Alrand Report Number: 42

Accession Number:
AD0488285

Full Text (pdf) Availability:
Size: 0 KB
Handle / proxy Url: No Full Text PDF Available

Citation Status:
A - Active

Title:
MEAN FAMILY REPLACEMENT FACTORS (MFRF),

Fields and Groups :
666666 -

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Report Date:
01 Mar 1964

Media Count:
58 Pages(s)

Organization Type:
N - NAVY AND MARINE CORPS - null

Report Number(s):

ALRAND42 *(ALRAND42)*

ALRAND42 *(ALRAND42)*

Monitor Acronym(s):
ALRAND *(ALRAND)*

20100224 433

Monitor Series:
42 *(42)*

Identifiers:
DEMAND.

Abstract:
Better estimates for the process of initial stock level determinations are sought. Factors are developed for families of items based on the generic noun name. They are classified into sub-families based on application as denoted by the first two digits of the Component Identification Number. The personnel of the Inventory Control Point can apply these factors to new items of the same type for the same or similar application unless some known reason would dictate otherwise. Standard statistical techniques are utilized to establish the degree of confidence associated with the factors produced for use in the Initial Provisioning Process.

Distribution Limitation(s):
01 - APPROVED FOR PUBLIC RELEASE

Source Code:
401587

Document Location:
1 - DTIC AND NTIS

Geopolitical Code:
4219

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Naval Inventory Control Point
Code 04
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03/01/1964

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REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
01-03-1963	Study	xx-xx-1964-xx-xx-1964

4. TITLE AND SUBTITLE
Mcan Family Replacement Factors (MFRF)

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Minnaugh, L A
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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
NAVAL SUPPLY DEPOT MECHANICSBURG PA APPLICATION DEVELOPMENT DIV

8. PERFORMING ORGANIZATION REPORT NUMBER
ALRAND 42

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Application Development Division, Data Processing Field Assistance Group

Weapons Support Division, U.S. Navy Ships Parts Control Centcr

10. SPONSOR/MONITOR'S ACRONYM(S)
ALRAND

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
42

12. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE

13. SUPPLEMENTARY NOTES

14. ABSTRACT
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15. SUBJECT TERMS
Logistics, Military Facilities and Supplics

16. SECURITY CLASSIFICATION OF: a. REPORT	b. ABSTRACT	c. THIS PAGE	17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
U	U	U	UU	58 Pagcs	Jason Harrison
					19b. TELEPHONE NUMBER *(Include area code)* 717-605-3292

ALRAND
REPORT 42

MEAN FAMILY
REPLACEMENT FACTORS (MFRF)

Application Development Division
Data Processing Field Assistance Group
U.S. Naval Supply Depot
Mechanicsburg, Pennsylvania
1 March 1964

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ALRAND Report 42

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PREFACE

New equipments are installed at a seemingly ever increasing rate in our modern Navy. These equipments tend to be more complex and more expensive. So too are the repair parts required to adequately support the equipments once they become operational. Personnel at the Inventory Control Point are faced with a difficult problem in making decisions on how much of which parts to procure initially. Demand history is nonexistent, and so the initial stock levels are based on estimates. If the estimate is excessive, funds are invested needlessly and we experience long supply. Quite possibly this material will become disposable excess. On the other hand, if the estimate is too conservative, the fleet will not receive adequate support in a timely manner. This will cause much effort in expediting actions and conceivably could adversely affect the successful completion of the ship's mission.

This report is directed to the problem of providing better estimates for the process of initial stock level determinations. Factors are developed for families of items based on the generic noun name. They are classified into sub-families based on application as denoted by the first two digits of the Component Identification Number. The personnel of the Inventory Control Point can apply these factors to new items of the same type for the same or similar application unless some known reason would dictate otherwise. Standard statistical techniques are utilized to establish the degree of confidence associated with the factors produced for use in the Initial Provisioning Process.

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I. BACKGROUND

About a year ago, ALRAND Report 39* proposed the use of Experienced Demand Replacement Factors (EDRF). The EDRF could be based on fact completely, or could be a blend of fact and experience of a technical nature. The facts on which the EDRF is built are the demand rate and item population. Certain limits were established in the consideration of full confidence in the EDRF. The item population had to be at least ten, and the item had to be on the stock list four years. During the ensuing year this concept has been implemented and further refinements added. The U.S. Navy Ships Parts Control Center (SPCC) now uses a "Best f" in the Follow-On Provisioning Process for stock level determinations. The factors are updated quarterly as additional data becomes available on an individual item demand basis. The program now encompasses the majority of stock list items and has contributed to some rather dramatic reductions in stock levels for certain items. A number of items, however, have received added levels. Where demand data dictates, the stock position is adjusted. The Bureau of Ships has given permission to utilize this technique for depth determinations of on board repair parts. By design, EDRF was limited to established stock list items.

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*ALRAND Report 39 - Experienced Demand Replacement Factor (EDRF) by L. A. Minnaugh

This paper is directed toward providing personnel at the Inventory Control Point with a technique of applying better factors in the Initial Provisioning Process. At the point in time that initial stocks must be acquired, usually little is known of the operating characteristics of the subject equipment. The technical people are placed in the unsavory position of assigning replacement factors on very scanty data. They must rely on experience with other similar equipments used for similar service. This study was made to compile experience as reflected in the records for similar items under similar operating conditions. The factors determined are labelled Mean Family Replacement Factors (MFRF).

The study arranged established stock list items according to the common generic noun name. These groupings of similar equipments or parts are called families. Then the family groupings were further divided according to similar service as denoted by the first two digits of the Component Identification Number (CID). These subdivisions were called sub-families. At the SPCC the first programmed MFRF machine run produced 5308 families and 15,956 sub-families.

Arranging items by family proved to be a worthy but frustrating task. The computer was used to do the sorting, and often the adjective modifier would cause the creation of a new family. To overcome this situation, the noun name was taken from the Component to Part

Record (CPR) reading the records from left to right for the twenty-five positions in the nomenclature field. Each character was checked for a number, positive sign, or a negative sign. If such an indicator was sensed, everything in that particular field prior to the indicator (i. e., 5, +, -) was printed as the item's noun name. A second pass was made on the remaining items to establish noun name families by taking the information prior to the first comma or first space. These simple schemes did much to correctly categorize items into the families to be considered. The following examples illustrate the process of establishing families from existing machine records. The nomenclature field (twenty-five positions) is shown in relation to the machine file on page 57.

Example A

V	A	L	V	E	+	S	A	F	E	T	Y	R	E	L	I	E	F							

Our search was designed so that this item would be placed in the family known as VALVE.

Example B

R	E	L	A	Y	S	U	B	A	S	S	Y	-	T	R	M	L	O	V	L	D				

The item listed would become a member of the family RELAY SUBASSY.

Example C

R	E	S	I	S	T	O	R	5	0	0	H	M												

This item would become a member of the family RESISTOR.

Example D

B	E	A	R	I	N	G		C	O	N	R	O	D		U	P	R							

This item would become a member of the family BEARING.

Example E

V	A	L	V	E	,	S	A	F	E	T	Y	R	E	L	I	E	F							

This item would be placed in the family VALVE.

It is also possible to pick up a positive sign, negative sign, or a number on the first pass and include a comma or a space in the item's family name.

Example F

L	A	M	P	,	I	C	D	N	T	3	6	A	M	P										

This item would become a member of the family LAMP, ICDNT.

Example G

R	E	S	I	S	T	O	R		A	D	J		5	0	0	0	0	H	M					

This item would be placed in the family RESISTOR ADJ.

The inclusion of commas and spaces results in increases to the number of families and sub-families. Our goal is to lower the number of unnecessary family names so as to make the administration of the MFRF Program an easier and more straight-forward task. To this end, further programming refinements will be necessary.

One phase of the family grouping process remains to be resolved. The symbol X is used frequently in the files as a means of separating the noun name and the adjective modifiers.

Example H

B	E	A	R	I	N	G	X	S	L	E	E	V	E											

X is also in the noun name of a number of items found on the stock list.

Example I

E	X	P	A	N	S	I	O	N	J	O	I	N	T											

The method has not yet been perfected to separate on a symbol which may be an integral part of the nomenclature. To the machine an X is an X no matter where it is found. Resolution of this problem, probably through some arbitrary approach, will further refine the process and reduce the number of families now established.

Once the families are established, the sub-families are arranged by sorting on the first two digits of the CID. The relative position of this data in the machine file is shown on page 57. Table I, appearing on page 49, lists the pertinent numbers and the corresponding equipment application.

II. MEAN FAMILY REPLACEMENT FACTORS

The "Best f" for each stock list item in a sub-family is accumulated. The sum of the sub-family individual item "Best f's" is then averaged. This average is the MFRF for that sub-family.

Mathematically we say:

$$\text{MFRF} = \frac{\sum_{i=1}^{n} f_i}{n} = \bar{f}$$

where:

n = number of items in a sub-family

f_i = the "Best f" for the individual item

$\bar{f}$ = "Best f" average for the sub-family, or the MFRF

Occasionally, an item might possibly find its way into two or more sub-family groupings. It is assumed that the results will not be significantly biased by such duplication.

Now that we have an MFRF, the question arises as to how representative the MFRF is for the sub-family.

III. CONFIDENCE INTERVAL (PROBABLE RANGE OF REPLACEMENT FACTORS)

Statistical methods are used to evaluate the degree of confidence with which we can apply the MFRF to new items. The first step is to compute the standard deviation for the sub-family.

$$\sigma_f = \sqrt{\frac{\sum_{i=1}^{n} d_i^2}{n-1}}$$

where:

σ_f = standard deviation of f_i about the true mean replacement factor for a given sub-family

d_i = difference between $\bar{f}$ and f_i

n = number of items in the sub-family

We assume the values of "Best f" (the individual item replacement factor) for the sub-family to be normally distributed. That is,

$f_i \sim N(\mu_f, \sigma_f^2)$ μ_f, σ_f^2 unknown.

Here, we seek to demonstrate that MFRF is a good estimate for the value of a new item's f_i.

To illustrate this point, a 95% confidence interval is constructed for MFRF about μ. To construct this interval, the following statistic was formed:

$$Y = \frac{\bar{f} - \mu}{\sqrt{\frac{\Sigma(f_i - \bar{f})^2}{n\ (n - 1)}}}$$

It is well known that the above statistic has the Student's t Distribution with (n - 1) degrees of freedom (d. f.). The following probability statement will now permit the construction of the desired confidence interval.

$$Pr \{ - t_{.05} < Y < t_{.05} \} = .95$$

Rewriting the above statement, the desired confidence interval is:

$$\bar{f} - t_{.05} \sqrt{\frac{\Sigma(\bar{f} - \mu)^2}{n(n - 1)}} < \mu < \bar{f} + t_{.05} \sqrt{\frac{\Sigma(\bar{f} - \mu)^2}{n(n - 1)}}$$

The $t_{.05}$ multiplier is selected from the Student's t Distribution (Table II, pages 55-56). Then, for a sub-family with 31 or greater items, approximately 95% of the possible MFRF values for items that really belong in the sub-family will fall within $\pm 1.96 \frac{\sigma_f}{\sqrt{n}}$ of the true mean replacement factor for the sub-family.

<u>Example J</u>

Family: COMPONENT BOARD ASSY

Sub-family: 28

Number of Items in Sub-family: 148

MFRF: .5318

Sigma: .21183

95% Confidence Interval for μ

$$C.I._{\mu} = MFRF \pm 1.96 \frac{\sigma_f}{\sqrt{n}}$$

$$= .5318 \pm 1.96\left(\frac{.21183}{\sqrt{148}}\right)$$

$$\doteq .5318 \pm 1.96\left(\frac{.21183}{12.165}\right)$$

$$= .5318 \pm .0174$$

$$= .5144 \text{ to } .5492$$

This example demonstrates that for a sub-family of reasonably large size, MFRF very closely approximates the true mean replacement factor (μ) for the sub-family.

Assuming MFRF $= \mu$, then

$$\Pr \{\bar{f} - 1.96\sigma_f < f_i < \bar{f} + 1.96\sigma_f\} = .95$$

If, when provisioning a new item that belongs to a particular sub-family of size 31 or greater, the MFRF is used as an initial estimate of item replacement factor, then in approximately 95 cases out of 100, the actual experienced replacement factor for the item will be within $\pm$ 1.96 σ_f of the initial estimate (MFRF).

