville, IN 46158	(317) 831-2990	JS
Mark Sutherland	Chevron Res. & Tech. Company 4502 Centerview Drive, Suite 210 San Antonio, TX 78228	(512) 734-4381	MS
John L. Zalar	ASTM Test Monitoring Center 4400 Fifth Avenue Pittsburgh, PA 15213	(412) 268-3316	JLZ
Guests:			
Grace E. Berriker	ASTM Test Monitoring Center 4400 Fifth Avenue Pittsburgh, PA 15213	(412) 268-3315	_____
Tom Franklin	Royal Lubricants Co., Inc. City View 10999 IH-10 West, Suite 305 San Antonio, TX 78230	(512) 561-9074	TF
BRENT SHEFFIELD (for) John W. Glaser	EG&G Automotive Research, Inc. 5404 Bandera Road San Antonio, TX 78238-1993	(512) 647-9459	BOAS
Rick L. Johnson	The Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092	(216) 943-4200	_____

Name	Company and Address	Phone No.	Present
Guests:			
Tony Lonardo	Paramin/Exxon Chemical 1900 Linden Avenue Linden, NJ 07036	(908) 474-2846	
Norbert Nann	Texaco, Inc. P. O. Box 509 Beacon, NY 12508	(914) 838-7625	
Rick Oliver	Texaco, Inc. 14855 Blanco Rd. Ste 414 San Antonio, TX 78216	(512) 493-2112	
Jim Rutherford	Chevron Research & Technology Co. 100 Chevron Way P.O. Box 2617 Richmond, CA 94802-0627	(415) 620-3410	
Charles Seymour	Castrol, Inc. 240 Centennial Ave. Piscataway, NJ 08854-3947		
Greg Shank	Mack Trucks, Inc. 1999 Pennsylvania Avenue Hagerstown, MD 21740	301-790-5815	
Philip R. Sinto	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092	(216) 943-4200	
Virginia Wiszniewski	Mobil Res. & Dev. Corp. Billingsport Road Paulsboro, NJ 08066	(609) 224-2907	

GUESTS

Name	Company and Address	Phone No.
Rick Johnson	Lubrizol 29400 Lakeland Blvd. Wickliffe, Oh 44092	216-943-1200 x2731 x2878 (fax)
Manuel Guzman	Cummins Engine Co. 1900 McKinley Ave Columbus IN	812-377-7765
Larry Bendele	SwRI 6220 Culebra San Antonio, TX 78284	
Tom Boschert		314-259-5201

Committee D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS

ATTACHMENT C.1.1

Chairman: EDMUND W. WHITE, U.S. Navy Annapolis, David Taylor Research Center, Code 2832, Annapolis, MD 21402 (301-267-2860) FAX: 301-267-2640
First Vice-Chairman: ALBERT W. DREWS, U O P Research Center, 50 E. Algonquin Rd., Box 5016, Des Plaines, IL 60017-5016 (708-391-3337) FAX: 708-391-3330
Second Vice-Chairman: NOLAN D. SMITH, North Carolina State Agric. Dept., 1 Edenton St., P.O. Box 27647, Raleigh, NC 27611 (919-733-3313) FAX: 919-733-0999
Secretary: JAMES K. WALTERS, American Petroleum Institute, 1220 L St., NW, Washington, DC 20005 (202-682-8000)
Staff Manager: EARL R. SULLIVAN (215-299-5514)

June 2, 1992

Mr. Gordon R. Farnsworth
Exxon Chemical Co.
P. O. Box 536
Linden, NJ 07036

Dear Gordon;

In a conversation with Mike McMillan and Dennis Groh, I confirmed that your statement

> how can the results of one test be used to determine if an oil does <u>not</u> meet the applicable performance standard with a certain degree of confidence

conveys the intent of the request. The suggested confidence was 90%, but the TGC could also consider any other reasonable level.

I am enclosing a copy of the original request from the MVMA/API Joint Task Force. In their request, they stated

> a technique that will determine if the results from a single engine sequence test run on a licensed oil satisfy the performance requirements **<u>for that test</u>** (within a specified confidence level) in the applicable minimum performance standard

indicating that they knew that conformance to the entire standard could not be determined by one test.

The attachment to the original request gave one possible procedure for this. (It is a excerpt from the NALSAS document; please, don't hold that against it.)

Thank you.

F. R. Duffey

cc: J. W. Dable
R. Romano

1916 Race Street, Philadelphia, PA 19103-1187 USA ■ Telephone: (215) 299-5400 ■ TWX: 710-670-1037 ■ FAX: 215-977-9679

ATTACHMENT C.1.2

Committee D-2 on PETROLEUM PRODUCTS AND LUBRICANTS

May 7, 1992

Mr. Francis R. Duffey
Chrysler Corporation
12000 Chrysler Drive
CIME 418-17-07
Highland Park, MI 48288-1118

Dear Mr. Duffey:

In September of 1991, I received a letter from you to Mr. Hendrickson which requested the Technical Guidance Committee to address a request from the MVMA/API Joint Task Force (See Attachment). The Technical Guidance Committee has discussed this topic at the last two meetings. In December of 1991, I reported to the Test Monitoring Board that we seek further clarification from MVMA/API. This request may have got lost in the TMB report, so I am repeating it herein. The request states that we are to develop criteria for judging whether the results from a single engine sequence test on a licensed product will, with a certain degree of confidence, indicate that the oil tested satisfies the requirements of the applicable performance standard. Is this really what they want?

For an oil to meet a performance standard (such as "SG") several engine test types are required. At best a single test result could only judge if the oil satisfies that specific test requirement. I suspect the real question they may be trying to answer is how can the results of one test be used to determine if an oil does <u>not</u> meet the applicable performance standard with a certain degree of confidence. From a statistical approach these two questions are very different. Could you help assist in getting the request clarified? The Technical Guidance Committee will be addressing this issue at the next meeting. No data has been set yet but I expect to meet before October 1992.

Very truly yours,

Gordon R. Farnsworth

GORDON R. FARNSWORTH
/jr

cc: J.W. Dable
C. Hendrickson
R. Romano

Chairman: EDMUND W. WHITE, U.S. Navy Annapolis, David Taylor Research Center, Code 2832, Annapolis, MD 21402
First Vice-Chairman: ALBERT W. DREWS, U O P Research Center, 50 E. Algonquin Rd., Box 5016, Des Plaines, IL 60017-5016 (708-391-3337)
Second Vice-Chairman: ELWIN N. DAVIS, 10842 Harris Lake Circle, Tavares, FL 32778 (904-343-2706)
Secretary: EARL A. HAP THOMPSON, American Petroleum Institute, Marketing Dept., 1220 L. St., NW, Washington, DC 20005 (202-682-8230)
Staff Manager: EARL R. SULLIVAN (215-299-5514)

Reply To:
Francis R. Duffey
Chrysler Corporation
12000 Chrysler Dr.
CIMS 418-17-07
Highland Park, MI 48288-1118

September 19, 1991

Carl Hendrickson
Chairman, Test Monitoring Board
Royal Lubricants Company
City View
10999 IH 10 West, Suite 305
San Antonio, TX 78230

Dear Mr. Hendrickson:

I have received the attached letter from the MVMA/API Joint Task Force. They ask ASTM to develop criteria for judging whether the results from a single engine sequence test on a licensed product will, with a certain degree of confidence, indicate that the oil tested satisfies the requirements of the applicable performance standard.

This request appears to fall within the area of responsibility of the Technical Guidance Committee. Please ask them to address this issue. The MVMA/API group has asked for completion by January 1, 1993.

Sincerely,

F. R. Duffey, Chairman
ASTM Subcommittee D02.B

cc: J. W. Dable
G. R. Farnsworth

ATTACHMENT C.1.4

MVMA/API
JOINT TASK FORCE

MOTOR VEHICLE MANUFACTURERS ASSOCIATION
7430 Second Avenue, Suite 300, Detroit, MI 48202 • 313/872-4311

AMERICAN PETROLEUM INSTITUTE
1220 L Street, Northwest, Washington, D.C. 20005 • 202/682-8230

August 30, 1991

Mr. Francis R. Duffey
D02.B Chairman
Materials Engineering Fuels & Lubes
Chrysler Corporation CIMS 418-17-07
12000 Chrysler Drive
Highland Park, Michigan 48288-1118

Dear Mr. Duffey:

An MVMA/API joint Task Force has been formed to develop a new licensing and approval system that requires monitoring of oils in the market. All motor oils licensed under this system must have a performance level that meets minimum standards using the Multiple Test Acceptance Criteria currently being developed within ASTM.

The Task Force is requesting the ASTM to develop a technique that will determine if the results from a single engine sequence test run on a licensed oil satisfy the performance requirements for that test (within a specified confidence level) in the applicable minimum performance standard. The development of this methodology should be completed by January 1, 1993, and should be applicable to engine sequence tests currently monitored by the ASTM Test Monitoring Center. Attached is a procedure originally included as part of the October 1990 MVMA NALSAS proposal, which could provide a useful starting point in these efforts.

Sincerely yours,

M. L. McMillan, Chairman
MVMA Lubricant Standards Committee

for W. P. Buhlinger, Chairman
API Lubricants Subcommittee

MLM\PB
Attachment

cc: Ed White
Jim Steiger
Hap Thompson

Determining Pass/Fail for CERTIFICATION MARK CONFORMANCE AUDIT

If an aftermarket oil produces test results greater than three standard deviations below the required performance level, the oil manufacturer will be notified that the license will be revoked. The oil manufacturer may elect to pay for additional testing.[7] The oil manufacturer does not need to prove the oil meets or exceeds the required performance standards, only that the oil is within the performance band at the 90% confidence level (one failed test). All additional testing must be scheduled within thirty days.

