[redacted]

[redacted]

Distribution of this document is unlimited.

[redacted]

CONVAIR (ASTRONAUTICS) DIVISION
GENERAL DYNAMICS CORPORATION

[redacted]

CONVAIR | ASTRONAUTICS FORM A2136-1 (9-60) AS

DISCLAIMER NOTICE

THIS DOCUMENT IS THE BEST QUALITY AVAILABLE.

COPY FURNISHED CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

GDA-
REPORT NO. AE61-0661
DATE 12 July 1961
NO. OF PAGES 18

CONVAIR | ASTRONAUTICS

CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION

REDUCTION OF MASS SPECTROMETER DATA FROM THE AEDC (PWT) ROCKET PLUME EXPERIMENTS

Distribution of this document is unlimited.

PREPARED BY F. P. Boynton

CHECKED BY

APPROVED BY J. T. Neu

APPROVED BY V. A. Dabits

This document has been approved for public release and sale; its distribution is unlimited

This report has been prepared for General Dynamics/Convair under Contract No. AF 04(647) 644, ARPA Order No. 153-60

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

Gas sampling and mass spectrometric analysis are to be used to determine the composition of RP-1/O_2 and H_2/O_2 rocket plumes at various locations downstream of the nozzle exit. The exhaust gases will be analyzed for the constituents H_2, He, H_2O, N_2, CO, O_2, Ar, and CO_2. The mass spectrometer output is to be digitized and reduced by computational methods presented in this report. From the mass spectrometer output voltages one may determine the sample composition in terms of mole fractions, the mass fraction of entrained air, and the mixture ratio of the rocket. Computer codes for the IBM 650, together with block-diagrams and sample calculations, have been included as an appendix.

I. Introduction:

General Dynamics will conduct a study of the high-altitude behavior of rocket plumes in the Propulsion Wind Tunnel at Arnold Engineering and Development Center, Tullahoma, Tenn. One of the parts of the study is the sampling and analysis of the exhaust gases at various locations. A Consolidated Electrodynamics Corporation mass spectrometer, Model 21-620A, will be used to continuously monitor the exhaust gases. The output from this instrument will be digitized on punched tape and reduced by computer within a short period after the test has been conducted. This report represents methods of data reduction and block-diagrams of the necessary computer programs.

We presume the reader is familiar with the operation of a mass spectrometer, and we will not present the operating principles here. The particular instrument which will be used at AEDC has been modified so that mass-to-charge ratios from 2 to 44 appear on a single repeller setting. A low-pressure inlet system admits a heated gas sample to the system at about 0.05 psia collection pressure. Two peak selectors (Model 133250) have been ganged together to permit automatic stepping between a maximum of 12 different mass/charge ratios. Because the accelerating voltage takes some time to decay to a new value when the position of the selector switch is changed, it has been found necessary to interpose one or two "extra" settings between mass numbers which are far apart in terms of required voltage settings.

Essentially five different types of analyses are to be performed: background check, calibration, oxygen feed, RP-1/O_2 plume, and H_2/O_2

plume. The RP-1/O_2 plume will be analyzed for H_2, He, H_2O, N_2, CO, O_2, Ar, and CO_2 with the peak selector channels assigned as shown in Procedure A, Table I. Background checks (run at the beginning of each day, and before every 30-minute run) and oxygen feed analyses will also be conducted under this procedure when an RP-1/O_2 firing is being conducted. All calibrations will also be performed under this procedure. The H_2/O_2 plume will be analyzed for H_2, He, H_2O, N_2, O_2, and Ar according to Procedure B, since about 20 seconds per sample can be saved in this fashion. Backgrounds and O_2 feed analyses will be run according to Procedure B if H_2/O_2 firings are scheduled. Propellant oxygen will be analyzed for He, O_2, N_2, and Ar.

The data to be taken from each sample in order to perform a complete analysis, consist of the following items:

1) A tag number, Q, which identifies the sample being taken. Values of Q required range from zero to nine (0 - 9) and are shown in Table II.
2) The peak being analyzed. There are 12 peaks in all, their positions are preset by potentiometers on the peak selector chassis. Probably the best way to monitor the peak selector output is to pick up the position of the stepping switch. This might conveniently be taken off at the pilot lamp which indicates the energized channel to the operator.
3) The base line for each peak, or zero (Zi)
4) The maximum output at each peak (Hi)
5) An attenuation factor (Ai) for each peak; this is the factor by

which the output has been divided in order to keep it in the 0 - 10 mv. range. (This is done by means of series resistances). These data must be operated upon in order to express the composition of the sampled gases in mole fractions. This data reduction is to be done by means of a digital computer which will use the digitized mass spectrometer output as input.

Two machine programs will be required. One program calculates the sensitivity of the instrument to the different gases relative to the mass 28 peak of N_2, which is arbitrarily set at 100. In the following discussion, we shall identify the sensitivity of the instrument to the $j^{\underline{th}}$ gas (where the identifying subscript j is assigned as shown in Table I) at the $i^{\underline{th}}$ mass number or peak selector channel as Sij. The second program uses the Sij's and the output from the mass spectrometer caused by the sampled gases to calculate the mole fractions xj of the constituents of the sample, the weight fraction R of entrained air determined from all the constituents, the weight fraction of air A determined from an argon-helium balance, the mixture ratio Mc of the rocket as determined from the sampled gases, and the carbon/hydrogen ratio D of the sample. This report includes block-diagrams, SOAP codes for the IBM 650, and complete hand-checks of the programs using representative inputs.

TABLE I: PEAK SELECTION PROCEDURES

	Procedure A				Procedure B			
Channel	Approx. Volts	Gas	Mass Peak	j	Approx. Volts	Gas	Mass Peak	j
1	160	—	—	—	160	—	—	0
2	156	H_2	2	1	156	H_2	2	1
3	80	—	—	—	80	—	—	—
4	76	He	4	2	76	He	4	2
5	26	—	—	—	20	—	—	—
6	24.5	N_2,CO	14	4,5	19	H_2O	18	3
7	19	H_2O	18	3	13	—	—	—
8	13	—	—	—	12.5	N_2	28	4
9	12.5	N_2,CO,CO_2	28	4,5,8	11.5	O_2	32	6
10	11.5	O_2	32	6	10	Ar	40	7
11	10	Ar	40	7	160	—	—	—
12	9	CO_2	44	8	160	—	—	—

TABLE II: ASSIGNMENT OF Q-NUMBERS

Q	Calibration	Analysis	
		Procedure A	Procedure B
0	Background	Background	Background
1	Air	O_2 feed	———
2	N_2	Plume	———
3	O_2	———	O_2 feed
4	Ar	———	Plume
5	CO	———	———
6	CO_2	———	———
7	H_2	———	———
8	He	———	———
9	H_2O	———	———

II. Analysis:

The instrument will be calibrated once each day, or oftener if it appears necessary, by admitting a sample of pure gas to the auxiliary inlet at exactly atmospheric pressure, expanding it to the expansion volume, and introducing it into the mass spectrometer in "batch" fashion. The mass spectrometer is sensitive to the partial pressure of a particular gas at its inlet. Since we are analyzing all gases, we do not need the absolute sensitivity of each gas in volts output per pressure unit, but only the relative sensitivity. We shall arbitrarily designate the sensitivity S_{ij} of N_2 at mass 28 as 100, and refer others to it. This is allowable if the calibrating gases are all introduced at the same pressure into the inlet system.

It is conceivable that we may introduce some air into the instrument together with the calibrating gas. We can correct for an air impurity if the first calibrating gas which we run each day is air. The mole fraction of air is then easily determined by monitoring either the mass 28 or mass 32 peak choosing whichever does not occur in the mass spectrum of the pure gas. If the pure gas peak whose sensitivity we are measuring does not occur in air (i.e., does not happen to be 14, 28, 32, or 40), then the sensitivity of the pure gas is determined by dividing its apparent sensitivity (measured with the air contamination present) by its mole fraction, which is one less the mole fraction of air if no other contaminants are assumed to be present. If the particular peak of interest is one which also occurs in air, the air contaminant must be

subtracted from the peak height in order to determine the true value.

As an instructive example, consider the calibration of the instrument for sensitivity to CO_2 (gas number, j = 8) at the mass 28 (i = 9) and 44 (i = 12) peaks. The amount of air is determined by monitoring the peak at mass 32 (i = 10); the sensitivity of the instrument to oxygen at this mass number has been previously determined. The instrument measures the output voltage or peak height (H_i), the zero line (Z_i), and the attenuation factor (A_j) at all twelve peaks; we choose to operate only on peaks number i = 9, 10, 12. The corrected peak height C_i is determined by subtracting the zero reading from the measured value and multiplying by the attenuation factor, thus:

$$C_i = A_i \ (H_i - Z_i)$$

The background reading, B_i, which was previously determined, is subtracted from C_i to give the true peak height T_i:

$$T_i = C_i - B_i$$

The mole fraction of oxygen in the sample may be determined by dividing the true output at peak 10 by the output of pure oxygen at the same peak (and at the same sampling pressure), or since we use nitrogen as our reference,

$$x_6 = T_{10} \ S_{9,4}/S_{10,6} \ P_9$$

In the above expression x_6 is the mole fraction of O_2 (gas number, j = 6), $S_{9,4}$ (= 100) is the instrument sensitivity to nitrogen (gas number, j = 4) at the mass 28 peak (i = 9), $S_{10,6}$ is the sensitivity to O_2 at mass 32 (i = 10, j = 6) and P_9 is the instrument's response to a pure nitrogen sample at mass 28 at the same pressure as the CO_2 sample. We may then

determine the instrument's response to CO_2 at mass 44 ($S_{12,8}$) by the relation

$$S_{12,8} = T_{12}\, S_{9,4}/P_9\, (1 - x_6/0.2095)$$

where 0.2095 is the mole fraction of oxygen in air. The response observed at mass 28 is due to both N_2 and CO_2. The response due to N_2 is

$$\frac{0.7808}{0.2095}\; x_6\; P_9$$

where 0.7808 is the mole fraction of N_2 in air. Then

$$S_{9,8} = \frac{S_{9,4}}{P_9}\quad \frac{T_9 - \frac{0.7808}{0.2095}\, x_6\, P_9}{1 - x_6/0.2095}$$

The block diagram of the calibration program was constructed from these and similar considerations. A bit of study will show how the corrections for air were performed in other cases.

The output of the calibration runs will be used in the analysis of the oxygen feed and plume samples, together with the output data (H, A, and Z) from these runs. For every component except N_2 and CO, the response factor F_j is determined by a relation

$$F_j = T_i/S_{i,j}$$

N_2 and CO both have major peaks at mass 14 and mass 28. The situation at mass 28 is further complicated because CO_2 has a peak there also. The procedure adopted is to subtract out the CO_2 contribution to the mass 28 output, as follows:

$$T_9' = T_9 - F_8\; S_{9,8}/S_{12,8}$$

Then we may solve the following simultaneous equations for F_4 and F_5 (response factors for N_2 and CO):

$$S_{9,5} F_5 + S_{9,4} F_4 = T_9'$$

$$S_{6,5} F_5 + S_{6,4} F_4 = T_6$$

Since there is no CO or CO_2 in the H_2/O_2 samples, we can calculate all response factors in the same manner. Once we have all the F_j's, we may calculate the mole fractions of the different components:

$$X_j = F_j / \sum_{j=1}^{5} F_j$$

The oxygen feed samples and the plume samples using H_2/O_2 propellant do not contain either CO or CO_2, so that we may revise our procedures slightly in order to conserve tunnel time. This is why the subscripts in the analysis program block-diagram under tag numbers 3 and 4 (O_2 feed and H_2/O_2 plume sample, respectively) do not always match up.

In the plume samples, there are a number of quantities of interest which may be derived from the composition in terms of mole fractions. One of these is the ratio of hydrogen atoms to carbon atoms in the sampled gas. In RP-1 this ratio is about 2.0; its deviation from this figure in the sampled gases is a measure of the sampling error, since neither H nor C is added to the gas by the oxygen feed or the entrained air. We can compute this ratio (D) simply by summing the hydrogen-containing compounds multiplied by the subscript of hydrogen in each compound, and dividing by the similar sum of the carbon-containing compounds, e.g.,

$$D = (2 X_{H_2O} + 2 X_{H_2}) / (X_{CO} + X_{CO_2}) = (2x_3 + 2x_1) / (x_5 + x_8)$$

This computation is of course not performed when H_2 is the fuel.

The weight fraction of entrained air may be computed in two ways: The first requires an accurate analysis of the sampled gas, in that the true proportions of all components must be known. Since nitrogen is nearly inert, its relative proportion in the sample is unchanged by any reactions in the gas or by the sampling process (if a true sample is taken). We may thus compute a "mole fraction" of air (not a true mole fraction, since in general some of the oxygen has reacted) by the relation

$$X_A = X_{N_2} / 0.7808 = X_4/0.7808$$

The "molecular weight" of air is 28.962; a molecular weight of the exhaust gases, N, may be calculated by the relation

$$N = \sum_{j=1}^{n} X_j M_j$$

where n is 6 in a H_2/O_2 firing and 8 in an RP-1/O_2 firing. Then the weight fraction of air computed in this manner is

$$A = 28.962 \; X_4/0.7808 \; N$$

A second method of computing the weight fraction of air does not require an accurate analysis of the sampled gases, but does require an analysis of the oxygen feed. This method utilizes an inert gas tracer (He) added to the O_2 feed and another inert tracer (Ar) which is naturally present in air. The weight fraction of He in the O_2 sample is

$$w_{2,o} = 4.003 \; X_{2,o}/N_o$$

This quantity is calculated from the oxygen analysis at the beginning of each 30-minute run. There will also probably be some argon present in

the oxygen; the weight fraction of argon is, similarly,

$$W_{7,o} = 39.944\ x_{4,o}/N_o$$

(These quantities may be corrected for an air leak). The weight ratio of helium to argon in the plume sample may easily be determined from the mole ratios:

$$(W_2/W_7)_p = 4.003\ x_2/39.944\ x_7$$

The weight fraction of argon in air is 0.01288. From these four quantities, $W_{2,o}$, $W_{7,o}$, $(W_2/W_7)_p$, and W_7, air = .01288, we may compute the fraction of air independently from any effects of reaction.

Let the mixture ratio (determined by measuring the propellant flow rates) of the rocket be M. Then, on the basis of one lb. of fuel, M lbs. of oxygen enters the chamber, and M + 1 lb. of exhaust gases are formed. The weight fraction of helium in the exhaust is

$$W_{2,E} = W_{2,o}\ \ M/(M+1)$$

and likewise for argon. Let B lbs. of air be mixed with the M+1 lbs. of exhaust to form M+1+B lbs. of plume. The weight fraction of He in the plume is:

$$W_2 = W_{2,o}\ \ M/(M + 1 + B)$$

The weight fraction of argon is:

$$W_7 = \frac{W_{7,o}\ M + 0.01288\ B}{M + 1 + B}$$

and the ratio is

$$W_7/W_2 = W_{7,o}/W_{2,o} + (B/M)\ 0.01288/W_{2,o}$$

whence (B/M) = $\dfrac{W_7/W_2 - W_{7,o}/W_{2,o}}{0.01288/W_{2,o}}$

The air/oxygen ratio B/M may be used to calculate the weight fraction of entrained air, R, as follows:

$$R = M\,(B/M) \,/\, \left[M + 1 + M\,(B/M)\right]$$

whence $$R = \frac{M\,(W_7/W_2 - W_{7,o}/W_{2,o})\; W_{2,o}/0.01288}{1 + M \quad 1 + (W_7/W_2 - W_{7,o}/W_{2,o})\; W_{2,o}/0.01288}$$

The mixture ratio may also be determined from a knowledge of the total composition. Let us call this quantity M_c, to distinguish it from the measured mixture ratio M. The weight of fuel in one mole of sampled plume gas is given by

$$W_F = 2.016\,(X_1 + X_3) + 12.010\,(X_5 + X_8)$$

(The second term is not present if an H_2/O_2 run is being analyzed). The weight of oxygen is

$$W_{ox} = 32.000\,(\tfrac{1}{2} X_3 + \tfrac{1}{2} X_5 + X_6 + X_8)$$

Part of this comes from entrained air, so that the amount due only to the propellant feed is

$$W_{ox,o} = 32.000\,(\tfrac{1}{2} X_3 + \tfrac{1}{2} X_5 + X_6 + X_8 - \frac{0.2095}{0.7808}\; X_4)$$

The mixture ratio is then

$$M_c = \frac{W_{ox,o}}{W_F} = \frac{32.000\,(\tfrac{1}{2} X_3 + \tfrac{1}{2} X_5 + X_6 + X_8 - \frac{0.2095}{0.7808}\; X_4)}{2.016\,(X_1 + X_3) + 12.010\,(X_5 + X_8)}$$

An alternative expression may be developed by using the relationship $X_1 + X_3 = X_5 + X_8$ if the H/C ratio of the fuel is 2. Then

$$M_c = \frac{32.000\ (\frac{1}{2} X_3 + \frac{1}{2} X_5 + X_6 + X_8 - 0.2683\ X_4)}{14.026\ (X_5 + X_8)}$$

This last expression puts less reliance on the accuracy of the analysis of the condensable component H_2O; it can only be used for the RP-1/O_2 runs.

