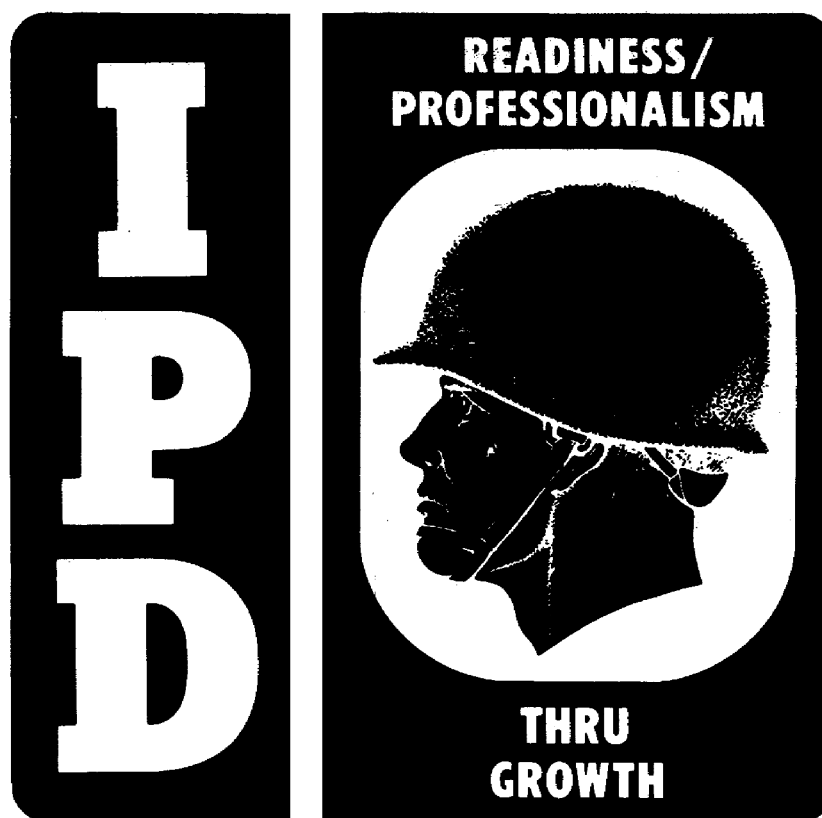


SUBCOURSE
QM5120

EDITION
3

REVIEW PETROLEUM ANALYSIS
TEST RESULTS (101-523-2102)



THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT
ARMY CORRESPONDENCE COURSE PROGRAM

REVIEW PETROLEUM ANALYSIS TEST RESULTS
(101-523-2102)

QM5120
Edition 3

United States Army Combined Arms Support Command
Fort Lee, VA 23801-1809

Four Credit Hours

CONTENTS

	<u>Page</u>
Introduction	ii
Lesson - Task No. 101-523-2102. Review Petroleum Analysis Test Results.	1
Review Exercise	25
Solution Sheet	26

Passing score for this subcourse is 70%.

INTRODUCTION

This subcourse is designed to train a 92C20 soldier to review petroleum analysis test results. We will cover each part of the task and your responsibilities.

Supplementary Training Material Provided: None.

Four credit hours will be awarded for successful completion of this subcourse.

LESSON

TASK: 101-523-2102. Review Petroleum Analysis Test Results. As a result of successful completion of this subcourse, you will be able to perform the following performance measures:

1. Identify errors in test result reporting by comparing the results to the test method standard.
2. Identify inconsistencies in test results submitted by a technician by reviewing several of his test reports for the same product (repeatability).
3. Identify possible erroneous test results by comparing all test results for the sample, using the significance of tests and product characteristic norms.
4. Identify test results that do not meet reproducibility precision standards.

CONDITIONS: You are the senior laboratory specialist in a petroleum laboratory. Your duties include reviewing DA Forms 2077 that are completed to the point of review using FM 10-70, ASTM Test Method Supplement to FM 10-92C, MIL-HDBK-200F, and the applicable military or federal specifications.

STANDARD: You must answer 70 percent of the written exam questions correctly to receive credit for this subcourse.

CREDIT HOURS: See page ii, Introduction.

REFERENCES: FM 10-70

FM 10-92C

ASTM Test Method Supplement to FM 10-92C

MI L-HDBK-200F

All applicable military or federal specifications

LESSON TEXT

1. GENERAL. As an NCO in the petroleum field, you must be able to review petroleum analysis test results. When reporting errors in results using test method, you must be able to identify repeatability and reproducibility precision standards. Also, you must be able to identify possible erroneous test results by comparing all test results for the sample, using the significance of tests and product characteristic norms.

2. IDENTIFY ERRORS. To identify errors in reported test results, you must go to each test method standard. In each test method you will find how to report the results in the REPORT paragraph. If the test method does not have a REPORT paragraph, you would use the PRECISION paragraph for accuracy in reporting results. There are two basic ways that the results of test methods are reported, (1) to the nearest... or (2) a certain number of significant figures.

a. An example of reporting the results to the nearest ... is shown in ASTM Method D445 Kinematic Viscosity (by multiplying the seconds x the constant) which reads "Report test results for both the kinematic and dynamic viscosity rounded to the nearest one part per thousand of the value measured or calculated, respectively." The result of this test is found on line 38 of the modified Petroleum Products Laboratory Analysis Report (DA Form 2077) (figure 1).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see FM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO.	LAB REPORT NO.
		83-69	83-969
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		SPEC NO. VV-F-800C	
TEST		SPEC/QUAL	RESULT
38. KIN CS/1000 AT 104 OF		1.9/4.1	2.516

Figure 1. Petroleum Products Laboratory Analysis Report (modified for training).

As shown in figure 1, the result is reported after it is rounded to the nearest one part per thousand. To determine the correct number of digits, divide the highest digit position by 1000, as for figure 1, ones position divided by 1000 equal 0.000 digits, as tens position equal 00.00 digits.

b. An example of reporting the results to a certain number of significant digits is shown in ASTM method D 482 (Ash From Petroleum Products). "Report the result to two significant figures as the ash, ASTM D 482 stating the weight of the sample taken." The result of this test is found on line 33 of the modified petroleum products laboratory analysis report (figure 2).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT For use of this form, see TM 10-1105; the proponent agency is TRADOC.		SAMPLE NO. 83-69	LAB REPORT NO. 83-969
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		SPEC NO. VV-F-800C	
TEST	SPEC/QUAL	RESULT	
33. % ASH PLAIN/ FROM MAX	0.01	0.0042	

Figure 2. Petroleum Products Laboratory Analysis Report (modified for training).

As shown in the figure, the results are reported after rounding off the number to two significant digits.

(1) The rounding rule for all test methods is as follows: Numbers ending in 1, 2, 3, and 4 will be rounded down (12.34 would be rounded to nearest one-tenth or 12.3). Numbers ending in 6, 7, 8, and 9 would be rounded up (678.9 would be rounded to the nearest whole number (679)). The number 5 would be rounded up to the next even number if the preceding digit is odd (65.75 would be rounded off to the nearest one-tenth (65.8)) or if the preceding digit is even, the 5 would just be dropped (68.5 would be rounded off to the nearest whole number (68)).

(2) The number of significant figures is not influenced in any way by the position of the decimal point. For numbers less than one expressed in decimal form, the zeros after the decimal point and preceding other digits are not significant, therefore 0.0042 as shown in figure 2 has only two significant figures. The rules for significant figures are as follows: When carrying out any sequence of multiplication or division, the answer should have no more significant digits than the smallest number of significant figures present in any of the numbers involved. In addition and subtraction, the significant digits of the sum or difference are determined by the number of digits in the number with the least amount of significant digits of the number involved.