H_o: Oil Performance $\geq$ pass limit
H_1: Oil Performance $<$ pass limit

Mathematically,

$$\bar{X} < \mu - {}_{.10}t_c \frac{s}{\sqrt{(N)}}$$

where x = average performance of oil
s = sample estimate of population's standard deviation (σ)
N = number of tests
${}_{.10}t_c$ = 90% confidence coefficient from Student's t tables based on sample size and one-tailed test
μ = performance limit (pass/fail)

EXAMPLE:
The performance requirements for a test is defined as 6.5 on a 0 to 10 merit scale. The industry published standard deviation is 0.221. If a random aftermarket engine test produces a 5.8, this oil would be subjected to revocation of the license.

If additional testing is conducted, this parameter's performance must exceed the following:

Degrees of freedom (N-1), where N = number of tests	Minimum average test results @ 0.10 Level of significance $\bar{X}$
1	5.82
5	6.35
10	6.40

[7]All testing must be scheduled through the Confidential Screening Group.

REGISTERED MARK CONFORMANCE AUDIT

Random Engine Tests

ATTACHMENT C.2

The oil licensee does not need to prove the oil meets or exceeds the required performance standards, only that the engine oil performance, as measured by an engine test conducted by the CMA protocol, is not below the allowed performance band set at a 90% confidence level (one-tailed test). In other words, an oil is assumed to meet or exceed the required performance standard unless proved otherwise. If an aftermarket engine oil produces an engine test result that does not pass the conformance test described below, the licensee will be notified that the oil has been found to be out-of-conformance. The licensee must respond to API on the non-conformity within 30 days of notification. The licensee may elect to pay for additional engine testing, in which case, the oil performance will be determined using MTAC (Appendix F) for conformance evaluation. Initial engine testing related to this conformance evaluation must be scheduled within sixty (60) days of the original notification and conducted according to the CMA protocol. The specific product to be engine tested must be approved by the EOLCS Program Manager prior to the start of engine testing, if the additional results are to be included in the conformance evaluation.

The statistical testing criteria are as follows:

H_0: True Oil Performance ≥ Performance Limit
(i.e. oil meets or exceeds performance standard)

H_1: True Oil Performance < Performance Limit
(i.e. oil does not meet performance standard)

Decision Rule:

Oil fails the test (i.e. H_0 is rejected) if:

$$\bar{X} < PL - Z_{0.10}\frac{s}{\sqrt{n}}$$

Or equivalently, the oil passes the test (i.e. H_0 is not rejected) if:

$$\bar{X} \geq PL - Z_{0.10}\frac{s}{\sqrt{n}}$$

where $\bar{X}$ = average performance of oil
s = industry published standard deviation based on reference oil testing conducted on CMA participating test stands.
n = number of tests
$Z_{0.10}$ = 90% (one-tailed) confidence coefficient from a standard normal table = 1.282
PL = Performance Limit (as defined by the applicable performance standard)

95% - 1.64
99% - 2.32

REGISTERED MARK CONFORMANCE AUDIT
(An Example)

The performance limit for a test is defined as 6.5 on a 0 to 10 merit scale. The industry published standard deviation is 0.221. If a random aftermarket engine oil test produces a 6.1, this oil would be found to be out of conformance.

If additional testing is conducted, this parameter's performance must exceed the following:

Number of tests (n)	Minimum average needed to pass the test $\left(PL - Z_{0.10}\frac{s}{\sqrt{n}}\right)$
1	6.22
3	6.34
5	6.37
10	6.41

Confidence Level

The stringency of the conformance test can be adjusted by changing the confidence level: raising the confidence level makes the test more lenient; lowering it makes the test more stringent. The confidence level used in this procedure would therefore be evaluated each year to determine its suitability. Results of the random engine sequence test audit will be on a rate and report basis (using a 90 percent confidence level) only the first year, and these results will be considered in establishing the confidence level in the second year. The Advisory Panel will be asked to provide input in this decision on confidence levels.

$$\bar{X} < \text{Pass limit} - Z \frac{S}{\sqrt{N}}$$

$Z = 1.282$

90% CL

		(S)	1 TEST	2 TESTS
IIIE	HRS. TO 375%	(5.03)	57.6	59.4
	AES	(0.167)	9.01	9.07
	PSV	(0.16)	8.69	8.75
	ORLD	(0.54)	2.22	3.01
	ACLW	(0.32)	45.2	40.1
	MCLW	(0.406)	106.0	91.0
VE	AES	(0.484)	7.79	7.99
	RACS	(0.576)	6.26	6.48
	PSV	(0.243)	6.19	6.28
	AEV	(0.468)	4.40	4.58
	ACW	(0.484)	8.16	7.15
	MCW	(0.817)	42.8	31.5
IID	AER	(0.12)	8.35	8.39
L-38	BWL	(11.2)	54.4	50.2
	PSV	(0.2)	8.74	8.82
VI	EFEI	(0.3)	2.32	2.43

$$\bar{X} < \text{Pass limit} - Z \frac{S}{\sqrt{N}}$$

$Z = 2.326$

99% CL

		(S)	1 TEST	2 TESTS
IIIE	HRS. TO 375%	(5.03)	52.30	55.73
	AES	(0.167)	8.82	8.95
	PSV	(0.16)	8.53	8.64
	ORLD	(0.54)	2.24	2.61
	ACLW	(0.32)	63.15	50.78
	MCLW	(0.406)	161.98	122.85
VE	AES	(0.484)	7.65	8.21
	RACS	(0.576)	-0.47	2.81
	PSV	(0.243)	5.93	6.10
	AEV	(0.468)	3.91	4.23
	ACW	(0.484)	11.30	6.79
	MCW	(0.817)	100.32	57.51
IID	AER	(0.12)	8.22	8.30
L-38	BWL	(11.2)	66.05	58.42
	PSV	(0.2)	8.53	8.67
VI	EFEI	(0.3)	2.00	2.22

CRITERIA FOR JUDGING WHETHER THE RESULTS FROM A SINGLE TEST INDICATE, WITH A CERTAIN DEGREE OF CONFIDENCE, THAT AN OIL DOES NOT SATISFY THE SPECIFICATION

A REVIEW OF ASTM D-3244

Presented to the Technical Guidance Committee
September 17, 1992
SwRI

ASTM D 3244-77/83

STANDARD PRACTICE FOR UTILIZATION OF TEST DATA TO DETERMINE CONFORMANCE WITH SPECIFICATIONS (A COMMITTEE D-2 STANDARD)

* DEFINITIONS

* COMPREHENSIVE

* DEALS WITH TEST REPEATABILITY, REPRODUCIBILITY, AND REJECTION OF RESULTS.

* ASTM COMMITTEE D-2 DOCUMENT

It deserves our scrutiny since it was written for our exact need.

MUST DECIDE WHICH JUDICIAL SYSTEM YOU WISH TO ADOPT:

- then one can calculate the "acceptance limit" based upon the specification.

a) **Guilty until proven innocent -**

The oil is substandard unless proven to meet or exceed the specification.

Our qualification system??

Defined as a "critical" specification per ASTM D 3244.

"If the result (average) meets or exceeds the acceptance limit, then you are (95%) sure that a poor oil has <u>not</u> made it through the qualification system".

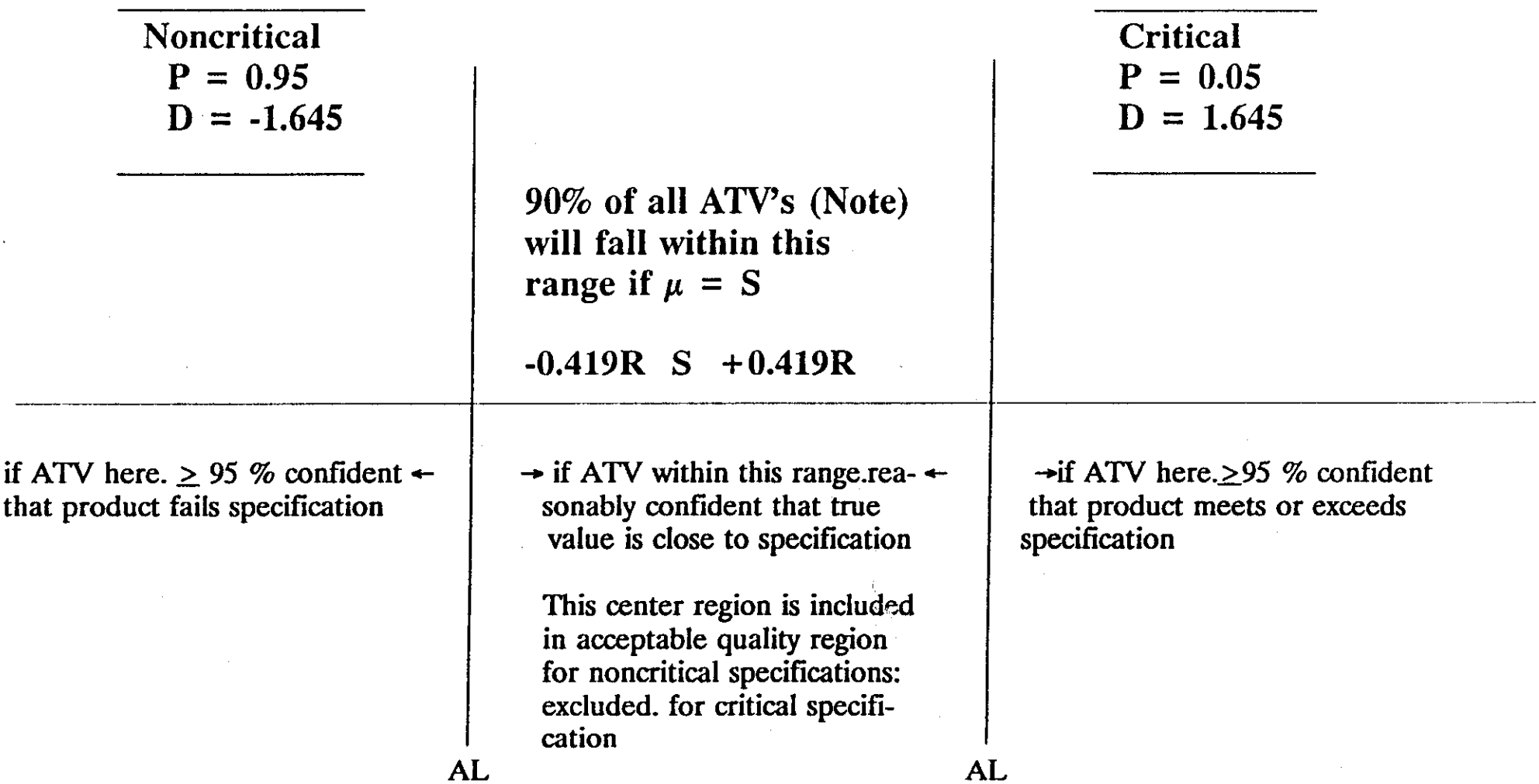
b) **Innocent until proven guilty -**

The oil is acceptable unless data supports a conclusion that it is substandard.

