• 5th annual ascope Laboratory Test Correlation Programme on CFR ENGINE (1983)

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ABSTRACT

A high precision CFR Engine Laboratory operating according to standard requirement is a must in the oil industry. It is also of very high importance within work of research activities on the use of hydrocarbon fuels.

In ASEAN we have the ASCOPE correlation program on CFR engine laboratory to obtain precision data in the gasoline by CFR test research method. Member countries taking part in the 5th laboratory test correlation program for CFR engines are Indonesia as coordinator with six laboratories participating, Malaysia, Philippines, Singapore and Thailand with two laboratories each and USA with are laboratory.

The 5th correlation program was started by sending sample by the program correlation in January, 1983 after being tested the participating laboratories, the test result were sent to the program coordinator who procured the result for the determination of standard deviation according to precision and statistics. Based on result, conclusion can be drawn about the deviation of laboratory test results.

I. INTRODUCTION

A high precision CFR engine laboratory operating according to standard requirements is a must in the oil industry. It is very important to back up the refineries in the production of motor fuels according to specifications. It is also of very high importance within the framework of research activities on the uses of hydrocarbon fuels and on alcohol as a substitute for gasoline.

The need of having a CFR engine laboratory to serve near each refinery, however, posed the problem of reproducibility of test results, if the same identical materials is tested by different laboratories. It is in facing these problems, that the CFR engine laboratories in ASEAN and other countries should continuously and regularly compare their test results through a test correlation programme for CFR engine laboratories. The ASCOPE Work Programme for 1983 as approved by the Eighth Council Meeting in Kualalumpur, Malaysia, October 22 — 23, 1982, directed the Technical Committee to conduct the 5th and 6th

ASCOPE laboratory test correlation programmes for CFR engines.

Member countries taking part in the 5th AS-COPE laboratory test correlation programme for CFR engines are Indonesia as coordinator with seven participating laboratories, Malaysia with one laboratory, the Philippines and Thailand with two laboratories each, and Ethyl Corporation Long Beach Laboratory of USA. The Ethyl Long Beach (USA) laboratory is participating for the first time in the ASCOPE laboratory test correlation programme on CFR engines this year and participated in both the 5th and 6th correlation programmes.

Member countries taking part in the CFR esgines are Indonesia as coordinator with seven laboratories participating, Malaysia with one laboratory, Philippines and Thailand with two laboratories each, and Singapore and USA with one laboratory each.

The Singapore laboratory is participating the first time in the 6th ASCOPE laboratory test relation programme on CFR engines.

The coordinator in their correlation programme is responsible in preparing the correlation samples and sending them by air to each participating laboratory through the respective country coordinator according to schedule.

The first of this 1983 programmes (5th correlation programme) was started by sending samples in January 1983, and the second (6th correlation programme) was started by sending samples in May 1983. After being tested by the participating laboratories, the test results were sent to the programme coordinator who procured the results for the determination of the standard deviation rejection of outliers according to precision and statistics. Based on these results, conclusion can be drawn about the deviation of laboratory test results.

For better analysis of the results, for each of the samples for correlation, it was also required to report physical and chemical test results such as specific gravity, RVP, distillation and lead (TEL) content by receiving laboratories. This is necessary in order to take into account any possible changes in the sample properties which might have occured during transportation and storage.

II. CORRELATION PROGRAMME EXECUTION

A. Correlation Samples

Lemigas as coordinator, provided and prepared the correlation samples shown in Table 1.

The correlation samples were sent to each participating laboratory. The amount of the correlation sample, was two liters for each grade, put into two one-litre cans; one litre cans were used in order to comply with IATA air transport regulations concerning the maximum fuel container volumes permitted for air transport of inflammable materials.

To facilitate and simplify the conduct of this programme, each sample was coded alpha-numerically according to sample type as follows: "SC-number". where SC indicates sample code and number, indicates sample type.

Tabel 1
5th ASCOPE LABORATORY TEST CORRELA—
TION PROGRAMMES ON CFR ENGINES (1983)
Types and Codes of Sample

Туре	Grade	Code
1. Commercial	Fuel High Grade	SC-01
2. Commercial	Fuel Low Grade	SC-02
3. Standardization	Toluene-Heptane	SC-03

B. Participating Laboratories

The participating laboratories were similarly coded alpha-numerically as follows: "LC-number", where LC indicates laboratory code and participant's number in this correlation programme.

In order to facilitate communication, laboratories in each country were coordinated through a Country Coordinator.

III. SAMPLE PREPARATION

Test samples for the 5th and 6th CFR Correlation Programmes were prepared by the Programme Coordinator and who distributed them to the participating laboratories through their respective Country Coordinators. Samples for the 5th CFR Correlation Programme were prepared and sent to the participating laboratories in January 1983, while for the 6th CFR Correlation Programme samples were prepared to be sent in May 1983.