3. INCONSISTENT RESULTS FOR REPEATABILITY. As the senior laboratory specialist, you will have to identify inconsistencies in test results submitted by a technician by reviewing several of his test reports for the same product. When doing this you are checking the repeatability of test results which is defined as: "The quantitative expression of the random error associated with a single operator in a given laboratory obtaining replicate results with the same apparatus under constant operation conditions on identical test material within a short period of time." The repeatability information can be found in the precision paragraph in the test methods. There are many different ways the repeatability for test methods can be found. It may vary from a certain value not to exceed..., to a certain percentage of the mean (the average of two or more quantities). The repeatability may also be expressed by a graph in certain test methods.

a. The first example of repeatability is shown in ASTM test method D 482 which reads "The difference between successive test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty:

Ash, %	Repeatability
0.001 to 0.079	0.003
0.080 to 0.180	0.007"

The results of the test to be checked for repeatability are found on line 33 of DA Form 2077, figures 3 and 4.

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT For use of this form, see TM 10-1105; the proponent agency is TRADOC.		SAMPLE NO. 83-69	LAB REPORT NO. 83-969
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		SPEC NO. VV-F-800C	
TEST	SPEC/QUAL	RESULT	
33. % ASH PLAIN/ PLAIN MAX	0.01	0.0042	

Figure 3. Petroleum Products Laboratory Analysis Report (modified for training).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT For use of this form, see TM 10-1105; the proponent agency is TRADOC.		SAMPLE NO. 83-69	LAB REPORT NO. 83-969A
PRODUCT NOMENCLATURE AND TYPE FUEL OIL DIESEL, GRADE-2 (DF-2)		SPEC NO. VV-F-800C	
TEST	SPEC/QUAL	RESULT	
33. % ASH PLAIN/ PLAIN MAX	0.01	0.039	

Figure 4. Petroleum Products Laboratory Analysis Report (modified for training).

As shown in figures 3 and 4, the ash level is between 0.001 and 0.079 and therefore the repeatability value is 0.003 and the results in figures 3 and 4 are within repeatability.

b. The second example of repeatability is shown in ASTM test method D 445 which reads, "The difference between successive test results, obtained by the same apparatus under constant operating conditions on identical test material, would in the long run, in the normal and correct operation of this test method, exceed 0.35% of their mean only in one case in twenty. Differences greater than this should be considered suspect." The results of the test to be checked for repeatability are found on line 38 of DA Form 2077, figures 5 and 6.

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO.	LAB REPORT NO.
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		83-69	83-969
			SPEC NO. VV-F-800C
TEST	SPEC/QUAL	RESULT	
38. KIN CS/SEC AT 104 OF	1.9/4.1	2.516	

Figure 5. Petroleum Products Laboratory Analysis Report (modified for training).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO.	LAB REPORT NO.
PRODUCT NOMENCLATURE AND TYPE FUEL OIL DIESEL, GRADE-2 (DF-2)		83-69	83-969A
			SPEC NO. VV-F-800C
TEST	SPEC/QUAL	RESULT	
38. KIN CS/SEC AT 104 OF	1.9/4.1	2.509	

Figure 6. Petroleum Products Laboratory Analysis Report (modified for training).

Take the results shown in figures 5 and 6, and then find the mean of the results as shown in the following:

$$\begin{array}{r}
 2.516 \quad (\text{figure 5}) \\
 + \frac{2.509}{5.025} \quad (\text{figure 6}) \\
 \hline
 \frac{5.025}{2} = 2.5125 \quad (\text{mean})
 \end{array}$$

The mean is then multiplied by 0.35% to find the repeatability value as shown in the following:

$$\begin{array}{r} 2.5125 \quad (\text{mean}) \\ \times 0.35 \quad (\%) \\ \hline 0.00879375 \end{array}$$

At this point, you should determine the number of significant digits required by the test method, in this case 4 significant digits are in the figure. So, the figure would be rounded to 0.0088 (repeatability value for figures 5 and 6). To determine if the results of figures 5 and 6 met the repeatability value of 0.0088 you would determine if the results are within 0.0088 of each other.

$$\begin{array}{r} 2.516 \quad (\text{figure 5 results}) \\ - 2.509 \quad (\text{figure 6 results}) \\ \hline 0.007 \text{ is less than } 0.0088 \text{ or within repeatability} \end{array}$$

c. The third example of repeatability is shown in ASTM test method D 86 (Distillation of Petroleum Products) which reads, "Duplicate results obtained by the same operator and apparatus should not be considered suspect unless they differ by more than the repeatability which, according to the repeatability graph, is appropriate to the test result obtained and to the rate of change in thermometer reading which prevailed at the stage at which the result was obtained." The results of the test to be checked for repeatability are found on the modified copies of DA Form 2077, lines 5a-g, figures 7, 8, and 9.

(1) Figure 7 shows the official test results for laboratory report 83-969 to be used in this example.

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>				SAMPLE NO. 83-69	LAB REPORT NO. 83-969
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)				SPEC NO. VV-F-800C	
5. DISTILLATION TEST				SPEC/QUAL	RESULT
a.	50	% REC -	EVAP AT °F	RPT	269
b.	90	% REC -	EVAP AT MAX °F	338	323
c.		FBP/ DRY PT	MAX °F	370	343

Figure 7. Official Test Results for Laboratory Report 83-969 (modified for training).

To determine the repeatability of the results for ASTM D 86 shown in figure 7, we must have a laboratory worksheet with the results for 10% above and below the points to be checked, except for the initial boiling point (IBP) and the final boiling point (FBP) which requires 5% above and below the point to be checked respectively, as shown in figure 8 laboratory worksheet (w/s).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>				SAMPLE NO. 83-69	LAB REPORT NO. 83-969 W/S
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)				SPEC NO. VV-F-800C	
5. DISTILLATION TEST				SPEC. QUAL	RESULT
a.	40	% REC	EVAP AT OF	N/A	253
b.	50	% REC	EVAP AT OF	RPT	269
c.	60	% REC	EVAP AT OF	N/A	282
d.	80	% REC	EVAP AT OF	N/A	310
e.	90	% REC	EVAP AT MAX OF	338	323
f.	95	% REC	EVAP AT OF	N/A	333
g.			FBP OF MAX OF	370	343

Figure 8. Laboratory worksheet (modified for training).

To determine the repeatability of the result 269° F at 50%, you would subtract the 40% results 253° F from the 60% results 282° F;

$$\begin{array}{r}
 282^{\circ} \text{ F } 60\% \\
 - 253^{\circ} \text{ F } 40\% \\
 \hline
 29
 \end{array}$$

The answer 29 is then divided by the total distances to either side of the point to be checked, of official test result, which is 20. This will give the rate of change of thermometer reading.

$$29 \div 20 = 1.45 \text{ Rounded to } 1.4$$

The rate of change of thermometer reading 1.4 is then charted on the ASTM D 86 repeatability and reproducibility to 1.4 on the right scale graph by drawing a horizontal line from 1.4 on the left scale across (figure 9). Then you would use notes A thru D on the bottom of figure 9 to determine which column will show repeatability, in this case, column c. The 1.4 line intersects column c at 2° F which is the plus or minus repeatability of 269° F at 50% for laboratory report number 83-969. The repeatability of 323° F at 90% is shown below and with figure 10.