That is, in approximately 95 cases out of 100, the experienced replacement factor for the individual item (f_i) will fall within the interval $(\bar{f} - 1.96\sigma_f, \bar{f} + 1.96\sigma_f)$. Using the sub-family data from Example J, this interval would be (.117, .947). The interval for family COMPONENT BOARD ASSY sub-family 28 appears under the heading 95% CONF in the Sample Output (Section VI), page 43.

For items of sample size 30 or less the basic relationships are valid; however, the required $t_{.05}$ values are found on Table II, page 55.

<u>Example K</u>

Family: CAM

Sub-family: 31

Number of Items in Sub-family: 4

MFRF: .2235

Sigma: .02723

95% Confidence Interval for μ

$$C.I._{\mu} = MFRF \pm 3.182 \frac{\sigma f}{\sqrt{n}}$$

$$= .2235 \pm 3.182 \left(\frac{.02723}{\sqrt{4}} \right)$$

$$= .2235 \pm 3.182 \left(\frac{.02723}{2} \right)$$

$$= .2235 \pm 3.182\ (.01361)$$

$$= .2235 \pm .0433$$

$$= .1802 \text{ to } .2688$$

It can be seen that as the size of the sub-family increases the probable range of variation between the MFRF and the true mean replacement factor for the sub-family becomes smaller. As shown previously, the computed MFRF is assumed to be effectively equal to the true mean family replacement factor. That is, in approximately

95 cases out of 100, the experienced replacement factor for the individual item will fall within $(\bar{f} - t_{.05}\,\sigma_f,\ \bar{f} + t_{.05}\,\sigma_f)$. Using the sub-family data from Example K, this interval would be (.137, .310). Summary data for items belonging to family CAM and sub-family 31 is shown under Section VI, Sample Output, page 42.

IV. MFRF VALIDATION

We can go further statistically and ascertain whether the MFRF is a good approximation of the true mean of the "Best f" values of the various members of a sub-family. This requires at least two separate runs with the MFRF computed for each. As we update the files quarterly at the SPCC and compute new MFRF's, the necessary statistical data is readily available. Of course, the greater the number of items we have for a particular sub-family, the better will be our measurement of the dispersion of the MFRF's about their own mean. The smaller the value of the standard error of the mean (σ_m) the more closely grouped we would expect the successive values of the MFRF to be for the sub-family. Thus a downward trend in σ_m would indicate that the MFRF is becoming more representative of the sub-family.

Mathematically we say:

$$\sigma_m = \frac{\sigma}{\sqrt{n}}$$

where:

σ_m = standard error of the mean

σ = standard deviation of the "Best f's"

n = number of items in the sub-family

This statistic, labelled SIGMA/X, is printed out quarterly in the MFRF Study output. Examples can be found under Section VI, page 42.

Not only do we check the MFRF for consistency, but we also measure the dispersion of the "Best f" standard deviations from one machine run (quarterly update) until the next. In other words, using a sub-family with many items, we are interested in knowing whether the normal curve representing the "Best f" distribution for a particular sub-family is becoming more peaked or flat. The larger the value of the standard error of the standard deviation (σ_s) the flatter the curve. The flatter the curve the less reliable the MFRF and the greater the range of values of "Best f" falling within our 95% confidence interval.

The mathematical expression is:

$$\sigma_s = \frac{\sigma}{\sqrt{2n}}$$

where:

σ_s = standard error of the standard deviation

σ = standard deviation of the MFRF values

n = number of items in the sub-family

Again we are programmed to compute this statistic quarterly subsequent to the update of the MFRF values. The printout, page 42, shows this statistic under the heading SIG/SIG.

Thus we see that a downward trend in the SIGMA/X or SIG/SIG of a sub-family indicates that its MFRF is good and improving.

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However, when the trend indicates an increase in either SIGMA/X or SIG/SIG or an increase in both, questions arise:

1. Have the items been assigned to the proper sub-family?

2. How valid is the sub-family's MFRF?

If desired, one can go further and manually determine the significance of the trends of the errors in a particular sub-family's statistics. However, before the significance of the trends can be determined, the size of the difference must be known.

One such statistic is the standard error of the difference (σ_d). We take the square root of the sum of the squares of the SIGMA/X values for two different quarters. This measures the size of the difference in the standard errors of our MFRF values for these two particular quarters.

Mathematically we say:

$$\sigma_d = \sqrt{\sigma_{m_1}^2 + \sigma_{m_2}^2}$$

where:

σ_d = standard error of the difference

σ_{m_1} = standard error of the MFRF for the previous quarter

σ_{m_2} = standard error of the MFRF for the present quarter

Note that σ_d can be calculated for any two quarters. One may use the statistics from some much earlier quarter for comparison with more recent results, if desired.

NOTE: At this writing, only one run of the MFRF has been made. Therefore, the values assigned to latter results (in this case σ_{m_2}) are assumed values, for sake of this illustration.

Example L

Family: COMPONENT BOARD ASSY

Sub-family: 28

σ_{m_1} = .5318 from page 43

σ_{m_2} = .5401 assumed

$$\sigma_d = \sqrt{\sigma_{m_1}^2 + \sigma_{m_2}^2} = \sqrt{.2828 + .2917}$$

$$\sigma_d = \sqrt{.5745} = .240$$

Another statistic which will indicate size differential in our process is known as the standard error of the standard deviation. Again we are seeking size differences by comparing data from one quarter with that of a previous quarter. This time we square the values of SIG/SIG for each of the two quarters involved and take the square root of their sum.

The mathematical expression is:

$$\sigma_D = \sqrt{\sigma_{s_1}^2 + \sigma_{s_2}^2}$$

where:

σ_D = standard error of the difference of the standard deviation

σ_{s_1} = standard error of the standard deviation for the previous quarter

σ_{s_2} = standard error of the standard deviation for the present quarter

<u>Example M</u>

Family: COMPONENT BOARD ASSY

Sub-family: 28

σ_{s_1} = .21183 from page 43

σ_{s_2} = .23914 assumed

$$\sigma_D = \sqrt{\sigma_{s_1}^2 + \sigma_{s_2}^2} = \sqrt{.04487 + .05719}$$

$$\sigma_D = \sqrt{.10206} = .319$$

The information provided by σ_d and σ_D is of value to technical personnel because such values can be plugged into the test for significant change. Significant change should be interpreted as cause for corrective action.

The test for the MFRF indicates significant changes in the sub-family's trend for that value. Here we divide the difference between the MFRF's for the two subject quarters by the standard error of the difference (σ_d).

Mathematically we say:

$$R_1 = \frac{ds\ MFRF}{\sigma_d}$$

where:

R_1 = critical ratio of the MFRF's

ds MFRF = difference between the sample MFRF's of the two subject quarters

σ_d = standard error of the difference

Hypotheses:

1. If $R_1 \leq 1.96$, there is no significant difference between the two subject MFRF's.

2. If $R_1 > 1.96$, there is a 95% chance of significant difference between the two MFRF's in question. Such information indicates that it is likely that items are not being assigned to their proper sub-families. Thus, technical personnel are cautioned to take immediate corrective action, or if in fact the MFRF should be changed, the action can be taken.

<u>Example N</u>

Family: GEAR

Sub-family: 05

$MFRF_1$ = .1220 from page 44

$MFRF_2$ = .1587 assumed

σ_d = .026 assumed

$$R_1 = \frac{ds\ MFRF}{\sigma_d} = \frac{.1587 - .1220}{.026}$$

$$R_1 = \frac{.0367}{.026} = 1.41$$

Since the critical ratio of the MFRF (R_1) is less than 1.96, there is no significant difference between the MFRF's of the two subject periods. Therefore, no corrective action need be taken.

The companion test for significant change is based on the standard deviation. Here we divide the difference between the standard deviations (SIGMA's) for the two subject quarters by the standard error of the standard deviation (σ_D).

Mathematically:

$$R_2 = \frac{ds\,\sigma}{\sigma_D}$$

where:

R_2 = critical ratio of the standard deviations

$ds\,\sigma$ = difference between the sample standard deviations of the two subject quarters

σ_D = standard error of the standard deviation

Hypotheses:

1. If $R_2 \leq 1.96$, there is no significant difference between the standard deviations of the two subject quarters.

2. If $R_2 > 1.96$, there is a significant difference between the standard deviations of the two subject quarters. This is an indication

that the distribution dispersions are getting larger for values of the MFRF. This is an undesirable occurrence. It means that the MFRF's assigned to new items coming into the sub-family are becoming less and less representative based on the history for similar items in similar service.

Example O

Family: GEAR

Sub-family: 05

σ_1 = .10295 from page 44

σ_2 = .14317 assumed

σ_D = .0187 assumed

$$R_2 = \frac{ds\,\sigma}{\sigma_D} = .14317 - .10295$$

$$R_2 = \frac{.04022}{.0187} = 2.15$$

Since $R_2 > 1.96$ the distribution dispersions are enlarging for the sub-family's MFRF. This is an indication that the MFRF values for the sub-family are decreasing in historical accuracy. The technician is made aware that the condition exists and he should proceed with caution.

Thus far our validation procedure has been for comparatively large sub-families. That is, in cases where the sub-family numbered

31 or more items normal distribution was assumed. For sub-families with 30 or fewer items, the Students' t Distribution is assumed. See Table II, page 55. The process for testing the significance of changes in small sub-families is exactly the same as for larger sub-families except that R_1 and R_2 must be compared to Students' t Distribution values. Thus, depending on the number of degrees of freedom involved, the test value will be selected from Table II. This value is merely exchanged for the 1.96 value used in the previous validation computations. The number of degrees of freedom to be used is determined as follows:

The total number of items for the two subject quarters minus two yields the number of degrees of freedom. If this total is less than 31, the Students' t Distribution is used for the specified number of degrees of freedom. If the total is 31 or greater, then the normal distribution may be used.

Mathematically:

$$d.f. = (n_1 + n_2) - 2$$

where:

d. f. = degrees of freedom

n_1 = number of items in the sub-family during the previous quarter

n_2 = number of items in the sub-family during the present quarter

Example P

Family: GEAR

Sub-family: 40

$n_1 = 10$ from page 45

$n_2 = 18$ assumed

$d.f = (n_1 + n_2) - 2$

$d.f = (10 + 18) - 2$

$d.f = 28 - 2 = 26$

Since 26 is less than 31, the Students' t Distribution is used with 26 degrees of freedom. This means that a value of 2.056 would be used instead of 1.96. Thus, R_1 and R_2 would be compared to 2.056.

Example Q

Family: PLUNGER

Sub-family: 88

$n_1 = 18$ from page 47

$n_2 = 24$

$d.f = (n_1 + n_2) - 2$

$d.f = (18 + 24) - 2$

$d.f = 42 - 2 = 40$

Since $40 \geq 31$ the normal distribution is assumed and 1.96 is used.

Thus, the MFRF validation procedures provide technical personnel with the capability to gauge the trends of the errors made in assigning

MFRF. The Inventory Control Point can determine whether the MFRF for a given sub-family is improving in accuracy or missing the mark by a greater margin. It is also provided with the capability of determining what type of corrective action should be taken and when such action should take place.

Significant change in either the MFRF or the standard deviation will indicate when corrective action should be taken.

The type of corrective action is indicated by the type of significant change. A significant change in the sub-family's MFRF indicates the possibility that we have been assigning a non-representative value as the MFRF for new items entering this sub-family. Corrective action should take the form of an updated replacement factor for these items. A significant change in the sub-family's standard deviation indicates the possibility that the sub-family has not been properly designed; i.e., it contains non-similar items. Corrective action should take the form of manual reassignment of the items to their proper sub-families.

Initially we recommend the computations of this section be manual on a sample basis. As experience and management use dictate, they may be machine programmed.

V. MACHINE PROGRAMMING

Since a significant part of the MFRF Study is based on programming techniques, a division of this report has been set aside to stress the MFRF Program in detail. The unique contributions of this Program are:

1. its method of breaking out the item noun names from the file records, and

2. its method of sub-grouping items into sub-families by application code; i.e., the first two digits of the CID.