In each case, sample preparation consisted of five stages, viz :

- Acquisition of substances for sample preparation, materials and equipment
- 2. Blending of sample

- 3. Filling of sample into containers
- 4. Packing
- 5. Dispacth.

Each of these steps was carried out in the routine manner, but with utmost care, by LEMIGAS as the coordinating laboratory.

IV. ROUNDING RULES FOR THE TEST RE-SULTS

The ASA rules for rounding as pertained to this procedure can be stated simply as follows:

- The value of the number is unchange when the last digit to be dropped is less than 5
- The digit proceeding the digit to be dropped is raised by one when the last digit is greater than 5
- When the last digit to be dropped is exactly 5 and the digit proceeding it is an even digit, the 5 is dropped without change to the number
- When the digit to be dropped is exactly 5 and the digit proceeding it is an odd digit, the digit proceeding is raised by one.

Example:

Number	Nearest Hundredth	Nearest Tenth
1. 97.642	97.64	97.6
2. 97.237	97.24	97.2
3. 97.355	97.36	97.4
4. 97.985	97.98	98.0

When rounding from the three digits to one digit the last two digit to be dropped must be considered together and the rule applies to values greater or less than 50.

V. PROCEDURE FOR TEST DATA ANALYSIS

Test results were analysed according to the following procedure for calculating basic statistical data for analysing programme results.

The data obtained by this procedure include average of results, average of deviations, standard deviations, and rejection of outliers, which are basic to other statistical treatment such as trend etc.

The data thus obtained also provide sufficient parameters for comparing like data from individual laboratories or groups of laboratories performing the same test. The procedure is presented in a step manner to standardize procedure and to simplify the calculations and evaluation. The following steps are taken to calculate the basic statistical data:

Step I Number of result = n

Results =
$$x_1, x_2, x_3, \dots, x_n$$

Sum of results = $\sum_{i=1}^{n} x_i$

. Step II Average of results =
$$\frac{\sum_{j=1}^{\infty} x_j}{n} = \bar{x}$$

Step III Deviation =
$$x_i - \overline{x}$$

Sum of deviation = $\sum_{i=1}^{n} x_i - \overline{x}$
 $\sum_{i=1}^{n} x_i - \overline{x}$
Average deviation = $\frac{\sum_{i=1}^{n} x_i - \overline{x}}{n}$

Average deviation =
$$\frac{1}{n}$$

Step IV Deviation squared = $(x_i - \bar{x})^2$

. Step V Variance =
$$\frac{\sum_{j=1}^{n} (x_j - \overline{x})^2}{n-1}$$

Step VI Standard deviation =
$$\sqrt{\frac{n}{\sum_{i=1}^{n} (x_i - \bar{x})^2}}$$

"T" factor times standard deviation

$$= T \times \sqrt{\frac{\sum_{j=1}^{n} (x_j - \bar{x})^2}{n-1}}$$

"T" factor is obtained from Table of Grubb's rejection criterion.

In the computation of standard deviation the use (n-1) is statistically more correct than n.

VI. TEST RESULTS

A. 5th ASCOPE CFR Engines Correlation Programme

The results submitted by the participating laboratories were compiled and evaluated following the procedure described above.

For 5th CFR engine programme, results for sample SC-01 are listed in Table 2 and 3, which show respectively the ambient temperature and engine oper-

Table 3

1th ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1983)

Lab. No.		10-01	LC-92	1.0-03	LC-04	LC-05	1.0-06	10-01	LC-08	LC-09	EC-10	LC-11	TC-13	EC-13	10.14
Motor Number		1	4-36	E-1814	1061150	F-L	6 (F1)	207441		1104652	G-17747 /78	9-69 178812	9.73 152382	CFR-45	3-17183
Total Hours		1143.8	100	3748.6	5912	1177	174	1332.0		1400	2656.2	1920.3	1910.4	11354	3205
Ranning Hours after Last Overhead		323.2	25	331.1	146	431	43	113.1		046	1185.2	47.9	W3.7	520	268
Use for Tower, Y	ec/No	No	Yes	Yes	No .	Ym	No	Ym		No	No -	No	Yes	Yes	No
limke Air Temperatur	e op	125	128	125	125	125	122	125		125	125	125	125	125	136
Andreas Temperature	100	28	30	29	25	29	30	.30		26.7	29	23,9	32-33	21	16
Barometric Pressure, re	-	763.9	766	780	760	764	750	761		762	760	759.5	753.5	757	7523
EFM		600	600	600	600	600	600	600		598	600	600	600	600	600
Abtitude,	- 10	3.65	2.5	3.61	- 5	4.7	35	4.		41	6	7.5	4	0	-
Knockmeter Sessitivit		29	30	11	15	23	-	18		-	14	30	20	47	-
	l pc				Torre	and the	814	-		836	Salar		1	877	3.18
Cylinder Posttian	MS	0.426	0.435	0.441	0.425	0.421		0.434			0.418	0.447	0.413		