Our random survey system??

Defined as a "non-critical" specification per ASTM D 3244.

"If the result (average) is less than the acceptance limit, then you are (95%) sure that the oil is substantially poorer than the specification".



NOTE - This applies when ATV is established by the average of two results.one each from two different laboratories.

FIG. 2. Relationships Between AL's for Critical and Noncritical Specifications.

* ASTM D-3244-77

STANDARD PRACTICE FOR UTILIZATION OF TEST DATA TO DETERMINE CONFORMANCE WITH SPECIFICATIONS

* FACTS:

THE PROPERTIES OF COMMERCIAL PETROLEUM PRODUCTS ARE MEASURED BY STANDARDIZED LABORATORY TEST METHODS TO CHECK THEIR CONFORMANCE TO SPECIFICATION.

TWO OR MORE MEASUREMENTS OF THE SAME PROPERTY OF A SPECIFIC SAMPLE BY ANY GIVEN TEST METHOD USUALLY WILL NOT GIVE PRECISELY THE SAME ANSWER.

MOST TEST METHODS INCLUDE A PARAGRAPH OR HAVE CONTINUALLY UPDATED STATEMENTS ON THE PRECISION OF RESULTS.

PRECISION IS A STATEMENT OF THE RELIABILITY OF THE VALUE OF THE MEASURED PROPERTY.

MOST DIFFICULTIES THAT ARISE IN INTERPRETING PERFORMANCE SPECIFICATIONS ARE DUE TO TEST IMPRECISION.

THE TRUE VALUE OF A PROPERTY CAN "NEVER" BE DETERMINED EXACTLY.

THUS IT IS NECESSARY TO INFER FROM MEASURED VALUES THE RANGE WITHIN WHICH THE "TRUE VALUE" IS LIKELY TO LIE.

THE MAIN PURPOSE OF D-3244-77 IS TO INDICATE HOW TEST IMPRECISION SHOULD BE INTERPRETED RELATIVE TO SPECIFICATION VALUES.

DEFINITIONS THAT ARE NECESSARY TO AGREE UPON

SPECIFICATION

THAT VALUE THAT APPROACHES THE "TRUE VALUE" OF A GIVEN PROPERTY.

ACCEPTANCE LIMIT

A NUMERICAL VALUE THAT DEFINES THE POINT BETWEEN ACCEPTABLE AND UNACCEPTABLE QUALITY.

(NOT NECESSARILY THE SPECIFICATION)

ASSIGNED TEST VALUE

THE AVERAGE OF ALL RESULTS OBTAINED AS LONG AS THEY ARE OBTAINED FROM SOURCES WITHIN THE REPEATABILITY AND/OR REPRODUCIBILITY OF THE TEST METHOD.

PRECISION

THE DEGREE OF AGREEMENT BETWEEN TWO OR MORE RESULTS ON THE SAME PROPERTY OF IDENTICAL TEST MATERIAL.

REPEATABILITY

QUANTITATIVE EXPRESSION OF THE RANDOM ERROR ASSOCIATED WITH A SINGLE OPERATOR IN A GIVEN LABORATORY OBTAINING REPLICATE RESULTS WITH THE SAME APPARATUS UNDER CONSTANT OPERATING CONDITIONS ON IDENTICAL TEST MATERIAL WITHIN A SHORT PERIOD OF TIME.

IT IS DEFINED AS THAT DIFFERENCE BETWEEN TWO SUCH SINGLE RESULTS AS WOULD BE EXCEEDED IN THE LONG RUN IN ONLY 1 CASE IN 20 IN THE NORMAL AND CORRECT OPERATION OF THE TEST METHOD. (95% CONFIDENCE LEVEL)

REPRODUCIBILITY

QUANTITATIVE EXPRESSION OF THE RANDOM ERROR ASSOCIATED WITH OPERATORS WORKING IN DIFFERENT LABORATORIES, EACH OBTAINING SINGLE RESULTS ON IDENTICAL TEST MATERIAL WHEN APPLYING THE SAME METHOD.

IT IS DEFINED AS THAT DIFFERENCE BETWEEN TWO SUCH SINGLE AND INDEPENDENT RESULTS AS WOULD BE EXCEEDED IN THE LONG RUN IN ONLY 1 CASE IN 20 IN THE NORMAL AND CORRECT OPERATION OF THE TEST METHOD. (95% CONFIDENCE LEVEL).

RESULT

THE VALUE OBTAINED BY FOLLOWING THE COMPLETE SET OF INSTRUCTIONS OF A TEST METHOD.

TRUE VALUE

THE VALUE TOWARDS WHICH THE AVERAGE OF SINGLE RESULTS OBTAINED BY "N" LABORATORIES TENDS, WHEN "N" BECOMES VERY LARGE.

CONSEQUENTLY, SUCH A TRUE VALUE IS ASSOCIATED WITH THE PARTICULAR TEST METHOD EMPLOYED.

SIGNIFICANCE OF REPEATABILITY (r)

ACCEPTANCE OF RESULTS

WHEN ONLY TWO RESULTS ARE OBTAINED UNDER CONDITIONS OF REPEATABILITY AND THE DIFFERENCE IS EQUAL TO OR LESS THAN THE REPEATABILITY OF THE METHOD, THE OPERATOR MAY REPORT THE AVERAGE OF THE TWO RESULTS AS BEING APPLICABLE TO THE SAMPLE TESTED.

REJECTION OF RESULTS

WHEN TWO RESULTS ARE OBTAINED THAT DIFFER BY MORE THAN THE REPEATABILITY OF THE METHOD, BOTH SHOULD BE REJECTED. OBTAIN TWO ADDITIONAL RESULTS IMMEDIATELY UNDER CONDITIONS OF REPEATABILITY.

IF THE DIFFERENCE BETWEEN THESE TWO RESULTS IS EQUAL TO OR LESS THAN THE REPEATABILITY OF THE METHOD, THE OPERATOR SHOULD REPORT THE AVERAGE OF THE TWO AS BEING APPLICABLE TO THE SAMPLE TESTED.

IF HOWEVER, THE DIFFERENCE SO OBTAINED AGAIN EXCEEDS THE REPEATABILITY, REJECT THE RESULTS AND INVESTIGATE THE APPLICATION OF THE METHOD.

SIGNIFICANCE OF REPRODUCIBILITY (R)

ACCEPTANCE OF RESULTS

WHEN TWO RESULTS ARE OBTAINED IN DIFFERENT LABORATORIES, AND THE DIFFERENCE IS EQUAL TO OR LESS THAN THE REPRODUCIBILITY OF THE METHOD, BOTH RESULTS SHOULD BE CONSIDERED ACCEPTABLE. THE VALUE ASSIGNED TO THE SAMPLE SHOULD BE THE AVERAGE OF THE TWO RESULTS.

REJECTION OF RESULTS

WHEN THE RESULTS FROM TWO LABORATORIES DIFFER BY MORE THAN THE REPRODUCIBILITY OF THE METHOD, REJECT BOTH RESULTS AND EACH LABORATORY SHOULD REPEAT THE TEST ON THE RETAINED SAMPLE.

IF THE DIFFERENCE IS NOW EQUAL TO OR LESS THAN THE REPRODUCIBILITY OF THE METHOD, BOTH TESTS SHOULD BE CONSIDERED ACCEPTABLE AND THE AVERAGE REPORTED.

IF HOWEVER, THE DIFFERENCE SO OBTAINED AGAIN EXCEEDS THE REPEATABILITY, REJECT THE RESULTS AND INVESTIGATE THE APPLICATION OF THE METHOD AT EACH LABORATORY.

MULTIPLE TESTING

IF THE NUMBER OF RESULTS OBTAINED IN EITHER ONE OR BOTH LABORATORIES IS MORE THAN ONE, THEN THE ALLOWABLE DIFFERENCE BETWEEN THE AVERAGES FROM THE TWO LABORATORIES IS GIVEN AS FOLLOWS:

R = REPRODUCIBILITY OF THE METHOD
r = REPEATABILITY OF THE METHOD
N = NUMBER OF RESULTS (LAB 1)
N = NUMBER OF RESULTS (LAB 2)

RESPONSIBILITIES:

FORMAT

* TECHNICAL GUIDANCE COMMITTEE

PRECISION (REPEATABILITY AND REPRODUCIBILITY

* TEST MONITORING CENTER AND SURVEILLANCE PANELS

  THE TMC WILL CONTINUE TO RECEIVE INDUSTRY DATA AND CALCULATE INDUSTRY PRECISION DATA. THIS DATA WILL BE USED IN LABORATORY CALCULATIONS

SPECIFICATIONS (TRUE VALUE)

* THE OIL CLASSIFICATION PANEL HAS THE RESPONSIBILITY TO SET THE SPECIFICATION (TRUE VALUE) LIMITS.

CRITICAL OR NON-CRITICAL PARAMETER

* OIL CLASSIFICATION PANEL/TEST SPONSOR/ASTM TO DETERMINE CUSTOMIZED FOR EACH TEST PROCEDURE.