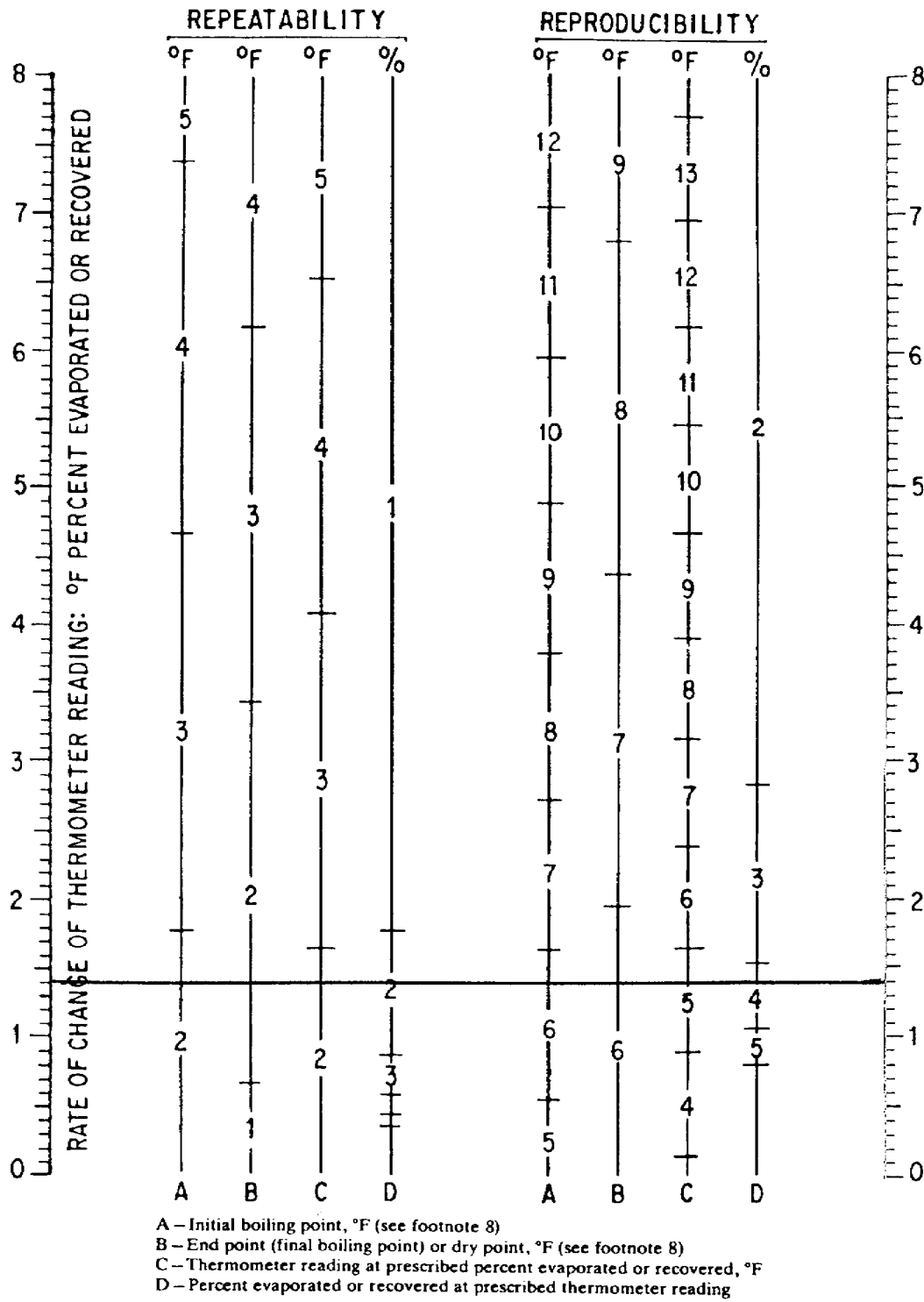


Figure 9. 269° F at 50% laboratory report number 83-969.

$$\begin{array}{r} 343 \text{ FBP} \\ - 310 \text{ 80\%} \\ \hline 33 \end{array}$$

$$33 \div 20 = 1.65 \text{ Rounded to } 1.6$$

Column c is used with figure 10, which gives a plus or minus repeatability of 2° F for 323° F at 90% for laboratory report number 83-969.

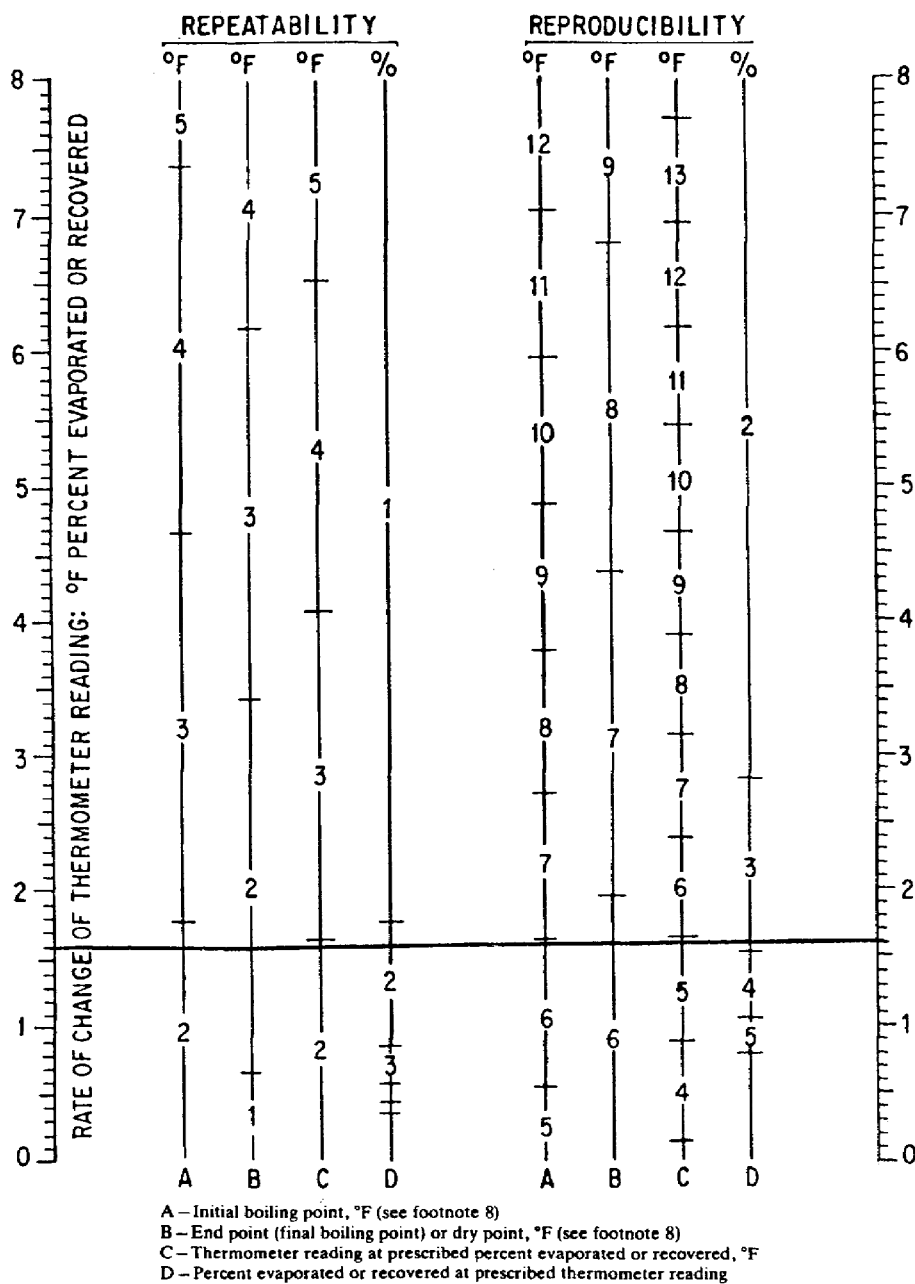


Figure 10. 323° F at 90% laboratory report number 83-969.

The repeatability of 343°F at the FBP is shown below and with figure 11.