III. Conclusions:

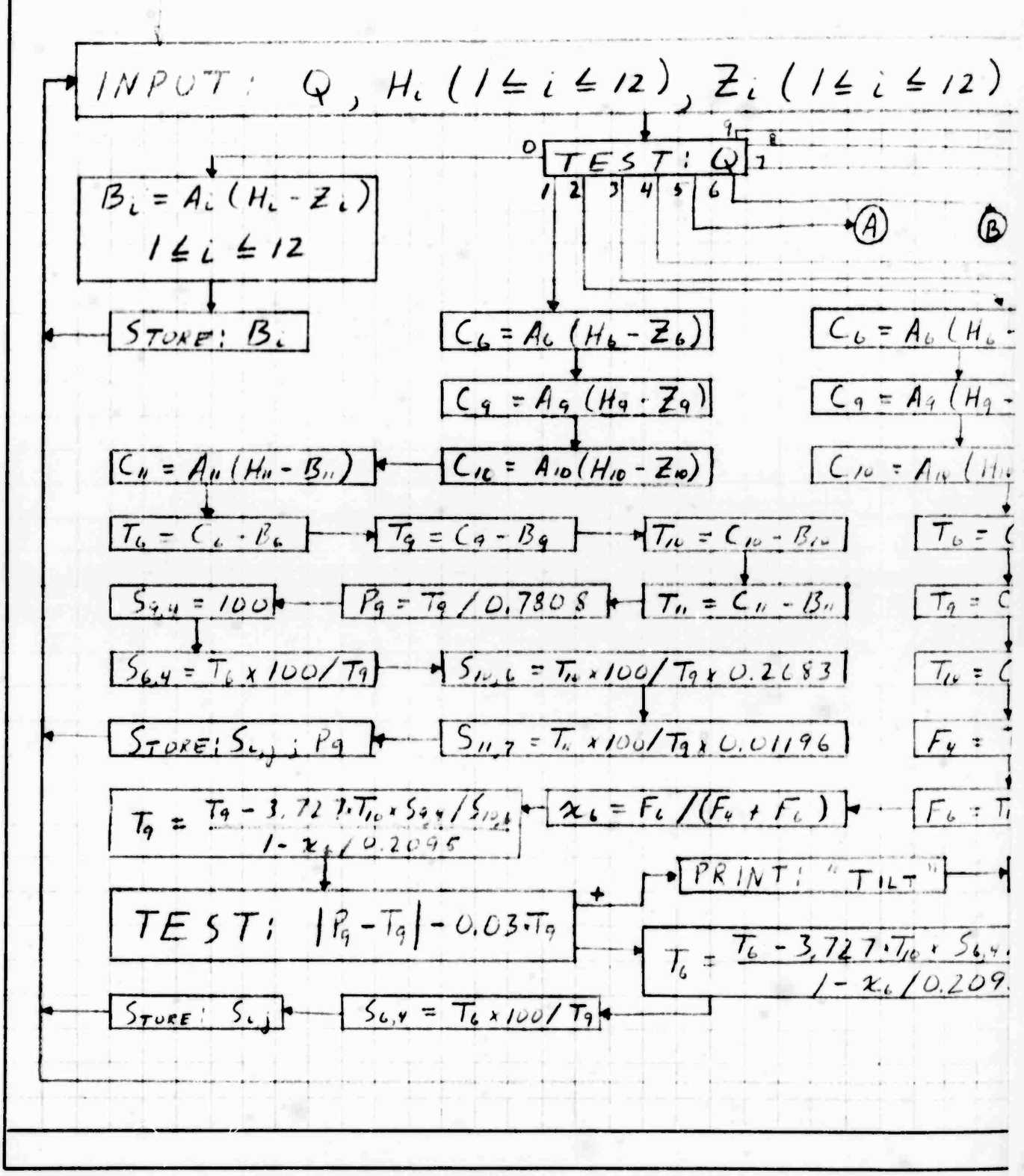
On the basis of the considerations indicated in the preceding section, we have developed computer programs suitable for the reduction of digitized mass spectrometer output data. In the appendix, block-diagrams, SOAP codes suitable for the IBM 650, sample inputs, and hand-computed results are presented. These results may be used in incorporating these data reduction procedures into the AEDC system. The input required for calibrations are the individual peak heights, base lines, and attenuation factors, as well as tag numbers (0 - 9) which identify the different gases. The output of the calibration data reduction program consists of the relative sensitivities of the different constituents. The analysis of a gas sample requires the same type of input as the calibration runs, and also the sensitivities and a measured propellant mixture ratio. The output of this program is the mole fractions of the different gases in the sample, the H/C ratio of the fuel (if it is RP-1), the weight fraction of entrained air (computed in two ways), and the mixture ratio of the propellant as computed from the sample composition. This information can be used in a number of subsequent calculations; some of these will be discussed in another report.

TABLE III: NOMENCLATURE

A	Mass fraction of entrained air (from total composition)
A_i	Attenuation factor at i^{th} mass peak
B_i	Background peak height at i^{th} mass peak
C_i	Corrected peak height at i^{th} mass peak
D	Hydrogen/carbon ratio of fuel
F_j	Response factor due to the j^{th} component
H_i	Measured peak height at i^{th} mass peak
M	Measured mixture ratio of propellant
M_e	Calculated mixture ratio
N	Molecular weight of sampled gases
P_9	Response of instrument to N_2 at mass 28
Q	Tag number, identifying sample
R	Mass fraction of entrained air (from Ar/He balance)
S_{ij}	Sensitivity at i^{th} mass peak of j^{th} component, relative to $S_{28,N_2} = 100$
T_i	True peak height at i^{th} mass peak
W_j	Weight fraction of j^{th} component in sample
X_j	Mole fraction of j^{th} component in sample
Z_i	Zero or base line at i^{th} mass peak

CONVAIR ASTRONAUTICS

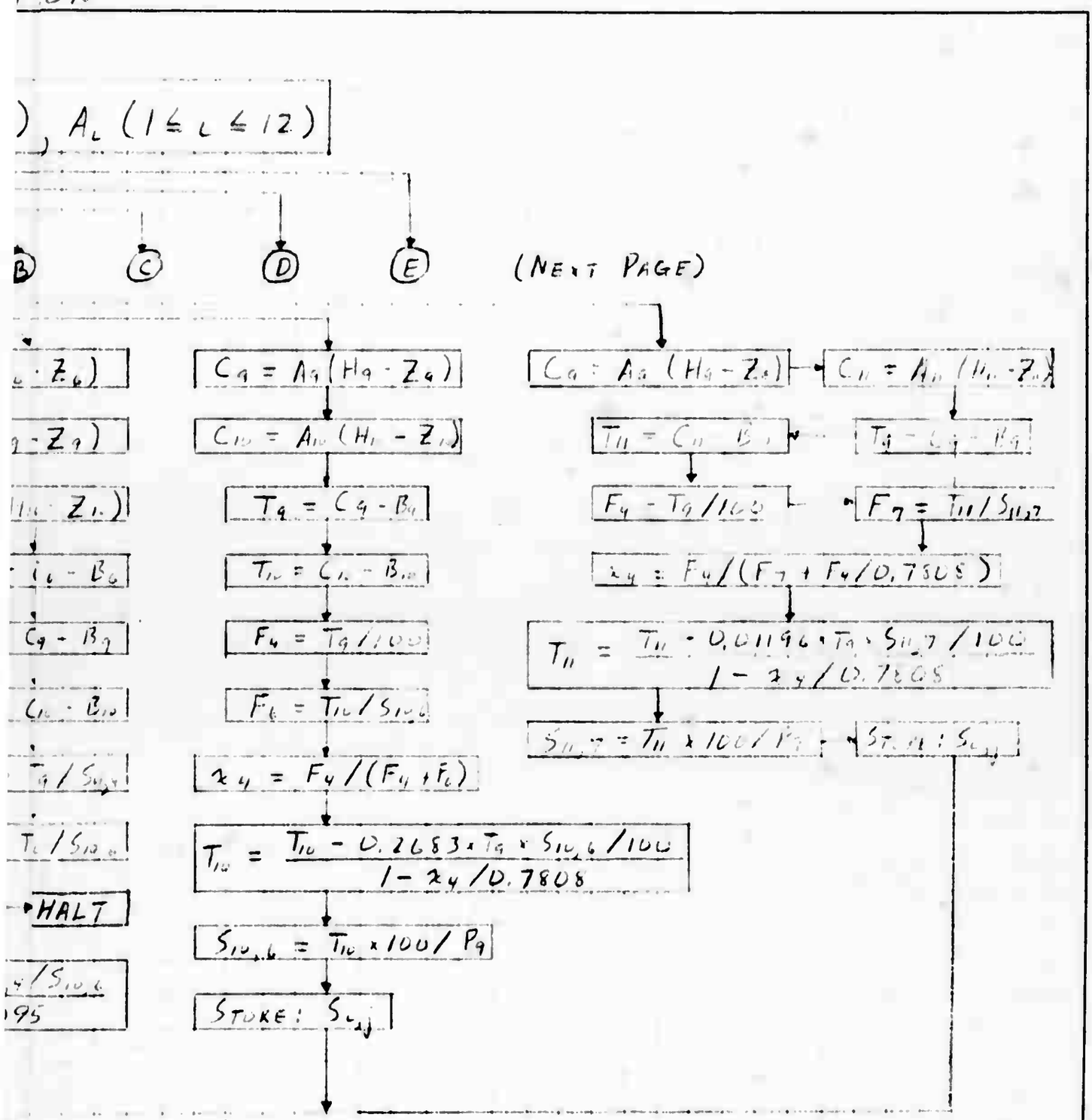
CALIBRATI



A

FORM NO. A706-4

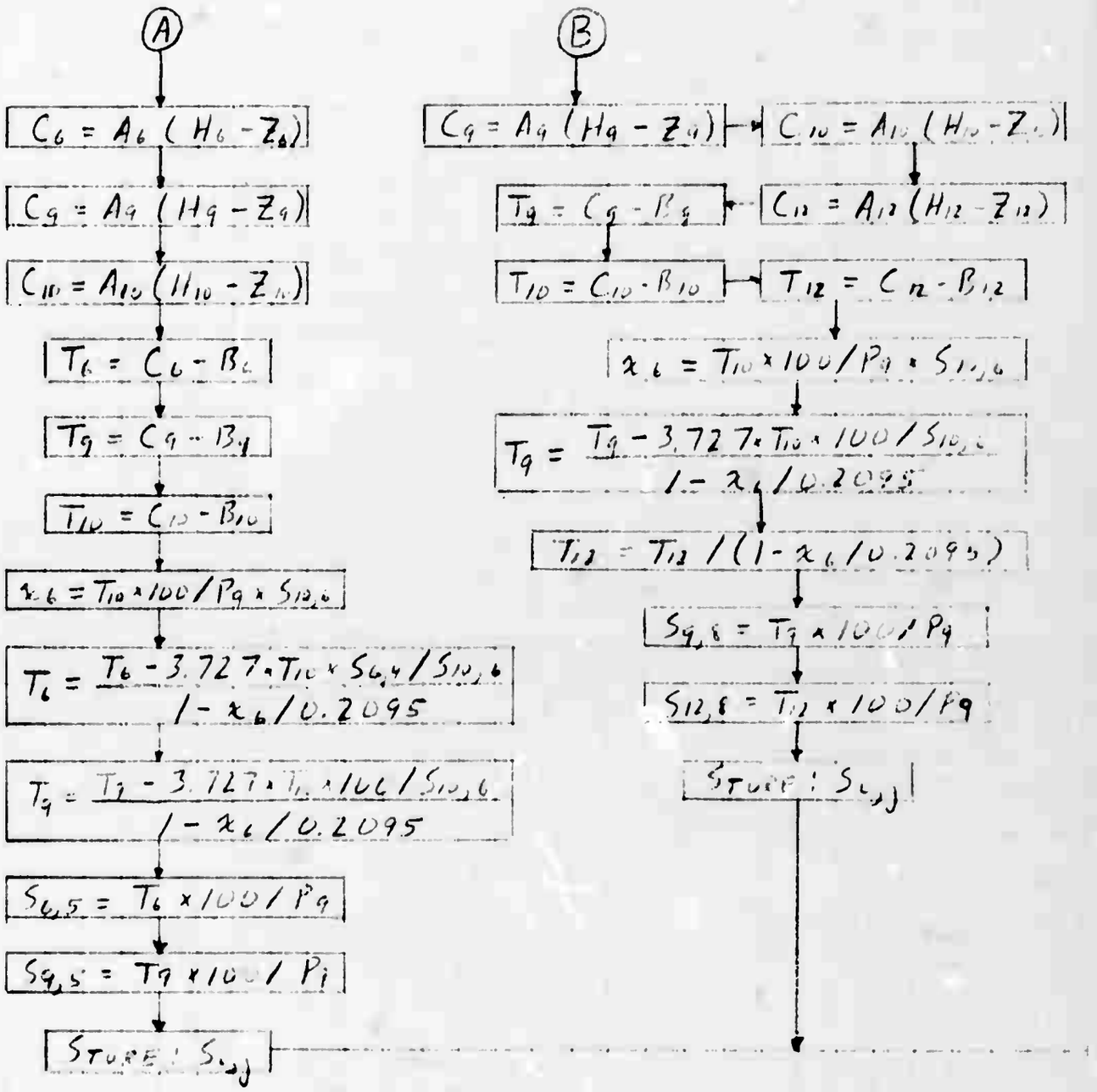
T.ON



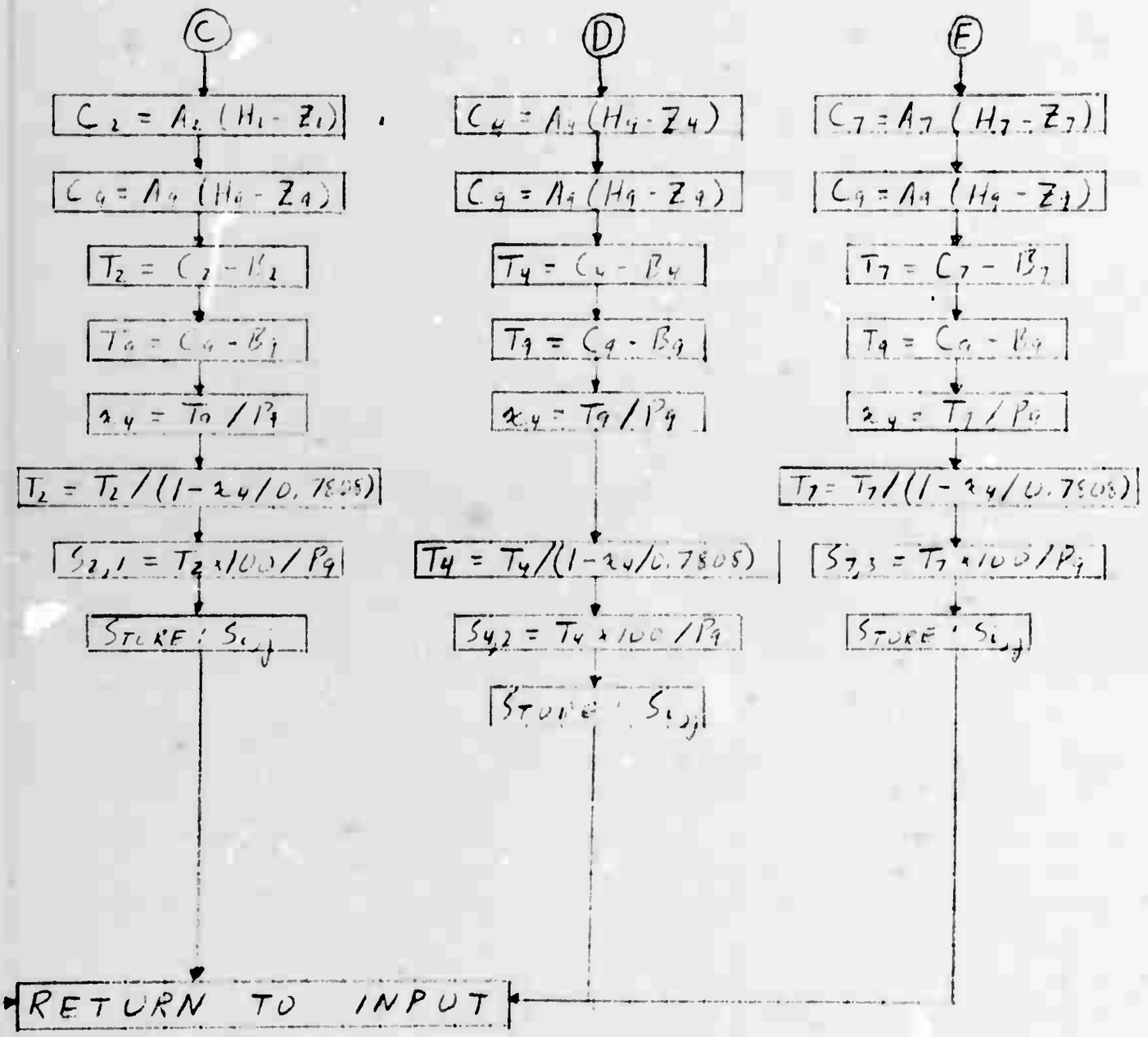
PREPARED BY	DATE	CHECKED BY	DATE	REVISED BY	DATE

B

CALIBRATION



ON (CONT.)