* NON-CRITICAL - ASSUME 95% CONFIDENCE LEVEL

  IF THE RESULT IS LESS THAN THE ACCEPTANCE LIMIT THEN YOU ARE 95% SURE THAT THE OIL IS SUBSTANTIALLY POORER THAN THE SPECIFICATION.

* CRITICAL - ASSUME 95% CONFIDENCE LEVEL.

  IF THE RESULT MEETS OR EXCEEDS THE ACCEPTANCE LIMIT THEN YOU HAVE A 95% CONFIDENCE THAT THE OIL MEETS OR EXCEEDS THE SPECIFICATION.

ASSIGNED TEST VALUE

* RESPONSIBILITY OF THE TEST SPONSOR AND SURVEILLANCE PANELS. HOW DO WE CONDUCT TESTING.

STATISTICAL TREATMENT AND MANIPULATION OF DATA

* STATISTICAL WORKING GROUP OF THE TECHNICAL GUIDANCE COMMITTEE USING D-3244-77

* UTILIZE THE D2 STATISTICAL GROUP

PRODUCT QUALITY CONFORMANCE

* TEST MARKETER, API, CMA, ?

Designation: D 3244 – 77 (Reapproved 1983)

An American National Standard

ATTACHMENT C.4

Standard Practice for Utilization of Test Data to Determine Conformance with Specifications[1]

This standard is issued under the fixed designation D 3244; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

The properties of commercial petroleum products are measured by standardized laboratory test methods to check their conformance to specifications. Two or more measurements of the same property of a specific sample by any given test method usually will not give precisely the same answer. Therefore, the test methods generally include a paragraph on the precision of results. This precision is an expression of the reliability of the value of the measured property.

Many difficulties that arise in interpreting specifications are due to test imprecision. Because of this, a true value of a property can never be determined exactly; and it is necessary to infer from measured values the range within which the "true value" is likely to lie. The main purpose of this practice is to indicate how test imprecision should be interpreted relative to specification values.

1. Scope

1.1 This practice presents guidelines with which two parties, usually a supplier and a receiver, can compare and combine independently obtained test results whenever there is a product quality dispute.

1.2 This practice defines a technique for comparing an assigned test value with a specification limit.

1.3 This practice applies only to those test methods which specifically state that the repeatability and reproducibility values conform to the definitions herein.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products[2]

D 4177 Method for Automatic Sampling of Petroleum and Petroleum Products[2]

2.2 *Other ASTM Documents:*

STP 15C, Manual on Quality Control of Materials[3]

RR: D-2-1007, Manual on Determining Precision Data for ASTM Methods on Petroleum Products and Lubricants[3]

3. Definitions

3.1 *acceptance limit (AL)*—a numerical value that defines the point between acceptable and unacceptable quality.

NOTE 1—The AL is not necessarily the specification limit. It is a value that takes into account the specification value, the test method precision, and the confidence level desired for defining minimum acceptable quality relative to the specification value.

3.2 *assigned test value (ATV)*—the average of all results obtained in the several laboratories which are considered acceptable based on the reproducibility of the test method.

3.3 *determination*—the process of carrying out the series of operations specified in the test method whereby a single value is obtained.

3.4 *dispute*—when there is a question as to product quality because a test value obtained falls outside the acceptance limit.

3.5 *operator*—a person who normally and regularly carries out a particular test.

3.6 *precision*—the degree of agreement between two or more results on the same property of identical test material. In this practice, precision statements are framed in terms of the repeatability and reproducibility of the test method.

3.7 *receiver*—any individual or organization who receives or accepts the product delivered by the supplier.

3.8 *repeatability (r)*—quantitative expression of the random error associated with a single operator in a given laboratory obtaining replicate results with the same apparatus under constant operating conditions on identical test material within a short period of time. It is defined (Note 2) as that difference between two such single results as would be exceeded in the long run in only 1 case in 20 in the normal and correct operation of the test method (Note 3). (This is known as the 95 % confidence level.)

NOTE 2—Not all standards organizations define repeatability and reproducibility in precisely these same terms, and attention should always be paid to definitions before comparing precision values quoted.

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[1] This practice is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.91 on Committee D-2 Standards.

Current edition approved Sept. 9, 1977. Published October 1977. Originally published as an appendix to the *1968 Annual Book of ASTM Standards*, Part 18. Last previous edition D 3244 – 74 T.

[2] *Annual Book of ASTM Standards*, Vol 05.03.

[3] Available from ASTM Headquarters, 1916 Race St., Philadelphia, PA 19103.

NOTE 3—This difference is related to the repeatability or the reproducibility standard deviation but is not the standard deviation.

3.9 *reproducibility (R)*—quantitative expression of the random error associated with operators working in different laboratories, each obtaining single results on identical test material when applying the same method. It is defined (Note 3) as that difference between two such single and independent results as would be exceeded in the long run in only 1 case in 20 in the normal and correct operation of the test method (Note 3).

3.10 *result*—the value obtained by following the complete set of instructions of a test method. It may be obtained from a single determination or several determinations, depending on the instruction of the test method.

3.11 *supplier*—any individual or organization responsible for the quality of a product just before it is taken over by the receiver.

3.12 *test sample*—a portion of the product taken at the place where the product is exchanged, that is, where the responsibility for the product quality passes from the supplier to the receiver. Actually, this is rarely possible and a suitable sampling location should be mutually agreed upon.

NOTE 4—Sampling should be carried out in accordance with standard sampling procedures for petroleum products (Practice D 4057 and Method D 4177). Obtain enough sample to allow all required determinations to be made. Divide the sample into three secondary samples: a receiver sample, a supplier sample, and a retain sample. The retain sample should itself be large enough to permit further subdivision into three portions in case additional test work is desirable.

3.13 *true value (μ)*—for practical purposes, the value towards which the average of single results obtained by N laboratories tends, when N becomes very large (Note 5). Consequently, such a true value is associated with the particular test method employed.

NOTE 5—It is recognized that there are cases where a true value not equal to the method average can exist. As used in this practice, the method average value is intended to mean "true value" even if the method is biased.

4. Applying Precision Data to Test Methods

4.1 This section describes procedures in which the precision limits of test methods may be used to indicate when results obtained by two laboratories differ significantly. This section may also be used for rejection of results of replicate tests by an operator.

4.2 *Significance of Repeatability (r):*

4.2.1 *Acceptance of Results*—When only two results are obtained under conditions of repeatability and the difference is equal to or less than the repeatability of the method, the operator may report the average of the two results as being applicable to the sample tested.

4.2.2 *Rejection of Results*—When two results are obtained that differ by more than the repeatability of the method, both should be rejected. Obtain two additional results immediately under conditions of repeatability. If the difference between these two results is equal to or less than the repeatability of the method, the operator should report the average of the two as being applicable to the sample tested. If, however, the difference so obtained again exceeds the repeatability, reject the results and investigate the application of the method.

4.3 *Significance of Reproducibility (R):*

4.3.1 *Acceptance of Results*—When two results are obtained in different laboratories (Note 6) and the difference is equal to or less than the reproducibility of the method, both results should be considered acceptable. The value assigned to the sample should be the average of the two results.

NOTE 6—When a comparison for reproducibility is made between results from two laboratories, it is assumed that single results from each will be compared. If each of the laboratories has produced more than a single result, see 4.4.

4.3.2 *Rejection of Results*—When the results from two laboratories differ by more than the reproducibility of the method, reject both results and each laboratory should repeat the test on the retained sample. If the difference is now equal to or less than the reproducibility, both results should be considered acceptable and their average reported. If, however, the difference between these results is still greater than the reproducibility, reject the results and investigate the application of the method at each laboratory.

4.4 *Multiple Testing*—If the number of results obtained in either one or both laboratories is more than one, then the allowable difference between the averages from the two laboratories is given as follows:

$$\text{Difference, } R' = \sqrt{R^2 - r^2\left(1 - \frac{1}{2n_1} - \frac{1}{2n_2}\right)}$$

where:

R = reproducibility of the method,
r = repeatability of the method,
n_1 = number of results of the first laboratory, and
n_2 = number of results of the second laboratory.

4.5 *Referee Laboratory*—In the event a third or referee laboratory is invited to make the test using a portion of one of the samples described in 4.3.2, multiply the reproducibility, R, by 1.2 (to convert a range for two to a range for three) and compare this value with the difference between the two extreme results for acceptance. If acceptance is indicated, the assigned test value (ATV) for the sample should be the average of the three results.

5. Applying Precision Data to Specifications

5.1 *Specifications*—A specification fixes a limit to the "true value" of a given property. In practice, however, this "true value" can never be established exactly. The property is measured in the laboratory by applying a standard test method, the results of which may show some scattering as defined by the repeatability and reproducibility limits. There is always, therefore, some uncertainty as to the "true value" of the tested property.

5.2 Although the "true value" is never known exactly, the probability of obtaining any specific test result, relative to the true value, can be calculated if the probability distribution function for the test method is known (for example, the normal distribution curve with its associated reproducibility).

5.2.1 Some specifications, because of the product characteristic or the end use of the product, or both, require that the receiver have a high degree of assurance that the product actually meets or exceeds the quality level indicated by the specification value. For the purpose of this practice, such

TABLE 1 Deviation of AL from Specification for Product Acceptance at a Given Probability

NOTE—Based on $N = 2$ = number of different laboratories' results used to obtain ATV. See text for use of this table.

	Probability (P) of Acceptance	$D = (AL - S)/0.255\ R$	
		Maximum Specification Limit	Minimum Specification Limit
Critical	0.001	−3.090	3.090
	0.005	−2.576	2.576
	0.010	−2.326	2.326
	0.025	−1.960	1.960
	0.050	−1.645	1.645
	0.100	−1.282	1.282
	0.150	−1.036	1.036
	0.200	−0.842	0.842
	0.300	−0.524	0.524
Noncritical	0.500	0.000	0.000
	0.700	0.524	−0.524
	0.800	0.842	−0.842
	0.850	1.036	−1.036
	0.900	1.282	−1.282
	0.950	1.645	−1.645
	0.975	1.960	−1.960
	0.990	2.326	−2.326
	0.995	2.576	−2.576
	0.999	3.090	−3.090

specifications are called *critical* specifications.