Table 3

Sth ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1983)

Tost Results Sample No. SC-85

Lah, No.		1001	10:02	LC-03	LC-04	FC-01	1.0-06	1.0-07	LC-OR	10:00	LC-10	10:11	10-12	10.13	10:14	Average
Motor Number		1.	4-62 1121197	B1814	1061150	FI	6 (F1)	207441		1104652	G37747 /78	9-89 178812	9-13 252362	CFR4II	3-17113	11/1
Knock Rating F-1 ASTM D-2699	ON	95.9	96.0	95.9	96.1	95.7	95.5	95.8		95.6	96.0	95.8	96.7	16.7	95.7	95.9
Spec. Grantry 60/60 ⁰ ASTM D-1298	Op.	0.7582	0.7991	0.7573	0.7563	0.7579	0.7597	0.7500		0.7599	0.7581	0.7599	0.7579	0.7586	10	0.7586
HVP, ASTM D-323	pet	6.8	6.5	Tal	0.0	6.8	6.8	75.		3.6	7.2	7.1	7,0	5.1		5.5
Desilation ASTM D-86																
381	PC.	-0	43.5	39	43	.99	45	42		48.9	42	52	42	45	9t	43.7
10%	90	64	60	66	-66	64	66	62		65	-64	70.	83.	84	24	64.7
50%	#c	100	15.5	100	102	101	102	99.5		96.7	100	100	100	101	1.5	99.8
90 %	#c	145	141	145	140	150	150	146.5		143.3	167	142	143	145	100	145.5
EF	90	183	189,5	185	183	185	166	176.5		191.1	179	171	182	181	-	181.3
TEL Content, mL/C ASTM D-526/B		239	2.38	133	0.93	2.31	2.0t	1.58		2.41	2.59	2.80	3.53	2.5	14	22

ating conditions, general properties of sample deviation of general properties of sample deviation of general properties and calculation.

average octane number, standard deviations and rejection of outliers for sample SC-01, SC-02, SC-03, respectively (see page 42 through 45).

Table 4

S^{GL} ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1983.)

Test Conditions Sample No. SC-02

		LC-01	1.0-01	LC-03	LC-04	10-05	TC-06	LO-07	LC-88	LC-09	LC-10	TOH	LC-12	10-11	10.14
Lah. No.			10000		- Contract	E-L	6 (P1)	207441		1104652	G-37747	178812	6-71 110541	CFR-46	3-17183
Hotor Number		8	1131197	E-1814	1001139			-			2656.8	1920.2	3090.2	11355	3305
Total Hours		1144.7	10	3749.4	5914	1172	175	1333/7		-	2830,8	272012			
Ranning Hours after Last Overhand		314.1	25	331.9	148	431	43	114.1		000	1185.8	47.9	3.0	921	168
	es/No	No	Yes	Yes	No	Yes	No	THE		No	260	No	Yes	Yes .	No
Carlotte Control of	-	-	-	125	125	125	122	125		125	125	125	125	125	125
betake Air Temperatur	4, "F	125	120					A CONTRACTOR OF THE PARTY OF TH		26.7	29	23.9	12-33	- 27	16
Applient Temperature	90	28.5	30	29	22	-29	30	. 30				-	-	757	752
Barrometric Pressure, it	um Ha	764.1	755	760	760	764	756	761		762	760	759.5	755.5	100	
EPM		600	600	800	600	- 600	600	600	-	996	600	500	600	600	600
		3.65	-	3.61	- 1	4.7	3.5	4		41	6.	3.5	4	0	-
Althuis,	m	-		- District	1000			- 11		14	14	29	16	47	-
Knockmeter Sensitivit	y .	22	23	12	15	35	-	44.	-	761	-	-	-	750	744
Cylinder Position	DC	1000		The same of	4 144		814	0.478		791	0.475	0.518	0.464		
Chiman Lourison	ME	0,483	0.495	0.490	0.485	0,435		0.678							

Tubis 5

5th Ancore Laboratory Test Correlation Programme for CFR Engines (1983)