343° F FBP
 - 333° F 95%
 10
 $10 \div 5 = 2$

ASTM D 86

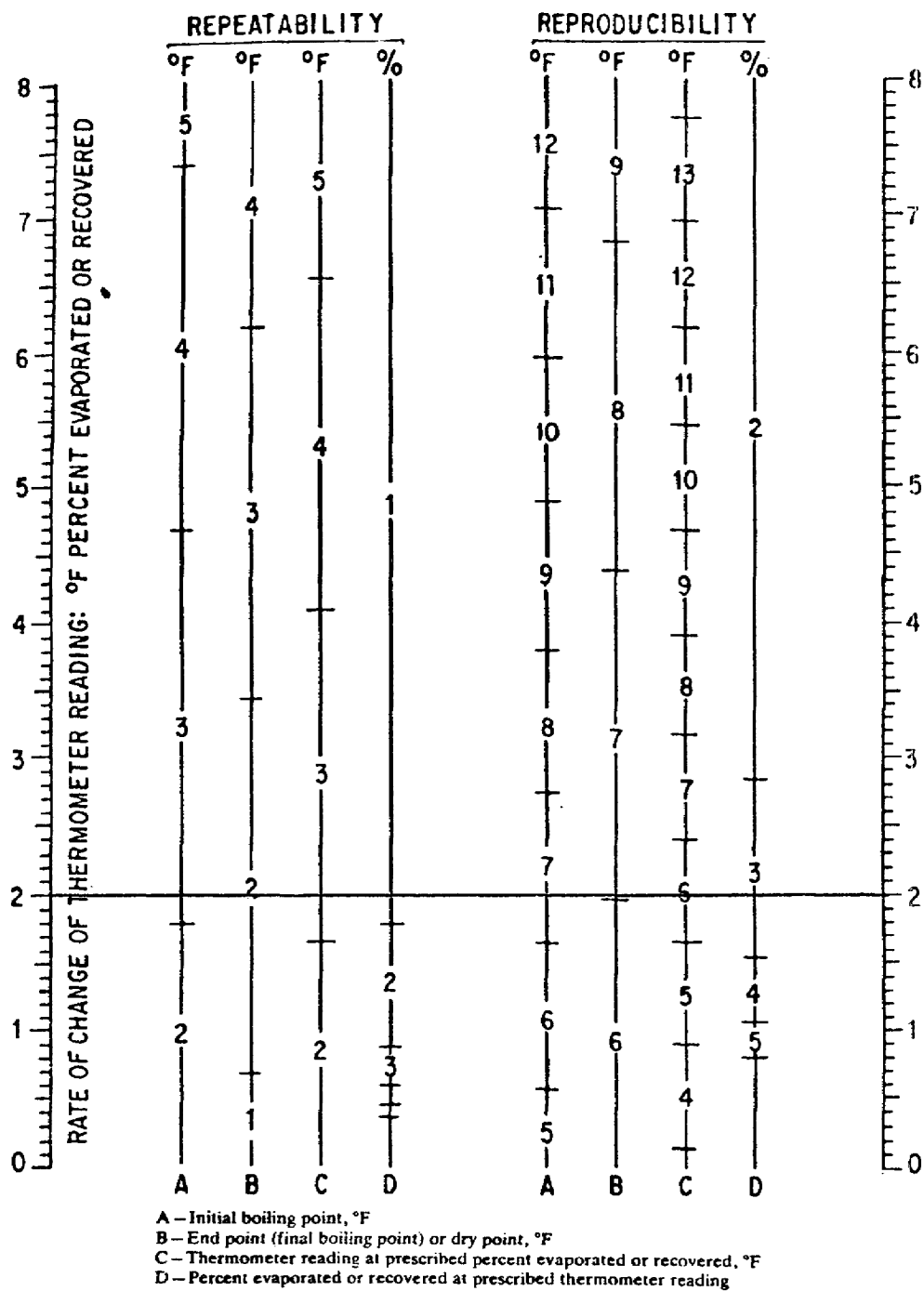


Figure 11. 343°F at FBP Laboratory Report Number 83-969.

Column b is used with figure 11, which gives a plus or minus repeatability of 2° F for 343° F at FBP laboratory report number 83-969.

(2) After finding the repeatability of the official results (figure 7) you will check to see if the repeatability test results (figure 12) meet repeatability limits of the official test results.

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT For use of this form, see TH 10-1105; the proponent agency is TRADOC.			SAMPLE NO.	LAB REPORT NO.
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)			83-69	83-969A
				SPEC NO. VV-F-800C
5. DISTILLATION TEST			SPEC/QUAL	RESULT
a. 50	% RECAL	EVAP AT °F	RPT	272
b. 90	% RECAL	EVAP AT MAX °F	338	326
c.	FBP/	MAX °F	370	347

Figure 12. Repeatability Test Results
(modified for training).

The official results and repeatability limits for laboratory report number 83-969 (figure 7) gives the limits in which the repeatability results must fall, at each reported point of the test results (figure 12).

% Evap	Figure 7 83-969	Repeatability Limit for 83-969	Figure 12 83-969A	Results Within Repeatability
50	269° F	± 2° F	272° F	NO
90	323° F	± 2° F	326° F	NO
FBP	343° F	± 2° F	347° F	NO

As shown above, the laboratory report number 83-969A is not within repeatability limits of laboratory report number 83-969.

4. REPRODUCIBILITY PRECISION STANDARDS. As the senior laboratory specialist, you will need to know if your test equipment and laboratory specialist are performing the test within reproducibility precision standards. To achieve this there is a correlation program that is set up by the USAGMPA that your laboratory falls under. The addresses for the offices are:

US AGMPA
Petroleum Field Office West
ATTN: STSGP-PW
Defense Depot-Tracy
Tracy, CA 95376

US AGMPA
Petroleum Field Office East
Bldg 85-3, STSGP-PE
New Cumberland Army Depot
New Cumberland, PA 17070

As your laboratory is involved in the correlation program, you will provide a check for reproducibility of test which is defined as: "The 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." The reproducibility information can be found in the precision paragraph in the test methods. There are many different ways the reproducibility for test methods are found. The different ways are similar to the ones already explained for repeatability. The test methods used for repeatability will also be used for reproducibility. The limits for reproducibility are found the same way that the limits for repeatability are found.

a. The first example of reproducibility is ASTM test method D 482 which reads: "The difference between two single and independent results obtained by different operators in different laboratories on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty:

Ash %	Reproducibility
0.001 to 0.079	0.005
0.080 to 0.180	0.024"

The results of the test to be checked for reproducibility are found on line 33 of DA Form 2077 (figures 13 and 14).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1103; the proponent agency is TRADOC.</small>		SAMPLE NO. 83-69	LAB REPORT NO. 83-969
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		SPEC NO. VV-F-800C	
NAME AND LOCATION OF LABORATORY 260th QM BN MBL POL LAB HAAF, Ga 31413	TEST		SPEC/QUAL
	33. % ASH PLAIN/ PL MAX		0.01
			RESULT 0.0042

Figure 13. Petroleum Products Laboratory Analysis Report (modified for training).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO. 83-69	LAB REPORT NO. 83-838	
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE-2 (DF-2)		SPEC NO. VV-F-800C		
NAME AND LOCATION OF LABORATORY QMS Seaman POL LAB FT. Lee, Va 23801	TEST		SPEC/QUAL	RESULT
	38. % ASH PLAIN/ SOLE MAX		0.01	0.0047

Figure 14. Petroleum Products Laboratory Analysis Report (modified for training).

As shown in figures 13 and 14, the ash level is between 0.001 and 0.079 and therefore the reproducibility is 0.005 and the results in figures 13 and 14 are within reproducibility.

b. The second example is shown in ASTM test method D 445 which reads, "The difference between two single and independent test results obtained by different operators working in different laboratories on identical test material, would in the long run, in normal and correct operation of this test method, exceed 0.70% of their mean only in one case in twenty. Differences greater than this should be considered suspect." The results of the test to be checked for reproducibility are found on line 38 of DA Form 2077, figures 15 and 16.

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO. 83-69	LAB REPORT NO. 83-969	
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		SPEC NO. VV-F-800C		
NAME AND LOCATION OF LABORATORY 260th QM BN MBL POL LAB HAAF, Ga 31413	TEST		SPEC/QUAL	RESULT
	38. KIN CS/ SO AT 104 OF		1.9/4.1	2.516

Figure 15. Petroleum Products Laboratory Analysis Report (modified for training).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO. 83-69	LAB REPORT NO. 83-838	
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE-2 (DF-2)		SPEC NO. VV-F-800C		
NAME AND LOCATION OF LABORATORY QMS Seaman POL LAB FT. Lee, Va 23801	TEST		SPEC/QUAL	RESULT
	38. KIN CS/600 AT 104 °F		1.9/4.1	2.531

Figure 16. Petroleum Products Laboratory Analysis Report (modified for training).