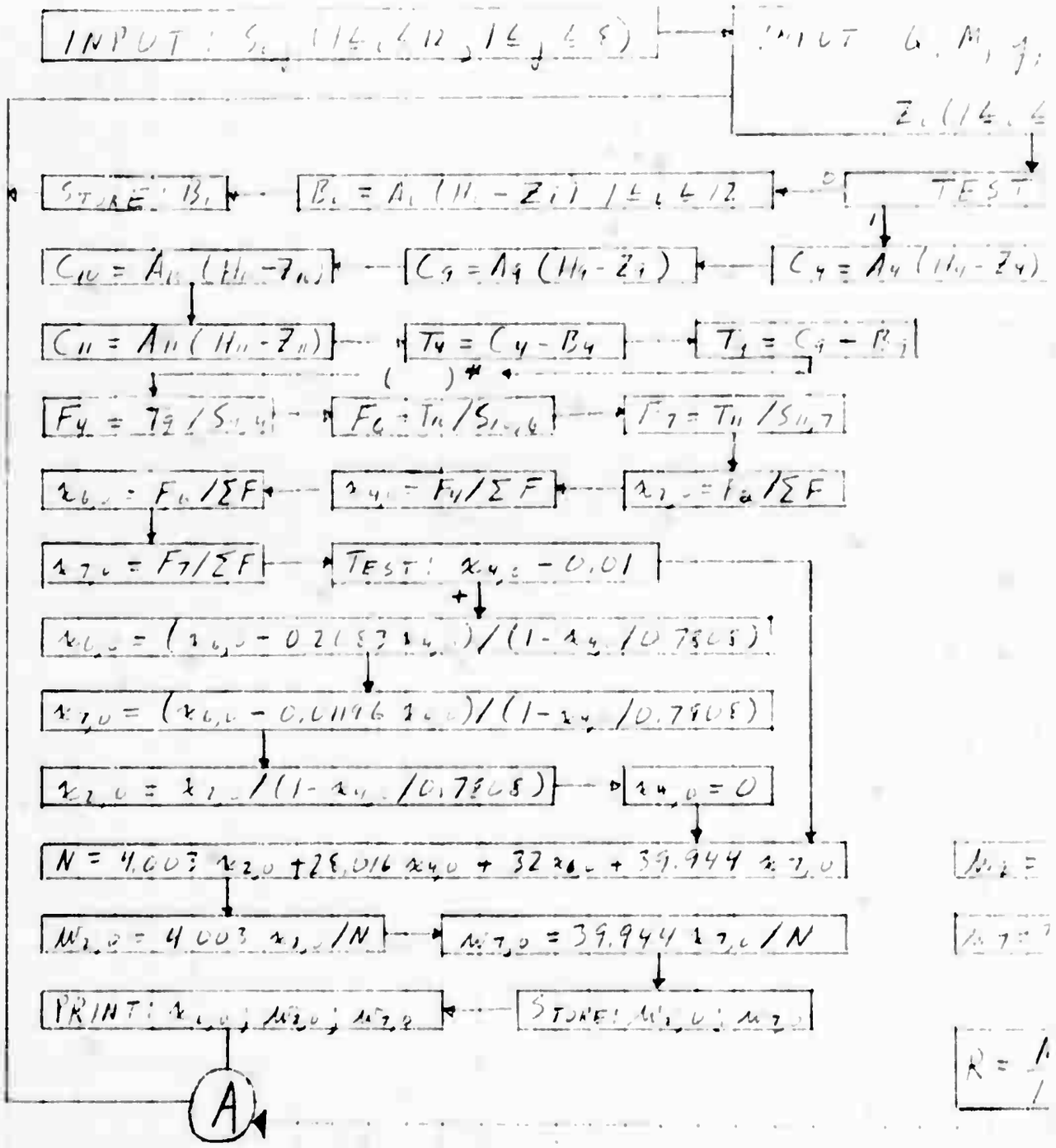


PREPARED BY	DATE	CHECKED BY	DATE	REVISED BY	DATE

B

CONVAIR ASTRONAUTICS

ANALYS



*($T_{10} = C_{10} - B_{10} \longrightarrow T_{11} = C_{11} - B_{11} \longrightarrow F_2 = T_4 / S_{4,2}$)

A

TEXT NOT REPRODUCIBLE

$C_2 = A_2 (H_2 - Z_2)$ — $C_4 = A_4 (H_4 - Z_4)$

$C_7 = A_7 (H_7 - Z_7)$ — $C_6 = A_6 (H_6 - Z_6)$

$C_9 = A_9 (H_9 - Z_9)$ — $C_{10} = A_{10} (H_{10} - Z_{10})$

$T_2 = C_2 - B_2$ — $C_{12} = A_{12} (H_{12} - Z_{12})$ — $C_{11} = A_{11} (H_{11} - Z_{11})$

$T_4 = C_4 - B_4$ — $T_6 = C_6 - B_6$ — $T_7 = C_7 - B_7$ — $T_9 = C_9 - B_9$

$F_1 = T_2 / S_{2,1}$ — $T_{12} = C_{12} - B_{12}$ — $T_{11} = C_{11} - B_{11}$ — $T_{10} = C_{10} - B_{10}$

$F_2 = T_4 / S_{4,2}$ — $F_3 = T_7 / S_{7,3}$ — $F_6 = T_6 / S_{6,6}$ — $F_7 = T_{11} / S_{11,7}$

$F_5 = \dfrac{L - T_1 \cdot S_{1,5} / S_{5,5}}{F_{4,5} - S_{4,5} \cdot S_{5,5} / S_{5,5}}$ — $L = T_9 - F_8 \cdot S_{8,5}$ — $F_8 = T_{12} / S_{12,8}$

$F_4 = (T_5 - F_5 \cdot S_{5,5}) / S_{4,4}$

$x_j = F_j / \Sigma F \quad (1 \le j \le 5)$

$N = 2.016\, x_1 + 4.003\, x_2 + 12.\ldots x_3 + 28.010\, x_4 + 32\, x_5 + 39.944\, x_7 + 44.010\, x_8$

$D = 2(x_1 + x_2)/(x_3 + x_5)$ — $A = 37.041\, x_4 / N$

$M_2 = (\tfrac{1}{2} x_3 + \tfrac{1}{2} x_5 + x_6 + x_8 - 0.268 x_4)/[.63(x_1 + x_2) + .375(x_3 + x_5)]$

$M(M_7/M_5 - M_{2,5}/M_{2,5}) M_2 / (0.0175$

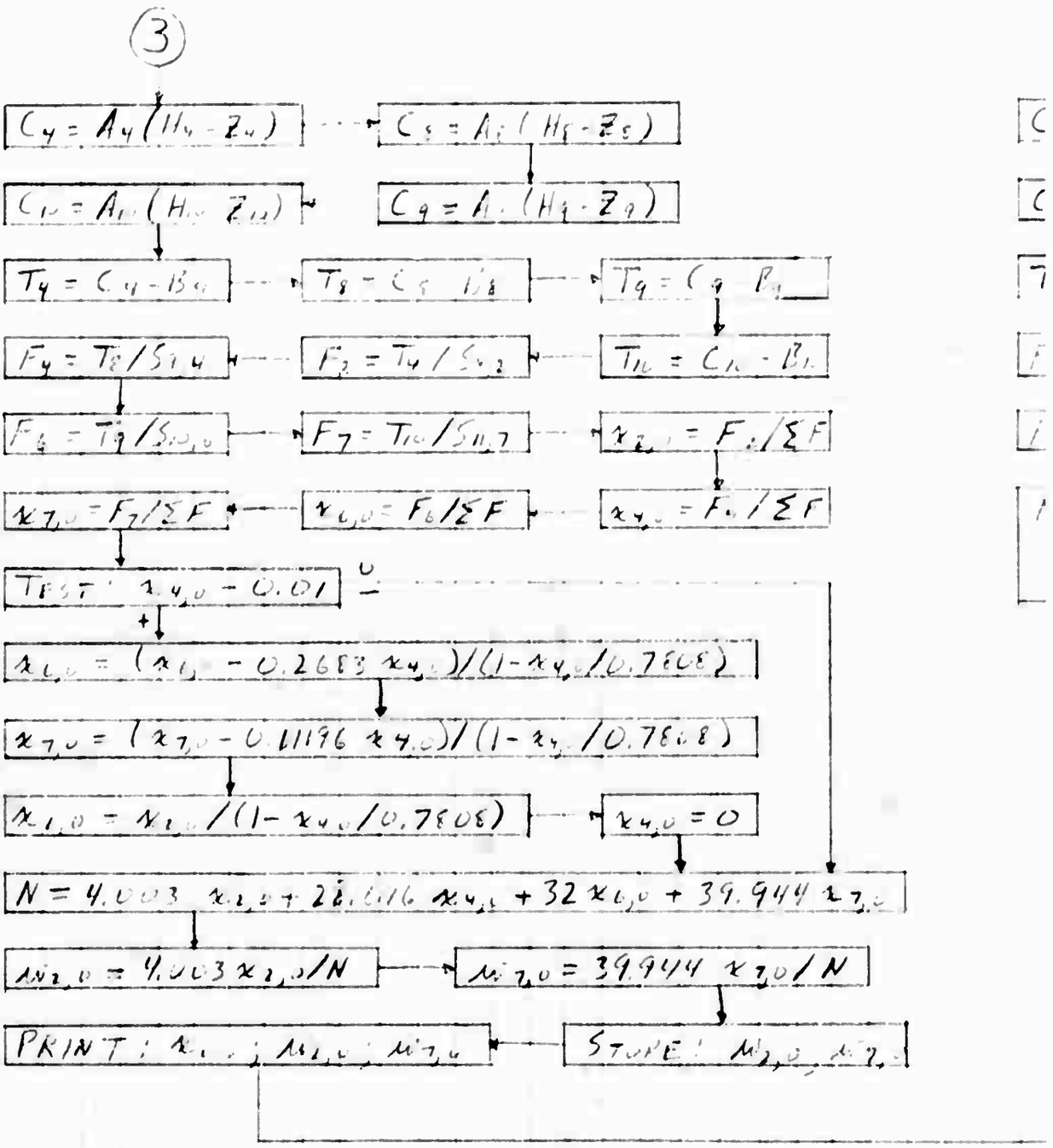
$/ + M[1 + (M \cdot M_2 - M_{2,5} M_{2,5}) M_{2,5} / (0.0175$

$P_{1,N} = \ldots x_j \quad (1 \le j \le \ldots)$

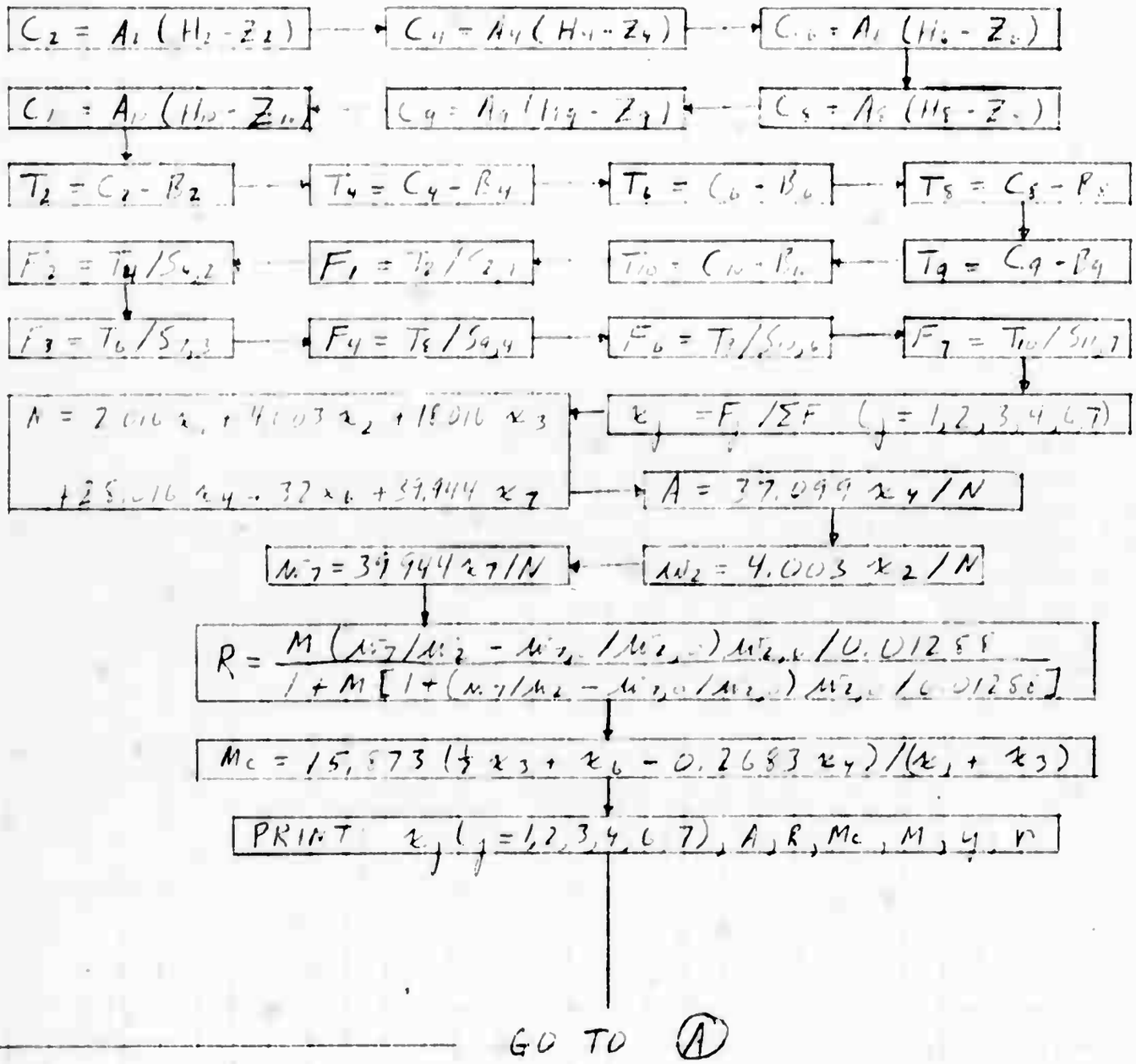
$A, x, D, M_2, M \ldots$

PREPARED BY	DATE	CHECKED BY	DATE	REVISED BY	DATE

ANALYSIS (CONT)