Test Results Sample No. 9C-93

						1100	HARRIES SE	April Land								_
Lah. No.		LC-01	10-01	10-09	10:04	tc-es	10:06	10:07	LC-08	LC-0V	LC-10	10:11	1012	10-13	10-14	Annu
Note Number		1	662 1131197	E-1814	1061130	F-)	6(F1)	227441	-	1104612	G-87747	9.69 175812	6-72 230541	CFB48	211111	
Koock Rating F-1 ANTM D-2699	(06)	90.4	0.19	91.0	91.5	91:1	91.0	91.5		90.8	95.4	963	91.2	90.8	91.3	91.1
Spec. Gravity 60/60 ^o ASTH D-1296	2ºF	6,7407	0.7401	0.7409	0.7397	10,7401	0.7412	0.7649		0,3420	0.3412	0.7428	0.5424	0,2410	-: 12	0.7414
RVP, ASTM D-323	pri	7.4	7.4	7.7	3.8	74	7.5	5.4		63	7,7	8.1	7.6	7.5	200	7,4
Distributions ASTM D-86																
182	40	40	36.5	36	_40	31	40	47		44.4	-43	45	40	43	-	40.9
10 %	-40	59	55.5	60	-61	19	-11	64.5		10	+1	60	80	60	-	60.2
50 %	nc.	91	94.5	17	301	96	- 98	100	-	94.4	61.	-98	97	100	11	97.6
90 %	80	141	.150	149	121	154	155	153		145.5	152	1114	131	155	10	151,4
EF	-Fc	192	189	188	188	190	192	1155		185.6	1107	310	187	186	-	187,3
TVI. Commit. III. ASTM D-326/B	/USG F-116	2.55	2.26	261	1.84	2.56	221	1.81		133	2.45	1.15	2.62	3.2		2.0

Results for sample SC-02 are similarly listed in VII. CONCLUSION
Table 4 and 5.

Similarly, the results for sample SC-03 are shown in A. Table 6 and 7 (see page 37).

The results are summarized visually in Fig. 1, 2, 3 and 4, which plot the laboratory test results, the

5th ASCOPE CFR Engines Correlation Programme

From the results of test conducted by all participating laboratories and the evaluation of standard deviation/rejection of outliers (see Fig. 1, Fig. 2, Fig. sions can be drawn.

Second calculation, after excluding LC-12 from test 3, Fig. 4, page 42 through 45) the following conclufied by all test results.

Test Results

Concerning sample SC-01, 1 (One) rating exceeds standard deviation, viz the ratings coming from LC-06, and LC-12 exceeds outliers rejection criteria.

As shown in Fig. 1 (page 42) the deviation from average in this laboratory (LC-12) is + 0,8.

Concerning sample SC-02, 5 (five) ratings exceed standard deviation, coming from LC-04, LC-07, LC-10 and LC-13, which are however not to be rejected as outliers being still within acceptable limits based on Grubb's Criteria for 99 percent probability, Hence, the ratings from all the participating, laboratories concerning sample SC-02 are satisfactory.

5th ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CPR ENGINES (1983) Test Conditions Sample No. SC-03

Lab. No.	10.01	LC-01	LC-01	LC-04	10-05	LC-06	10:07	LC-08	10:00	LC-10	10:11	LC-12	1,0-13	LC-14
	100.01	4-28 1131141		1061190	F-1	p.(F1)	207441		1104652	G-31747 /78	179812	672 18041	CFR48	3-17183
Motor Number		1131141		The second second	-			-		2657.4	1920.2	3090.2	11356	3205
Total Hosty	1145.5		3710.3	5936	1173	176	1334.0		1.	200.00	1740-4	2010116	1000	
Recording Hause after Last Overhand	334.9	25	332.8	150	431	44	115.1		666	3186.4	47.9	3.0	522	268
the im Town. Yes/No	No	Yes	Yes	No	Nes	760	- Ves.		345	Ne	- No	Yes	Yes.	No
Ole In Land	-	129	125	125	125	122	125		325	125	125	125	125	126
trisler Air Temperature, "F	125				2000	30	30	_	76.7	29	23.8	33-51	- 27	16
Ambient Temperature, DC	29.5	30	20	-25	29	-	-		and the last	-	100	755.5	757	752
Burometric Pressure, mm Hg	364.9	706.1	790	790	764	756	761	_ 11	362	76/1	759.5			
RPM	600	600	600	100	600	100	600		-918.	100	600	600	600	600
Altroide III	365	25	3.61	-1	4.2	3.5	4.		41	- 11	- 2.5	4	- 0	-
-	26	24	13	15	-31	7.0	21		1000	141	30	10	34	
Knockesetin Strolithity		-	1100	-		614	1		3103			in the same		170
Cylinder Pressure DC	1000000	GA30	0.468	0.400	9,456	-	11.468		70.00	0.151	0.489	0.458		

5th ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1985) Test Bendte Sample No. SC-03