Take results shown in figures 15 and 16 and find the mean of the results as shown in the following:

$$\begin{array}{r}
 2.516 \text{ (figure 15)} \\
 + \underline{2.531 \text{ (figure 16)}} \\
 5.047 \\
 \\
 \frac{5.047}{2} = 2.5235 \text{ (mean)}
 \end{array}$$

The mean 2.5235 is multiplied by 0.70% to arrive at the reproducibility value as shown in the following:

$$\begin{array}{r}
 2.5235 \text{ (mean)} \\
 \times \underline{0.007} \\
 0.0176645
 \end{array}$$

Now determine the number of significant digits required by the test method, in this case, 4 significant digits. So the figure would be 0.0176 (reproducibility limit for figures 15 and 16). To determine if the results of figures 15 and 16 met the reproducibility limit of 0.0176 you would determine if the results are within 0.0176 of each other.

$$\begin{array}{r}
 2.531 \text{ (figure 15)} \\
 - \underline{2.516 \text{ (figure 16)}} \\
 0.015 \text{ is less than } 0.0176 \text{ or within reproducibility.}
 \end{array}$$

c. The third example of reproducibility is shown in ASTM test method D 86 which reads "The results obtained by each of two laboratories should not be considered suspect unless the two results differ by more than the reproducibility which, according to the reproducibility graph is appropriate to the test results obtained and to the rate of change in thermometer reading which prevailed at the stage at which the results were obtained."

(1) The results of the test to be checked for reproducibility are found on the modified copies of DA Form 2077, lines 5a-g, figures 17, 18, and 19. Reproducibility is found the same way repeatability is found, except the reproducibility graph is used. Figure 17 shows the official test results for report 83-969 that will be used in this example.

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO. 83-69	LAB REPORT NO. 83-969	
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		SPEC NO. VV-F-800C		
NAME AND LOCATION OF LABORATORY 260th QM BN MBL POL LAB HAAF, Ga 31413	5. DISTILLATION TEST		SPEC. QUAL	RESULT
	a. 50 % REC -	EVAP AT °F	RPT	269
	b. 90 % REC -	EVAP AT MAX °F	338	323
	c.	FBP: STYP MAX °F	370	343

Figure 17. Official Test Results for Report 83-969 (modified for training).

Figure 18 shows the reproducibility worksheet results for report 83-969.

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO. 83-69	LAB REPORT NO. 83-969 W/S	
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE 2 (DF-2)		SPEC NO. VV-F-800C		
NAME AND LOCATION OF LABORATORY 260th QM BN MBL POL LAB HAAF, Ga 31413	5. DISTILLATION TEST		SPEC QUAL	RESULT
	a. 40 % REC -	EVAP AT °F	N/A	253
	b. 50 % REC -	EVAP AT °F	RPT	269
	c. 60 % REC -	EVAP AT °F	N/A	282
	d. 80 % REC -	EVAP AT °F	N/A	310
	e. 90 % REC -	EVAP AT MAX °F	338	323
	f. 95 % REC -	EVAP AT °F	N/A	333
g.	FBP: STYP MAX °F	370	343	

Figure 18. Reproducibility Worksheet Results (modified for training).

To determine the reproducibility of the result at 50%, 90%, and the FBP you would perform the same steps as already explained in the repeatability of test results for ASTM test method D 86, except that your reproducibility limits would be derived from the reproducibility portion of the graph.

(a) To determine the reproducibility of 269° F at 50%, refer back to figure 9. Read column c on the reproducibility side of the graph, at the point which the vertical line intersects. In this case, the reproducibility of 269° F at 50% is 5° F.

(b) To determine the reproducibility of 323° F at 90% refer back to figure 10. Read column c on the reproducibility side of the graph, at the point which the vertical line intersects. In this case, the reproducibility of 323° F at 90% is 5° F.

(c) To determine the reproducibility of 343° F at the FBP, refer back to figure 11. Read column b on the reproducibility side of the graph, at the point which the vertical line intersects. In this case, the reproducibility of 343° F at the FBP is 7° F.

(2) After finding the reproducibility of the official results (figure 17), you will check to see if the reproducibility test results (figure 19) meet repeatability test limit of the official test results. The official results and reproducibility limits for laboratory report number 83-969 (figure 17) gives the area in which the reproducibility results must fall, at each reported point of the test results (see figure 19).

PETROLEUM PRODUCTS LABORATORY ANALYSIS REPORT <small>For use of this form, see TM 10-1105; the proponent agency is TRADOC.</small>		SAMPLE NO.	LAB REPORT NO.			
PRODUCT NOMENCLATURE AND TYPE FUEL OIL, DIESEL, GRADE-2 (DF-2)		83-69	83-838			
SPEC NO.		VV-F-800C				
NAME AND LOCATION OF LABORATORY QMS Seaman POL LAB FT. Lee, Va 23801	S. DISTILLATION TEST			SPEC/QUAL	RESULT	
	a.	50 % REG	EVAP AT	OF	RPT	262
	b.	90 % REG	EVAP AT	OF	338	315
	c.	FBP/ DRY PT	MAX	OF	370	335

Figure 19. Petroleum Products Laboratory Analysis Report (modified for training).

<u>% Evap</u>	<u>Figure 17 83-969</u>	<u>Reproducibility Limit for 83-969</u>	<u>Figure 19 83-838</u>	<u>Results within Reproducibility Limits</u>
50	269° F	+ 5° F	262	NO
90	323° F	+ 5° F	315	NO
FBP	343° F	+ 7° F	335	NO

As shown above, the laboratory report number 83-838 is not within repeatability limits of laboratory report number 83-969.

5. POSSIBLE ERRONEOUS TEST RESULTS. As the senior laboratory specialist in a petroleum laboratory, you must be able to identify possible erroneous test results by comparing all test results for the sample, using the significance of test and product characteristic norms.

a. The product characteristic (physical and chemical) trends are established by reviewing a minimum of three test results over a period of time.

(1) The characteristic norms of a stored product will change slowly by deterioration (see figure 20). The abnormal rate of change of a characteristic norm may indicate accelerated deterioration, contamination, or incorrect sampling procedures. An example of an accelerated rate change is shown by West Side Burbank tank farm, which has established the product characteristic normal trend for the JP-4 in tank 42, after reviewing three B-2 test results. The fourth B-2 test results shows an accelerated deterioration rate above the normal trend. After the product characteristic normal trend has been broken, no matter by what, it must be reestablished if the product is not consumed or contaminated by another outside source before the trend can be established. In this case, the rate of change was greater than the normal trend, but the same attention must be given to the product, if the rate is less than the normal trend. In either case, an investigation of the handling history of the product is warranted, as is a probable increase of quality surveillance testing.

b. The performance characteristics of the tests will indicate specific physical and chemical traits of the products performance during storage and consumption, as well as the indication of deterioration and contamination.