A. General Flow Diagrams

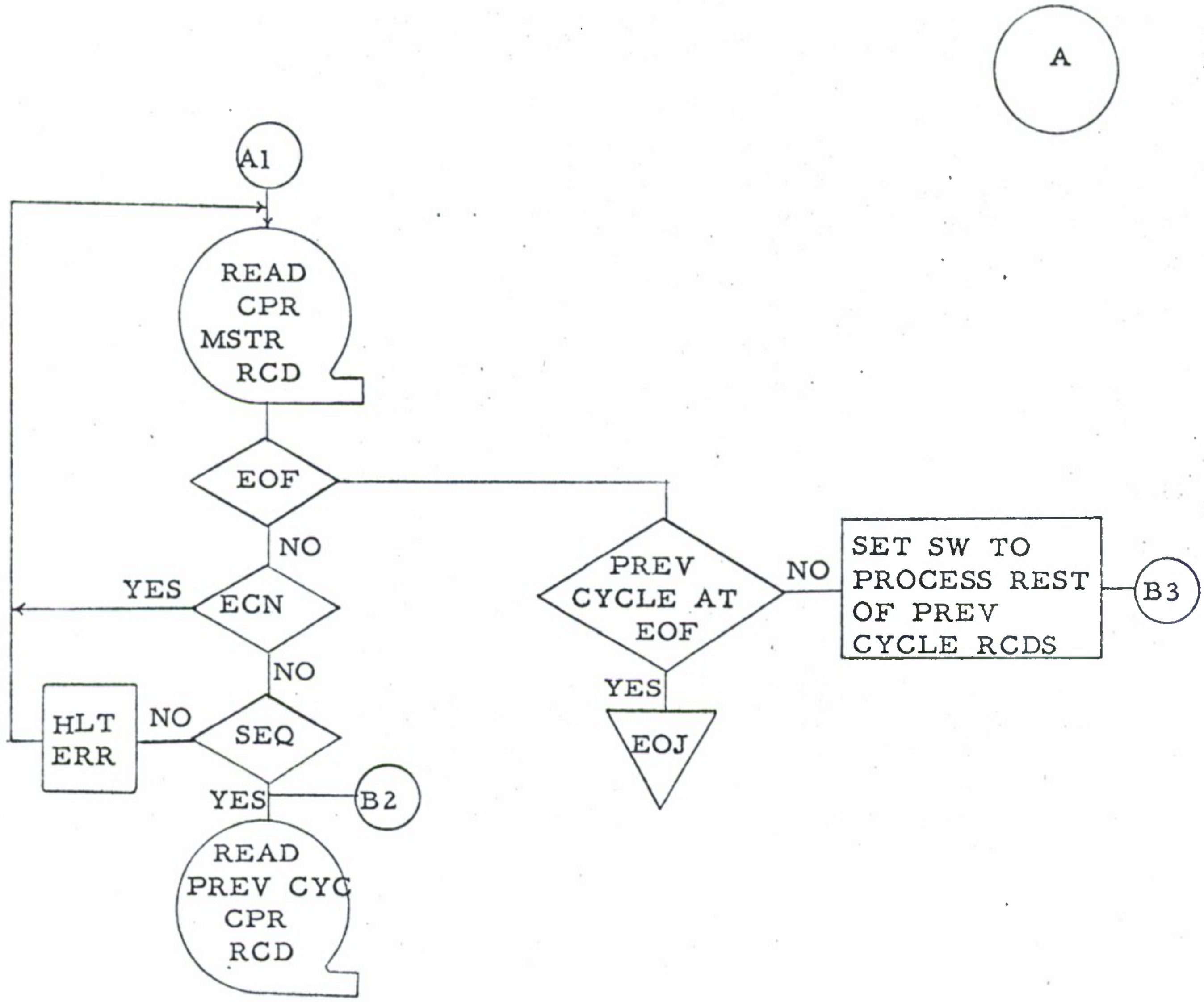
1. Program I. The flow chart depicts the process of breaking out the item noun name, Replacement Factor (RF), and Federal Stock Number (FSN) from the Component to Part Record (CPR) to create input data for Program II.

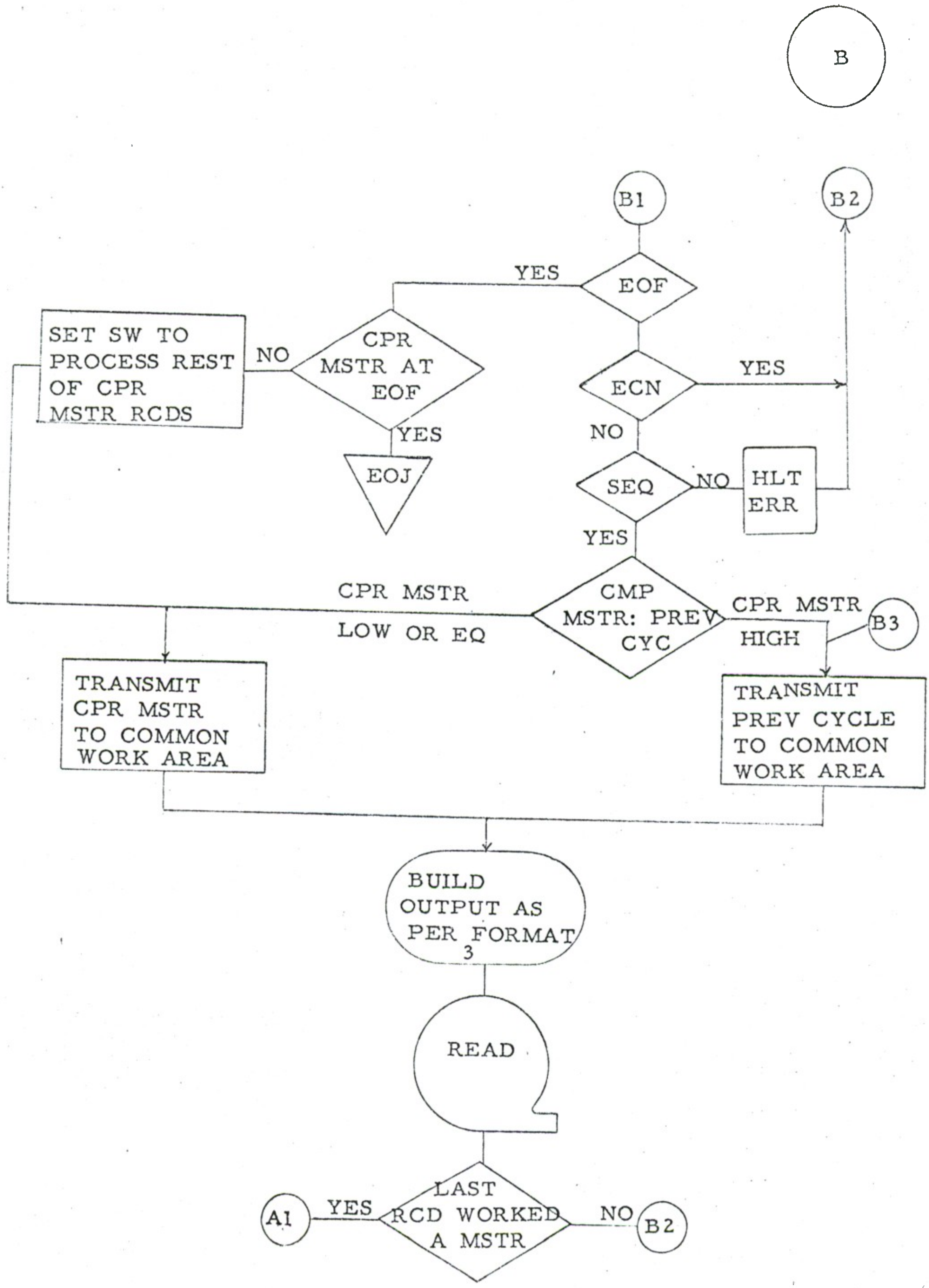
2. Program II. The flow chart describes the matching of the first program's output against the Experienced Demand Replacement Factor (EDRF) file and against the Perpetual Inventory Record (PIR). The PIR provides lead times for a companion program. Based on these same families and sub-families Mean Lead Time (M/LT) is computed. The data for the EDRF file and the first program are merged and "Best f" is computed and listed. The second program also develops data change cards for all affected master records; for

example, CPR, PIR, and the Repair Parts Data Master (RPDMR). Finally, the second program develops input to the next program, Program III.

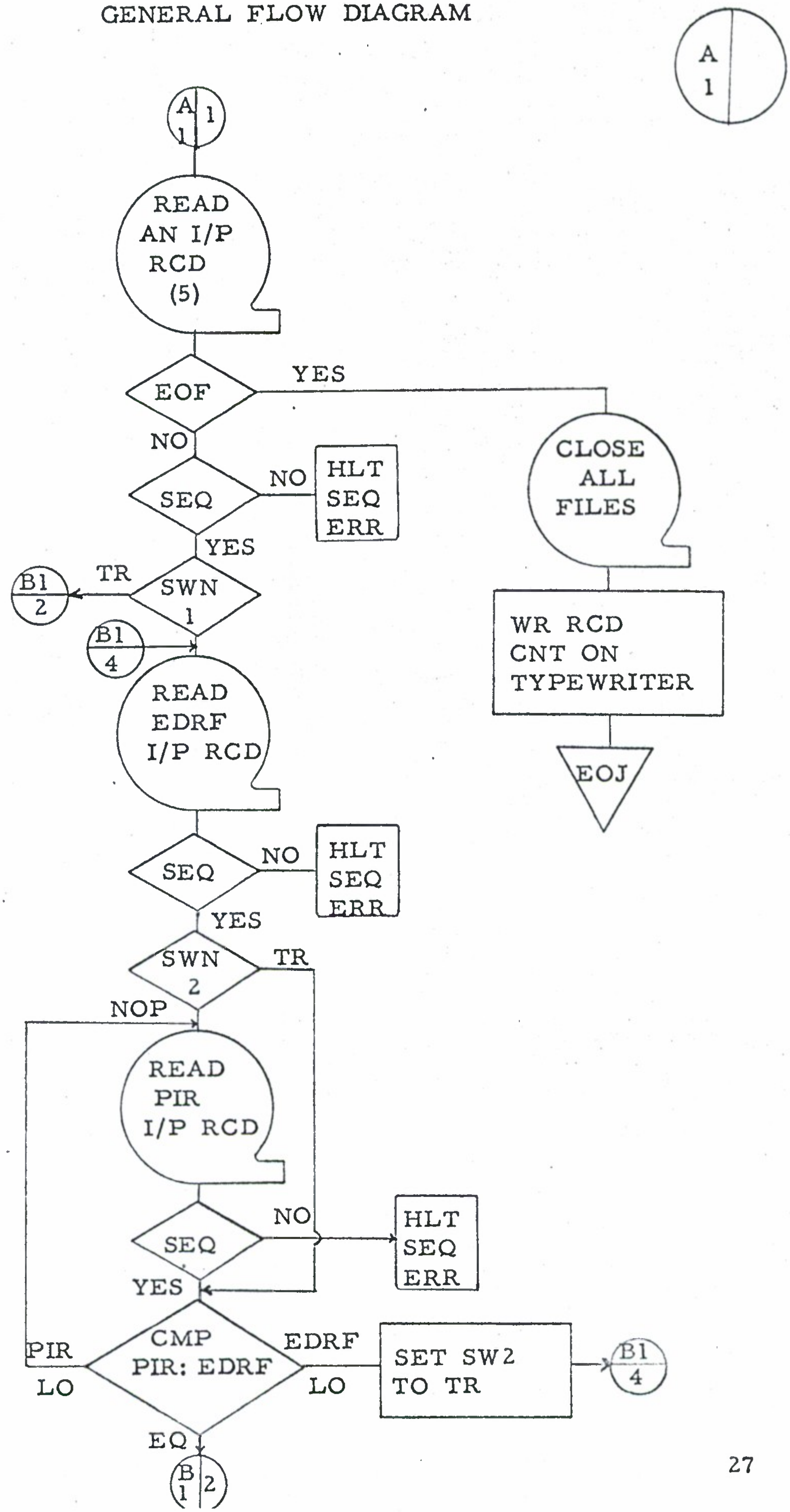
3. Program III. The flow chart describes the computation of the MFRF and summary output for each sub-family under H and P cognizance. Sample output is provided on page 42.