						CALL OF THE PARTY						10.11	10.11	15.12	16:14	Arroge
Ash. No.		TC-01	10-00	LC-03	\$C-04	EC-05	1.0-06	10-07	TC-04	TC-66	\$10-19	LC-11	FC-13	1.6-13	14014	Arrag
Motor Number		1	4-82	E:1814	1041150	74	n(F1)	207441		1104652	G-57747	176612	330541	CFR48	3-17193	
Knock Haring F-1 ASTM D-2699	ON	93.2	99.2	V2.8	93.5	93.3	93.1	0.00		92.9	93.6	99.5	103.6	99.3	0.00	95.2
Spec Gravey 60/60 ⁰ ASTM D-1298	o.F	0.8214	0.0233	0.8219	0.5197	BAIR?	0.8713	B.N255		0.8251	0.8713	0.8222	0.8212	0.8237		0.822
RVP, ASTM D-323	316	1.2	1.2	1.4	1.4	0.5	1.2	1.4		0.5	0.4	1.1	1.6	1.0	60	.1.1
Decilation ASTM D-86			-								ma!				-	
187	90	100	101	100	1043	100	101	102		101.1	101	103	100	102	2.4	101-2
10 %	o _C	103	204	103	101.8	194	104	194.5		103.9	103	194	104	104	1	1037
50 %	e.C	105	105.5	104	187.2	106	206	106		105.6	105	105	105.3	106	19	105,6
90 %	°C.	106	309	107	110.7	308	109	106		198.5	107	108	108.3	106	9-1	1000
EP	°C	118	125.5	121	111.2	130	120	111		110	110	130	124	313	100	117/
TEL COMMON, TEL COMMON DISTANT	4/USG	0.01	HE	0.00	0.003	NI	0.02	-916		368	NE.	NU	340	com	1	0.00

Table 8 5th ascope Laboratory test correlation programme for CFR engines (1983) Calculation SC-01 (First Calculation)

Col. A Laboratory	Motor Number F-1	Col. B Octane Number	Col. C Deviation of Average	Col. D Deviation squared
LC-01	8	95.9	0.0	0.0
LC-02	4-62-1131197	96.0	+0.1	0.01
LC-03	E - 1814	95.9	0.0	0.0
LC-04	1061150	96.1	+0.2	0.04
LC-05	F-1	95.7	-0.2	0.04
LC-06	6 (F 1)	95.5	- 0.4	0.16
LC-07	207441	95.8	-0.1	0.01
LC-08				
LC-09	1104652	95.6	- 0.3	0.09
LC-10	G-37747-78	96.0	+0.1	0.01
LC-11	9-69-178812	95.8	-0.1	0.01
LC-12	9-73-252382	96.7	+0.8	0.64
LC-13	CFR - 48	95.7	- 0.2	0.04
LC-14	3 - 17183	95.7	- 0.2	0.04
	Sum No. of Results (n)	1246.4 13	2.7 13	1.09 13

Step 1 : Average Octane Number: $\frac{\text{sum of results}}{\text{no. of results}} = \frac{1246.4}{13} = 95.9$

Step 2:

 $\frac{\text{sum of deviation}}{\text{no. of deviation}} = \frac{2.7}{13} = 0.21$ Average Deviation

Step 3: $\frac{\text{sum of dev. squared}}{\text{(no. of dev. squared-1)}} = \frac{1.09}{(13-1)} = \frac{1.09}{12} = 0.091$ Variance

Step 4: Standard Deviation : square root of variance = $\sqrt{\text{variance}} = \sqrt{0.091} = 0.30$

Step 5 : Rejection of Outliers : "T" factor x std. deviation = 2.61 x 0.30 = 0.78

Laboratory No. LC-12 is rejected.

Table 9
5th ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1983)
Calculation SC-01

(Second Calculation)

Col. A Laboratory	Motor Number F-1	Col. B Octane Number	Col. C Deviation of Average	Col. D Deviation squared
LC-01	8	95.9	+ 0.1	0.01
LC-02	4-62-1131197	96.0	+0.2	0.04
LC-03	E - 1814	95.9	+0.1	0.01
LC-04	1061150	96.1	+ 0.3	0.09
LC-05	F-1	95.7	- 0.1	0.01
LC-06	6 (F 1)	95.5	- 0.3	0.09
LC-07	207441	95.8	0.0	0.0
LC-08		14		
LC-09	1104652	95.6	- 0.2	0.04
LC-10	G-37747-78	96.0	+0.2	0.04
LC-11	9-69-178812	95.8	0.0	0.0
LC-12			1	
LC-13	CFR - 48	95.7	+ 0,1	0.01
LC-14	3 - 17183	95.7	-0.1	0.01
III P	Sum No. of Results (n)	1149.7 12	1.7	0.35 12

Step 1:

Average Octane Number: $\frac{\text{sum of results}}{\text{no. of results}} = \frac{1149.7}{12} = 95.8$

Step 2 :

Average Deviation : $\frac{\text{sum of deviation}}{\text{no. of deviation}} = \frac{1.7}{12} = 0.14$

Step 3 :

Variance : $\frac{\text{sum of dev. squared}}{\text{(no. of dev. squared-1)}} = \frac{0.35}{12-1} = \frac{0.35}{12} = 0.032$

Step 4:

Standard Deviation : square root of variance = $\sqrt{\text{variance}} = \sqrt{0.032} = 0.18$

Step 5 :

Rejection of Outliers : "T" factor x std. deviation = 2.55 x 0.18 = 0.46

All results are not rejected.