TEST	SPEC / QUAL	JAN 80	JUN 80	JAN 81	ESTABLISHED	
					TREND	JUN 81
1C. Gravity °API/60°F AVG	45/57	54.6	53.9	53.2	~ 0.7	51.9
2. Workmanship	C + B	C + B	C + B	C + B	C + B	C + B
3. Color Visual	RPT	W/W	W/W	W/W	W/W	W/W
5. Distillation IBP °C	RPT	44.0	45.5	47.0	+ 1.5	49.5
5A. 10% REC °C	RPT	66.5	67.5	68.5	+ 1.0	70.5
5B. 20% REC MAX °C	145	125.0	126.0	127.0	+ 1.0	129.5
5C. 50% REC MAX °C	190	168.0	169.5	170.5	+ 1.2	173.0
5D. 90% REC MAX °C	245	234.0	234.5	235.5	+ 0.8	236.5
5E. FBP MAX °C	270	250.5	253.0	254.5	+ 1.8	258.0
5F. % Recovered	RPT	98.5	98.5	98.5	0	98.5
5G. % Loss MAX	1.5	1.0	1.0	1.0	0	0.5
5H. % Residue MAX	1.5	0.5	0.5	0.5	0	1.0
7. RVP (PSI)	2/3	2.8	2.7	2.7	0	2.6
8. Gum Existent MG/100 ML MAX	7	0.6	0.6	0.8	+ 0.1	1.0
9. TEL MG/L MAX	14	0.000	0.000	0.000	0	0.000
13. Freezing PT °C MAX	-72	-74	-74	-75	- 0.5	-74
14. Corrosion Copper Strip 2HR@212°F MAX	16	1	1	1	0	16
23. Water Reaction Interface Rating MAX	16	1	1	1	0	16
28. FSII % VOL AVG.	0.10/0.15	0.11	0.11	0.11	0	0.10
32. Water Separometer Index MIN.	70	N/A	N/A	N/A	N/A	N/A
58. SDA ps/m	200/600	371	350	331	-20	279
60. Sed. Contam. Millipore MG/L MAX	1.0	0.4	0.5	0.5	+ 0.02	0.8
61. Effectiveness of Filtration MAX	15 Min	9	9	9	0	11
62. In. of Hg MIN	20	25	26	26	+ 0.5	27

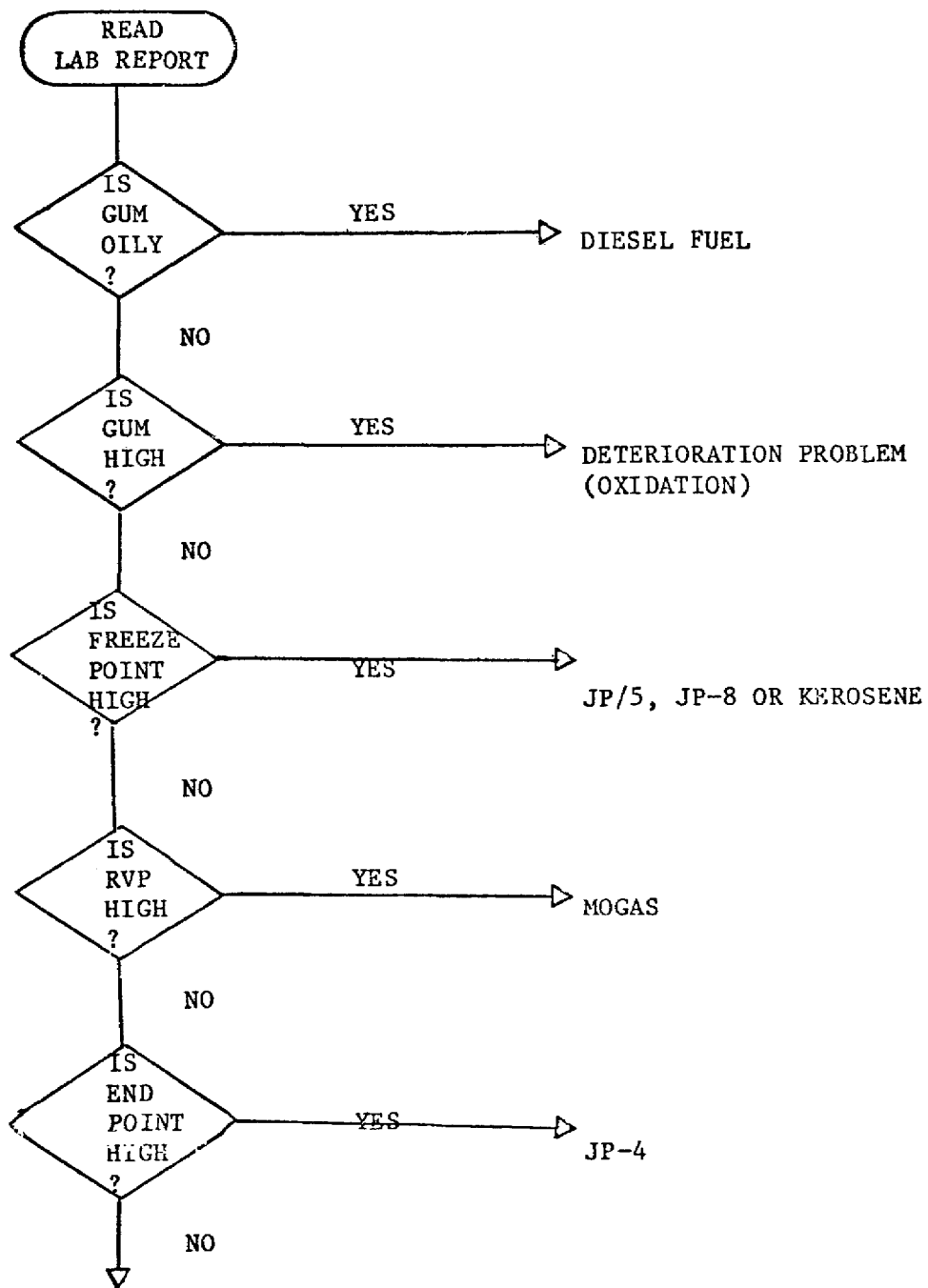
Figure 20. Product Characteristic Norms (trend).

(1) All test results must be considered together since generally no one result will, by itself, be out of trend. For example, when the flash point (FIP) drops, the initial boiling point (IBP) will also drop. Many results are directly related. If a product is contaminated with a lighter, more volatile product the API gravity, Reid vapor pressure, and freezing point readings will be higher and the initial boiling point and the flash point readings will be lower. If the product is contaminated with a heavier, less volatile product, the final boiling point, flash point, and the gum (if oily) readings will be higher and the API gravity, initial boiling point, and Reid vapor pressure readings will be lower. All the above reading changes are based on the percentage of contaminants. If a product is deteriorating the API gravity, Reid vapor pressure, and freezing point, readings will be lower and the initial boiling point, flash point, and gum (dry) readings will be higher. Figures 21 through 25 are flowcharts designed to show you how to systematically analyze a laboratory report to determine what is causing the change in trend.

(2) When possible, take steps to prevent or correct problems with the products, to save money as well as the products. The problems may be caused by different forms of contamination or deterioration.

6. SUMMARY. As an NCO in the petroleum field, you should now be able to review petroleum analysis test results and determine any erroneous test results and establish and review characteristic norms/trends. If you are not sure about any of the material covered, reread and review the text and references listed on page 2.

AV-GAS SAMPLE



DETERIORATION PROBLEM
(WEATHERING)

Figure 21. AVGAS Flowchart.