TEXT NOT REPRODUCIBLE



	PREPARED BY	DATE	CHECKED BY	DATE	REVISED BY	DATE

B

CONVAIR
SAN DIEGO

FORM 73-1

SAMPLE INPUT (ANALYSIS)

			i = 1	2	3	4	5	6	7	
INIT	$S_{i,j}$ = 1			39.36						
	2					16.70				
	3								96.71	
	4							7.224		
	5							0.2663		
	6									
	7									
	8									
Q = 0	H		10	15	4	7	10	20.5	36	1
	A		1	1	1	1	1	1	3	
	Z		10	10	4	6	10	10	10	1
Q = 1	H		4	15	4	29.4	10	20.5	36	1
	A		1	1	1	1	1	1	3	
	Z		4	10	4	6	10	10	10	1
Q = 2	H		10	49.5	4	18	10	77.5	54.3	1
	A		1	10	1	1	10	10	100	
	Z		10	10	4	6	10	10	10	1
Q = 0	H		10	20	4	6	10	36	10	6
	A		1	1	1	1	1	3	1	
	Z		10	10	4	6	10	10	10	1
Q = 3	H		10	20	4	47.3	10	36	10	67
	A		1	1	1	3	1	3	1	3
	Z		10	10	4	9	10	10	10	10
Q = 4	H		10	76.1	4	47.3	10	47.6	10	99
	A		1	100	1	3	1	300	1	1
	Z		10	10	4	9	10	10	10	10

A

8	9	10	11	12						
	100.0									
	99.47									
		76.75								
			123.1							
	7.248			114.3						
10	54.5	39	16	20						
1	3	1	1	1						
10	10	10	13	11						
10	62.5	46.6	46	20						
1	3	300	1	1						
10	10	10	13	11						
10	50	85	64.6	48.1			r	3		
1	300	1	3	100			y	60		
10	10	10	10	10			M	1.9		
65	15.4	14	2	2						
1	1	1	10	10						
10	10	13	2	2						
67.3	70.2	28	2	2						
3	100	1	10	10						
10	10	13	2	2						
99.4	74	19.4	2	2			r	3		
1	1	1	10	10			y	60		
10	10	13	2	2			M	3.5		

CONVAIR
SAN DIEGO

FORM 73-1

SAMPLE CALCULATION (ANALYSIS)

		Q= 0	1	2	0	3	4
B	L=1	0			0		
	2	5			10		
	3	0			0		
	4	1			0		
	5	0			0		
	6	10.5			78		
	7	78			0		
	8	0			55		
	9	133.5			5.4		
	10	29			1		
	11	6			0		
	12	9			0		
C	L=1						
	2		~~55~~	385			6610
	3						
	4		23.4	12		114.9	114.9
	5						
	6			675			11,280
	7			4430			
	8			~~[illegible]~~		171.9	99.4
	9		167.5	12,000		6020	64
	10		10,980	75		15	6.4
	11		33	163.8			
	12			3810			
T	L=1						
	2			380			6600
	3						
	4		22.4	11		114.9	114.9
	5			~~[illegible]~~			
	6			664.5			11,200
	7			4352			
	8					116.9	35.4
	9		26	11866		6015	59.6
	10		10,950	46		14	5.4
	11		27	157.8			
	12			3801			
L A				11625			

AEL1-0661
21

		0	1	2	0	3	3*	4
F	j = 1			9.654				167.7
	2		1.341	.6597		6.980		6.980
	3			50.19				129.2
	4		.240	91.06		1.169		0.354
	5			25.33				~~0.776~~
	6		142.7	.5493		78.37		0.776
	7		.2193	1.282		.1137		.0472
	8			33.25				
ΣF			144.4	212.0		86.53		305.0
α	j = 1		~~.009246~~	.04553				.5498
	2		.009286	.003407				.02256
	3			.2367				.4236
	4		.001662	.4295				.00116
	5		~~.000~~	.1195				~~.~~
	6		.9882	.002926				.002544
	7		.001518	.006047				.000154
	8			.1568				
N			31.77	26.98				8.952
N_2			.001170	.000461				.01009
N_7			.001908	.008953				.000687
A				.5905				.004806
R				.5144				
D				2.043				
M_c				1.839				
M				1.9				

* Corrected for Air Leak

CONVAIR
SAN DIEGO

FORM 73-1

SAMPLE INPUT (CALIBRATION)

		L = 1	2	3	4	5
Q = 0	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10
Q = 1	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10
Q = 2	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10
Q = 3	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10
Q = 4	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10
Q = 5	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10
Q = 6	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10
Q = 7	H	710	76	4	7	10
	A	100	100	1	1	1
	Z	110	10	4	6	10
Q = 8	H	10	15	4	39	10
	A	1	1	1	100	1
	Z	10	10	4	10	10
Q = 9	H	10	15	4	7	10
	A	1	1	1	1	1
	Z	10	10	4	6	10

A

v)

6	7	8	9	10	11	12
19	36	10	55	36	16	17
1	3	1	3	1	1	1
10	10	10	10	10	13	11
42	38	10	54.3	40	82.3	22
30	3	1	300	100	3	11
10	10	10	10	10	11	11
51	36	10	66.5	58	17	17
30	3	1	300	1	1	1
10	10	10	10	10	13	11
26	36	10	82	53	18	17
1	3	1	3	300	1	1
10	10	10	10	10	13	11
26	36	10	82	46	78.7	17
1	3	1	3	1	300	1
10	10	10	10	10	10	11
66.7	36	10	64.8	44	16	17
1	3	1	300	1	1	1
10	10	10	10	10	13	11
20	36	10	24.1	48	16	74
1	3	1	100	1	1	300
10	10	10	10	10	13	10
26	36	10	15	4	10	10
1	3	1	1	1	1	1
10	10	10	10	4	13	10
26	36	10	82	46	18	17
1	3	1	3	1	1	1
10	10	10	10	10	13	11
19	59	10	55	36	16	17
1	300	1	3	1	1	1
10	10	10	10	10	13	11

CONVAIR
SAN DIEGO

FORM 73

SAMPLE CALCULATION (CALIBRATION

	Q=1	2		3		4		5	
C_2									
T_2									
C_4									
T_4									
C_6	960	1270						56.7	
T_6	951	1,221	1,223					47.7	44.
C_7									
T_7									
C_9	13,290	16,950		216		216		16,440	
T_9	13,160	16,920	16,930	81		91		16,300	16,:
C_{10}	5,000	48		12,900				34	
T_{10}	2,974	22		12,870	12,940			8	
C_{11}	213.9					20,610			
T_{11}	210.9					20,607	20,750		
C_{12}									
T_{12}									
P_9	16,860								
F_4			168.2		0.81		0.81		
F_6			0.2612		152.8				
F_7							153.8		
x_4					.00527		.00527	.00062	
x_6			.00155						
$S_{2,1}$									
$S_{4,2}$									
$S_{6,4}$	7.226		7.224						
$S_{6,5}$									0.2
$S_{9,3}$									
$S_{9,4}$	100.0								
$S_{9,5}$									99.
$S_{9,8}$									
$S_{10,6}$	84.23				76.75				
$S_{11,7}$	134.0						123.1		
$S_{12,8}$									
A									

)N)

6		7		8		9	i	B.
		6,600					1	0
		6,595	6,636				2	5
				2,800			3	0
				2,799	2,816		4	1
							5	0
4.89							6	9
						14,700	7	78
						14,620	8	0
	1,410		216		216	135	9	135
6,310	1,275	1,222	81		81	0	10	26
	38						11	3
	12						12	6
	19,200							
	19,190	19,270						
		.00092		.00480		00480	0	
				39.36				
						16.70		
.2663								
						86.71		
9.47								
		7.24?						
		114.3						

B

```
1                    SOAP CODE ANALYSIS
1                    IBM 650 INPUT
1                    Q 0 1 2 PART A    CELL LOCATION
1                    Q 0 3 4 PART B
1                    H I 1 I 12          0  1 TO 0012
1                    Z I 1 I 12          0 13 TO 0024
1                    A I 1 I 12          0 25 TO 0036
1                    SIJ 2 I  9 1 J  8 0 57TO 0064
1                    M 1A OR M 1B        0 48
1                    Y 1A OR Y 1B        0 49
1                              LOWER CASE Y
1                    R 1A OR R 1B        0 50
1                              LOWER CASE R
1                    IBM 650 OUTPUT ANALYSIS
1                    Q 0 1 2 PART A    CELL LOCATION
1                    Q 0 3 4 PART B
1                    X I 1 I  8          0 77 TO 0084
1                                  PUNCH X
1                    XIJ 2 I 7  J 0      0127 TO 0130
1                                  PUNCH P
1                    WIJ 2 I 7  J 0      0177 TO 0179
1                         PUNCH W
1                    A      PUNCH  W      0180
1                    D      PUNCH  W      0181
1                    N      PUNCH W       0182
1                    R      PUNCH W       0183
1                    MC     PUNCH W       0184
1                              LOWER  CASE C
1                    M      PUNCH L       0227
1                    Y      PUNCH L       0228
1                              LOWER  CASE Y
1                    R      PUNCH L       0229
1                              LOWER  CASE R
1                    THIS PROGRAM USES IBM 650 7PER
1                    CARD LOAD SUBROUTINE
1                         END
1              BLR    1000     1999
2              REG   H0001     0012          READ
3              REG   Z0013     0024          READ
4              REG   A0025     0036          READ
5              REG   S0037     0050          READ
6              REG   B0051     0062
7              REG   T0063     0074
8              REG   X0077     0086        PUNCH XI
9              REG   P0127     0136        PUNCH  XIJ
10             REG   W0177     0186        PUNCH W,MC
11             REG   L0227     0236        PUNCH MYR
12             REG   R0327     0336
13             REG   F0100     0111
14             REG   C0112     0123
15             SYN   START     1950
16             SYN   HALT      0000
17     START   RSB    0012    LOOP2                    1950    83   0012   0156
18     LOOP2   RAU   H0013 B                           0156    60   4013   0167
               FSB   Z0013 B                           0167    33   4025   0151
20             FMP   A0013 B                           0151    39   4037   0087
21             STU   B0013 B                           0087    21   4063   0166
22             LDD   PETE                              0166    69   0169   0172
```

```
23                STD    1950                                  0172  24  1950  0153
24                AXB    0001                                  0153  52  0001  0159
25                NZB    LOOP2     1961                        0159  42  0156  1961
26      RETF      RSB    0012      RETR1                       0160  83  0012  0075
27      RETR1     RAU    H0013 B                               0075  60  4013  0217
28                FSB    Z0013 B                               0217  33  4025  0201
29                FMP    A0013 B                               0201  39  4037  0137
30                STU    C0013 B                               0137  21  4124  0277
31                AXB    0001                                  0277  52  0001  0283
32                NZB    RETR1                                 0283  42  0075  0187
33                RSB    0012      RETR2                       0187  83  0012  0093
34      RETR2     RAU    C0013 B                               0093  60  4124  0279
35                FSB    B0013 B                               0279  33  4063  0089
36                STU    I0013 B                               0089  21  4075  0278
37                AXB    0001                                  0278  52  0001  0284
38                NZB    RETR2                                 0284  42  0093  0088
39                RAU    T0004                                 0088  60  0066  0171
40                FDV    S0002                                 0171  34  0038  0138
41                STU    F0002                F 2              0138  21  0101  0154
42                RAU    T0009                                 0154  60  0071  0125
43                FDV    S0006                                 0125  34  0042  0092
44                STU    F0004                F 4              0092  21  0103  0206
45                RAU    T0010                                 0206  60  0072  0377
46                FDV    S0009                                 0377  34  0045  0095
47                STU    F0006                                 0095  21  0105  0158
48                RAU    T0011                                 0158  60  0073  0427
49                FDV    S0010                                 0427  34  0046  0096
50                STU    F0007                F 7              0096  21  0106  0209
                  FAD    F0002                                 0209  32  0101  0477
52                FAD    F0004                                 0477  32  0103  0379
53                FAD    F0006                                 0379  32  0105  0281
54                STU    SUMF                                  0281  21  0286  0139
55                RAU    F0002                                 0139  60  0101  0155
56                FDV    SUMF                                  0155  34  0286  0386
57                STU    P0001                X 2.0            0386  21  0127  0280
58                RAU    F0004                                 0280  60  0103  0157
59                FDV    SUMF                                  0157  34  0286  0436
60                STU    P0002                X 4.0            0436  21  0128  0381
61                RAU    F0006                                 0381  60  0105  0259
62                FDV    SUMF                                  0259  34  0286  0486
63                STU    P0003                X 6.0            0486  21  0129  0282
64                RAU    F0007                                 0282  60  0106  0161
65                FDV    SUMF                                  0161  34  0286  0536
66                STU    P0004                X 7.0            0536  21  0130  0383
67                RAU    P0002                                 0383  60  0128  0433
68                FSB    01                                    0433  33  0586  0163
69                NZU    NEXT      CONT                        0163  44  0267  0168
70      NEXT      BMI    CONT                                  0267  46  0168  0221
71                RAU    P0002                                 0221  60  0128  0483
72                FDV    P780H                                 0483  34  0636  0686
73                FAD    ONE                                   0686  32  0189  0165
74                STU    BOTT1                                 0165  21  0170  0173
75                RAU    P0002                                 0173  60  0128  0533
76                FMP    P268C                                 0533  39  0736  0786
                  FAD    P0003                                 0786  32  0129  0205
78                FDV    BOTT1                                 0205  34  0170  0220
79                STU    P0003                X 6.0            0220  21  0129  0382
80                RAU    P0002                                 0382  60  0128  0583
```

```
 81                 FMP   P119F                          0583  39  0836  0886
 82                 FAD   P0003                         0886  32  0129  0255
 83                 FDV   P0111                         0255  34  0170  0270
 84                 STU   P0004          X 7.0          0270  21  0130  0633
 85                 RAU   P0001                         0633  60  0127  0431
 86                 FDV   P0111                         0431  34  0170  0320
 87                 STU   P0001          X 2.0          0320  21  0127  0380
 88                 RAU   ZERO                          0380  60  0683  0237
 89                 STU   P0002    CONT  X 4.0          0237  21  0128  0168
 90      CONT       RAU   4P003                         0168  60  0271  0175
 91                 FMP   P0001                         0175  39  0127  0527
 92                 STU   TERM1                         0527  21  0432  0285
 93                 RAU   28016                         0285  60  0188  0143
 94                 FMP   P0002                         0143  39  0128  0378
 95                 FAD   TERM1                         0378  32  0432  0309
 96                 STU   TERM1                         0309  21  0432  0385
 97                 RAU   32P0                          0385  60  0238  0193
 98                 FMP   P0003                         0193  39  0129  0429
 99                 FAD   TERM1                         0429  32  0432  0359
100                 STU   TERM1                         0359  21  0432  0435
101                 RAU   39944                         0435  60  0288  0243
102                 FMP   P0004                         0243  39  0130  0430
103                 FAD   TERM1                         0430  32  0432  0409
104                 STU   N              N              0409  21  0164  0317
105                 RAU   P0001                         0317  60  0127  0481
106                 FMP   4P003                         0481  39  0271  0321
107                 FDV   N                             0321  34  0164  0214
108                 STU   W0001                         0214  21  0177  0480
109                 RAU   P0004                         0480  60  0130  0485
110                 FMP   39944                         0485  39  0288  0338
111                 FDV   N                             0338  34  0164  0264
112                 STU   W0003                         0264  21  0179  0482
113                 LDD   PETE2                         0482  69  0535  0388
114                 STD    1950                         0388  24  1950  0203
115                 PCH   P0001                         0203  71  0127  0577
116                 PCH   W0001     1961                0577  71  0177  1961
117      PETE2      RSB    0012    RETR3                0535  83  0012  0091
118      RETR3      RAU   H0013 R                       0091  60  4013  0367
119                 FSB   Z0013 R                       0367  33  4025  0251
120                 FMP   A0013 R                       0251  39  4037  0287
121                 STU   C0013 R                       0287  21  4124  0627
122                 AXR    0001                         0627  52  0001  0733
123                 NZR   RETR3                         0733  42  0091  0337
124                 RSB    0012    RETR4                0337  83  0012  0293
125      RETR4      RAU   C0013 R                       0293  60  4124  0479
126                 FSB   B0013 R                       0479  33  4063  0239
127                 STU   T0013 R                       0239  21  4075  0428
128                 AXR    0001                         0428  52  0001  0384
129                 NZR   RETR4                         0384  42  0293  0438
130                 RAU   T0002                         0438  60  0064  0219
131                 FDV   S0001                         0219  34  0037  0387
132                 STU   F0001          F 1            0387  21  0100  0253
133                 RAU   T0004                         0253  60  0066  0371
134                 FDV   S0002                         0371  34  0038  0488
135                 STU   F0002          F 2            0488  21  0101  0204
136                 RAU   T0007                         0204  60  0069  0223
137                 FDV   S0005                         0223  34  0041  0141
138                 STU   F0003          F 3            0141  21  0102  0305
```

```
139                 RAU   T0010                          0305  60  0072  0677
140                 FDV   S0009                          0677  34  0045  0145
1                   STU   F0006          F 6             0145  21  0105  0208
1                   RAU   T0011                          0208  60  0073  0727
143                 FDV   S0010                          0727  34  0046  0146
144                 STU   F0007          F 7             0146  21  0106  0459
145                 RAU   T0012                          0459  60  0074  0529
146                 FDV   S0011                          0529  34  0047  0097
147                 STU   F0008          F 8             0097  21  0107  0160
148                 FMP   S0008                          0160  39  0044  0094
149                 STU   E8S98                          0094  21  0098  0301
150                 RAU   T0009                          0301  60  0071  0225
151                 FSB   E8S98                          0225  33  0098  0275
152                 STU   L                              0275  21  0530  0783
153                 RAU   S0006                          0783  60  0042  0147
154                 FDV   S0003                          0147  34  0039  0289
155                 STU   GOON                           0289  21  0144  0197
156                 FMP   S0004                          0197  39  0040  0090
157                 STU   S6S9                           0090  21  0194  0247
158                 RAU   S0007                          0247  60  0043  0297
159                 FSB   S6S9                           0297  33  0194  0421
160                 STU   LOW1                           0421  21  0076  0579
161                 RAU   GOON                           0579  60  0144  0099
162                 FMP   T0006                          0099  39  0068  0218
163                 STU   UPPER                          0218  21  0222  0325
164                 RAU   L                              0325  60  0530  0585
165                 FSB   UPPER                          0585  33  0222  0149
166                 FDV   LOW1                           0149  34  0076  0126
1                   STU   F0005          F 5             0126  21  0104  0207
168                 FMP   S0004                          0207  39  0040  0140
169                 STU   S6F5                           0140  21  0244  0347
170                 RAU   T0006                          0347  60  0068  0273
171                 FSB   S6F5                           0273  33  0244  0471
172                 FDV   S0003                          0471  34  0039  0339
173                 STU   F0004          F4              0339  21  0103  0256
174                 RAU   ZERO                           0256  60  0683  0437
175                 STU   SUMF                           0437  21  0286  0389
176                 RSB    0008   LOOP3                  0389  83  0008  0195
177       LOOP3     RAU   F0009 B                        0195  60  4108  0213
178                 FAD   SUMF                           0213  32  0286  0263
179                 STU   SUMF           SUM F           0263  21  0286  0439
180                 AXB    0001                          0439  52  0001  0245
181                 NZB   LOOP3                          0245  42  0195  0199
182                 RSA    0008   LOOP4                  0199  81  0008  0355
183       LOOP4     RAU   F0009 A                        0355  60  2108  0313
184                 FDV   SUMF                           0313  34  0286  0936
185                 STU   X0009 A                        0936  21  2085  0538
186                 AXA    0001                          0538  50  0001  0294
187                 NZA   LOOP4                          0294  40  0355  0148
188                 RAU   X0001                          0148  60  0077  0531
189                 FMP   2P016                          0531  39  0434  0484
190                 STU   SUMX                           0484  21  0588  0191
191                 RAU   X0002                          0191  60  0078  0833
1                   FMP   4P003                          0833  39  0271  0521
1                   FAD   SUMX                           0521  32  0588  0215
194                 STU   SUMX                           0215  21  0588  0241
195                 RAU   X0003                          0241  60  0079  0883
196                 FMP   18016                          0883  39  0986  0487
```