Table 10 5th ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1983) Calculation SC-02

Col. A Laboratory	Motor Number F-1	Col. B Octane Number	Col. C Deviation of Average	Col. D Deviation squared
LC-01	8	90.9	-0.2	0.04
LC-02	4-62-1131197	91.0	-0.1	0.01
LC-03	E-1814	91.0	+0.1	0.01
LC-04	1061150	91.5	+ 0.4	0.16
LC-05	F-1	91.1	0.0	0.0
LC-06	6 (F 1)	91.0	-0.1	0.01
LC-07	207441	91.5	+0.4	0.16
LC-08				
LC-09	1194652	90.8	- 0.3	0.09
LC-10	G-37747-78	91.4	+0.3	0.09
LC-11	9-69-178812	91.1	0.0	0.0
LC-12	6-72-230541	91.2	+0.1	0.01
LC-13	CFR - 48	90.8	- 0.3	0.09
LC-14	3 - 17183	91.3	+0.2	0.04
10.14	Sum No. of Results (n)	1184.6 13	2.5 13	0.71 13

Step 1 :

Average Octane Number: $\frac{\text{sum of results}}{\text{no, of results}} = \frac{1184.6}{13} = 91.1$

Step 2:

Average Deviation : $\frac{\text{sum of deviation}}{\text{no. of deviation}} = \frac{2.5}{13} = 0.19$

Step 3:

 $\frac{\text{sum of dev. squared}}{\text{(no. of dev. squared-1)}} = \frac{0.17}{(13-1)} = \frac{0.71}{12} = 0.059$ Variance

Step 4:

Standard Deviation ; square root of variance = $\sqrt{\text{variance}} = \sqrt{0.059} = 0.24$

Rejection of Outliers : "T" factor x std. deviation = 2.61 x 0.24 = 0.63

All results are not rejected.

Table 11
5th ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1983)
Calculation SC-03

Col. A Laboratory	Motor Number F-1	Col. B Octane Number	Col. C Deviation of Average	Col. D Deviation squared
LC-01	8	93.2	0.0	0.0
LC-02	4-62-1131197	93.2	0.0	0.0
LC-03	E · 1814	92.8	-0.4	0.16
LC-04	1061150	93.6	+0.4	0.16
LC-05	F-1	93.3	+0.1	0.01
LC-06	6 (F 1)	93.1	-0.1	0.01
LC-07	207441	93.0	-0.2	0.04
LC-08				**
LC-09	1104652	92.9	-0.3	0.09
LC-10	= G-37747-78	93.6	+0.4	0.16
LC-11	9-69-178812	93.1	- 0.1	0.01
LC-12	6-72-230541	93.6	+0.4	0.16
LC-13	CFR-48	93.3	+ 0.1	0.01
LC-14	3 - 17183	93.0	- 0.2	0.04
Na min	Sum No. of Results (n)	1211.7 13	2.7	0.85 13

Step 1 :

Average Octane Number : $\frac{\text{sum of results}}{\text{no. of results}} = \frac{1211.7}{13} = 93.2$

Step 2 :

Average Deviation : $\frac{\text{sum of deviation}}{\text{no. of deviation}} = \frac{2.7}{13} = 0.21$

Step 3:

Variance : $\frac{\text{sum of dev. squared}}{(\text{no. of dev. squared-1})} = \frac{0.85}{(13-1)} = \frac{0.85}{12} = 0.071$

Step 4:

Standard Deviation : square root of variance = $\sqrt{\text{variance}} = \sqrt{0.071} = 0.27$

Step 5 :

Rejection of Outliers : "T" factor x std. deviation = 2.61 x 0.27 = 0.70

All results are not rejected.

Figure 1

CFR 5th Correlation

Deviation vs Lab. Code (Sample No. SC-01)

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Figure 2

CFR 5th Correlation

Deviation vs Lab. Code (Sample No. SC-01)

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Figure 3

CFR 5th Correlation

Deviation vs Lab. Code (Sample No. SC-02)