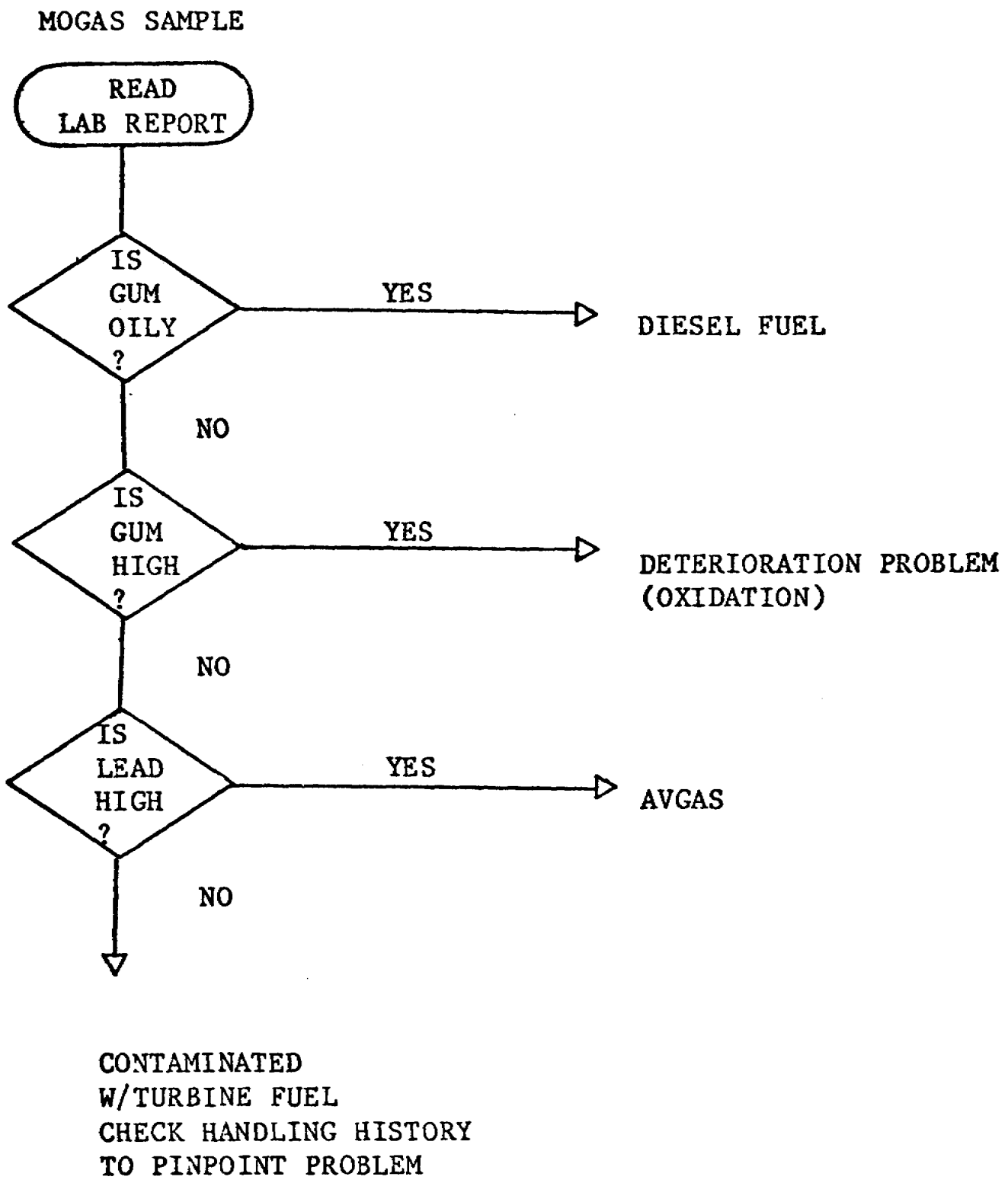


Figure 22. MOGAS Flowchart.

JP-4 SAMPLE

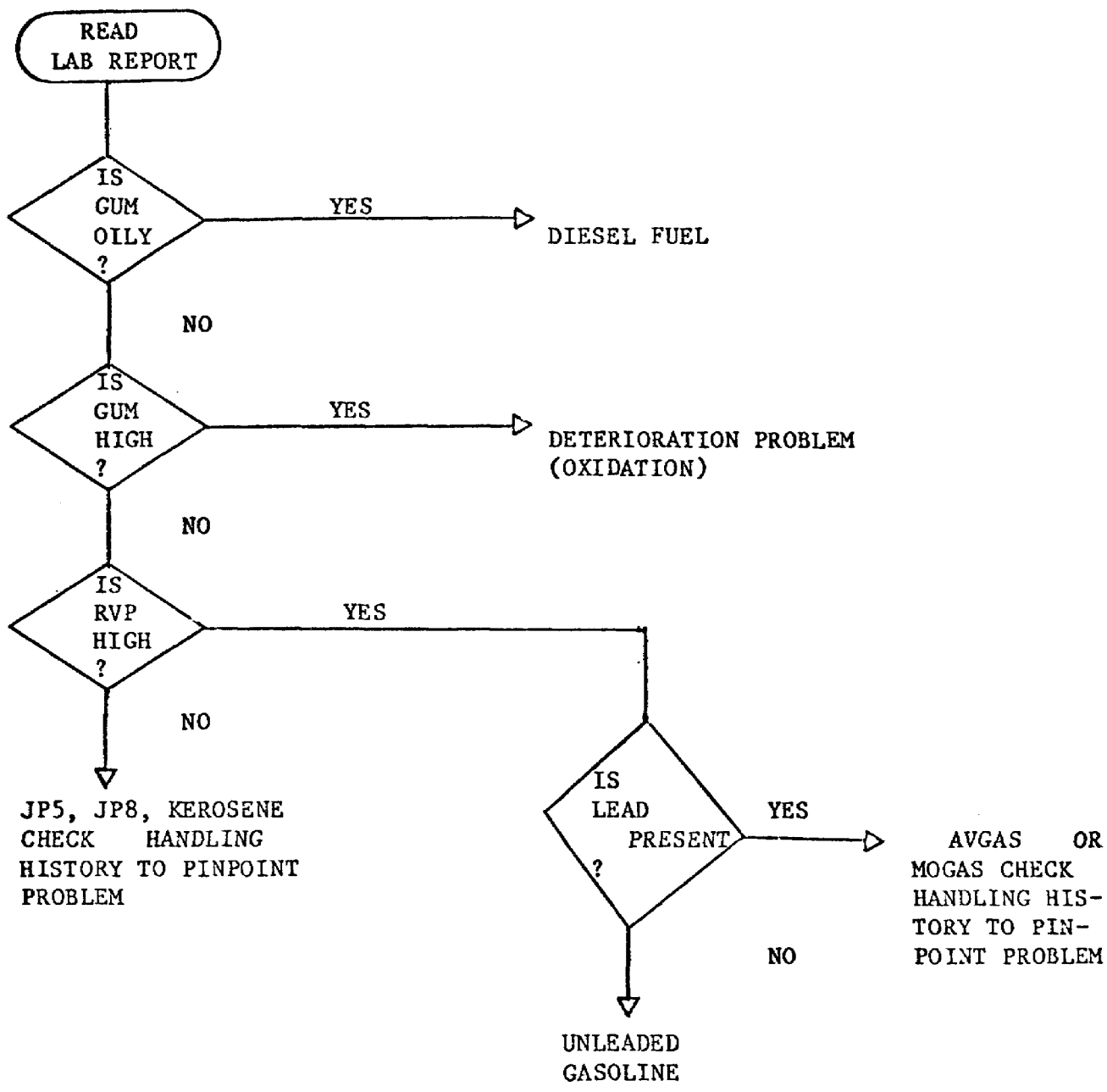
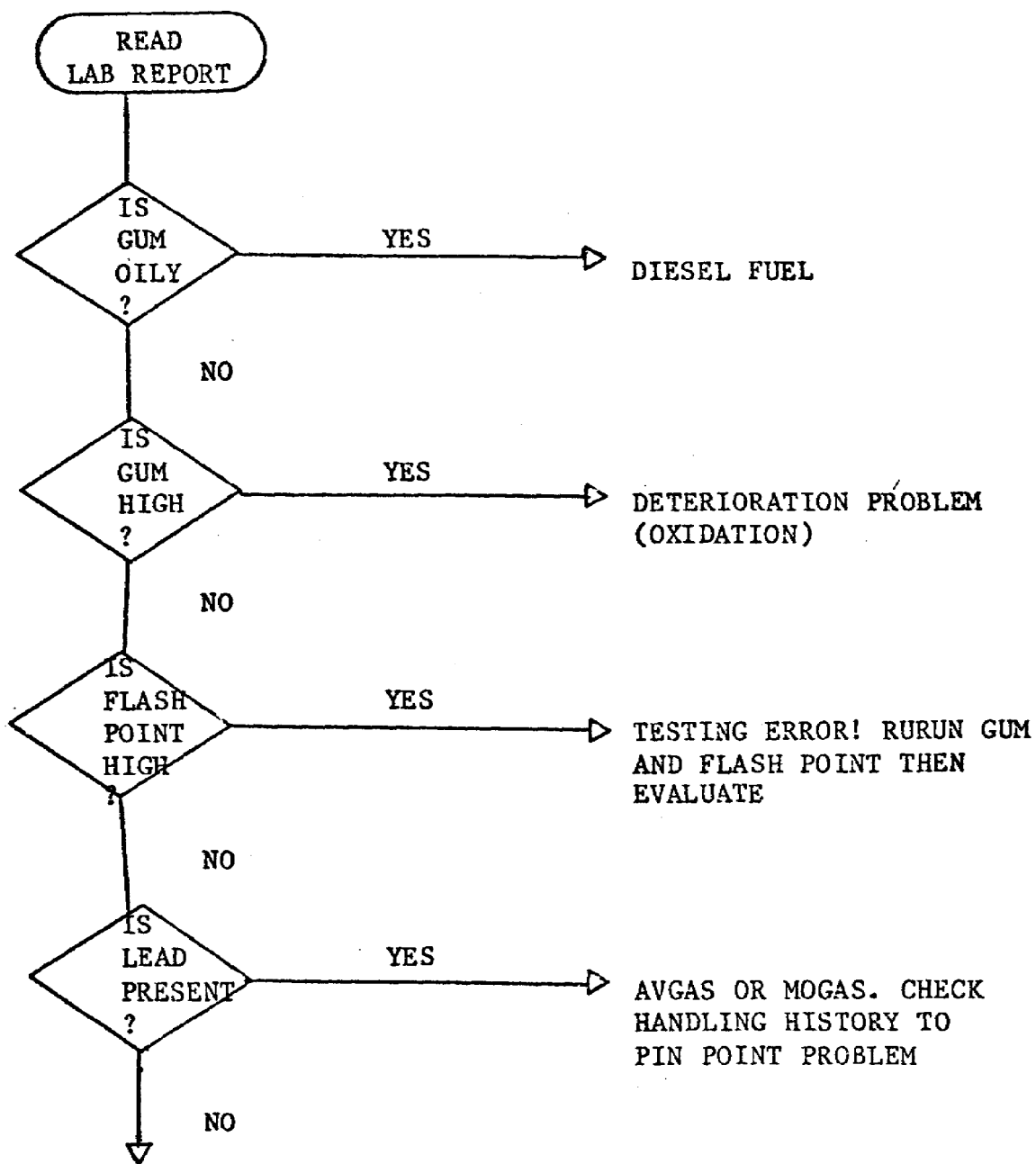