197	FAD	SUMX		0487	32	0588	0265
198	STU	SUMX		0265	21	0588	0291
199	RAU	X0004		0291	60	0080	0635
200	FMP	28016		0635	39	0188	0638
201	FAD	SUMX		0638	32	0588	0315
202	STU	SUMX		0315	21	0588	0341
203	RAU	X0005		0341	60	0081	0685
204	FMP	28010		0685	39	0688	0738
205	FAD	SUMX		0738	32	0588	0365
206	STU	SUMX		0365	21	0588	0391
207	RAU	X0006		0391	60	0082	0537
208	FMP	32P0		0537	39	0238	0788
209	FAD	SUMX		0788	32	0588	0415
210	STU	SUMX		0415	21	0588	0441
211	RAU	X0007		0441	60	0083	0587
212	FMP	39944		0587	39	0288	0838
213	FAD	SUMX		0838	32	0588	0465
214	STU	SUMX		0465	21	0588	0491
215	RAU	X0008		0491	60	0084	0489
216	FMP	44010		0489	39	0142	0192
217	FAD	SUMX		0192	32	0588	0515
218	STU	W0006	N	0515	21	0182	0735
219	RAU	X0004		0735	60	0080	0785
220	FMP	37099		0785	39	0888	0938
221	FDV	W0006		0938	34	0182	0532
222	STU	W0004	A	0532	21	0180	0933
223	RAU	X0005		0933	60	0081	0835
224	FAD	X0008		0835	32	0084	0211
225	STU	X5X8		0211	21	0216	0269
226	RAU	X0001		0269	60	0077	0581
227	FAD	X0003		0581	32	0079	0405
228	FDV	X5X8		0405	34	0216	0266
229	FMP	TWO		0266	39	0319	0369
230	STU	W0005	D	0369	21	0181	0534
231	RAU	X0002		0534	60	0078	0983
232	FDV	W0006		0983	34	0182	0582
233	FMP	4P003		0582	39	0271	0571
234	STU	J2	W 2	0571	21	0176	0629
235	RAU	X0007		0629	60	0083	0637
236	FMP	39944		0637	39	0288	0988
237	FDV	W0006		0988	34	0182	0632
238	STU	J7	W 7	0632	21	0687	0190
239	RAU	W0003		0190	60	0179	0584
240	FDV	W0001		0584	34	0177	0777
241	STU	W7W2		0777	21	0682	0885
242	RAU	J7		0885	60	0687	0541
243	FDV	J2		0541	34	0176	0226
244	FSB	W7W2		0226	33	0682	0509
245	FMP	W0001		0509	39	0177	0827
246	FDV	1288		0827	34	0580	0630
247	STU	GOON1		0630	21	0634	0737
248	FAD	ONE		0737	32	0189	0565
249	FMP	S0012		0565	39	0048	0198
250	FAD	ONE		0198	32	0189	0615
251	STU	DENR		0615	21	0370	0323
252	RAU	GOON1		0323	60	0634	0539
253	FMP	S0012		0539	39	0048	0248
254	FDV	DENR		0248	34	0370	0420

```
255                STU   W0007                    R     0420  21  0193  0787
256                RAU   X5X8                           0787  60  0216  0621
2(                 FMP   3753                           0621  39  0124  0174
258                STU   3X5X8                          0174  21  0478  0631
259                RAU   X0001                          0631  60  0077  0681
260                FAD   X0003                          0681  32  0079  0455
261                FMP   63                             0455  39  0258  0308
262                FAD   3X5X8                          0308  32  0478  0505
263                STU   DENMC                          0505  21  0210  0363
264                RAU   X0003                          0363  60  0079  0684
265                FMP   FIVE                           0684  39  0837  0887
266                STU   Y11                            0887  21  0242  0295
267                RAU   X0005                          0295  60  0081  0935
268                FMP   FIVE                           0935  39  0837  0937
269                FAD   Y11                            0937  32  0242  0419
270                STU   Y11                            0419  21  0242  0345
271                RAU   X0006                          0345  60  0082  0987
272                FAD   Y11                            0987  32  0242  0469
273                STU   Y11                            0469  21  0242  0395
274                RAU   X0008                          0395  60  0084  0589
275                FAD   Y11                            0589  32  0242  0519
276                STU   Y11                            0519  21  0242  0445
277                RAU   P268C                          0445  60  0736  0591
278                FMP   X0004                          0591  39  0080  0680
279                FAD   Y11                            0680  32  0242  0569
280                FDV   DENMC                          0569  34  0210  0260
281                STU   W0008                   MC     0260  21  0184  0639
28?                RAU   S0012                          0539  60  0048  0303
2(                 STU   L0001                   M      0303  21  0227  0730
284                RAU   S0013                          0730  60  0049  0353
285                STU   L0002                   Y      0353  21  0228  0731
286                RAU   S0014                          0731  60  0050  0555
287                STU   L0003                   R      0555  21  0229  0732
288                LDD   PETE3                          0732  69  0985  0689
289                STD    1950                          0689  24  1950  0403
290                PCH   X0001                          0403  71  0077  0877
291                PCH   L0001                          0877  71  0227  0927
292                PCH   W0001      1961                0927  71  0177  1961
293   PETE3        RSB    0012     LOOPA                0985  83  0012  0641
294   LOOPA        RAU   H0013 B                        0641  60  4013  0417
295                FSB   Z0013 B                        0417  33  4025  0351
296                FMP   A0013 B                        0351  39  4037  0739
297                STU   B0013 B                        0739  21  4063  0316
298                LDD   PETE4                          0316  69  0619  0272
299                STD    1950                          0272  24  1950  0453
300                AXB    0001                          0453  52  0001  0559
301                NZB   LOOPA      1961                0559  42  0641  1961
302   PETE4        RSB    0012     RETR5                0619  83  0012  0375
303   RETR5        RAU   H0013 B                        0375  60  4013  0467
304                FSB   Z0013 B                        0467  33  4025  0401
305                FMP   A0013 B                        0401  39  4037  0789
306                STU   C0013 B                        0789  21  4124  0977
307                AXB    0001                          0977  52  0001  0734
(                  NZB   RETR5                          0734  42  0375  0839
309                RAU   C0004                          0839  60  0115  0669
310                FSB   B0004                          0669  33  0054  0791
311                STU   T4                             0781  21  0889  0292
312                RAU   C0008                          0292  60  0119  037?
```