5.2.2 Specifications that require assurance only that the product quality is not substantially poorer than is indicated by the specification level are called *noncritical* specifications for the purposes of this practice.

5.3 *Specification Conformance Guidelines:*

5.3.1 Whenever a product is tested for conformity to a specification, a decision must ultimately be made as to the acceptance or rejection of the product.

5.3.2 The numerical value that divides the regions of acceptable and unacceptable product test values is the acceptance limit (AL). The AL may or may not coincide with the specification value (S) used to define a product quality or grade.

5.3.3 The AL value, which must be agreed upon by the supplier and receiver, is that level of quality such that, if the "true value" is exactly AL, they are willing to take a 50 % chance of either accepting or rejecting the product as tested.

5.3.4 In the absence of an agreement to the contrary, the specification will be considered a noncritical specification for which there is 95 % assurance that the product will be accepted if the true quality is the specification value. Thus, the AL will be set by using a confidence level $P = 0.95$ as shown in 5.3.6.

5.3.5 The probability of accepting a product (deciding that product quality is acceptable) when the true value equals the specification value is shown in Table 1 and Fig. 1 as a function of $D = (AL - S)/0.255R$, a direct measure of the difference between AL and S. This relationship is based (*1*) on the assumption of normally (Gaussian) distributed testing

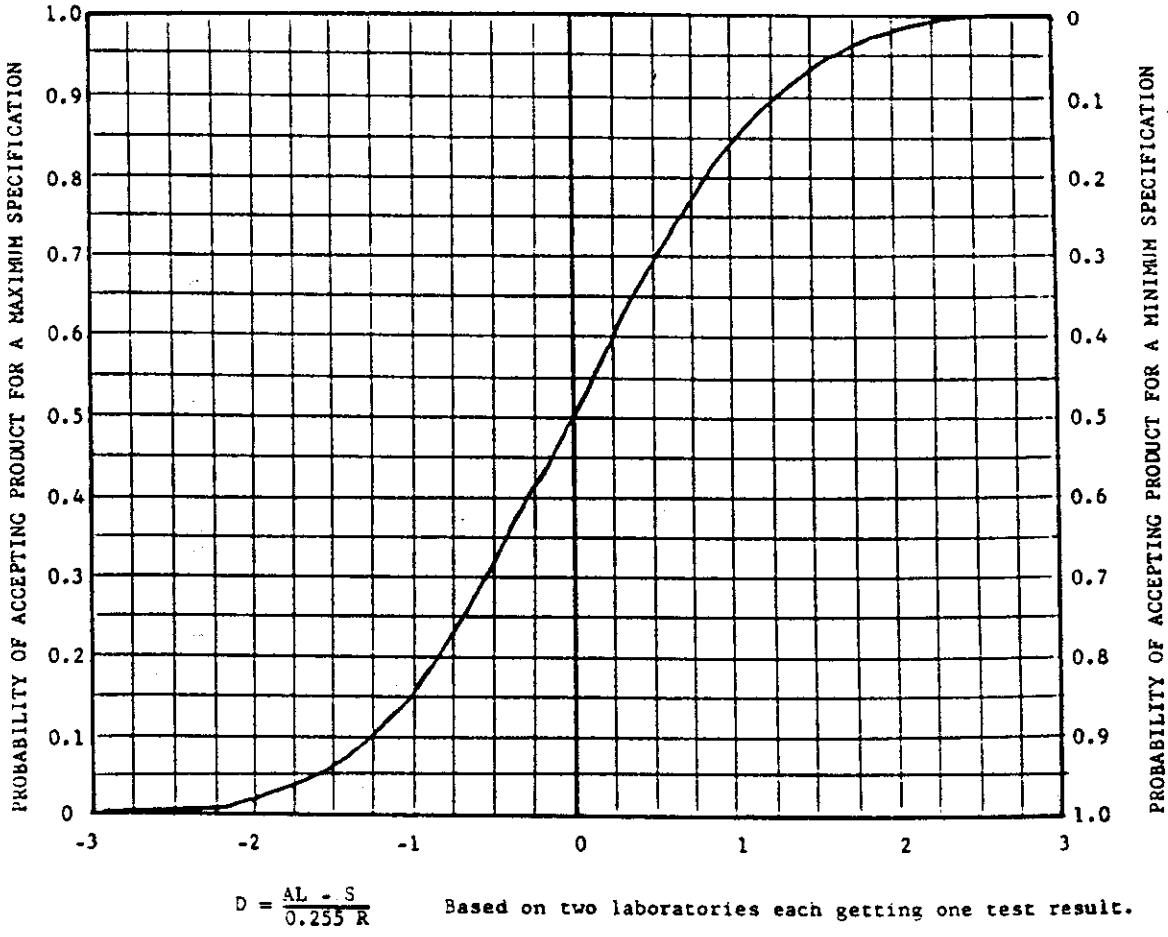
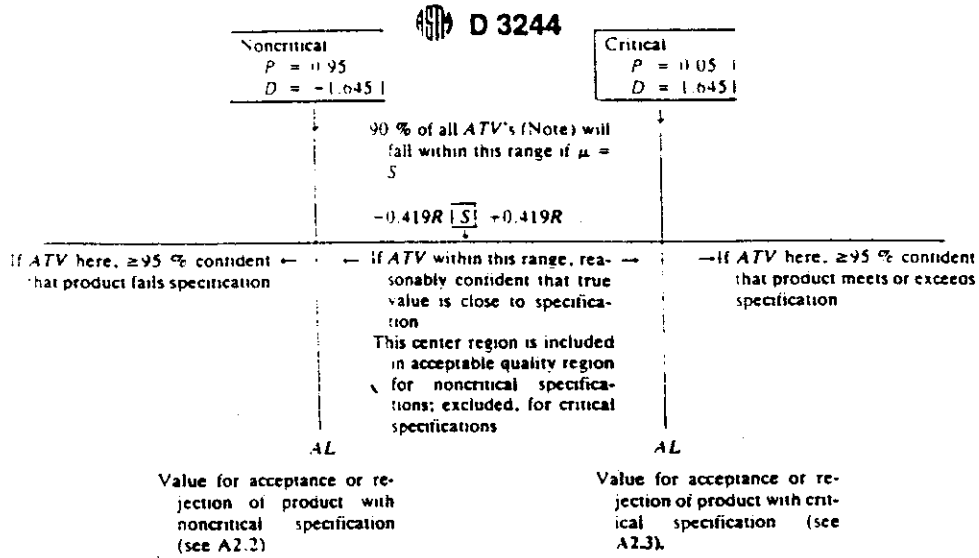


FIG. 1 Probability of Acceptance vs Deviation of AL from True Value = 5



NOTE – This applies when *ATV* is established by the average of two results, one each from two different laboratories.

FIG. 2. Relationships Between *AL*'s for Critical and Noncritical Specifications.

rors, which is adequate for most test procedures, and (*2*) using an assigned test value (*ATV*) for making the specification conformance decision that is the average of precision-acceptable results from two laboratories.

5.3.6 Instead of deciding directly on an *AL*, the receiver may select a given probability *P* of accepting the product when the true value equals the specification value *S*. From the relationship given, read a value *D* corresponding to the ordinate value *P*. The proper *AL* is then given by

$$AL = S + 0.255 \times R \times D$$

For *N*, other than two different laboratory results, the 0.255 factor should be multiplied by $\sqrt{2/N}$.

5.3.6.1 For specifications having both minimum and maximum limits, the procedure in 5.3.6 must be applied twice to give both upper and lower *AL*'s. There must be some allowable region remaining between the lower and upper *AL*'s.

5.3.7 When only a single test result is or will be available, the relationships given should be used with $N = 1$ (5.3.6). Obviously, no check on reproducibility precision can be made with a single test result, and the single value becomes the *ATV* for the sample.

5.3.8 The *AL* for critical specifications is thus set so that if the true value is less than or equal to *S*, there is only a small probability (defined by selection of *P*) of accepting the product.

5.3.9 For noncritical specifications, the *AL* is set so that if the true value is equal to or greater than *S*, there is a high probability (defined by selection of *P*) of accepting the product.

5.3.10 The relationships between the *AL*'s for critical and noncritical specifications are shown in Fig. 2 for a minimum specification.

6. Obtaining the Assigned Test Value (ATV)

6.1 The following procedure will produce an *ATV* with precision control based on the reproducibility of the test method.

6.2 The receiver and supplier should obtain independent test results, X_R and X_S, respectively.

NOTE 7—The supplier's result must be on the *test sample* (see 3.12) and not a reported value by the supplier. In many cases, a reported value by the supplier is obtained on a different sample, for example, at point of manufacture, and may be the average of several determinations.

6.3 *ATV Procedure:*

6.3.1 If the absolute value of $\Delta = X_R - X_S$ is less than or equal to *R*, the reproducibility of the test method, average the two results to obtain the following in accordance with 4.3.1:

$$ATV = (X_R + X_S)/2$$

6.3.2 If the absolute value of Δ exceeds *R*, reject both results and retest on portions of the retain sample to obtain X_R', X_S'.

6.3.3 If the absolute value of $\Delta' = X_R' - X_S'$ is less than or equal to *R*, average the two results to obtain the following in accordance with 4.3.2:

$$ATV = (X_R' + X_S')/2$$

6.3.4 If the absolute value of Δ' exceeds *R*, obtain a new test value X_{RL} from a referee laboratory (4.5).

6.3.5 If $\Delta_3 = X_{max} - X_{min}$ is less than or equal to 1.2 *R*, obtain the following:

$$ATV = (X_R' + X_S' + X_{RL})/3$$

6.3.6 If Δ_3 exceeds 1.2 *R*, obtain *ATV* as the average of the closer pair.

NOTE 8—This last step for obtaining an *ATV* does not comply rigidly to statistical concepts. It is done in this manner because in most cases the test sample (see 3.12) is depleted.