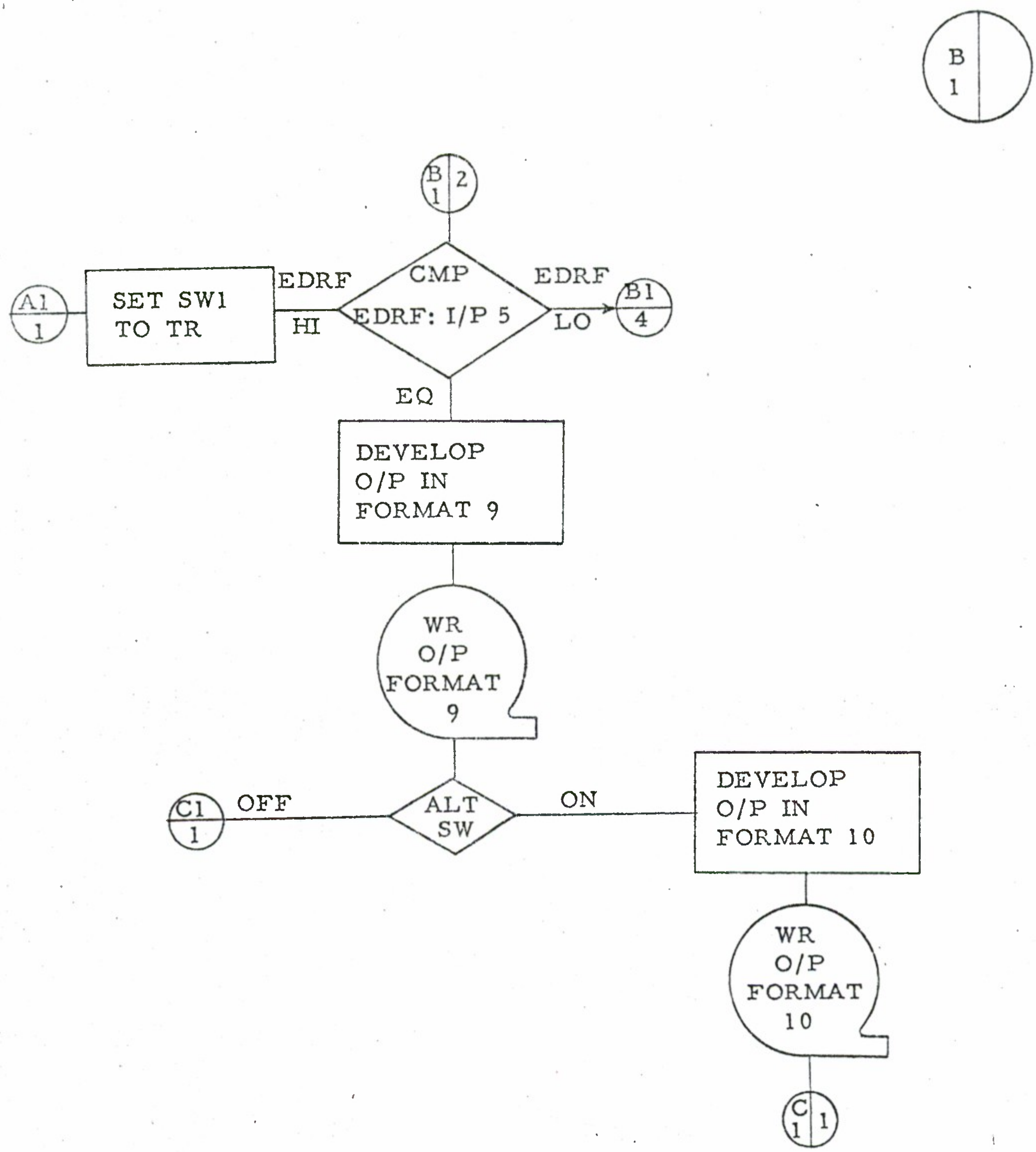
GENERAL FLOW DIAGRAM

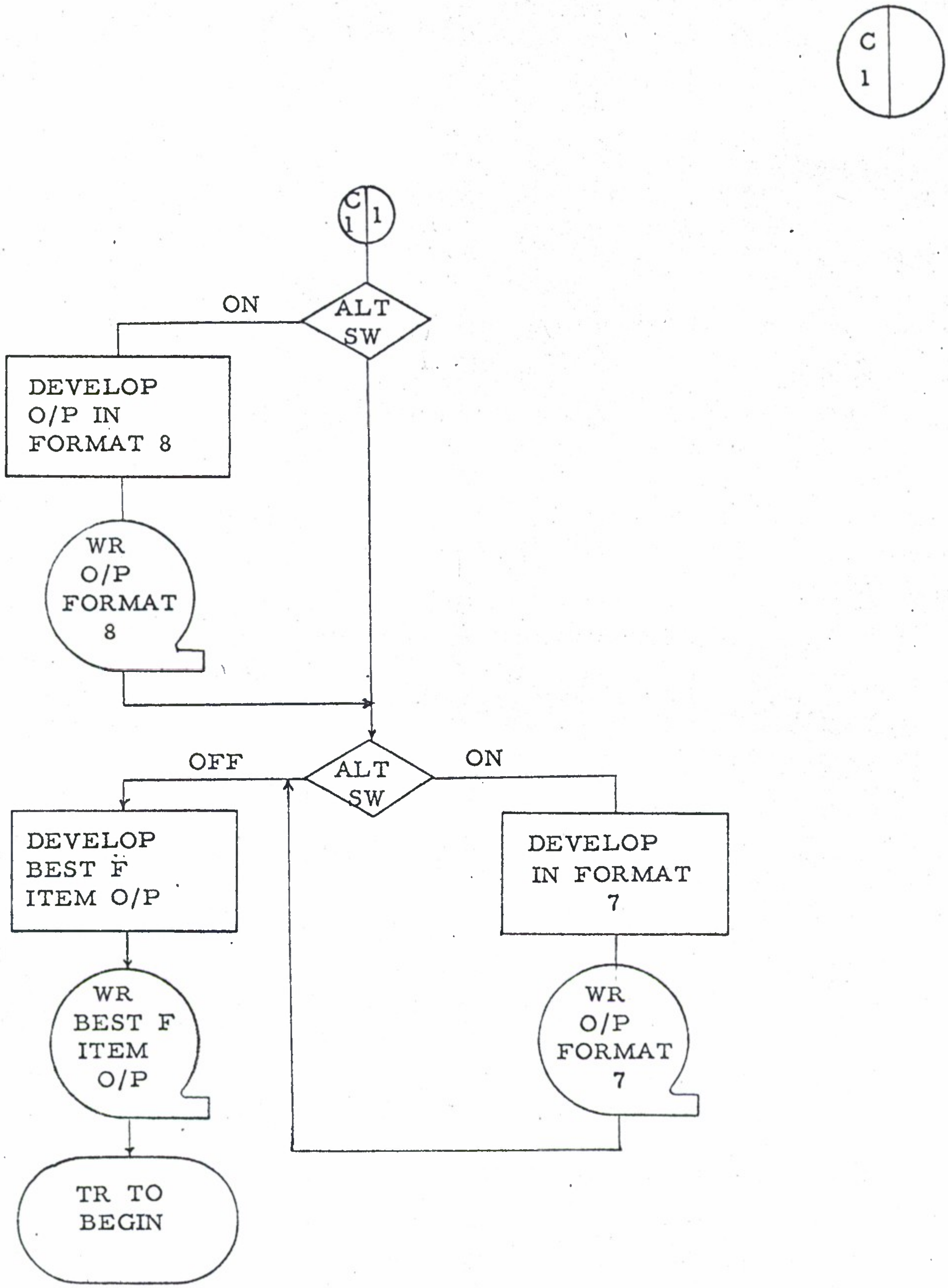



B
B1
B2
EOF
YES
CPR MSTR AT EOF
NO
SET SW TO PROCESS REST OF CPR MSTR RCDS
YES
EOJ
ECN
YES
NO
SEQ
NO
HLT ERR
YES
CMP MSTR: PREV CYC
CPR MSTR LOW OR EQ
CPR MSTR HIGH
B3
TRANSMIT CPR MSTR TO COMMON WORK AREA
TRANSMIT PREV CYCLE TO COMMON WORK AREA
BUILD OUTPUT AS PER FORMAT 3
READ
LAST RCD WORKED A MSTR
YES
A1
NO
B2