313		FSB	P0008			0373	33	0058	0939
314		STU	T8			0939	21	0344	0397
315		RAU	C0009			0397	60	0120	0425
316		FSB	P0009			0425	33	0059	0989
317		STU	T9			0989	21	0394	0447
318		RAU	C0010			0447	60	0121	0475
319		FSB	P0010			0475	33	0060	0240
320		STU	T10			0240	21	0444	0497
321		RAU	T4			0497	60	0889	0343
322		FDV	S0002			0343	34	0038	0290
323		STU	F2		F 2	0290	21	0494	0547
324		RAU	T8			0547	60	0344	0249
325		FDV	S0006			0249	34	0042	0342
326		STU	F4		F 4	0342	21	0196	0299
327		RAU	T9			0299	60	0394	0349
328		FDV	S0009			0349	34	0045	0495
329		STU	F6		F 6	0495	21	0150	0503
330		RAU	T10			0503	60	0444	0399
331		FDV	S0010			0399	34	0046	0246
332		STU	F7		F 7	0246	21	0200	0553
333		RAU	ZERO			0553	60	0683	0340
334		STU	SUMF			0340	21	0286	0390
335		FAD	F2			0390	32	0494	0671
336		FAD	F4			0671	32	0196	0423
337		FAD	F6			0423	32	0150	0528
338		FAD	F7			0528	32	0200	0578
339		STU	SUMF			0578	21	0286	0440
340		RAU	F2			0440	60	0494	0449
341		FDV	SUMF			0449	34	0286	0490
342		STU	P0001			0490	21	0127	0780
343		RAU	F4			0780	60	0196	0451
344		FDV	SUMF			0451	34	0286	0540
345		STU	P0002			0540	21	0128	0831
346		RAU	F6			0831	60	0150	0605
347		FDV	SUMF			0605	34	0286	0590
348		STU	P0003			0590	21	0129	0782
349		RAU	F7			0782	60	0200	0655
350		FDV	SUMF			0655	34	0286	0640
351		STU	P0004			0640	21	0130	0784
352		RAU	P0002			0784	60	0128	0834
353		FSB	01			0834	33	0586	0413
354		NZU	NEXT4	CONT3		0413	44	0517	0268
355	NEXT4	BMI	CONT3			0517	44	0268	0721
356		RAU	P0002			0721	60	0128	0884
357		FDV	P780H			0884	34	0636	0690
358		FAD	ONE			0690	32	0189	0665
359		STU	BOTT3			0665	21	0470	0473
360		RAU	P0002			0473	60	0128	0934
361		FMP	P268C			0934	30	0736	0740
362		FAD	P0003			0740	32	0129	0705
363		FDV	BOTT3			0705	34	0470	0520
364		STU	P0003			0520	21	0129	0832
365		RAU	P119F			0832	60	0836	0691
366		FMP	P0002			0691	30	0128	0628
367		FAD	P0004			0628	32	0130	0257
368		FDV	BOTT3			0257	34	0470	0570
369		STU	P0004			0570	21	0130	0984
370		RAU	P0001			0984	60	0127	0881

```
371                FDV   BOTT3                                  0891  34  0470  0620
372                STU   P0001                                  0620  21  0127  0830
3                  RAU   ZERO                                   0830  60  0683  0790
3                  STU   P0002    CONT3                         0790  21  0128  0268
375      CONT3     RAU   P0001                                  0268  60  0127  0931
376                FMP   4P003                                  0931  39  0271  0771
377                STU   TERMF                                  0771  21  0276  0679
378                RAU   P0002                                  0679  60  0128  0840
379                FMP   28016                                  0840  39  0188  0890
380                FAD   TERMF                                  0890  32  0276  0603
381                STU   TERMF                                  0603  21  0276  0729
382                RAU   P0003                                  0729  60  0129  0940
383                FMP   32P0                                   0940  39  0238  0990
384                FAD   TERMF                                  0990  32  0276  0653
385                STU   TERMF                                  0653  21  0276  0779
386                RAU   P0004                                  0779  60  0130  0741
387                FMP   39944                                  0741  39  0288  0791
388                FAD   TERMF                                  0791  32  0276  0703
389                STU   N                          N           0703  21  0164  0567
390                RAU   P0001                                  0567  60  0127  0981
391                FMP   4P003                                  0981  39  0271  0821
392                FDV   N                                      0821  34  0164  0314
393                STU   W0001                      W2.0        0314  21  0177  0880
394                RAU   P0004                                  0880  60  0130  0841
395                FMP   39944                                  0841  39  0288  0891
396                FDV   N                                      0891  34  0164  0364
397                STU   W0003                      W7.0        0364  21  0179  0882
398                LDD   PETE5                                  0882  69  0941  0544
3                  STD    1950                                  0544  24  1 50  0753
400                PCH   P0001                                  0753  71  0127  0678
401                PCH   W0001     1961                         0678  71  0177  1961
402      PETE5     RSA    0012    LOOP5                         0941  81  0012  0597
403      LOOP5     RAU   H0013 A                               0597  60  2013  0617
404                FSB   Z0013 A                               0617  33  2025  0501
405                FMP   A0013 A                               0501  39  2037  0991
406                STU   C0013 A                    C          0991  21  2124  0728
407                AXA    0001                                  0728  50  0001  0392
408                NZA   LOOP5                                  0392  40  0597  0296
409                RSA    0012    LOOP6                         0296  81  0012  0152
410      LOOP6     RAU   C0013 A                               0152  60  2124  0829
411                FSB   B0013 A                               0829  33  2063  0442
412                STU   T0013 A                               0442  21  2075  0778
413                AXA    0001                                  0778  50  0001  0492
414                NZA   LOOP6                                  0492  40  0152  0346
415                RAU   T0002                                  0346  60  0064  0719
416                FDV   S0001                                  0719  34  0037  0542
417                STU   F0001                      F 1         0542  21  0100  0803
418                RAU   T0004                                  0803  60  0066  0871
419                FDV   S0002                                  0871  34  0038  0592
420                STU   F0002                      F 2         0592  21  0101  0254
421                RAU   T0006                                  0254  60  0068  0523
422                FDV   S0005                                  0523  34  0041  0642
423                STU   F0003                      F 3         0642  21  0102  0755
4                  RAU   T0008                                  0755  60  0070  0525
4                  FDV   S0006                                  0525  34  0042  0692
426                STU   F0004                      F 4         0692  21  0103  0306
427                RAU   T0009                                  0306  60  0071  0575
428                FDV   S0009                                  0575  34  0045  0545
```

```
429                 STU   F0006                F 6     0545  21  0105  0358
430                 RAU   T0010                        0358  60  0072  0828
4[illegible]        FDV   S0010                        0828  34  0046  0396
4[illegible]        STU   F0007                F 7     0396  21  0106  0609
433                 RSA    0007                        0609  81  0007  0715
434                 RAU   ZERO                         0715  60  0683  0742
435                 STU   SUMF     LOOP7              0742  21  0286  0792
436   LOOP7         RAU   F0008 A                      0792  60  2107  0261
437                 FAD   SUMF                        0261  32  0286  0463
438                 STU   SUMF                        0463  21  0286  0842
439                 AXA    0001                        0842  50  0001  0298
440                 NZA   LOOP7                       0298  40  0792  0202
441                 RAU   SUMF                        0202  60  0286  1807
441                 FSB   F0005                       1807  33  0104  1800
441                 STU   SUMF                        1800  21  0286  1801
441                 RSA    0007    LOOP9              1801  81  0007  0408
442   LOOP9         RAU   F0008 A                      0408  60  2107  0311
443                 FDV   SUMF                        0311  34  0286  0892
444                 STU   X0008 A                      0892  21  2084  0942
445                 AXA    0001                        0942  50  0001  0348
446                 NZA   LOOP9                       0348  40  0408  0252
447                 RAU   ZERO                        0252  60  0683  0992
448                 STU   SUMX                        0992  21  0588  0393
449                 RAU   X0001                       0393  60  0077  0932
450                 FMP   2P016                       0932  39  0434  0443
451                 FAD   SUMX                        0443  32  0588  0765
452                 STU   SUMX                        0765  21  0588  0493
453                 RAU   4P003                       0493  60  0271  0625
4[illegible]        FMP   X0002                       0625  39  0078  0878
455                 FAD   SUMX                        0878  32  0588  0815
456                 STU   SUMX                        0815  21  0588  0543
457                 RAU   18016                       0543  60  0986  0593
458                 FMP   X0003                       0593  39  0079  0879
459                 FAD   SUMX                        0879  32  0588  0865
460                 STU   SUMX                        0865  21  0588  0643
461                 RAU   28016                       0643  60  0188  0693
462                 FMP   X0004                       0693  39  0080  0930
463                 FAD   SUMX                        0930  32  0588  0915
464                 STU   SUMX                        0915  21  0588  0743
465                 RAU   32P0                        0743  60  0238  0793
466                 FMP   X0006                       0793  39  0082  0982
467                 FAD   SUMX                        0982  32  0588  0965
468                 STU   SUMX                        0965  21  0588  0843
469                 RAU   39944                       0843  60  0288  0893
470                 FMP   X0007                       0893  39  0083  0943
471                 FAD   SUMX                        0943  32  0588  0366
472                 STU   N                    N      0366  21  0164  0667
472                 STU   W0006                       0667  21  0182  1810
473                 RAU   X0004                       1810  60  0080  0993
474                 FMP   37099                       0993  39  0888  0594
475                 FDV   N                           0594  34  0164  0414
476                 STU   W0004              A        0414  21  0180  0644
477                 RAU   X0002                       0644  60  0078  0694
47[illegible]       FMP   4P003                       0694  39  0271  0921
4                   FDV   N                           0921  34  0164  0464
480                 STU   J2                 W 2      0464  21  0176  0929
481                 RAU   X0007                       0929  60  0083  0744
482                 FMP   39944                       0744  39  0288  0794
```

```
             FDV   N                        0794  34  0164  0514
             STU   J7                W 7    0514  21  0687  0844
             RAU   W0003                    0844  60  0179  0894
             FDV   W0001                    0894  34  0177  0928
             STU   W7W2                     0928  21  0682  0944
             RAU   J7                       0944  60  0687  0994
             FDV   J2                       0994  34  0176  0326
             FSB   W7W2                     0326  33  0682  0659
             FMP   W0001                    0659  39  0177  0978
             FDV   1288                     0978  34  0580  0980
             STU   BOTT4                    0980  21  0595  0398
             FAD   ONE                      0398  32  0189  0416
             FMP   S0012                    0416  39  0048  0448
             FAD   ONE                      0448  32  0189  0466
             STU   BOTTR                    0466  21  0670  0573
             RAU   BOTT4                    0573  60  0595  0499
             FMP   S0012                    0499  39  0048  0498
             FDV   BOTTR                    0498  34  0670  0720
             STU   W0007             R      0720  21  0183  0645
             RAU   X0001                    0645  60  0077  0695
             FAD   X0003                    0695  32  0079  0805
             STU   X1X3                     0805  21  0310  0513
             RAU   X0003                    0513  60  0079  0745
             FMP   FIVE                     0745  39  0837  0795
             STU   QTMC                     0795  21  0250  0853
             RAU   X0006                    0853  60  0082  0845
             FAD   QTMC                     0845  32  0250  0979
             STU   QTMC                     0979  21  0250  0903
             RAU   X0004                    0903  60  0080  0895
             FMP   P268C                    0895  39  0736  0945
             FAD   QTMC                     0945  32  0250  0995
             FMP   15873                    0995  39  0548  0598
             FDV   X1X3                     0598  34  0310  0360
             STU   W0008             MC     0360  21  0184  0446
             RAU   S0012                    0446  60  0048  0953
             STU   L0001             M      0953  21  0227  0496
             RAU   S0013                    0496  60  0049  0304
             STU   L0002             Y      0304  21  0228  0546
             RAU   S0014                    0546  60  0050  0855
             STU   L0003             R      0855  21  0229  0596
             PCH   X0001                    0596  71  0077  0646
             PCH   L0001                    0646  71  0227  0696
             PCH   W0001    HALT            0696  71  0177  0000
      01     10    0000     0049            0586  10  0000  0049
      ONE    10    0000     0051            0189  10  0000  0051
      ZERO   00    0000     0000            0683  00  0000  0000
      4R003  40    0300     0051            0271  40  0300  0051
      28016  28    0160     0052            0188  28  0160  0052
      32R0   32    0000     0052            0238  32  0000  0052
      39944  39    9440     0052            0288  39  9440  0052
      18016  18    0160     0052            0986  18  0160  0052
      28010  28    0100     0052            0688  28  0100  0052
      44010  44    0100     0052            0142  44  0100  0052
      1288   12    8800     0049            0580  12  8800  0049
      TWO    20    0000     0051            0319  20  0000  0051
      3753   37    5300     0050            0124  37  5300  0050
      63     63    0000     0049            0258  63  0000  0049
      FIVE   50    0000     0050            0837  50  0000  0050
```

541	15873		15	8730	0052	0548		15	8730	0052
542	P2680	-	26	8300	0050	0736	-	26	8300	0050
[illegible]	P780H	-	78	0800	0050	0636	-	78	0800	0050
544	P119E	-	11	9600	0049	0836	-	11	9600	0049
545	2P016		20	1600	0051	0434		20	1600	0051
546	37099		37	0990	0052	0888		37	0990	0052

IBM 650 PUNCH CARD

```
6919541953+          547   2400008000+    199999999+
6919531952+  2419611954+   7019621950+   6919561955+
6919531952+  2419631954+   3000011964+   6919561955+
6919531952+  2419651954+   6580021966+   6919561955+
6919531952+  2419671954+   8280031968+   6919561955+
6919531952+  2419691954+   6979501970+   6919561955+
6919531952+  2419711954+   5300011972+   6919561955+
6919531952+  2419731954+   5000011974+   6919561955+
        17+  1000000052+   1500000052+   4000000051+
        85+  1000000052+   5450000052+   3900000052+
       137+  1000000052+   1000000052+   4000000051+
       205+  1000000052+   1000000052+   1000000052+
       257+  1000000051+   1000000051+   1000000051+
       325+  1000000051+   3000000051+   1000000051+

        17+  4000000051+   1500000052+   4000000051+
        85+  1000000052+   6250000052+   4660000052+
       137+  4000000051+   1000000052+   4000000051+
       205+  1000000052+   1000000052+   1000000052+
       257+  1000000051+   1000000051+   1000000051+
       325+  1000000051+   3000000051+   3000000053+
       377+  3936000052+   1670000052+   7224000051+
       447+  7248000051+   7675000052+   1231000053+

        17+  1000000052+   4850000052+   4000000051+
        85+  1000000052+   5000000052+   8500000052+
       137+  1000000052+   1000000052+   4000000051+
       205+  1000000052+   1000000052+   1000000052+
       257+  1000000051+   1000000052+   1000000051+
       325+  1000000051+   3000000053+   1000000051+

        17+  1000000052+   2000000052+   4000000051+
        85+  6500000052+   1540000052+   1400000052+
       137+  1000000052+   1000000052+   4000000051+
       205+  1000000052+   1000000052+   1300000052+
       257+  1000000051+   1000000051+   1000000051+
       325+  1000000051+   1000000051+   1000000051+

        17+  1000000052+   2000000052+   4000000051+
        85+  6730000052+   7020000052+   2800000052+
       137+  1000000052+   1000000052+   4000000051+
       205+  1000000052+   1000000052+   1300000052+
       257+  1000000051+   1000000051+   1000000051+
       325+  3000000051+   1000000053+   1000000051+
       377+  3936000052+   1670000052+   7224000051+
       447+  7248000051+   7675000052+   1231000053+

        17+  1000000052+   7610000052+   4000000051+
        85+  3940000052+   7400000052+   1340000052+
       137+  1000000052+   1000000052+   4000000051+
       205+  1000000052+   1000000052+   1300000052+
       257+  1000000051+   1000000053+   1000000051+
       325+  1000000051+   1000000051+   1000000051+
```