6.4 The above procedure will always yield an *ATV*. If the supplier's and receiver's laboratories have little or no bias relative to each other, then the procedure will end at 6.3.1 about 95 % of the time, and some 95 % of the remaining 5 %, at 6.3.3.

6.5 If any particular supplier and receiver pair find they frequently must go as far as calling for a reference laboratory

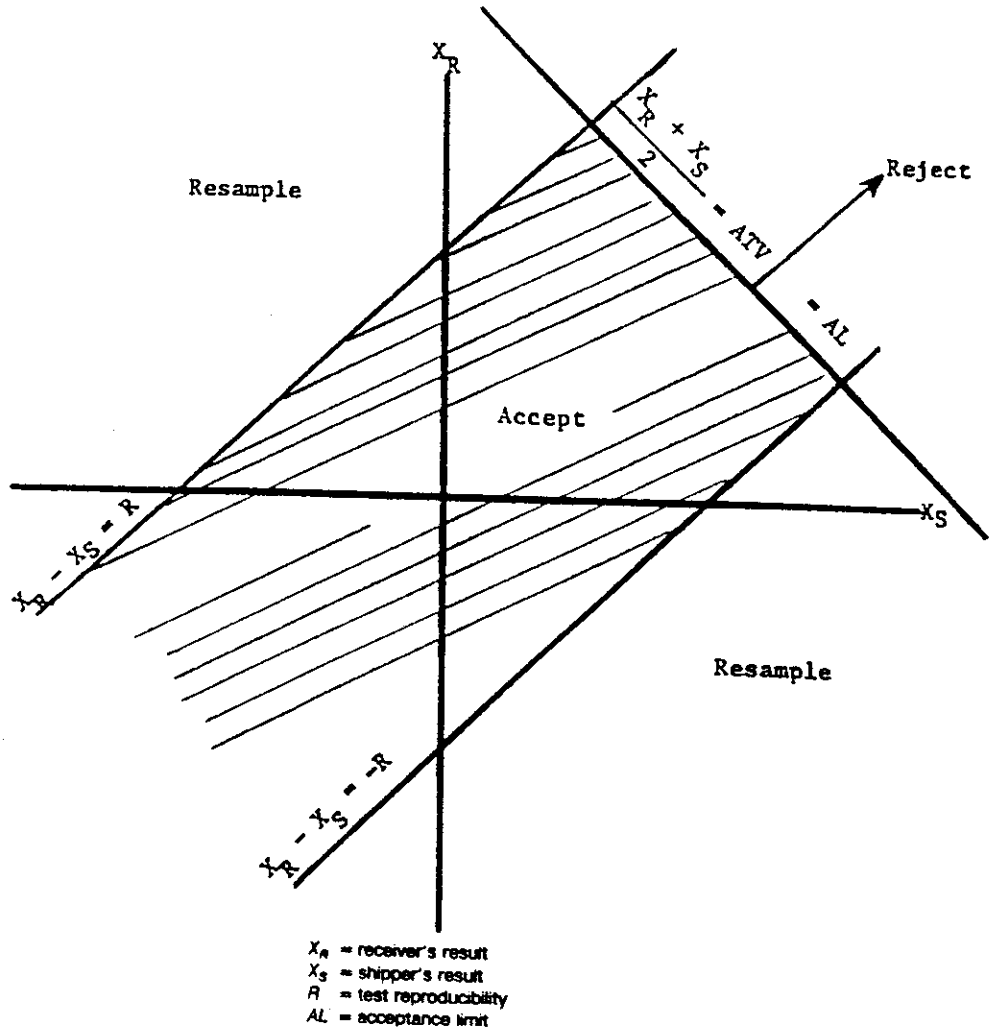


FIG. 3 Diagram Showing Regions of Acceptance, Rejection, and Resampling

test, they should carefully check their running of the test and, if possible, calibrate their results with other laboratories.

6.6 This procedure for obtaining an *ATV* is designed for the test of samples obtained according to 3.12.

6.6.1 If more extensive testing is needed for special situations, comparable procedures can be developed. A statistician or quality control expert should be consulted to do this.

7. Product Quality Conformance

7.1 A product should be considered as conforming to the specifications if the *ATV* of each property meets the *AL* value.

7.2 The supplier should ship product only if there is confidence that each property meets specification values.

7.3 When the receiver has obtained a single result, the product quality should be considered suspect if the test result fails the *AL* value (see A3.5).

7.4 A dispute between supplier and receiver may arise whenever a receiver's result fails the *AL* value.

7.5 The dispute should be resolved by obtaining an assigned test value (*ATV*) for the product as an estimate of the "true value" and comparing this to the acceptance limit (*AL*) as determined in 5.3.

8. Acceptance or Rejection of Product

8.1 If the *ATV* is equal to or better than the *AL* limit, the product is to be accepted as having met specification.

8.2 If the *ATV* fails the *AL* value, the product is to be rejected as failing specification.

8.3 These concepts are presented graphically in Fig. 3.

8.3.1 The plotted lines are boundary conditions separating acceptable results from those indicating other alternative actions.

8.3.1.1 The sample is considered acceptable if the two results fall to the left of the line. $(X_R + X_S)/2 = ATV = AL$ if they are also within the lines. $X_R - X_S = \pm R$.

8.3.2 The sample is unacceptable if the results lie to the right of the line $(X_R + X_S)/2 = ATV = AL$.

8.3.3 Initial results falling in the region labeled "resample" call for a retest.

8.3.3.1 If results for a second sample also fall in the "resample" region, a reference laboratory should be included in the new testing program.

8.4 The actual consequences of rejecting a product for failure to meet specification are subject to prior agreement or negotiation between the parties concerned.

ANNEXES

(Mandatory Information)

A1. GUIDES FOR DETERMINING *AL*

1.1 As *AL* is the dividing line between acceptable and ceptable test results, it is an important step in deter- ing conformance to specification.

1.2 The probability of rejection or acceptance of any luct whose "true value" is *AL* is always 50 %, regardless he precision of the *ATV* value used in making the sion. This statement requires only the assumption of a metric distribution of testing errors (such as, but not icted to, the normal distribution).

1.3 Referring to 5.3.7, to determine an *AL* that will give esired probability *P* that the product is accepted: For noncritical specifications, the *P* value may be chosen to be fairly large, perhaps 0.90 or 0.95; for critical specifications, *P* would be chosen below 0.50, perhaps 0.05 or 0.10. Even lower values would be called for in cases of extreme criticality.

A1.4 For critical specifications, the product is acceptable only if the *ATV* is better than *S* at nearly the 100 (1 − *P*) % significance level.

A1.5 For noncritical specifications, the product is rejected only if the *ATV* is worse than *S* at nearly the 100 *P* % significance level.

A2. EXAMPLES OF *AL* DETERMINATION AND USE

.2.1 Assume that we are testing a product whose quality ieasured by ASTM D XYZ which has a repeatability of 1 a reproducibility of 2. There is a maximum specification 10.0 for the property measured by D XYZ. In any case, supplier will not ship the product unless his tests at point manufacture show that the limit of 10 has not been eeded. Only two laboratories, supplier's and receiver's, l make tests to determine *ATV* (*N* = 2).

\2.2 *Noncritical Specification*—Receiver establishes a it of 10 maximum as a noncritical specification with *P* = 5.

\2.2.1 At *P* = 0.95, from Table 1 or Fig. 1, obtain *D* = 45.

\2.2.2 *AL* = *S* + 0.255 *R*·*D* (from 5.3.6). *AL* = 10 + 55 × 2 × 1.645 = 10.84. Product as tested must average *TV*) 10.84 or lower to be acceptable.

\2.2.3 Upon testing of sample (Section 6), receiver ob- ns test result X_R = 10.8, supplier obtains X_S = 9.9. Δ = .8 − 9.9 = 0.9 < *R* = 2, meeting the reproducibility uirement, so that

$$ATV = (10.8 + 9.9)/2 = 10.34$$

\2.2.4 The *ATV* as obtained is below *AL*, so the product ıccepted.

A2.3 *Critical Specification*—Another receiver needs, for isons known best to him, a very high level of assurance it the product meets the specification of 10.0.

A2.3.1 Using *P* = 0.025, obtain *D* = −1.960 from Table 1 ig. 1).

A2.3.2 *AL* = *S* + 0.255 *R*·*D*. *AL* = 10 + 0.255 × 2 × (−1.960) = 9.00. Thus, the product as tested (*ATV*) must average 9.00 or lower to be acceptable.

A2.3.3 Testing of sample (Section 6) gives

$$X_R = 9.4$$

$$X_S = 9.2$$

Δ = 0.2 meets reproducibility criterion

thus *ATV* = (9.4 + 9.2)/2 = 9.3.

A2.3.4 The *ATV* as obtained is above the *AL* so the product is rejected as unacceptable in quality even though the *ATV* is better than the specification value.

A2.4 *Converting a Critical Specification to a Noncritical Specification:*

A2.4.1 The receiver in the example of A2.3 wanted a high level of assurance that the product met a specification of 10 and, hence, applied a low value for *P* in establishing the *AL*. He could have used a noncritical specification of 8.16 to accomplish the same objective.

A2.4.2 To obtain a noncritical specification value having the same *AL* as a critical specification value, we solve the equation of 5.3.6.

$$AL = S + (0.255)(R)(D)$$

for *S* using the value of 9.00 from A2.3.2. A value of *D* = 1.645 is used for a noncritical specification. Thus,

$$S = 9.00 - (0.255)(2)(1.645) = 8.16$$

A2.4.3 In reality, the actual quality of product needed by this receiver is 1.84 units better (10 − 8.16) than the receiver described in A2.1.