GENERAL FLOW DIAGRAM

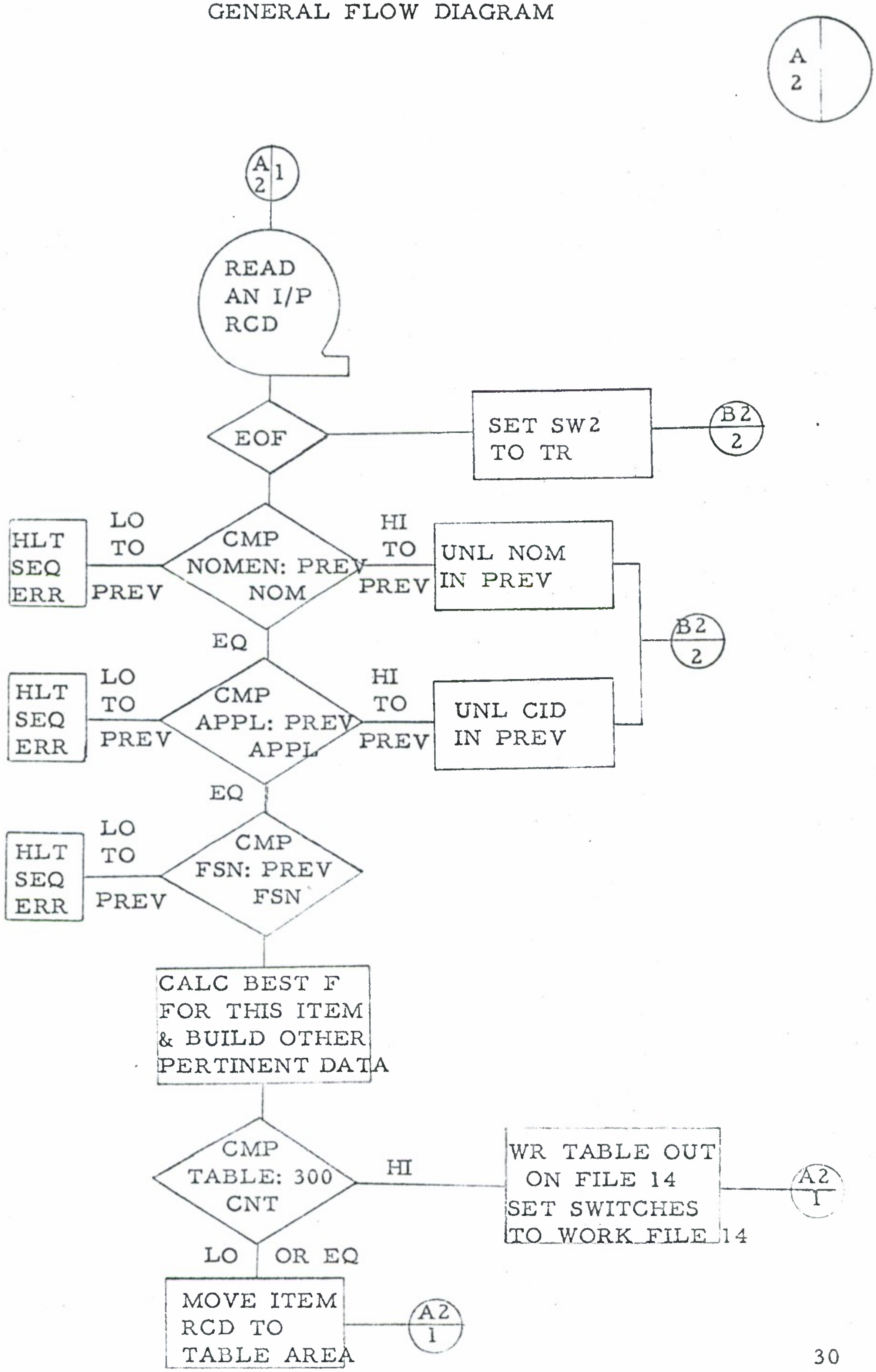


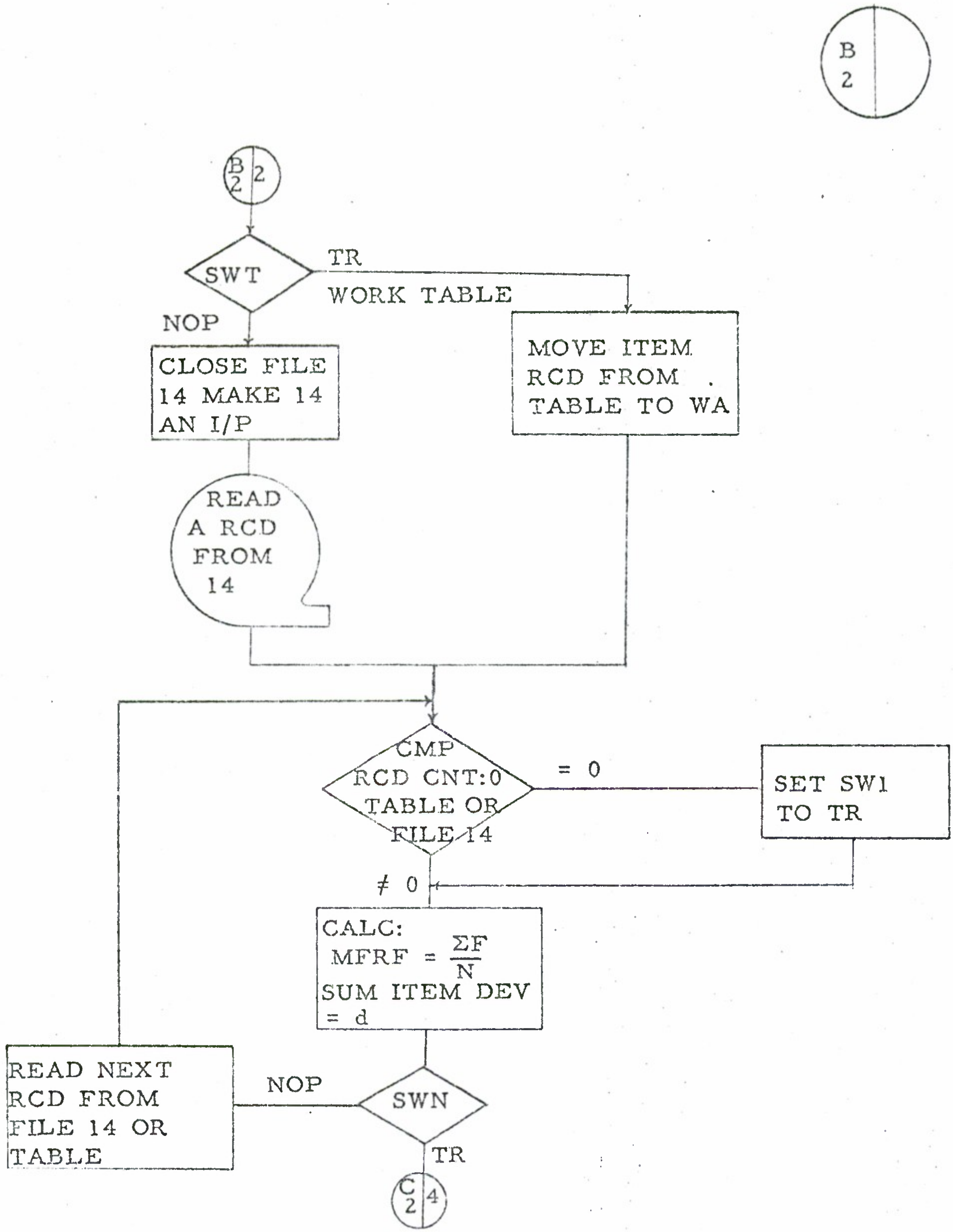

B
1
B
1
2
A1
1
SET SW1
TO TR
EDRF
HI
CMP
EDRF: I/P 5
EDRF
LO
B1
4
EQ
DEVELOP
O/P IN
FORMAT 9
WR
O/P
FORMAT
9
C1
1
OFF
ALT
SW
ON
DEVELOP
O/P IN
FORMAT 10
WR
O/P
FORMAT
10
C
1
1

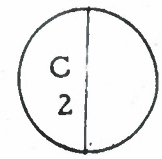

C
1
C
1
1
ON
ALT
SW
DEVELOP
O/P IN
FORMAT 8
WR
O/P
FORMAT
8
OFF
ALT
SW
ON
DEVELOP
BEST F
ITEM O/P
DEVELOP
IN FORMAT
7
WR
BEST F
ITEM
O/P
WR
O/P
FORMAT
7
TR TO
BEGIN

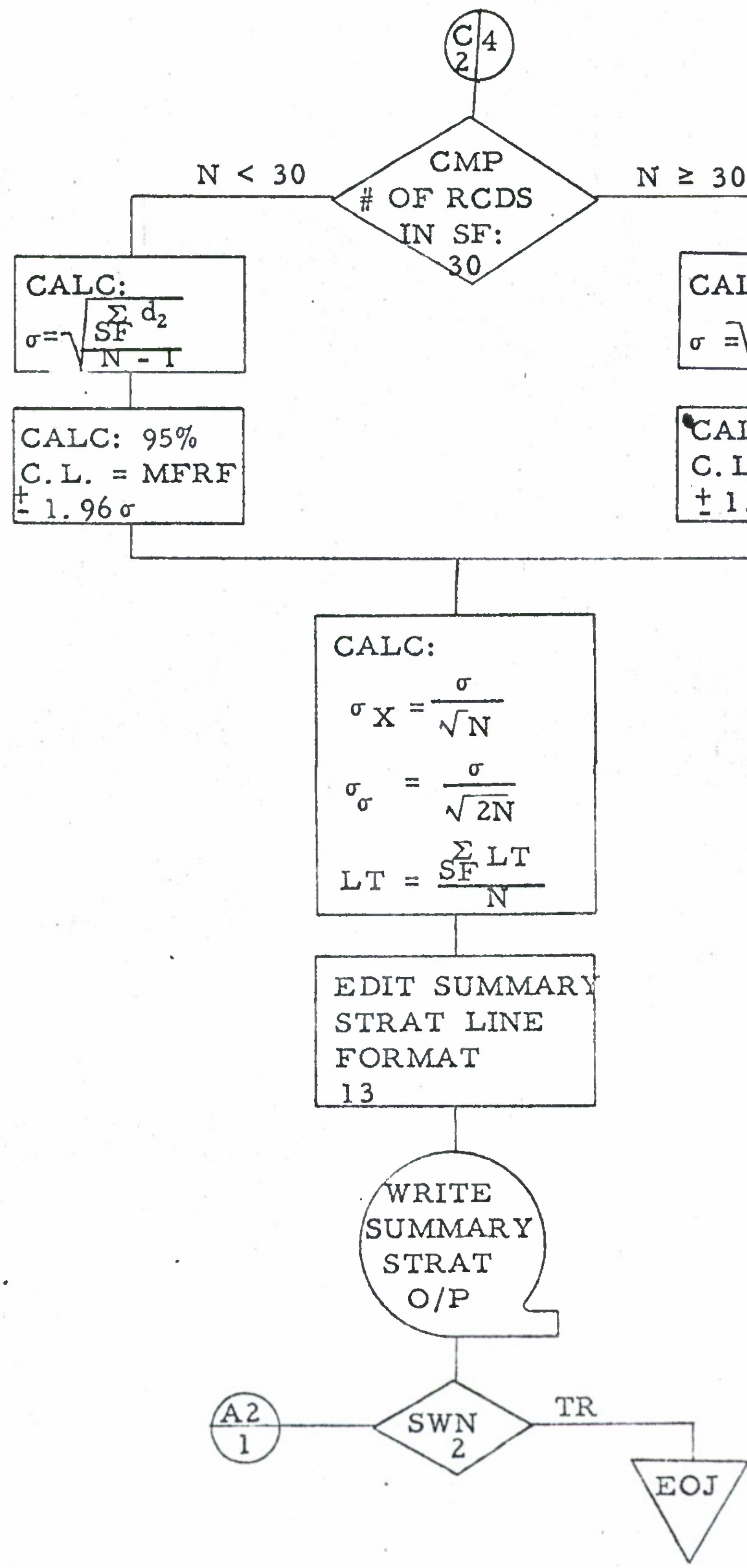
7080 PROGRAM III

GENERAL FLOW DIAGRAM




B 2
B 2 2
SWT
TR
WORK TABLE
NOP
CLOSE FILE 14 MAKE 14 AN I/P
MOVE ITEM RCD FROM TABLE TO WA
READ A RCD FROM 14
CMP RCD CNT:0 TABLE OR FILE 14
= 0
SET SW1 TO TR
≠ 0
CALC: MFRF = ΣF / N SUM ITEM DEV = d
READ NEXT RCD FROM FILE 14 OR TABLE
NOP
SWN
TR
C 2 4


C
2


C 4
2
CMP # OF RCDS IN SF: 30
N < 30
N ≥ 30
CALC: $\sigma = \sqrt{\frac{\sum_{SF} d_2}{N - 1}}$
CALC: $\sigma = \sqrt{\frac{\sum_{SF} d_2}{N}}$
CALC: 95% C. L. = MFRF $\pm$ 1.96 σ
CALC: 95% C. L. = MFRF $\pm$ 1.96 σ
CALC:
$\sigma_X = \frac{\sigma}{\sqrt{N}}$
$\sigma_\sigma = \frac{\sigma}{\sqrt{2N}}$
$LT = \frac{\sum_{SF} LT}{N}$
EDIT SUMMARY STRAT LINE FORMAT 13
WRITE SUMMARY STRAT O/P
A2
1
SWN 2
TR
EOJ