A

IBM 650 7 PER CARD LOAD

```
.7   24000008000+   199999999+   HALT  01    9999  999   9
4+   7019621950+   6919561955+   2419628000+   6019511963+                    1
4+   3000011964+   6919561955+   2419648000+   8080021965+                    2
4+   6580021966+   6919561955+   2419668000+   3500011967+                    3
4+   8280031968+   6919561955+   2419688000+   8800021969+                    4
4+   6979501970+   6919561955+   2419708000+   2420001971+                    5
4+   5200011972+   6919561955+   2419728000+   4219731961+                    6
4+   5000011974+   6919561955+   2419741961+   5800011969+                    7
2+   1500000052+   4000000051+   7000000051+   1020000052+   2050000052+   3600000052+
2+   5450000052+   3900000052+   1600000052+   2000000052+                 0 0    21+
2+   1000000052+   4000000051+   6000000051+   1000000052+   1000000052+   1000000052+
2+   1000000052+   1000000052+   1300000052+   1100000052+
1+   1000000051+   1030000051+   1000000051+   1000000051+   1000000051+   3000000051+
1+   3000000051+   1000000051+   1000000051+   1000000051+

1+   1500000052+   4000000051+   2940000052+   1000000052+   2050000052+   3600000052+
2+   6250000052+   4660000052+   4600000052+   2000000052+                 0 1    21+
1+   1000000052+   4000000051+   6000000051+   1000000052+   1000000052+   1000000052+
2+   1000000052+   1000000052+   1300000052+   1100000052+
1+   1000000051+   1000000051+   1000000051+   1000000051+   1000000051+   3000000051+
1+   3000000051+   3000000053+   1000000051+   1000000051+
2+   1670000052+   7224000051+   2663000050+   8671000052+   1000000053+   9947000052+
1+   7675000052+   1231000053+   1143000053+   1900000051+   6000000052+   3000000051+

2+   4850000052+   4000000051+   1800000052+   1000000052+   7750000052+   5430000052+
2+   5000000052+   8500000052+   6460000052+   4810000052+                 0 2    21+
2+   1000000052+   4000000051+   6000000051+   1000000052+   1000000052+   1000000052+
2+   1000000052+   1000000052+   1000000052+   1000000052+
1+   1000000052+   1000000051+   1000000051+   1000000052+   1000000052+   1000000053+
1+   3000000053+   1000000051+   3000000051+   1000000053+

2+   2000000052+   4000000051+   6000000051+   1000000052+   3600000052+   1000000052+
2+   1540000052+   1400000052+   2000000051+   2000000051+                 0 0    22+
2+   1000000052+   4000000051+   6000000051+   1000000052+   1000000052+   1000000052+
2+   1000000052+   1300000052+   2000000051+   2000000051+
1+   1000000051+   1000000051+   1000000051+   1000000051+   3000000051+   1000000051+
1+   1000000051+   1000000051+   1000000052+   1000000052+

2+   2000000052+   4000000051+   4730000052+   1000000052+   3600000052+   1000000052+
2+   7020000052+   2800000052+   2000000051+   2000000051+                 0 3    22+
2+   1020000052+   4000000051+   8000000051+   1000000052+   1000000052+   1000000052+
2+   1000000052+   1300000052+   2000000051+   2000000051+
1+   1000000051+   1000000051+   3000000051+   1000000051+   3000000051+   1000000051+
1+   1000000053+   1000000051+   1000000052+   1000000052+
2+   1670000052+   7224000051+   2663000050+   8671000052+   1000000053+   9947000052+
1+   7675000052+   1231000053+   1143000053+   3500000051+   6000000052+   3000000051+

2+   7610000052+   4000000051+   4730000052+   1000000052+   4760000052+   1000000052+
2+   7400000052+   1340000052+   2000000051+   2000000051+                 0 4    22+
2+   1000000052+   4000000051+   8000000051+   1000000052+   1000000052+   1000000052+
2+   1000000052+   1300000052+   2000000051+   2000000051+
1+   1000000053+   1000000051+   3000000051+   1000000051+   3000000053+   1000000051+
1+   1000000051+   1000000051+   1000000052+   1000000052+
```

```
1                SOAP CODE CALIBRATION
1                IBM 650 INPUT
1                Q 1 1 I  9        CELL LOCATION
1                H 1 1 1 12         0  1 TO 0012
1                Z 1 1 1 12         0 13 TO 0024
1                A 1 2 I 12         0 25 TO 0036
1                IBM 650 OUTPUT CALIBRATION
1                                   CELL LOCATION
1                S1J 2 1  9 1 J  8 0 77 TO 0084
1                S1J 101 12 6 J  8 0127 TO 0129
1                P9  LOWER CASE P  0130
1                THIS PROGRAM USES IBM 650 7PER
1                CARD LOAD SUBROUTINE
1                      END
 1              BLR    1000     1999
 2              REG    H0001    0012        READ
 3              REG    Z0013    0024        READ
 4              REG    A0025    0036        READ
 5              REG    B0037    0048
 6              REG    S0077    0084          PUNCH
 7              REG    10127    0136          PUNCH
 8              SYN    START    1950
 9              SYN    HALT     0000
10      START   RSA     0012   RETRN                          1950   81  0012  0056
11      RETRN   RAU    H0013 A                  2 0           0056   60  2013  0067
12              FSB    Z0013 A                                0067   33  2025  0051
13              FMP    A0013 A                                0051   39  2037  0087
14              STU    B0013 A                                0087   21  2049  0052
1               LDD    G0                                     0052   69  0055  0058
16              STD     1950                                  0058   24  1950  0053
17              AXA     0001                                  0053   50  0001  0059
18              NZA    RETRN    1961                          0059   40  0056  1961
19      G0      RAU    H0006                    0 1           0055   60  0006  0061
20              FSB    Z0006                                  0061   33  0018  0095
21              FMP    A0006                                  0095   39  0030  0180
22              STU    C6                                     0180   21  0184  0137
23              RAU    H0009                                  0137   60  0009  0063
24              FSB    Z0009                                  0063   33  0021  0097
25              FMP    A0009                                  0097   39  0033  0183
26              STU    C9                                     0183   21  0088  0091
27              RAU    H0010                                  0091   60  0010  0065
28              FSB    Z0010                                  0065   33  0022  0049
29              FMP    A0010                                  0049   39  0034  0234
30              STU    C10                                    0234   21  0138  0141
31              RAU    H0011                                  0141   60  0011  0115
32              FSB    Z0011                                  0115   33  0023  0099
33              FMP    A0011                                  0099   39  0035  0085
34              STU    C11                                    0085   21  0090  0093
35              RAU    C6                                     0093   60  0184  0089
36              FSB    B0006                                  0089   33  0042  0069
37              STU    T6                                     0069   21  0074  0177
38              RAU    C9                                     0177   60  0088  0143
39              FSB    B0009                                  0143   33  0045  0071
4               STU    T9                                     0071   21  0076  0179
4               RAU    C10                                    0179   60  0138  0193
42              FSB    B0010                                  0193   33  0046  0073
43              STU    T10                                    0073   21  0178  0181
44              RAU    C11                                    0181   60  0090  0145
```

```
45                FSB   B0011                          0145  33  0047  0123
46                STU   T11                            0123  21  0228  0231
47                RAU   T9                             0231  60  0076  0281
48                FDV   P780H                          0281  34  0284  0334
49                FMP   MIN1                           0334  39  0187  0237
50                STU   P9                             0237  21  0092  0195
51                RAU   100                            0195  60  0098  0103
52                STU   S0006                  S 9.4   0103  21  0082  0185
53                RAU   T6                             0185  60  0074  0229
54                FMP   100                            0229  39  0098  0148
55                FDV   T9                             0148  34  0076  0126
56                STU   S0003                  S 6.4   0126  21  0079  0182
57                RAU   T10                            0182  60  0178  0233
58                FMP   100                            0233  39  0098  0198
59                FDV   P268C                          0198  34  0101  0151
60                FMP   MIN1                           0151  39  0187  0287
61                FDV   T9                             0287  34  0076  0176
62                STU   I0001                 10.6     0176  21  0127  0230
63                RAU   T11                            0230  60  0228  0283
64                FMP   100                            0283  39  0098  0248
65                FDV   1196                           0248  34  0201  0251
66                FDV   T9                             0251  34  0076  0226
67                STU   I0002                 11.7     0226  21  0128  0331
68                LDD   G01                            0331  69  0384  0337
69                STD    1950      1961                0337  24  1950  1961
70          G01   RAU   H0006                START Q2   0384  60  0006  0111
71                FSB   Z0006                          0111  33  0018  0245
72                FMP   A0006                          0245  39  0030  0280
73                STU   C6                             0280  21  0184  0387
74                RAU   H0009                          0387  60  0009  0113
75                FSB   Z0009                          0113  33  0021  0147
76                FMP   A0009                          0147  39  0033  0333
77                STU   C9                             0333  21  0088  0191
78                RAU   H0010                          0191  60  0010  0165
79                FSB   Z0010                          0165  33  0022  0149
80                FMP   A0010                          0149  39  0034  0434
81                STU   C10                            0434  21  0138  0241
82                RAU   C6                             0241  60  0184  0139
83                FSB   B0006                          0139  33  0042  0119
84                STU   T6                             0119  21  0074  0227
85                RAU   C9                             0227  60  0088  0243
86                FSB   B0009                          0243  33  0045  0121
87                STU   T9                             0121  21  0076  0279
88                RAU   C10                            0279  60  0138  0293
89                FSB   B0010                          0293  33  0046  0173
90                STU   T10                            0173  21  0178  0381
91                RAU   T9                             0381  60  0076  0431
92                FDV   S0006                          0431  34  0082  0232
93                STU   F4                             0232  21  0086  0189
94                RAU   T10                            0189  60  0178  0383
95                FDV   I0001                          0383  34  0127  0277
96                STU   F6                             0277  21  0282  0235
97                FAD   F4                             0235  32  0086  0163
98                STU   F4+6                           0163  21  0068  0171
99                RAU   F6                             0171  60  0282  0437
100               FDV   F4+6                           0437  34  0068  0118
101               STU   X6                   X 6       0118  21  0072  0075
102               FDV   P2085                          0075  34  0278  0328
```

```
103                FAD   ONE                                    0328  32  0481  0057
104                STU   BOT1                                   0057  21  0062  0215
105                RAU   T10                                    0215  60  0178  0433
106                FMP   S0006                                  0433  39  0082  0332
107                FMP   3P727                                  0332  39  0285  0335
108                FDV   I0001                                  0335  34  0127  0327
109                FAD   T9                                     0327  32  0076  0153
110                FDV   BOT1                                   0153  34  0062  0112
111                STU   T9                                     0112  21  0076  0329
112                RAU   P9                                     0329  60  0092  0197
113                FSB   T9                                     0197  33  0076  0203
114                STU   P9T9                                   0203  21  0108  0161
115                RAU   T9                                     0161  60  0076  0531
116                FMP   THREF                                  0531  39  0484  0534
117                FAM   P9T9                                   0534  37  0108  0385
118                NZU   NEXT    CONT1                          0385  44  0239  0140
119    NEXT        BMI   CONT1   CONT2                          0239  46  0140  0343
120    CONT2       PCH   S0001                                  0343  71  0077  0377
121                PCH   I0001   0000          HALT             0377  71  0127  0000
122    CONT1       RAU   T10                                    0140  60  0178  0483
123                FMP   S0003                                  0483  39  0079  0379
124                FMP   3P727                                  0379  39  0285  0435
125                FDV   I0001                                  0435  34  0127  0427
126                FAD   T6                                     0427  32  0074  0301
127                FDV   BOT1                                   0301  34  0062  0162
128                STU   T6                                     0162  21  0074  0477
129                FMP   100                                    0477  39  0098  0298
130                FDV   T9                                     0298  34  0076  0276
131                STU   S0003                                  0276  21  0079  0382
132                LDD   G02                                    0382  69  0485  0188
133                STD    1950   1961                          0188  24  1950  1961
134    G02         RAU   H0009                 START Q3         0485  60  0009  0213
135                FSB   Z0009                                  0213  33  0021  0247
136                FMP   A0009                                  0247  39  0033  0533
137                STU   C9                                     0533  21  0088  0291
138                RAU   H0010                                  0291  60  0010  0265
139                FSB   Z0010                                  0265  33  0022  0199
140                FMP   A0010                                  0199  39  0034  0584
141                STU   C10                                    0584  21  0138  0341
142                RAU   C9                                     0341  60  0088  0393
143                FSB   B0009                                  0393  33  0045  0221
144                STU   T9                                     0221  21  0076  0429
145                RAU   C10                                    0429  60  0138  0443
146                FSB   B0010                                  0443  33  0046  0223
147                STU   T10                                    0223  21  0178  0581
148                RAU   T9                                     0581  60  0076  0631
149                FDV   100                                    0631  34  0098  0348
150                STU   F4                                     0348  21  0086  0289
151                RAU   T10                                    0289  60  0178  0583
152                FDV   I0001                                  0583  34  0127  0527
153                STU   F6                                     0527  21  0282  0535
154                FAD   F4                                     0535  32  0086  0263
155                STU   F4+6                                   0263  21  0068  0271
156                RAU   F4                                     0271  60  0086  0391
157                FDV   F4+6                                   0391  34  0068  0168
158                STU   X4                      X 4            0168  21  0122  0125
159                FDV   P780H                                  0125  34  0284  0634
160                FAD   ONE                                    0634  32  0481  0107
```

```
161                 STU   BOT1                                    0107   21  0062  0315
162                 RAU   T9                                      0315   60  0076  0681
163                 FMP   I0001                                   0681   39  0127  0577
164                 FMP   P268C                                   0577   39  0101  0351
165                 FDV   100                                     0351   34  0098  0398
166                 FAD   T10                                     0398   32  0178  0105
167                 FDV   BOT1                                    0105   34  0062  0212
168                 STU   T10                                     0212   21  0178  0731
169                 FMP   100                                     0731   39  0098  0448
170                 FDV   P9                                      0448   34  0092  0142
171                 STU   I0001                                   0142   21  0127  0330
172                 LDD   G03                                     0330   69  0633  0186
173                 STD    1950      1961                       0186   24  1950  1961
174       G03       RAU   H0009                 START Q4          0633   60  0009  0313
175                 FSB   Z0009                                   0313   33  0021  0297
176                 FMP   A0009                                   0297   39  0033  0683
177                 STU   C9                                      0683   21  0088  0441
178                 RAU   H0011                                   0441   60  0011  0365
179                 FSB   Z0011                                   0365   33  0023  0249
180                 FMP   A0011                                   0249   39  0035  0585
181                 STU   C11                                     0585   21  0090  0493
182                 RAU   C9                                      0493   60  0088  0543
183                 FSB   B0009                                   0543   33  0045  0321
184                 STU   T9                                      0321   21  0076  0479
185                 RAU   C11                                     0479   60  0090  0295
186                 FSB   B0011                                   0295   33  0047  0273
187                 STU   T11                                     0273   21  0228  0781
188                 RAU   T9                                      0781   60  0076  0831
189                 FDV   100                                     0831   34  0098  0498
190                 STU   F4                                      0498   21  0086  0339
191                 RAU   T11                                     0339   60  0228  0733
192                 FDV   I0002                                   0733   34  0128  0378
193                 STU   F7                                      0378   21  0432  0635
194                 RAU   F4                                      0635   60  0086  0491
195                 FDV   P780H                                   0491   34  0284  0684
196                 STU   MIDEN               NEG QT              0684   21  0238  0541
197                 RAU   F7                                      0541   60  0432  0487
198                 FSB   MIDEN               POS QT              0487   33  0238  0415
199                 STU   DEN                                     0415   21  0070  0323
200                 RAU   F4                                      0323   60  0086  0591
201                 FDV   DEN                                     0591   34  0070  0120
202                 STU   X4                  X 4                 0120   21  0122  0175
203                 RAU   T9                                      0175   60  0076  0881
204                 FMP   I0002                                   0881   39  0128  0428
205                 FMP   1196                                    0428   39  0201  0401
206                 FDV   100                                     0401   34  0098  0548
207                 STU   NUM                                     0548   21  0102  0155
208                 RAU   X4                                      0155   60  0122  0627
209                 FDV   P780H                                   0627   34  0284  0734
210                 FAD   ONE                                     0734   32  0481  0157
211                 STU   BOT1                                    0157   21  0062  0465
212                 RAU   T11                                     0465   60  0228  0783
213                 FSB   NUM                                     0783   33  0102  0529
214                 FDV   BOT1                                    0529   34  0062  0262
215                 STU   T11                                     0262   21  0228  0931
216                 FMP   100                                     0931   39  0098  0598
217                 FDV   P9                                      0598   34  0092  0192
218                 STU   I0002                                   0192   21  0128  0981
```

```
219             LDD   G04                          0981  69  0784  0537
220             STD    1950   1961                 0537  24  1950  1961
221   G04       RAU   H0006          START Q5      0784  60  0006  0211
222             FSB   Z0006                        0211  33  0018  0345
223             FMP   A0006                        0345  39  0030  0380
224             STU   C6                           0380  21  0184  0587
225             RAU   H0009                        0587  60  0009  0363
226             FSB   Z0009                        0363  33  0021  0347
227             FMP   A0009                        0347  39  0033  0833
228             STU   C9                           0833  21  0088  0641
229             RAU   H0010                        0641  60  0010  0515
230             FSB   Z0010                        0515  33  0022  0299
231             FMP   A0010                        0299  39  0034  0834
232             STU   C10                          0834  21  0138  0691
233             RAU   C6                           0691  60  0184  0389
234             FSB   B0006                        0389  33  0042  0169
235             STU   T6                           0169  21  0074  0677
236             RAU   C9                           0677  60  0088  0593
237             FSB   B0009                        0593  33  0045  0371
238             STU   T9                           0371  21  0076  0579
239             RAU   C10                          0579  60  0138  0643
240             FSB   B0010                        0643  33  0046  0373
241             STU   T10                          0373  21  0178  0482
242             FMP   100                          0482  39  0098  0648
243             FDV   P9                           0648  34  0092  0242
244             FDV   I0001                        0242  34  0127  0727
245             STU   X6           X6              0727  21  0072  0225
246             FDV   P209E                        0225  34  0278  0478
247             FAD   ONE                          0478  32  0481  0207
248             STU   BOT1                         0207  21  0062  0565
249             RAU   T10                          0565  60  0178  0883
250             FMP   S0003                        0883  39  0079  0629
251             FMP   3P727                        0629  39  0285  0685
252             FDV   I0001                        0685  34  0127  0777
253             FAD   T6                           0777  32  0074  0451
254             FDV   BOT1                         0451  34  0062  0312
255             STU   T6                           0312  21  0074  0827
256             RAU   T10                          0827  60  0178  0933
257             FMP   100                          0933  39  0098  0698
258             FMP   3P727                        0698  39  0285  0735
259             FDV   I0001                        0735  34  0127  0877
260             FAD   T9                           0877  32  0076  0253
261             FDV   BOT1                         0253  34  0062  0362
262             STU   T9                           0362  21  0076  0679
263             RAU   T6                           0679  60  0074  0729
264             FMP   100                          0729  39  0098  0748
265             FDV   P9                           0748  34  0092  0292
266             STU   S0004                        0292  21  0080  0983
267             RAU   T9                           0983  60  0076  0532
268             FMP   100                          0532  39  0098  0798
269             FDV   P9                           0798  34  0092  0342
270             STU   S0007                        0342  21  0083  0236
271             LDD   G05                          0236  69  0439  0392
272             STD    1950   1961                 0392  24  1950  1961
273   G05       RAU   H0009          START Q6      0439  60  0009  0413
274             FSB   Z0009                        0413  33  0021  0397
275             FMP   A0009                        0397  39  0033  0884
276             STU   C9                           0884  21  0088  0741
```

```
277                 RAU   H0010                          0741   60  0010  0615
278                 FSB   Z0010                          0615   33  0022  0349
27                  FMP   A0010                          0349   39  0034  0934
28                  STU   C10                            0934   21  0138  0791
281                 RAU   H0012                          0791   60  0012  0117
282                 FSB   Z0012                          0117   33  0024  0501
283                 FMP   A0012                          0501   39  0036  0286
284                 STU   C12                            0286   21  0190  0693
285                 RAU   C9                             0693   60  0088  0743
286                 FSB   B0009                          0743   33  0045  0421
287                 STU   T9                             0421   21  0076  0779
288                 RAU   C10                            0779   60  0138  0793
289                 FSB   B0010                          0793   33  0046  0423
291                 STU   T10                            0423   21  0178  0582
292                 RAU   C12                            0582   60  0190  0395
293                 FSB   B0012                          0395   33  0048  0275
294                 STU   T12                            0275   21  0430  0984
295                 RAU   T10                            0984   60  0178  0785
296                 FMP   100                            0785   39  0098  0848
297                 FDV   P9                             0848   34  0092  0442
298                 FDV   I0001                          0442   34  0127  0927
299                 STU   X6                   X 6       0927   21  0072  0325
300                 FDV   P209F                          0325   34  0278  0528
301                 FAD   ONE                            0528   32  0481  0257
302                 STU   BOT1                           0257   21  0062  0665
303                 RAU   T10                            0665   60  0178  0835
304                 FMP   100                            0835   39  0098  0898
305                 FMP   3P727                          0898   39  0285  0885
3                   FDV   I0001                          0885   34  0127  0977
307                 FAD   T9                             0977   32  0076  0303
308                 FDV   BOT1                          0303   34  0062  0412
309                 STU   T9                             0412   21  0076  0829
310                 RAU   T12                            0829   60  0430  0935
311                 FDV   BOT1                          0935   34  0062  0462
312                 STU   T12                            0462   21  0430  0985
313                 RAU   T9                             0985   60  0076  0632
314                 FMP   100                            0632   39  0098  0948
315                 FDV   P9                             0948   34  0092  0492
316                 STU   S0008                          0492   21  0084  0637
317                 RAU   T12                            0637   60  0430  0336
318                 FMP   100                            0336   39  0098  0998
319                 FDV   P9                             0998   34  0092  0542
320                 STU   I0003                          0542   21  0129  0682
321                 LDD   G06                            0682   69  0386  0489
322                 STD    1950          1961            0489   24  1950  1961
323           G06   RAU   H0002                START 07  0386   60  0002  0307
324                 FSB   Z0002                          0307   33  0014  0841
325                 FMP   A0002                          0841   39  0026  0326
326                 STU   C2                             0326   21  0480  0436
327                 RAU   H0009                          0436   60  0009  0463
328                 FSB   Z0009                          0463   33  0021  0447
329                 FMP   A0009                          0447   39  0033  0486
330                 STU   C9                             0486   21  0088  0891
33                  RAU   C2                             0891   60  0480  0536
3                   FSB   B0002                          0536   33  0038  0715
333                 STU   T2                             0715   21  0170  0473
334                 RAU   C9                             0473   60  0088  0843
335                 FSB   B0009                          0843   33  0045  0471
```

```
336                 STU   T9                                  0471  21  0076  0879
337                 FDV   P9                                  0879  34  0092  0592
338                 STU   X4                  X 4             0592  21  0122  0375
339                 FDV   P780H                               0375  34  0284  0586
340                 FAD   ONE                                 0586  32  0481  0357
341                 STU   BOT1                                0357  21  0062  0765
342                 RAU   T2                                  0765  60  0170  0425
343                 FDV   BOT1                                0425  34  0062  0512
344                 STU   T2                                  0512  21  0170  0523
345                 FMP   100                                 0523  39  0098  0399
346                 FDV   P9                                  0399  34  0092  0642
347                 STU   S0001                               0642  21  0077  0530
348                 LDD   G07                                 0530  69  0636  0539
349                 STD    1950      1961                     0539  24  1950  1961
350           G07   RAU   H0004                 START 08      0636  60  0004  0109
351                 FSB   Z0004                               0109  33  0016  0893
352                 FMP   A0004                               0893  39  0028  0578
353                 STU   C4                                  0578  21  0732  0686
354                 RAU   H0009                               0686  60  0009  0513
355                 FSB   Z0009                               0513  33  0021  0497
356                 FMP   A0009                               0497  39  0033  0736
357                 STU   C9                                  0736  21  0088  0941
358                 RAU   C4                                  0941  60  0732  0687
359                 FSB   B0004                               0687  33  0040  0167
360                 STU   T4                                  0167  21  0172  0475
361                 RAU   C9                                  0475  60  0088  0943
362                 FSB   B0009                               0943  33  0045  0521
363                 STU   T9                                  0521  21  0076  0929
364                 FDV   P9                                  0929  34  0092  0692
365                 STU   X4                  X 4             0692  21  0122  0525
366                 FDV   P780H                               0525  34  0284  0786
367                 FAD   ONE                                 0786  32  0481  0407
368                 STU   BOT1                                0407  21  0062  0815
369                 RAU   T4                                  0815  60  0172  0628
370                 FDV   BOT1                                0628  34  0062  0562
371                 STU   T4                                  0562  21  0172  0575
372                 FMP   100                                 0575  39  0098  0449
373                 FDV   P9                                  0449  34  0092  0742
374                 STU   S0002                               0742  21  0078  0782
375                 LDD   G08                                 0782  69  0836  0589
376                 STD    1950      1961                     0589  24  1950  1961
377           G08   RAU   H0007                 START 09      0836  60  0007  0261
378                 FSB   Z0007                               0261  33  0019  0445
379                 FMP   A0007                               0445  39  0031  0832
380                 STU   C7                                  0832  21  0886  0639
381                 RAU   H0009                               0639  60  0009  0563
382                 FSB   Z0009                               0563  33  0021  0547
383                 FMP   A0009                               0547  39  0033  0936
384                 STU   C9                                  0936  21  0088  0991
385                 RAU   C7                                  0991  60  0886  0792
386                 FSB   B0007                               0792  33  0043  0219
387                 STU   T7                                  0219  21  0124  0678
388                 RAU   C9                                  0678  60  0088  0993
389                 FSB   B0009                               0993  33  0045  0571
390                 STU   T9                                  0571  21  0076  0979
391                 FDV   P9                                  0979  34  0092  0842
392                 STU   X4                  X 4             0842  21  0122  0625
393                 FDV   P780H                               0625  34  0284  0986
```

```
394                FAD   ONE
395                STU   BOT1
396                RAU   T7
397                FDV   BOT1
398                STU   T7
399                FMP   100
400                FDV   P9
401                STU   S0005
402                RAU   P9
403                STU   I0004
404                PCH   I0001
405                PCH   S0001    HALT
406   ONE           10    0000    0051
407   1196          11    9600    0049
408   100           10    0000    0053
409   P780H  -      78    0800    0050
410   P268C  -      26    8300    0050
411   3P727  -      37    2700    0051
412   P209E  -      20    9500    0050
413   THREE  -      30    0000    0049
414   MIN1   -      10    0000    0051
415   HALT          01    9999    9999
```

```
0986     32  0481  0457
0457     21  0062  0865
0865     60  0124  0580
0580     34  0062  0612
0612     21  0124  0728
0728     39  0098  0499
0499     34  0092  0892
0892     21  0081  0737
0737     60  0092  0597
0597     21  0130  0787
0787     71  0127  0778
0778     71  0077  0000
0481     10  0000  0051
0201     11  9600  0049
0098     10  0000  0053
0284  -  78  0800  0050
0101  -  26  8300  0050
0285  -  37  2700  0051
0278  -  20  9500  0050
0484  -  30  0000  0049
0187  -  10  0000  0051
0000     01  9999  9999
```