A3. CONSTANTS USED IN EQUATIONS

A3.1 The constant used in equation of 5.3.6 was developed as shown in the following paragraphs.

A3.1.1 The AL equals the specification value plus a term reflecting the probability of a deviation between the true value = S and an observed value of a given property. Thus,

$$AL = S + (\sigma D/\sqrt{N})$$

where:

σ = standard deviation of measurement for the test method under reproducibility conditions,
D = deviation between a measured value and the true value for a specified probability, and
N = number of different laboratories whose test results are averaged to establish the assigned test value (ATV).

A3.1.2 The definition for reproducibility (3.9) is as follows:

$$R = \sigma t_{05} \sqrt{2}$$

where the t_{05} value is 1.96 for 95 % probability or confidence level. Thus,

$$R = \sigma\ (1.96)(\sqrt{2})$$

$$= 2.77\ \sigma$$

$$\text{or} \quad \sigma = R/2.77 = 0.361R$$

A3.1.3 When the assigned test value (ATV) is obtained by averaging two results from two different laboratories, $N = 2$. Substituting the values of $\sigma = 0.361R$ from A3.1.2 and $N = 2$ in the equation of A3.1.1 gives the following:

$$AL = S + (0.361RD)\sqrt{2}$$

$$= S + 0.255\ RD$$

A3.1.4 For the conditions described in 5.3.4, the value for D from Table 1 for 95 % assurance of acceptance of a product meeting specification exactly is +1.645 for a maximum specification and −1.645 for a minimum specification substituting these values in the equation of A3.1.3 gives the following for a *maximum* specification:

$$AL = S + (0.255)(+1.645)(R)$$

$$= S + 0.419\ R$$

and for a *minimum* specification:

$$AL = S + (0.255)(-1.645)(R)$$

$$= S - 0.419\ R$$

The constant, 0.419, is the one shown in the diagram of 5.3.10.

A3.1.5 It is emphasized that the constants developed for calculation of AL are based on an ATV established by averaging two test results, one each from two different laboratories. If a result from only one laboratory is used to determine the AQL, the value for N is one and the equation for establishing the AL in accordance with A3.1.3 is as follows:

$$AL = S + \frac{(0.361R)(D)}{\sqrt{1}}$$

$$= S + 0.361\ RD$$

and the equation for a *maximum* specification in accordance with A3.1.4 becomes

$$AL = S + (0.361)(1.645)R$$

$$= S + 0.594\ R$$

and for a *minimum* specification

$$AL = S - 0.594\ R$$

A3.1.6 The equations presented in A3.1.5 should be used to establish AL for comparison with a result from a single laboratory. A single result is usually insufficient to estimate the ATV of a property with a high degree of accuracy. If the single observed value does not meet the AL in accordance with A3.1.5, additional testing and investigation is justified.

--PROPOSED--

CMA CORNERSTONES FOR ENGINE TESTS IN THE CODE OF PRACTICE

The CMA will use the following Cornerstones when judging whether a test method should be included in the Code of Practice.

TEST DEVELOPMENT

- Tests included in the Code of Practice will be of sufficient precision to allow sound application of multiple test acceptance criteria (MTAC) for cost effective evaluation of oil quality. The preferred method of MTAC is one which fully recognizes the precision of the test and statistical reality that the confidence in a result increases as the number of tests on the oil increases.

- Future tests included in the Code of Practice will use sound management techniques throughout the test development process. One key element will be to define future success criteria and milestones. Test work and the decision to proceed at each step of the development process must be measured against these. Precision matrices must be developed and reviewed by Industry statisticians prior to conducting the proposed tests. Operational and hardware data from test matrices should be made available prior to the balloting process to allow independent statistical analysis, and prior to any data being discarded.

- Any new or existing test must have as its foundation reference oils which demonstrate a test's ability to discriminate oil quality. The passing reference oil must pass all tests in the category for which the test is destined. Ideally this oil should be identified early and included in the precision and correlation process matrices. This technique simplifies the limit setting process because this oil must consistently meet all pass/fail criteria in the test and performance category.

TEST QUALITY MAINTENANCE

- Test precision is dependent on consistency and uniformity in test parts, fuels, and reference oils. The following would therefore be desirable for any test included in the Code of Practice:
  - A minimum of five year's uninterrupted supply.
  - A written quality control plan.
  - All Critical Parts, fuel and reference oils will be subjected to quality control measures to ensure a test that is essentially identical to that used for the original developmental matrix. This may involve control of sourcing, metallurgy, and finishing techniques using methods of measurement and inspection, and in the case of fuel and reference oils, analyses of critical constituents. Some element of independent audit is desired.

- Tests included in the Code of Practice will include a methodology for monitoring the test precision at various levels (stand, lab,

industry) and a referencing process that ensures adequate data is available.

- Tests included in the Code of Practice must have oils distributed, and laboratories monitored and calibrated by the ASTM Test Monitoring Center.

EXCERPT FROM DIVISION 08 TIPS MANUALS

1) Standard practice for rating lubricant tests at SwRI is a single rating by a qualified rater. The rating coordinator spot checks ratings. The Project Engineer has overall responsibility and authority to ensure that ratings are accurate.

2) Situations exist where review of the ratings are requested and accomplished.

   a) Borderline pass/fail test results.
   b) Project Engineer request based on past testing/lubricant history.
   c) Project Engineer request based on part problems.
   d) Client request

3) In cases where questions, as above, are raised several actions, directed by the Project Engineer, can be taken.

   a) Request a rerate, by another qualified rater, of the entire test. (In house or another laboratory)

   b) Request a rerate, by another qualified rater, of the part in question. (In house or another laboratory)

   c) Request a review of all raw data and calculations pertaining to the ratings.

4) Unless an obvious error is discovered or an obvious misrating is agreed upon the final ratings reported in the final test result will be the <u>average of all ratings.</u>

TEST DEVELOPMENT FLOW PLAN

- IDENTIFY NEED FOR NEW TEST
- ASSURE NO REDUNDANCY WITH EXISTING TESTS
- BEGIN PROCESS OF COLLECTING FIELD TEST DATA AND RUNNING FIELD TESTS AS NECESSARY
- ESTABLISH SUCCESS CRITERIA (PRECISION/DISCRIMINATION/ETC.)
- OEM IN-HOUSE TEST WORK
  - IDENTIFY TEST ENGINE
  - IDENTIFY CRITICAL ENGINE PARTS
  - ESTABLISH SPECIFICATIONS AND PROCESS FOR ASSURING CONSISTENT HARDWARE QUALITY
  - OEM COMMITS TO LONG-TERM (5 YEARS MINIMUM) SUPPLY OF HARDWARE
- HARDWARE RELEASED TO INDUSTRY FOR REFERENCE OIL MATRIX TESTING
- ESTABLISH SOURCE AND SPECIFICATION FOR FUEL
  - DEVELOP PROCESS FOR REBLEND APPROVAL
- ESTABLISH PERFORMANCE PARAMETERS TO BE RATED/MEASURED
- SELECT REFERENCE OILS
  - AT LEAST ONE OIL MEETING ENTIRE PERFORMANCE SPECIFICATION FOR WHICH THIS TEST IS ONLY A PART
  - CURRENT CHEMISTRY
  - FIVE-YEAR BATCH SUPPLY
- INITIAL TEST PROCEDURE DOCUMENTED
- SURVEILLANCE PANEL/TASK GROUP ESTABLISH DESIGN OF SIGNIFICANT TEST STAND EQUIPMENT

- ENGINE BUILDERS WORKSHOP TO DEVELOP CONSISTENT INDUSTRY ENGINE ASSEMBLY PRACTICE

- INDUSTRY ENGINE TEST STAND SHAKEDOWN TESTING

- LABORATORY VISITATION BY TEAM OF SELECTED EXPERTS TO ASSURE COMMONALITY OF TEST STANDS

- INDUSTRY CONDUCTS DESIGNED TEST MATRIX/MATRICES ON REFERENCE OILS
  - STATISTICALLY-DESIGNED MATRICES
  - QUANTIFY PRECISION, DISCRIMINATION, FIELD CORRELATION
  - FINALIZE PROCEDURE IN ASTM FORMAT

- ESTABLISH CALIBRATION REQUIREMENTS
  - REFERENCE FREQUENCY
  - CONTROL CHARTING

- ESTABLISH OPERATIONAL VALIDITY GUIDELINES
  - CONTROLLED PARAMETERS
  - SPECIAL ITEMS (EX. DOWNTIME, BLOWBY, ETC.)

- DEVELOP SEVERITY ADJUSTMENT SYSTEM

- WRITE TEST DEVELOPMENT REPORT AND SUBMIT IT TO THE OIL CLASSIFICATION PANEL
  - SOUND DATA ANALYSIS BY INDUSTRY STATISTICIANS

- OIL CLASSIFICATION PANEL ESTABLISH PASS/FAIL LIMITS
  - FINALIZE PERFORMANCE PARAMETERS
  - ESTABLISH DATA-HANDLING TECHNIQUE (MTAC, TRANSFORMS, ETC.)
  - USE SOUND STATISTICAL METHODS
  - CONFIRM CORRELATION WITH FIELD DATA

- TECH B TO BALLOT TEST PROCEDURE AND PERTINENT PERFORMANCE LIMITS

- RESOLVE ANY NEGATIVE BALLOTS AND ADDRESS POSITIVE COMMENTS

MEETING SCHEDULE - NOVEMBER 1992
ASTM SUBCOMMITTEE D02.B SURVEILLANCE PANEL WEEK
LOCATION: ADAMS MARK HOTEL, ST. LOUIS, MO