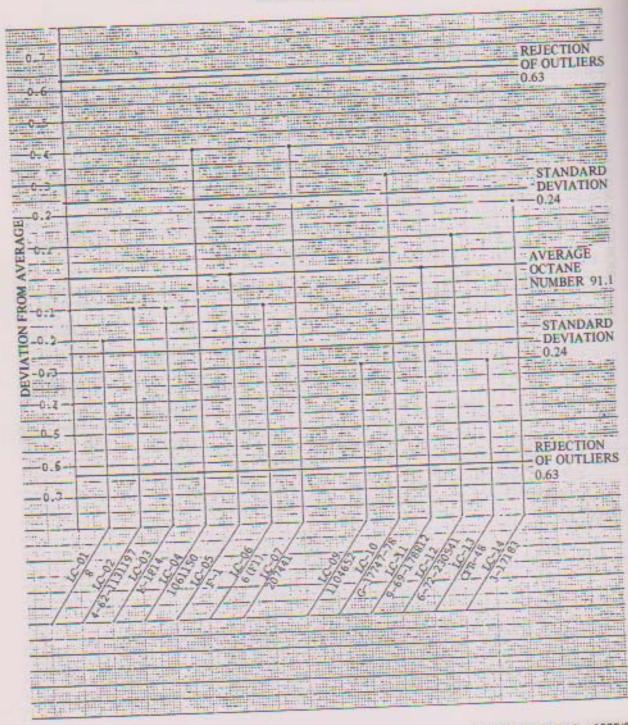
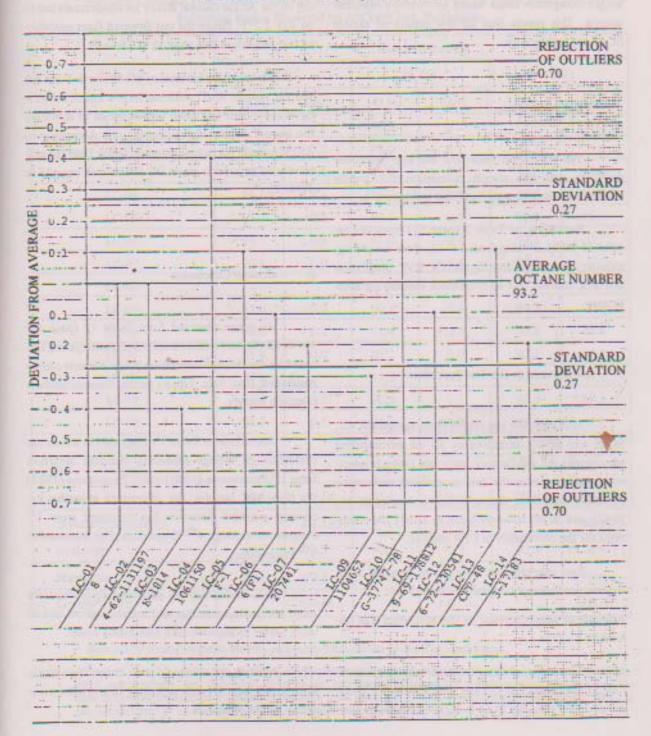


Figure 4

CFR 5th Correlation

Deviation vs Lab. Code (Sample No. SC-03)



Concerning sample SC-03, 5(five) ratings exceed standard deviation, coming from LC-03, LC-04, LC-09, LC-10 and LC-12. Which are however are still within acceptable limits based on Grubb's rejection criteria. This means that all test results of sample SC-03 are satisfactory.

2. Inspection Tests

The inspection tests data can also point out problems with the sample correlation (i.e. poorly mixed, evaporation, poor handling, leaking etc.).

According to Table 3 (page 35) from test results of SC-01 coming from LC-12, there are no significant deviation in specific gravity, RVP, distillation and TEL content that all correlation samples are satisfactory.

3. Adherence to the Test Procedure

Although, the test results of the samples SC-01, SC-02 and SC-03 submitted by all the participating laboratories are satisfactory, only one rating is rejected as outlier. From the data on ambient and engine operating conditions, during testing on samples SC-01, SC-02, and SC-03 however it can be satisfy the conditions for the correlation of CFR engines.

Two participating laboratories deviated from the test procedure established by the ASTM.

Example of non-adherence to the procedure is as follows:

Concerning sample SC-01, participating laboratory LC-14 carried out the test with barometric pressure at 752,9 mm Hg(29,64 in Hg) and Intake air temperature at 126°F. According to Table 2 of ASTM manual barometric pressure at 29,64 in Hg. Hence intake air temperature has to be at 121 ± 2°F. According to the ASTM manual intake air temperature has to be 121 ± 2°F. Hence the test deviated from established test procedure (see page 35 in Table 2).

Participating laboratory LC-13 carried out the test for sample SC-01 with too large a knock sensitivity viz. 47. This can cause inaccurancies in acquiring the octane number by interpolation. According to ASTM manual for octane numbers lower than the sensitivity to be used is about 30 or less (see page 35 in Table 2).

R. General Conclusion

As it can observed from Table 12 (page 47) out of all the correction samples and participating laboratories for the 5th correlation programme, it can be concluded that only 1(one) rating exceeds outliers rejection criteria.