KEY FOR GENERAL FLOW DIAGRAMS

CPR MSTR RCD = Component to Part Master Record

EOF = End of File

ECN = Equipage Category Number

SEQ = Sequence

HLT ERR = Halt Error

PREV CYC = Previous Cycle

EOJ = End of Job

SW = Switch

CMP MSTR: PREV CYC = Compare Master Record to Previous CYC

EQ = Equal

I/P = Input

SWN = Switch No-Operation

WR RCD CNT = Write Record Count

PIR = Perpetual Inventory Record

TR = Transfer

EDRF = Experienced Demand Replacement Factor

LO = Low

HI = High

O/P = Output

ALT = Alteration

NOMEN = Nomenclature

UNL = Unload

APPL = Application

FSN = Federal Stock Number

SWT = Switch Transfer

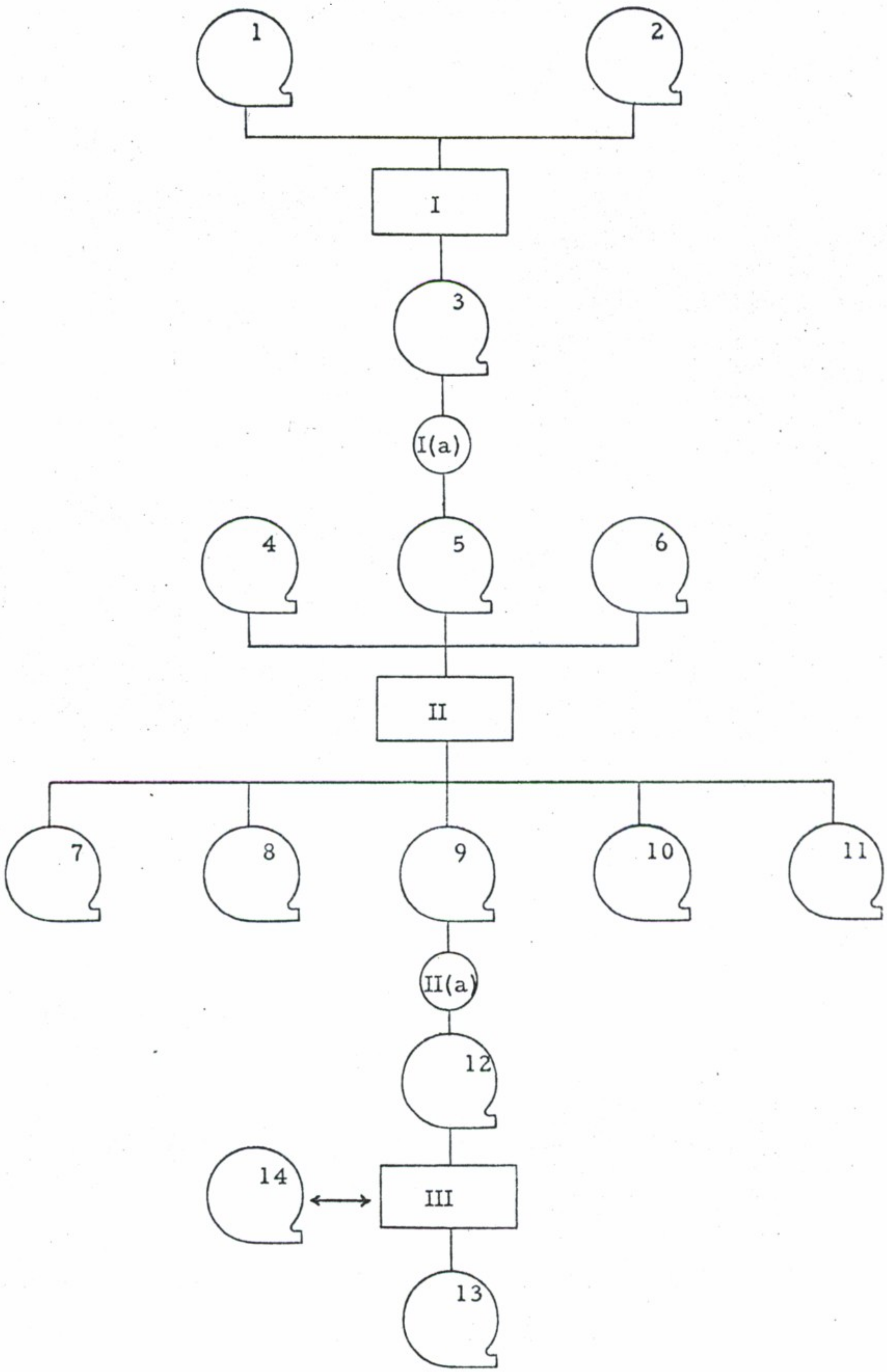
WA = Work Area

CALC = Calculate

SF = Sub-family

MEAN FAMILY REPLACEMENT FACTOR STUDY

GENERAL FLOW DIAGRAM



KEY TO SOURCE AND FINAL DOCUMENT FILES IN GENERAL FLOW DIAGRAM.

1 = Component Parts Master Record (CPR)

2 = Component Parts Master Record (previous cycle)

3 = Output of Program I developed in Format 3, page 38

4 = Perpetual Inventory Record (PIR)

5 = Output (3) ordered by Federal Stock Number

6 = Experienced Demand Replacement Factor File (EDRF)

7 = Repair Parts Master Record Transaction Cards in Format 7, page 38

8 = PIR Data Change Cards in Format 8, page 38

9 = Output of Program II developed in Format 9, page 39

10 = CPR Data Change Cards in Format 10, page 39

11 = Edited "Best f" Listing (see Section VII, page 57)

12 = Output (9) ordered by noun name, Catalog ID, and FSN

13 = Edited MFRF Summary Statistics (see Section VI, page 42)

14 = Alternating Input/Output File used to process large sub-families in Program III

I 7080 program to extract data shown in Format 3, page 38 from the CPR

I(a) 7080 sort to order data for input to next program

II 7080 program to develop the "Best f" Listing with concurrent generation of data change cards for updating various master files

II(a) 7080 sort to order the input data for the next program

III 7080 program to calculate and edit the MFRF Summary Statistics

OUTPUT RECORD FORMATS

Format 3 Primary Output of Program I

5	2	3	1	11	14	25	2	3	6	2	2	2	2	1	3	1
CAT ID		COG		FSN		NOMENCLATURE		R/F		U/I	S	M	R			≠

Format 7 Repair Parts Transaction Card

11	2	2	20	25	7	10	3	4	1
		S S CODE	STOCK NO.		Best f		S 11		≠

Format 8 PIR Data Change Card

3	4	11	11	6	33	1	1	1	1	2	4	2	1	3	1
PIR		FSN		Best f		COG	2	FRAC			LOC	LNG	2		≠

Format 9 Primary Output of Program II

5	2	3	11	2	6	1	3	2	25	2	3	2	3	1	2	2	2	2	1	3	1
CAT ID		COG	FSN		EDRF		LT		NOMENCLATURE		R/F		ALP		U/I	S	M	R			≠

Format 10 CPR Data Change Card

5	2	16	34	2	3	2	2	2	1	9	2	4	1
CAT ID		COG + FSN		U/I	Best f	S	M	R	*		08		≠

OUTPUT RECORD FORMATS DEVELOPED BY THE MFRF PROGRAM

Key and Record Layouts

CAT ID = Category Identification Number (first five digits of the Component Identification Number)

COG = Cognizance

FSN = Federal Stock Number

R/F = Replacement Factor

U/I = Unit of Issue

S = Source Code

M = Maintenance Code

R = Recoverability Code

≠ = End of Record

S S CODE = Supply Support Code

STOCK NO. = Federal Stock Number

S11 = Constant

PIR = Perpetual Inventory Record

2 = Constant (type of change card)

FRAC = Fraction Code

LOC = Location in the PIR

LNG = Length of file place in the PIR

ALP = Alpha (confidence level in EDRF)

* = Indicator (shows that we placed an updated "Best f" in the Replacement Factor field of the Component to Part Record)

08 = Constant (type of change card)

VI. SAMPLE OUTPUT

MEAN FAMILY REPLACEMENT FACTOR SUMMARY STATISTICS

EORF FROM QTR/YR XXX   DATE RUN XXXXX   PAGE 76

FAMILY	SUB-FAM		NR/SF	MFRF	SIGMA	95 % CONF		M/LT	SIGMA/X	SIG/SIG
CALIPER	61	SUMMARY STATISTICS	1	.0256	.00000	.026	.026	2.8	.00000	.00000
CAM	01	SUMMARY STATISTICS	18	.1731	.16679	.000	.525	2.8	.03931	.02779
CAM	05	SUMMARY STATISTICS	3	.0717	.11134	.000	.551	3.0	.06428	.04545
CAM	06	SUMMARY STATISTICS	2	.1000	.14142	.000	1.897	3.0	.09999	.07071
CAM	15	SUMMARY STATISTICS	8	.0522	.07395	.000	.227	2.8	.02614	.01848
CAM	16	SUMMARY STATISTICS	1	.2000	.00000	.200	.200	4.0	.00000	.00000
CAM	19	SUMMARY STATISTICS	1	.0257	.00000	.026	.026	3.0	.00000	.00000
CAM	21	SUMMARY STATISTICS	19	.1583	.23680	.000	.656	2.5	.05432	.03841
CAM	22	SUMMARY STATISTICS	8	.0387	.05317	.000	.164	2.6	.01879	.01329
CAM	23	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	3.3	.00000	.00000
CAM	25	SUMMARY STATISTICS	1	.0123	.00000	.012	.012	3.0	.00000	.00000
CAM	26	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	2.3	.00000	.00000
CAM	27	SUMMARY STATISTICS	1	.0607	.00000	.061	.061	2.5	.00000	.00000
CAM	28	SUMMARY STATISTICS	4	.1450	.08386	.000	.412	3.5	.04193	.02964
CAM	31	SUMMARY STATISTICS	4	.2235	.02723	.137	.310	3.9	.01361	.00962
CAM	38	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	2.9	.00000	.00000
CAM	39	SUMMARY STATISTICS	2	.2000	.00000	.200	.200	2.1	.00000	.00000
CAM	41	SUMMARY STATISTICS	1	.0366	.00000	.037	.037	2.4	.00000	.00000
CAM	42	SUMMARY STATISTICS	1	.0257	.00000	.026	.026	3.0	.00000	.00000
CAM	44	SUMMARY STATISTICS	5	.3200	.16431	.000	.777	4.9	.07348	.05195
CAM	49	SUMMARY STATISTICS	1	.2000	.00000	.200	.200	3.0	.00000	.00000
CAM	52	SUMMARY STATISTICS	3	.0250	.02783	.000	.145	3.7	.01606	.01136
CAM	57	SUMMARY STATISTICS	1	.0895	.00000	.090	.090	1.7	.00000	.00000
CAM	58	SUMMARY STATISTICS	1	.0018	.00000	.002	.002	4.5	.00000	.00000
CAM	59	SUMMARY STATISTICS	1	.2000	.00000	.200	.200	1.9	.00000	.00000
CAM	60	SUMMARY STATISTICS	5	.0424	.08826	.000	.288	2.9	.03947	.02791

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MEAN FAMILY REPLACEMENT FACTOR SUMMARY STATISTICS

EORF FROM QTR/YR XXX DATE RUN XXXXX

FAMILY	SUB-FAM		NR/SF	MFRF	SIGMA	95 % CONF		M/LT	SIGMA/X	SIG/SIG
COMPONENT BD ASSY	28	SUMMARY STATISTICS	1	.3000	.00000	.300	.300	3.3	.00000	.00000
COMPONENT BD ASSY	61	SUMMARY STATISTICS	11	.5545	.41076	.000	1.471	2.5	.12384	.08757
COMPONENT BD ASSY TB	38	SUMMARY STATISTICS	1	.0625	.00000	.063	.063	3.1	.00000	.00000
COMPONENT BOARD	28	SUMMARY STATISTICS	7	.2157	.04156	.114	.318	4.4	.01570	.01110
COMPONENT BOARD	46	SUMMARY STATISTICS	1	.0500	.00000	.050	.050	5.6	.00000	.00000
COMPONENT BOARD ASSY	26	SUMMARY STATISTICS	148	.5318	.21183	.117	.947	5.3	.01741	.01231
COMPONENT BOARD ASSY NO	46	SUMMARY STATISTICS	6	.2750	.28240	.000	1.001	4.9	.11528	.08152
COMPONENT BOARD ASSY T	28	SUMMARY STATISTICS	1	.1585	.00000	.159	.159	3.3	.00000	.00000
COMPONENT BOARD ASSY T	46	SUMMARY STATISTICS	11	.1091	.03014	.042	.176	4.0	.00908	.00642
COMPONENT BOARD ASSY TB	27	SUMMARY STATISTICS	9	.1000	.00000	.100	.100	2.6	.00000	.00000
COMPONENT BOARD ELEV	28	SUMMARY STATISTICS	1	.3009	.00000	.301	.301	3.1	.00000	.00000
COMPONENT BOARD TB	27	SUMMARY STATISTICS	3	.1667	.11546	.000	.663	2.6	.06666	.04713
COMPOUND	28	SUMMARY STATISTICS	1	.0100	.00000	.010	.010	2.2	.00000	.00000
COMPOUND	39	SUMMARY STATISTICS	1	.3571	.00000	.357	.357	2.3	.00000	.00000
COMPOUND	61	SUMMARY STATISTICS	1	.0500	.00000	.050	.050	3.5	.00000	.00000
COMPOUND	97	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	2.3	.00000	.00000
COMPRESSED	46	SUMMARY STATISTICS	1	1.9783	.00000	1.978	1.978	2.2	.00000	.00000
COMPRESSION	06	SUMMARY STATISTICS	1	1.0000	.00000	1.000	1.000	2.3	.00000	.00000
COMPRESSOR	00	SUMMARY STATISTICS	1	.1000	.00000	.100	.100	3.3	.00000	.00000
COMPRESSOR	01	SUMMARY STATISTICS	1	.2273	.00000	.227	.227	3.0	.00000	.00000
COMPRESSOR	06	SUMMARY STATISTICS	73	.0559	.11062	.000	.273	3.5	.01294	.00915
COMPRESSOR	32	SUMMARY STATISTICS	4	.0727	.08606	.000	.346	2.9	.04303	.03042
COMPRESSOR	33	SUMMARY STATISTICS	7	.0758	.07028	.000	.248	3.2	.02656	.01878
COMPRESSOR	66	SUMMARY STATISTICS	9	.0906	.12834	.000	.387	3.9	.04278	.03025
COMPRESSOR	86	SUMMARY STATISTICS	1	.0392	.00000	.039	.039	3.7	.00000	.00000
COMPRESSOR	88	SUMMARY STATISTICS	3	.0500	.00000	.050	.050	5.6	.00000	.00000