Date/Time	Group	Attendees	Viewgraph?
Monday, November 16			
8:00 a.m. -12:00 p.m.	B.1 - Sequence IID Surveillance Panel	40	Yes
12:00 p.m. - 1:00 p.m.	Lunch		
1:00 p.m. - 5:00 p.m.	B.1 - Sequence IIIE Surveillance Panel	40	Yes
Tuesday, November 17			
8:00 a.m. - 12:00 p.m.	B.1 - Sequence VE Surveillance Panel	40	Yes
12:00 p.m. - 1:00 p.m.	Lunch		
1:00 p.m. - 5:00 p.m.	B.1 - Sequence VI Surveillance Panel	40	Yes
Wednesday, November 18			
8:00 a.m. - 12:00 p.m.	B.2 - L-38 Surveillance Panel	40	Yes
12:00 p.m. - 1:00 p.m.	Lunch		
1:00 p.m. - 3:00 p.m.	B.2 - Mack T6/T7 Surveillance Panel	15	Yes
3:00 p.m. - 6:00 p.m.	Two-Cycle Diesel Surveillance Panel	40	Yes
Thursday, November 19			
8:00 a.m. - 12:00 p.m.	B.2 - Single Cylinder Diesel Surveillance Panel	40	Yes
12:00 p.m. - 1:00 p.m.	Lunch		
1:00 p.m. - 5:00 p.m.	B.2 - NTC-400 Surveillance Panel	40	Yes

PROPOSED MEETING SCHEDULE - JUNE 1992
SUBCOMMITTEE D02.B

Date/Time	Group	Purpose	Attendees	Viewgraph?
Wednesday, December 9				
8:00 a.m. - 9:00 a.m.	B - Advisory	Plan subcommittee activities	100	Yes
9:00 a.m. - 11:00 a.m.	B.5 - Section	Receive panel reports and take appropriate action	50	Yes
9:00 a.m. - 11:00 a.m.	B.1 - Section	Receive panel reports and take appropriate action	100	Yes
11:00 a.m. - 12:00 p.m.	B.10- Facilitator Monitoring	Conduct section business	25	Yes
12:00 p.m. - 1:00 p.m.	Lunch			
1:00 p.m. - 2:30 p.m.	B.3 Section	Receive panel reports and take appropriate action	60	Yes
1:00 p.m. - 2:30 p.m.	B.6 - Section	Receive panel reports and take appropriate action	50	Yes
1:00 p.m. - 3:00 p.m.	B.8 - Test Monitoring Board	Receive and act on reports	30	Yes
2:00 p.m. - 3:00 p.m.	B.4 - Section	Receive panel reports and take appropriate action	25	Yes
3:00 p.m. - 5:00 p.m.	B.2 - Section	Receive panel reports and take appropriate action	100	Yes
Thursday, December 10				
8:00 a.m. - 12:00 p.m.	B - Subcommittee	Conduct subcommittee business	100	Yes

PROPOSED MEETING SCHEDULE - DECEMBER 1992
SUBCOMMITTEE D02.B

Date/Time	Group	Purpose	Attendees	Viewgraph?
Monday, December 7				
1:00 p.m. - 3:00 p.m.	B.3 - Test Quality Task Force	Conduct task force business	40	Yes
3:00 p.m. - 4:00 p.m.	B.3 - Mack Transmission Cyclic Durability Task Force	Conduct task force business	40	Yes
4:00 p.m. - 5:00 p.m.	B.3 - Oil Seal Task Force	Conduct task force business	40	Yes
Tuesday, December 8				
8:00 a.m. - 9:00 a.m.	B.3 - L-33 Surveillance Panel	Review procedures and precision	40	Yes
8:00 a.m. - 10:30 a.m.	B.2 - HD Engine Oil Classification Panel	Conduct panel business	80	Yes
9:00 a.m. - 10:00 a.m.	B.3 - L-37 Surveillance Panel	Conduct panel business	40	Yes
10:00 a.m. - 12:00 p.m.	B.3 - L-42 Surveillance Panel	Review numerical rating system and reference oil results	40	Yes
10:30 a.m. 5:00 p.m.	B.6 - Panel Chairmen	Review panel meetings	50	Yes
12:00 p.m. - 1:00 p.m.	Lunch			
1:00 p.m. - 3:00 p.m.	B.3 - L-60 Task Force	Conduct task force business	40	Yes
1:00 p.m. - 3:30 p.m.	B.5 - Powershift Transmission Fluid Subsection	Receive and act on panel reports	50	Yes
1:00 p.m. - 4:00 p.m.	B.1 - PC Engine Oil Classification Panel	Conduct panel business	80	Yes
3:00 p.m. - 4:00 p.m.	B.3 - Gear Spalling Task Force	Conduct panel business	40	Yes
3:30 p.m. - 5:00 p.m.	B.5 - Multipurpose Transmission Fluid Subsection	Receive and act on panel reports	50	Yes
4:00 p.m. - 5:00 p.m.	B.9 - Editorial Support	Conduct section business	25	Yes
4:00 p.m. - 5:00 p.m.	B.3 - PG-1/PG-2 Task Force	Conduct panel business	40	Yes

AUTHORITY TO SUSPEND INDUSTRY WIDE LABORATORY CALIBRATION STATUS WHEN A TEST IS JUDGED TO BE GIVING UNITERPRETABLE PERFORMANCE

BACKGROUND

The ASTM D02 Subcommittee B Surveillance Panels are requesting the authority to suspend industry wide laboratory calibration status when a test is judged to be giving uninterpretable performance. This is needed to get immediate industry expertise solely focused on solving the test problem and prevent the continued approval of oils based on suspect data. To assure that any decision to temporarily suspend testing is justified, the following analysis process will be used and documented. This process also includes a method for determining when the test is back in control and calibrated testing can resume. This process was developed to address the concerns expressed during the first balloting of this subject.

FLOW PLAN

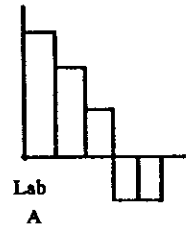
Step 1: An action alarm at the industry level must trigger on the Exponentially Weighted Moving Average (EWMA) plots, for either precision or severity, using the ASTM Reference Monitoring system.

Step 2a: The test surveillance panel must consider the scope and size of the problem:

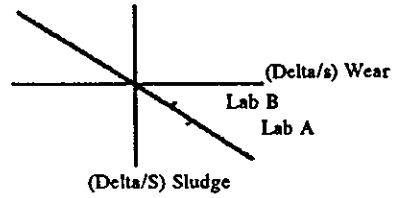
- Is the problem due to an identifiable cause?
- Is the problem affecting precision and/or severity?
- If the problem only affects severity, can a temporary correction be applied?
- Is the problem reference oil specific?
- Is the problem test lab or stand specific?
- When did the problem start?
- Are critical, non-critical, or both types of parameters involved?
- Does the problem transcend test type?
- What tools (statistical) were used to assess the problem?
- Was the problem a gradual one or an abrupt one?
- Does existing candidate oil experience support any reference oil trends?
- Has the problem been defined clearly?
- Has the available data been analyzed in alogical and methodical manner?

Step 2b: The following tools will be used, as a minimum, in the analysis of the problem:

DATA ANALYSIS	POTENTIAL INSIGHTS
1. All charts (lab, stand) should be made available for the Test Parameter which has gone out.	1. Time trends and changes, start of problem
2. Mark on charts when Industry changed parts, fuel batches, etc.	2. Special cause.
3. Plot each lab's last EWMA for the affected parameter:	3. Scope of problem, special cause.



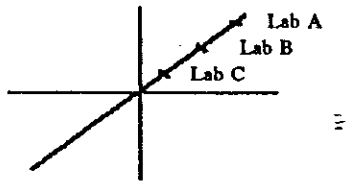
4. Provide a list of coded labs (or stands) which have had out of control signals on the Test Parameter within the last three months.	4. Scope of problem, special cause.
5. Plots of known problem parameters (e.g. sludge/wear).	5. Problem discrimination.



6. EWMA charts with $\lambda=0.1$ (detect small shifts)

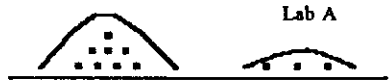
6. Gradual vs step change.

7. Youden plot of labs' last two points:



7. Precision vs. severity, scope, special cause.

8. Dot plot of all data in last three months.



8. Special cause.

Step 3a: The Surveillance Panel decision to declare a test our of control will require a ¾ approval vote of voting members (or their alternates) present at a special Surveillance Panel meeting held to review all data developed. All negative votes must be resolved (declared non-persuasive, persuasive, or non-germane). For purposes of determining persuasiveness of a negative, a ⅔ majority vote of members present (or their alternates) will be used. The final vote plus all persuasive arguments will be forwarded to the appropriate Section Chairman.

Step 3b: Within 2 weeks of a successful Surveillance Panel decision to declare a test out of control, a technical memorandum will be issued by the TMC (advising that calibration status for the appropriate test type cannot be technically supported in all previously calibrated laboratories effective for each stand prior to the start of the next test). This memorandum will be issued to all members of the Surveillance Panel involved, all calibrated test labs, the appropriate classification panel, and all members of Subcommittee B. This memorandum will provide the background on the Surveillance Panel's decision, as well as a proposed action plan with timetables and milestones. A comment period will be extended for 30 days after the memorandum. Comments will go to the Subcommittee B Chairman who will determine if they are of sufficient quality to call a special session of B within 30 more days. TMC calibration status will continue to be suspended during this period.

Step 3c: Any external communication (outside of ASTM Subcommittee B) will be sent through the Chairman of Subcommittee B.

API will be sent a letter by the Chairman of Subcommittee B notifying them of this action and stating that the performance category xx as stated in ASTM D4485 can no longer be measured until further notice. The reason that this performance can no longer be measured is that the calibration status of the uniterpretable test can not be technically supported.

Step 4c: Determination that the test is back in control will be made when the industry EWMA charts for precision and severity are back within the defined control limits. At that point, an information memorandum will be issued by the TMC to the same distribution outlined in Step 3b. Any requirements, if necessary, to resume calibrated testing will be defined in this memorandum.

GENERAL OVERVIEW

The following flow chart is a depiction of the process that each Surveillance Panel is recommended to follow when deciding if a test is out of control.

/spc

FLOW DIAGRAM