Figure 23. JP-4 Flowchart.

JP-5/JP-8/KEROSENE



UNLEADED GASOLINE
CHECK HANDLING
HISTORY TO PIN-
POINT PROBLEM

Figure 24. JP-5/JP-8/Kerosene Flowchart.

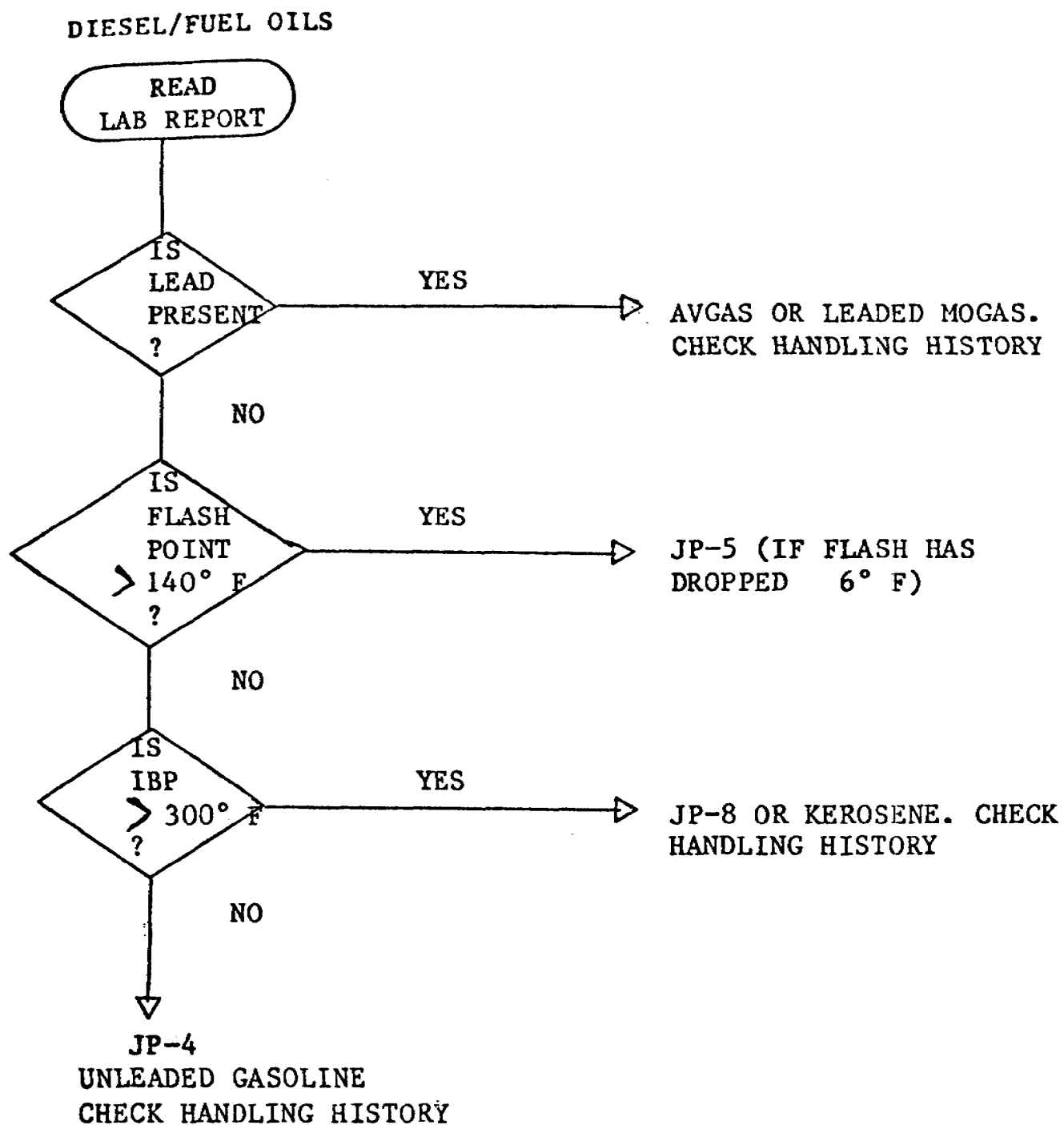


Figure 25. Diesel/Fuel Oils Flowchart.

REVIEW EXERCISE

This review exercise gives you a chance to see how well you have learned the material in the lesson. This exercise is based on the key points covered in the lesson.

Read each question/statement and write your answer. If you do not know or are not sure what the answer is, check the paragraph reference that is shown in the parentheses; then go back and study or read once again all of the referenced material and write your answer.

Upon completion of the review exercise, check your answers with the solution sheet. If you did not give the right answer, erase it, restudy the lesson reference once more, and write the correct solution.

1. To identify errors in reported test results, you must go to each _____ . (para 2)
2. By reviewing several test reports performed by a single technician on a single sample, you would be checking _____. (para 3)
3. By reviewing several test reports performed by different laboratories on a single sampled product, you would be checking _____. (para 4)
4. To be able to identify possible erroneous test results, you must compare all test results for the sample using the _____ and _____ (para 5)

DO YOU UNDERSTAND EVERYTHING IN THIS REVIEW EXERCISE?
HAVE YOU CHECKED YOUR RESPONSES, MADE CORRECTIONS, AND
RESTUDIED THE TEXT, IF NECESSARY? IF YOU HAVE, GO ON
TO THE EXAMINATION.

SOLUTION SHEET

Exercise

- 1.
- 2.
- 3.
- 4.

Solution

- test method
- repeatability
- reproducibility
- significance of test
product characteristic norms