MEAN FAMILY REPLACEMENT FACTOR SUMMARY STATISTICS

FAMILY	SUB-FAM		NR/SF	MFRF	SIGMA	95 % CONF		M/LT	SIGMA/X	SIG/SIG
GAUGE	62	SUMMARY STATISTICS	1	.2000	.00000	.200	.200	4.3	.00000	.00000
GAUGE	63	SUMMARY STATISTICS	1	.0615	.00000	.062	.062	3.0	.00000	.00000
GAUGE	65	SUMMARY STATISTICS	1	.5000	.00000	.500	.500	3.3	.00000	.00000
GAUGE	66	SUMMARY STATISTICS	6	.2135	.08232	.002	.425	2.8	.03360	.02376
GAUGE	69	SUMMARY STATISTICS	2	.0111	.01568	.000	.210	2.7	.01108	.00784
GAUGE	88	SUMMARY STATISTICS	5	.1014	.06660	.000	.287	3.0	.02978	.02106
GAUGE	91	SUMMARY STATISTICS	2	.5530	.56370	.000	7.718	4.8	.39859	.28185
GAUGE	92	SUMMARY STATISTICS	2	.1678	.06166	.000	.952	3.1	.04360	.03083
GAUGE	97	SUMMARY STATISTICS	2	.2056	.11398	.000	1.654	2.3	.08059	.05699
GAUGE ASSY	66	SUMMARY STATISTICS	2	.0370	.00435	.000	.092	4.6	.00307	.00217
GAUGE PRESS	02	SUMMARY STATISTICS	1	.1734	.00000	.173	.173	3.0	.00000	.00000
GAUGE PRESS OUPLEX	61	SUMMARY STATISTICS	1	.4030	.00000	.403	.403	2.3	.00000	.00000
GAUGEXPRESSUREXDIAL	61	SUMMARY STATISTICS	1	.4030	.00000	.403	.403	2.3	.00000	.00000
GAUZE	46	SUMMARY STATISTICS	2	1.0000	.00000	1.000	1.000	2.2	.00000	.00000
GEAR	00	SUMMARY STATISTICS	10	.3088	.45638	.000	1.340	3.2	.14432	.10204
GEAR	01	SUMMARY STATISTICS	190	.1578	.15021	.000	.452	3.3	.01089	.00770
GEAR	02	SUMMARY STATISTICS	1	.2000	.00000	.200	.200	3.0	.00000	.00000
GEAR	05	SUMMARY STATISTICS	485	.1220	.10295	.000	.324	3.6	.00467	.00330
GEAR	06	SUMMARY STATISTICS	73	.1147	.12499	.000	.360	3.0	.01462	.01034
GEAR	10	SUMMARY STATISTICS	12	.0901	.11522	.000	.344	2.1	.03326	.02351
GEAR	11	SUMMARY STATISTICS	9	.0000	.00000	.000	.000	2.3	.00000	.00000
GEAR	15	SUMMARY STATISTICS	5	.0605	.08464	.000	.296	2.8	.03785	.02676
GEAR	16	SUMMARY STATISTICS	5	.1544	.08462	.000	.390	3.5	.03784	.02675
GEAR	17	SUMMARY STATISTICS	126	.0938	.08413	.000	.259	3.7	.00749	.00529
GEAR	18	SUMMARY STATISTICS	2	.1563	.04419	.000	.718	2.6	.03124	.02209
GEAR	21	SUMMARY STATISTICS	1	.0137	.00000	.014	.014	3.0	.00000	.00000

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MEAN FAMILY REPLACEMENT FACTOR SUMMARY STATISTICS

EORF FROM QTR/YR XXX   DATE RUN XXXXX

FAMILY	SUB-FAM		NR/SF	MFRF	SIGMA	95 % CONF		M/LT	SIGMA/X	SIG/SIG
GEAR	22	SUMMARY STATISTICS	14	.0446	.04645	.000	.145	2.9	.01241	.00877
GEAR	23	SUMMARY STATISTICS	11	.0238	.07712	.000	.195	3.5	.02325	.01644
GEAR	25	SUMMARY STATISTICS	342	.0564	.13298	.000	.317	3.4	.00719	.00508
GEAR	26	SUMMARY STATISTICS	19	.3745	.47255	.000	1.367	3.1	.10841	.07665
GEAR	27	SUMMARY STATISTICS	57	.0482	.07874	.000	.203	2.8	.01042	.00737
GEAR	28	SUMMARY STATISTICS	307	.0815	.05173	.000	.183	3.5	.00295	.00208
GEAR	29	SUMMARY STATISTICS	8	.1871	.16531	.000	.577	3.4	.05844	.04132
GEAR	30	SUMMARY STATISTICS	8	.1718	.17972	.000	.596	2.9	.06354	.04493
GEAR	31	SUMMARY STATISTICS	16	.0724	.08852	.000	.261	3.1	.02213	.01564
GEAR	34	SUMMARY STATISTICS	13	.1006	.10381	.000	.327	3.1	.02879	.02035
GEAR	38	SUMMARY STATISTICS	52	.0740	.08456	.000	.240	3.0	.01172	.00829
GEAR	39	SUMMARY STATISTICS	6	.0500	.00000	.050	.050	2.3	.00000	.00000
GEAR	40	SUMMARY STATISTICS	10	.3268	.22761	.000	.841	3.0	.07197	.05089
GEAR	41	SUMMARY STATISTICS	11	.0823	.11448	.000	.338	2.6	.03451	.02440
GEAR	42	SUMMARY STATISTICS	1	.0375	.00000	.038	.038	2.3	.00000	.00000
GEAR	43	SUMMARY STATISTICS	50	.0956	.15631	.000	.402	2.6	.02210	.01563
GEAR	44	SUMMARY STATISTICS	12	.3083	.17816	.000	.700	3.9	.05143	.03636
GEAR	46	SUMMARY STATISTICS	12	.0983	.11469	.000	.351	4.6	.03310	.02341
GEAR	50	SUMMARY STATISTICS	5	.0434	.02561	.000	.115	2.6	.01145	.00809
GEAR	52	SUMMARY STATISTICS	27	.1207	.17400	.000	.479	3.2	.03348	.02367
GEAR	53	SUMMARY STATISTICS	26	.0194	.02570	.000	.072	3.0	.00504	.00356
GEAR	54	SUMMARY STATISTICS	17	.0122	.01174	.000	.037	3.5	.00284	.00201
GEAR	55	SUMMARY STATISTICS	39	.0194	.04428	.000	.106	3.0	.00709	.00501
GEAR	56	SUMMARY STATISTICS	1	.5000	.00000	.500	.500	3.0	.00000	.00000
GEAR	57	SUMMARY STATISTICS	39	.0580	.06918	.000	.194	3.1	.01107	.00783
GEAR	58	SUMMARY STATISTICS	9	.0458	.05861	.000	.181	3.0	.01953	.01381

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MEAN FAMILY REPLACEMENT FACTOR SUMMARY STATISTICS

EORF FROM QTR/YR XXX   DATE RUN XXXXX

FAMILY	SUB-FAM		NR/SF	MFRF	SIGMA	95 % CONF		M/LT	SIGMA/X	SIG/SIG
LEVER	06	SUMMARY STATISTICS	4	.0565	.02903	.000	.149	3.1	.01451	.01026
LEVER	12	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	3.0	.00000	.00000
LEVER	15	SUMMARY STATISTICS	2	.0852	.06809	.000	.951	2.3	.04814	.03404
LEVER	16	SUMMARY STATISTICS	4	.1199	.02340	.046	.194	3.5	.01170	.00827
LEVER	17	SUMMARY STATISTICS	2	.1355	.02609	.000	.467	3.6	.01844	.01304
LEVER	21	SUMMARY STATISTICS	4	.0111	.00768	.000	.036	3.5	.00384	.00271
LEVER	22	SUMMARY STATISTICS	4	.0810	.08952	.000	.366	2.8	.04476	.03165
LEVER	25	SUMMARY STATISTICS	6	.0348	.06984	.000	.214	4.0	.02851	.02016
LEVER	26	SUMMARY STATISTICS	3	.1265	.11824	.000	.635	4.0	.06826	.04827
LEVER	27	SUMMARY STATISTICS	5	.0134	.01944	.000	.067	3.6	.00869	.00614
LEVER	28	SUMMARY STATISTICS	9	.2000	.00000	.200	.200	2.5	.00000	.00000
LEVER	30	SUMMARY STATISTICS	3	.2010	.17141	.000	.938	3.0	.09896	.06997
LEVER	31	SUMMARY STATISTICS	2	.0500	.07071	.000	.949	2.4	.04999	.03535
LEVER	34	SUMMARY STATISTICS	1	.0061	.00000	.006	.006	3.0	.00000	.00000
LEVER	35	SUMMARY STATISTICS	1	.0009	.00000	.001	.001	1.9	.00000	.00000
LEVER	38	SUMMARY STATISTICS	4	.1029	.08972	.000	.388	2.7	.04486	.03172
LEVER	39	SUMMARY STATISTICS	4	.0542	.06767	.000	.269	2.6	.03383	.02392
LEVER	41	SUMMARY STATISTICS	3	.1000	.17320	.000	.845	2.9	.09999	.07070
LEVER	43	SUMMARY STATISTICS	1	.0013	.00000	.001	.001	3.0	.00000	.00000
LEVER	44	SUMMARY STATISTICS	2	.3500	.21213	.000	3.046	2.9	.14999	.10606
LEVER	47	SUMMARY STATISTICS	1	.3300	.00000	.330	.330	3.0	.00000	.00000
LEVER	49	SUMMARY STATISTICS	1	.1000	.00000	.100	.100	3.0	.00000	.00000
LEVER	52	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	5.0	.00000	.00000
LEVER	54	SUMMARY STATISTICS	3	.0000	.00000	.000	.000	3.0	.00000	.00000
LEVER	58	SUMMARY STATISTICS	2	.1750	.10606	.000	1.523	3.0	.07499	.05303
LEVER	61	SUMMARY STATISTICS	11	.0873	.08143	.000	.269	3.1	.02455	.01736

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MEAN FAMILY REPLACEMENT FACTOR SUMMARY STATISTICS

ECRF FROM CTR/YR XXX DATE RUN XXXXX

FAMILY	SUB-FAM		NR/SF	MFRF	SIGMA	95 % CONF		M/LT	SIGMA/X	SIG/SIG
PLUNGER	76	SUMMARY STATISTICS	3	.0455	.03612	.000	.201	3.9	.02085	.01474
PLUNGER	88	SUMMARY STATISTICS	18	.1173	.12064	.000	.372	2.6	.02843	.02010
PLUNGER	91	SUMMARY STATISTICS	1	.5000	.00000	.500	.500	2.1	.00000	.00000
PLUNGER	92	SUMMARY STATISTICS	2	.1591	.11179	.000	1.580	3.4	.07904	.05589
PLUNGER	97	SUMMARY STATISTICS	8	.0978	.10450	.000	.344	2.7	.03694	.02612
PLUNGER	98	SUMMARY STATISTICS	1	.1000	.00000	.100	.100	2.6	.00000	.00000
PLUNGER AND BARREL	66	SUMMARY STATISTICS	2	.4600	.05656	.000	1.179	3.0	.03999	.02828
PLUNGER AND SLEEVE	65	SUMMARY STATISTICS	1	.2500	.00000	.250	.250	3.0	.00000	.00000
PLUNGER ASSY	01	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	3.0	.00000	.00000
PLUNGER ASSY	45	SUMMARY STATISTICS	1	.0154	.00000	.015	.015	1.8	.00000	.00000
PLUNGER ASSY	61	SUMMARY STATISTICS	2	.4258	.20484	.000	3.029	3.0	.14484	.10242
PLUNGER ASSY	66	SUMMARY STATISTICS	2	.1250	.17677	.000	2.372	4.0	.12499	.08838
PLUNGER FOLLOWER	29	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	3.0	.00000	.00000
PLUNGER UNIT	60	SUMMARY STATISTICS	1	.0500	.00000	.050	.050	3.3	.00000	.00000
PLUNGER X BARREL	01	SUMMARY STATISTICS	1	.0069	.00000	.007	.007	3.0	.00000	.00000
PLUNGER X BARREL	29	SUMMARY STATISTICS	3	.4316	.11641	.000	.941	3.3	.06836	.04834
PLUNGER X BARREL	66	SUMMARY STATISTICS	2	.2224	.03160	.000	.624	3.0	.02234	.01580
PLUNGER X BARREL	83	SUMMARY STATISTICS	1	.1000	.00000	.100	.100	3.3	.00000	.00000
PLUNGER X BUSHING	29	SUMMARY STATISTICS	2	.4375	.08838	.000	1.561	3.1	.06249	.04419
PLUNGER X CYLINDER	06	SUMMARY STATISTICS	1	.0556	.00000	.056	.056	2.3	.00000	.00000
PLUNGER X LOCK	66	SUMMARY STATISTICS	1	.0513	.00000	.051	.051	3.3	.00000	.00000
PLUNGER X RESTRICTOR	01	SUMMARY STATISTICS	1	.0116	.00000	.012	.012	4.4	.00000	.00000
PLUNGER X RESTRICTOR	52	SUMMARY STATISTICS	1	.0116	.00000	.012	.012	4.4	.00000	.00000
PLUSE	16	SUMMARY STATISTICS	1	.0650	.00000	.065	.065	3.0	.00000	.00000
PNL BATT CHRG	09	SUMMARY STATISTICS	1	.0000	.00000	.000	.000	2.3	.00000	.00000
PNN	05	SUMMARY STATISTICS	1	.1000	.00000	.100	.100	3.0	.00000	.00000

VII. TABLES AND COMPONENT TO PART RECORD LAYOUT

Table I:

A listing of the sub-family codes and their corresponding applications.