IBM 650 IPES (A.) LOAD

```
6919531952+  2419611954+  7019622950+  6919561955+  2419628000+  60195
6919531952+  2419631954+  3000011964+  6919561955+  2419648000+  80800
6919531952+  2419651954+  5580021966+  6919561955+  2419668000+  35000
6919531952+  2419671954+  8280031968+  6919561955+  2419688000+  88000
6919531952+  2419691954+  6979501970+  6919561955+  2419708000+  24200
6919531952+  2419711954+  5300011972+  6919561955+  2419728000+  42197
6919531952+  2419731954+  5000011974+  6919561955+  2419741961+  58000
7000000017+  1000000052+  1500000052+  4000000051+  7000000051+  10000
          85+  1000000052+  5500000052+  3600000052+  1600000052+  17000
         137+  1000000052+  1000000052+  4000000051+  6000000051+  10000
         205+  1000000052+  1000000052+  1000000052+  1300000052+  11000
         257+  1000000051+  1000000051+  1000000051+  1000000051+  10000
         325+  1000000051+  3000000051+  1000000051+  1000000051+  10000

          17+  1000000052+  1500000052+  4000000051+  7000000051+  10000
          85+  1000000052+  5430000052+  4000000052+  8230000052+  22000
         137+  1000000052+  1000000052+  4000000051+  6000000051+  10000
         205+  1000000052+  1000000052+  1000000052+  1100000052+  11000
         257+  1000000051+  1000000051+  1000000051+  1000000051+  10000
         325+  1000000051+  3000000053+  1000000053+  3000000051+  10000

          17+  1000000052+  1500000052+  4000000051+  7000000051+  10000
          85+  1000000052+  6650000052+  5800000052+  1700000052+  17000
         137+  1000000052+  1000000052+  4000000051+  6000000051+  10000
         205+  1000000052+  1000000052+  1000000052+  1300000052+  11000
         257+  1000000051+  1000000051+  1000000051+  1000000051+  10000
         325+  1000000051+  3000000053+  1000000051+  1000000051+  10000

          17+  1000000052+  1500000052+  4000000051+  7000000051+  10000
          85+  1000000052+  8200000052+  5300000052+  1800000052+  17000
         137+  1000000052+  1000000052+  4000000051+  6000000051+  10000
         205+  1000000052+  1000000052+  1000000052+  1300000052+  11000
         257+  1000000051+  1000000051+  1000000051+  1000000051+  10000
         325+  1000000051+  3000000051+  3000000053+  1000000051+  10000

          17+  1000000052+  1500000052+  4000000051+  7000000051+  10000
          85+  1000000052+  8200000052+  4600000052+  7870000052+  17000
         137+  1000000052+  1000000052+  4000000051+  6000000051+  10000
         205+  1000000052+  1000000052+  1000000052+  1000000052+  11000
         257+  1000000051+  1000000051+  1000000051+  1000000051+  10000
         325+  1000000051+  3000000051+  1000000051+  3000000053+  10000

          17+  1000000052+  1500000052+  4000000051+  7000000051+  10000
          85+  1000000052+  6480000052+  4400000052+  1600000052+  17000
         137+  1000000052+  1000000052+  4000000051+  6000000051+  10000
         205+  1000000052+  1000000052+  1000000052+  1300000052+  11000
         257+  1000000051+  1000000051+  1000000051+  1000000051+  10000
         325+  1000000051+  3000000053+  1000000051+  1000000051+  10000

          17+  1000000052+  1500000052+  4000000051+  7000000051+  10000
          85+  1000000052+  2410000052+  4800000052+  1600000052+  74000
         137+  1000000052+  1000000052+  4000000051+  6000000051+  10000
         205+  1000000052+  1000000052+  1000000052+  1300000052+  10000
         257+  1000000051+  1000000051+  1000000051+  1000000051+  10000
         325+  1000000051+  1000000053+  1000000051+  1000000051+  30000

          17+  1000000052+  7600000052+  4000000051+  7000000051+  10000
          85+  1000000052+  1500000052+  4000000051+  1600000052+  10000
```

IBM 650 TYPE CARD LOAD

```
4+  7019621950+  6919561955+  2419628000+  6019511963+                                  1
4+  3000011964+  6919561955+  2419648000+  8080031965+                                  2
4+  6580021966+  6919561955+  2419668000+  3500011967+                                  3
4+  8280031968+  6919561955+  2419688000+  8800021969+                                  4
4+  6979501970+  6919561955+  2419708000+  2420001971+                                  5
4+  5300011972+  6919561955+  2419728000+  4219731961+                                  6
4+  5000011974+  6919561955+  2419741961+  5800011969+                                  7
2+  1500000052+  4000000051+  7000000051+  1000000052+  1900000052+  3600000052+
2+  5500000052+  3600000052+  1600000052+  1700000052+               CALIB  Q 0
2+  1000000052+  4000000051+  6000000051+  1000000052+  1000000052+  1000000052+
2+  1000000052+  1000000052+  1300000052+  1100000052+
1+  1000000051+  1000000051+  1000000051+  1000000051+  1000000051+  3000000051+
1+  3000000051+  1000000051+  1000000051+  1000000051+

2+  1500000052+  4000000051+  7000000051+  1000000052+  4200000052+  3800000052+
2+  5430000052+  4000000052+  8230000052+  2200000052+               CALIB  Q 1
2+  1000000052+  4000000051+  6000000051+  1000000052+  1000000052+  1000000052+
2+  1000000052+  1000000052+  1100000052+  1100000052+
1+  1000000051+  1000000051+  1000000051+  1000000051+  3000000052+  3000000051+
1+  3000000053+  1000000053+  3000000051+  1000000051+

2+  1500000052+  4000000051+  7000000051+  1000000052+  5100000052+  3600000052+
2+  6650000052+  5800000052+  1700000052+  1700000052+               CALIB  Q 2
2+  1000000052+  4000000051+  6000000051+  1000000052+  1000000052+  1000000052+
2+  1000000052+  1000000052+  1300000052+  1100000052+
1+  1000000051+  1000000051+  1000000051+  1000000051+  3000000052+  3000000051+
1+  3000000053+  1000000051+  1000000051+  1000000051+

2+  1500000052+  4000000051+  7000000051+  1000000052+  2600000052+  3600000052+
2+  8200000052+  5300000052+  1800000052+  1700000052+               CALIB  Q 3
2+  1000000052+  4000000051+  6000000051+  1000000052+  1000000052+  1000000052+
2+  1000000052+  1000000052+  1300000052+  1100000052+
1+  1000000051+  1000000051+  1000000051+  1000000051+  1000000051+  3000000051+
1+  3000000051+  3000000053+  1000000051+  1000000051+

2+  1500000052+  4000000051+  7000000051+  1000000052+  2600000052+  3600000052+
2+  8200000052+  4600000052+  7870000052+  1700000052+               CALIB  Q 4
2+  1000000052+  4000000051+  6000000051+  1000000052+  1000000052+  1000000052+
2+  1000000052+  1000000052+  1000000052+  1100000052+
1+  1000000051+  1000000051+  1000000051+  1000000051+  1000000051+  3000000051+
1+  3000000051+  1000000051+  3000000053+  1000000051+

2+  1500000052+  4000000051+  7000000051+  1000000052+  6670000052+  3600000052+
2+  6480000052+  4400000052+  1600000052+  1700000052+               CALIB  Q 5
2+  1000000052+  4000000051+  6000000051+  1000000052+  1000000052+  1000000052+
2+  1000000052+  1000000052+  1300000052+  1100000052+
1+  1000000051+  1000000051+  1000000051+  1000000051+  1000000051+  3000000051+
1+  3000000053+  1000000051+  1000000051+  1000000051+

2+  1500000052+  4000000051+  7000000051+  1000000052+  2000000052+  3600000052+
2+  2410000052+  4800000052+  1600000052+  7400000052+               CALIB  Q 6
2+  1000000052+  4000000051+  6000000051+  1000000052+  1000000052+  1000000052+
2+  1000000052+  1000000052+  1300000052+  1000000052+
1+  1000000051+  1000000051+  1000000051+  1000000051+  1000000051+  3000000051+
1+  1000000053+  1000000051+  1000000051+  2000000053+

2+  7600000052+  4000000051+  7000000051+  1000000052+  2600000052+  3600000052+
2+  1500000052+  4000000051+  1600000052+  1000000052+               CALIB  Q 7
```

```
137+  10000000052+  10000000052+  40000000051+  60000000051+  10000000052+  10000000052+  10000000052+
205+  10000000052+  10000000052+  40000000051+  13000000052+  10000000052+
257+  10000000051+  10000000053+  10000000051+  10000000051+  10000000051+  10000000051+  30000000051+
325+  10000000051+  10000000051+  10000000051+  10000000051+  10000000051+

 17+  10000000052+  15000000052+  40000000051+  39000000052+  10000000052+  26000000052+  36000000052+
 85+  10000000052+  82000000052+  46000000052+  18000000052+  17000000052+                CALIB  Q 8
137+  10000000052+  10000000052+  40000000051+  10000000052+  10000000052+  10000000052+  10000000052+
205+  10000000052+  10000000052+  10000000052+  13000000052+  11000000052+
257+  10000000051+  10000000051+  10000000051+  10000000053+  10000000051+  10000000051+  30000000051+
325+  10000000051+  30000000051+  10000000051+  10000000051+  10000000051+

 17+  10000000052+  15000000052+  40000000051+  70000000051+  10000000052+  19000000052+  59000000052+
 85+  10000000052+  55000000052+  36000000052+  16000000052+  17000000052+                CALIB  Q 9
137+  10000000052+  10000000052+  40000000051+  60000000051+  10000000052+  10000000052+  10000000052+
205+  10000000052+  10000000052+  10000000052+  13000000052+  11000000052+
257+  10000000051+  10000000051+  10000000051+  10000000051+  10000000051+  10000000051+  30000000053+
325+  10000000051+  30000000051+  10000000051+  10000000051+  10000000051+
```