According to Table 13 (page 48) in which the evaluation of ratings exceeding standard deviation from 1st Programme (1980) to 6th Programme (1983) for three test samples, the percentage of ratings exceeding standard deviation has decreased from 1st Programme through 4th Programme, but increased in 5th Programme.

This means that all participating laboratories must put more attention and remain vigilant and to work better to improve each correlation result.

Particularly attention must be paid to some participants who are still persisting in non-adherence to the ASTM procedure.

Table 12

5th ASCOPE LABORATORY TEST CORRELATION PROGRAMME FOR CFR ENGINES (1983)
Individual Rating Reported by ASCOPE Lab. Participant

TOTAL DESCRIPTION OF	3 700		Researc	ch Method	The second	The state of the s		
Lab. No.	SC	-01	SC	-02	SC-03			
Table 19	0.N.	Dev.	0.N.	Dev.	O.N.	Dev.		
LC-01	95.9	+0.1	90.9	- 0.2	93,2	0.0		
LC-02	96.0	+0.2	91.0	- 0.1	93.2	0.0		
LC-03	95.9	+ 0.1	91.0	- 0.1	92.8	- 0.4		
LC-04	96.1	+0.3	91.5	+0.4	93.6	+0.4		
LC-05	95.7 -	- 0.1	91.1	0.0	93.3	+0.1		
LC-06	95.5	- 0.3	91.0	- 0.1	93.1	- 0.1		
LC-07	95.8	0.0	91.5	+0.4	93.0	+0.2		
LC-08	3		-		m.	1000		
LC-09	95.6	- 0.2	90.8	- 0.3	92.9	-0.3		
LC-10 =	96.0	+ 0.2	91.4	+0,3	93.6	+0.4		
LC-11	95.8	0.0	91.1	0.0	93.1	- 0.1		
LC-12	(*)	HE THE	91.2	+0.1	93.6	+0.4		
LC-13	95.7	+ 0.1	90.8	- 0.3	93.3	+0.1		
LC-14	95.7	- 0.1	91.3	+0.2	93.0	- 0.2		
LC-15								
n	12	THE DESIGNATION OF THE PERSON	13		13			
Average	95.8	±0.14	91.1	±0.19	93.2	±0.21		
Standard Deviation		±0.18	em .	±0.24		±0.2		
Minimum	95.5	- 0.3	90.8	- 0.3	92.8	-0.4		
Maximum	96.1	+0.3	91.5	+0.4	93.6	+0.4		
Grubbs' Limits		± 0.46	-Edh	±0.63		±0.70		

^{*} Rejected by Grubbs' criterian for 99% probability. Results not included in computation.

Note: All ratings that fall within plus or minus two standar deviation the group average are to be considered statistically equal, precision-wise. Any underlined values exceed two standar deviations but are within acceptable limits on the basis of Grubbs' criterian for 99 percent probability. Such values are included in the computations. Rejected values, if any, are indicated by an asterisk (*) and are not included in computations.

Table 13
EVALUATION OF THE ASCOPE CFR ENGINE CORRELATION PROGRAMMES
Conducted from 1980 tp 1983

Percentage of ratings exceeding Standard Deviation

Sample Correlation	1 st Programme (1980)	2 nd Programme (1981)	3rd Programme (1982)	4 th Programme (1983)	5th Programme (1984)
SC-01	30.8	33.3	25	25	41.7
SC-02	38.5	16.7	25	16.7	38.5
SC-03	38.5	25	25	16.7	38.5

Note: One of the caused of unsatisfactory test results is non adherence to the test procedure established by ASTM.

REFERENCES

Weissmann, Dr. J., 1972, Fuel for Internal Combus-

tion Engine and Furnaces.

1974, Ethyl Corporation Technical Service Laboratories Precision and Statistic.

1980, Manual Book of ASTM Standard.

ERRATA

Several mistake have occured in an S.C. article entitled "Generation and Maturation of Hydrocarbons in Cepu Area, Central Java", appeared on S.C. No. 1/1985 on pages 14, 16, 17, 18, 19, and 21.

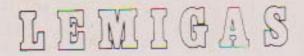
The breakdowns are as follows:

Page	Line	Column	Written	It should read
14	1	2	information	informations
16	5	1	in depth to reverse faults are	in depth to reverse faults with
				northward displacement of the upthrown block. Those reverse faults are
	2	2	to related	to be related
17	4	1	more 5000 m.	more than 5000 m.
	5	2	to prevailed	to be prevailed
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	19	2	(0.26 0.13 kg/ton).	(0.26 * 0.13 kg/ton).
	23	2	dept	depth
19	6	1	T-Max	T-max
	7	2	TOOC	TOC

In table 3, page 21 the Potential Yield column in kg/ton should read 0.34 instead of 0,34

The Editor

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