Table II:

The Students' t Distribution values for 95% confidence.

CPR Record Layout:

The program source for noun nomenclature, Federal Stock Number, and Replacement Factor.

TABLE I. SUB-FAMILY DESIGNATORS

01	PUMPS
02	BOILERS
03	HEAT EXCHANGERS
04	CONDENSERS
05	TURBINES
06	COMPRESSORS
07	HEATERS
08	DISTILLING PLANTS
09	BATTERY CHARGERS
10	METERS
11	CONVERTERS
12	MAINTENACE AND REPAIR SHOP EQUIPMENT
13	TRANSFORMERS
14	CIRCUIT BREAKERS
15	CONTROLLERS
16	GENERATORS
17	MOTORS
18	MOTOR GENERATORS
19	RELAYS
20	RHEOSTATS
21	SWITCHES

TABLE I. SUB-FAMILY DESIGNATORS (Continued)

22	SWITCHBOARDS
23	ALARMS & SIGNALLING DEVICES - VISUAL
24	LIGHTNING FIXTURES & LAMPS (ELECT - NONELECT)
25	GYRO COMPASS EQUIPMENT
26	PROJECTION EQUIPMENT
27	INTERIOR COMMUNCIATION EQUIPMENT
28	NAVIGATIONAL EQUIPMENT (ALSO TIMEPIECES)
29	INJECTORS
30	BURNERS
31	MARINE HARDWARE & HULL ITEMS
32	REFRIGERATION EQUIPMENT
33	AIR CONDITIONING EQUIPMENT
34	STARTERS
35	WIPERS
36	ALARMS & SIGNALLING DEVICES - AUDIBLE
37	BEARINGS
38	INDICATORS
39	CLUTCHES
40	FANS
41	SHOP EQUIPMENT
42	REGULATORS

(6

TABLE I. SUB-FAMILY DESIGNATORS (Continued)

43	GALLEY EQUIPMENT
44	DEHUMIDIFICATION EQUIPMENT
45	GAGES
46	TESTING & MEASURING EQUIPMENT
47	CHEMICAL WARFARE EQUIPMENT
48	FILTERS
49	CARBURETORS
50	PANELS
51	ISOLATORS
52	HYDRAULIC EQUIPMENT
53	CAPSTANS
54	PRINTING EQUIPMENT
55	REELS & TOWING EQUIPMENT
56	DAVITS
57	CRANES
58	HOISTS & AMMUNITION HANDLING EQUIPMENT
59	ELEVATORS
60	STEERING GEARS
61	CONTROL EQUIP - CONSTANT FREQUENCY
	CONTROLS - AMPLIFIER
	CONTROLS - ELECTRICAL

TABLE I. SUB-FAMILY DESIGNATORS (Continued)

	CONTROLS - MECHANICAL
	CONTROLS - ROTOTROL
	CONTROLS - SELF SYNCHRONOUS
62	WINCHES
63	WINDLASSES
64	FIRE FIGHTING EQUIPMENT
65	LUBRICATORS
66	ENGINES
67	PLUMBING EQUIPMENT
68	MAGNETOS
69	GEARS
70	GOVERNORS
71	IGNITION EQUIPMENT
72	MINOR LANDING CRAFT & SMALL BOATS
73	EJECTORS
74	EDUCTORS
75	STRAINERS
76	PURIFIERS
77	TRAPS
78	COUPLINGS
79	SILENCING EQUIPMENT

TABLE I. SUB-FAMILY DESIGNATORS (Continued)

80	BRAKES
81	BLOWERS
82	WELDING SYSTEMS
83	SHIP & BOAT PROPULSION COMPONENTS
84	SICK-BAY EQUIPMENT
85	DECK MACHINERY
86	PHOTOGRAPHIC EQUIPMENT
87	UNDERWATER LOG EQUIPMENT
88	VALVES
89	FIRE FIGHTING, RESCUE & SAFETY EQUIPMENT
90	RIGGING AND RIGGING GEAR (BOOMS, ETC)
91	LAUNDRY EQUIPMENT
92	TANKS
93	PIPE, TUBING, HOSE, AND FITTINGS (METAL & FLEXIBLE)
94	ASW & MINESWEEPING EQUIPMENT
95	
96	
97	PERISCOPES & MASTS
98	NUCLEAR
99	MISCELLANEOUS EQUIPMENT

NOTE: Code OO is not an application, but an indication of Supply Support. In cases involving Supply Support, SPCC provisions to

TABLE I. SUB-FAMILY DESIGNATORS (Continued)

support equipment managed by another Inventory Control Point or Defense Supply Agency, as well as its own requirements. Thus, an item can be used in an application code 13 type job which is Supply Support. Sub-family OO will be a conglomeration of items with similar nomenclature and varying application and will therefore be of negligible value to the provisioner.

TABLE II. STUDENT'S t DISTRIBUTION

Degrees of Freedom	0.05 95% C.I.
1	12.706
2	4.303
3	3.182
4	2.776
5	2.571
6	2.447
7	2.365
8	2.306
9	2.262
10	2.228
11	2.201
12	2.178
13	2.160
14	2.145
15	2.131
16	2.120
17	2.110
18	2.101
19	2.093
20	2.086

TABLE II. STUDENT'S t DISTRIBUTION (Continued)

21	2.080
22	2.074
23	2.069
24	2.064
25	2.060
26	2.056
27	2.052
28	2.048
29	2.045
30	2.042
∞	1.95996

DATE PREPARED: 3/23/60
PREPARED BY: C. Kissinger
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SHIPS PARTS CONTROL CENTER
AUTOMATIC DATA PROCESSING BRANCH
ADPS RECORD LAYOUT

COMPONENT TO PART MASTER RECORD (CPR)

JOB IDENTIFICATION NO.: 333102/032
INPUT: [X]
OUTPUT: [X]
WORK AREA: [X]

CTR — MASTER LAYOUT

CTR	bbbbb	5
	Cat. ID No	5
	bb	2
8-31	Stock No.	24
1-11	ECN No.	11
12-31	Stock No.	20
32-33	Rcd. Des.	2
34-37	Rcd Length	4
38-39	Qty K/C 0	2
40-41	Qty K/C 1	2
42-43	Qty K/C 2	2
44-45	Qty K/C 3	2
46-47	Qty K/C 4	2
48-49	Qty K/C 5	2
50-51	Qty K/C 6	2
52-53	Qty K/C 7	2
54-55	Qty K/C K	2
56-57	Qty K/C Q	2
58-59	Qty K/C S	2
60-61	Qty K/C T	2
62-63	Qty K/C U	2
64-65	Qty K/C 9	2
66-67	Qty K/C R	2
68-69	Qty K/C I	2
70-94	Nomenclature	25
95-96	U/I	2
97-99	R/F	3
100-101	S	2
102-103	M	2

CTR — Static - 0175 — 0041 (ECN Only) — File No. (0016)

104-105	R	2
106	ELC	1
107-111	Mfr's. Code (Program)	5
112-116	Mfr's. Code (Supply)	5
117-126	FCN	10
127-132	WT	6
133-138	CU	6
139-140	MW	2
141	SMA	1
142-145	DSN No.	4
146-172		27
173	Int Code	1
174	Con Code	1
175	Blank	1
	File No.	4
	Notes	2
	L/M	1
	All. Fac.	4
	QFC	4
	SNL	1
	ECN TABLE 1	3
	ECN TABLE 2	3
	ECN TABLE 3	3
	ECN TABLE 4	3
	ECN TABLE 5	3
	ECN TABLE 6	3
	ECN TABLE 7	3
	ECN TABLE 8	4

Variable (Continued)

0037	Key 1 (BuShips Plan No.)	32
	P/S	1
	SC	2
	SNL	1
	Control	1
0042	Key 2 (Mfr's. Dwg. No.)	32
	Mfr's. Code	5
	P/S	1
	SC	2
	SNL	1
	Control	1
0037	Key 3 (Assembly No.)	32
	SNL	1
	QFC/A	4
0041	Key 4 (Superseded Stock or Part No.)	32
	Mfr's. Code	5
	P/S	1
	SC	2
	SNL	1
0040	Key 5 (Prime Mfr's. No.)	32
	Mfr's. Code	5
	P/S	1
	SNL	1
	Control	1

Variable (Continued)

0040	Key 6 (Assembly or Component Mfr's No.)	32
	Mfr's. Code	5
	P/S	1
	SNL	1
	Control	1
0042	Key 7 (Other Identifying No.)	32
	Mfr's. Code	5
	P/S	1
	SC	2
	SNL	1
	Control	1
0036	Key K (Identifying No. of Superseded Stock No.)	32
	P/S	1
	SC	2
	SNL	1
0040	Key Q (Superseded Stock or Part No.)	32
	P/S	1
	SC	2
	SNL	1
	QFC/A	4
0035	Key S Specification	32
	SC	2
	SNL	1

333/02-032

S RECORD LAYOUT
M NO. 2102

DATE PREPARED: 3/23/60
PREPARED BY: C. Kissinger
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SHIPS PARTS CONTROL CENTER
AUTOMATIC DATA PROCESSING BRANCH
ADPS RECORD LAYOUT

COMPONENT TO PART MASTER RECORD (CPR)

JOB IDENTIFICATION NO.: 333102/032
INPUT: ☒
OUTPUT: ☐
WORK AREA: ☒

Variable - 0825 Maximum

0038			0042				0040					0044					0045					
Key T (Alternate CID)	Mfr's Code	SNL	Key U (Other SICP Component)	SDCP Number Code	SNL	QPC/A	Key 9 (Procurement No.)	Mfr's Code	P/S	SNL	Control	Key R (Superseding Part or Stock No.)	Mfr's Code	SC	SNL	QFCA	Key Y Additional Information	Mfr's Code	P/S	SNL	SC	QPC/A
32	5	1	32	5	1	4	32	5	1	1	1	32	5	2	1	4	32	5	1	1	2	4

TRAILER RECORD LAYOUT — Static - 0070 — Variable - 0830 Max

Cat. ID. No. 5	bb 2	Stock No. 24	Rcd Des.	No. of Char. This Record	Qty K/C 0	Qty K/C 1	Qty K/C 2	Qty K/C 3	Qty K/C 4	Qty K/C 5	Qty K/C 6	Qty K/C 7	Qty K/C M	Qty K/C Q	Qty K/C S	Qty K/C T	Qty K/C U	Qty K/C 9	Qty K/C R	Qty K/C Y	Blank	Variable Data — See Master Record Layout For Key Details
ECN		Stock No.																				
11		20	2	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	

Record Designators: ML - Last Master.
MT - Master with Trailer following.
Tb- Trailer with Trailer following.
TL - Last Trailer.

Master Record Static Length - 0175
Trailer Record Static Length - 0070
Maximum Record Length - 1000

Last character of each record is a record mark.
Total Length (incl. R/M) of each record is divisible by (5). Blanks, if required, will precede R/M.
No restrictions on number of keys or number of trailer records.
The data contained on each record may be variable.

If 1st pos. of Key Y Alt. field is blank, Key "X" applies. Alt. No., Mfr's. Code, SC, QFCA, fields apply.
If 1st pos. is not blank, Key "Y" applies. Alt. No., Mfr's. Code, P/S, SNL, fields apply.

Grouping - Variable . . . Max. Group Length - 1505 . . . First 5 pos. of group will consist of four blanks, and one (1) position signed counter . . . TID on Tape . . . Sequence - (1) Cat. ID. No./ECN (2) Stock No. (3) Alt. No.

0 LAYOUT
102

333/02-032