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Data Processing Techniques

Document and Accounting Controls

Design 

This manual describes major control techniques for tape, RAMAC[®] and unit record systems. It is assumed that the reader has an understanding of data processing equipment.

A number of different control techniques are discussed. These are categorized by those which are established and used inside the data processing installation and those established and used outside the installation. Each technique is explained in terms of what it is and where it might be used.

Controls inside the installation are further discussed by (1) type of processing operation — punching, sorting and merging, summarizing, report preparation, calculation and posting, (2) those which are machine built-in checks and controls, and (3) those which surround the audit trail.

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Introduction

The system of checks and balances which accompany the delegation of accounting responsibilities is known as *accounting controls*. Their purpose is to protect company assets and create a satisfactory audit trail. In so doing they must provide for the documentation of transactions and insure that only correct and authorized data enter the accounting operation, that all authorized data is included and processed, and that accounting operations are performed accurately and in the proper sequence. The degree of checking and balancing that is necessary for control depends upon the nature of the application to be processed as well as the equipment and procedures employed in processing it.

Controls are not superimposed on a previously established procedure. Rather, good controls should be built into and become an integral part of every procedure during the planning phase.

The discussion of accounting controls which follows will be concerned first with those controls established and used outside the data processing installation and secondly with those controls established and used inside the data processing installation. The theory of good control through the proper separation of duties is applicable in both areas. Accounting control outside the data processing installation consists primarily of the initiation, authorization and verification of source documents which represent accounting transactions. Within the data processing installation, accounting control consists of (1) checking operations, in which transcribed transaction data is verified, and (2) balancing operations, which insure the accurate processing of all transaction data.

Generally, the necessity for accounting control increases with the volume of transactions or documents processed and the complexity of operations performed. A variety of control techniques will be discussed. The techniques to be employed by an organization depend upon individual conditions. It is important that the controls which are used always provide a proper balance between their cost and their value. Since a system of accounting controls may be obsoleted by a change in accounting procedure, company policy, company organization and/or data processing equipment, controls should be examined and evaluated periodically.

Controls Outside the Data Processing Installation

Control techniques described in the following text are not necessarily limited in use to a particular application; they are easily modified for use with different ones.

Document Register

Control of individual documents can be maintained effectively by the preparation of a register on which each document is listed at the point of receipt or origin (see Figure 1). The register should include either a description that is sufficient to identify each document quickly, or a serial identification number. The serial number not only furnishes positive identification and an effective method for later reference, but it also is most easily used at the point of entry or origin. When each document has been completely processed, it is "checked off" or canceled on the register. Uncanceled numbers represent documents which are either in process or have been mislaid. Intermediate processing operations for each document may be shown on the register, and dated as the document passes that point in the procedure. Figure 1 illustrates a document register for

sales orders. It not only discloses a missing or misplaced document, but it also indicates any delays in processing as might be the case with order number 12843, which, several days after its receipt, has not yet been billed.

Serial Numbering and the Batch Control Ticket

Where serial numbers are printed or stamped on each document, rearrangement in serial-number order and a check for missing numbers may be performed during, as well as after, processing to insure inclusion of all documents. This plan is particularly adaptable to documents such as checks or drafts, where each document must be accounted for. When the document is an IBM card, the serial number may be punched into, as well as printed or interpreted on, the card; then arrangement of the documents, as well as a count of and sequence check for missing documents, may be accomplished automatically.

Serial numbering may also be used for groups and batches. If so, the quantity or number of documents

ORDER REGISTER					
					MONTH <u>October</u>
DATE RECEIVED	ORDER NUMBER	DATE AUDITED	DATE BILLED	DATE SHIPPED	REMARKS
10/14	12831	10/14	10/18	10/18	
"	12832	"	10/16	10/16	
"	12833	"	"	"	
"	12834	10/15	10/17	10/18	
"	12835	10/14	10/16	10/17	
"	12836	"	"	"	
"	12837	10/15	10/17	10/19	
"	12838	10/14	"	"	
"	12839	"	10/15	10/17	
"	12840	"	"	"	
"	12841	"	10/16	10/17	
10/15	12842	10/15	10/17	10/18	
"	12843	10/16			Awaiting spec. instructions
"	12844	"	10/19	10/19	

Figure 1. Order Register

in each batch is recorded, together with the batch serial number, either on the first document or on a separate form accompanying the batch. For large volume operations, batch size should be predetermined for ease and efficiency in handling.

Figure 2 illustrates the use of a batch control ticket which employs a document count as well as document and batch serial numbering. By maintaining a file of the batch control tickets, both the sending and receiving departments can account for all documents.

slip (Figure 3) is employed, either in addition to or in combination with the letter of transmittal. The route slip is similar to the batch control ticket shown in Figure 2, except that in this case each department or operational step which the accompanying documents pass through is identified together with an indication of the processing time and the operator or clerk responsible for each job. Responsibility is fixed and the means to effect a degree of work control as well as document control has been incorporated into the same form.

BATCH NO 142	TO: <i>Receiving Dept.</i>	
DATE 10/13/51	FROM: <i>Purchasing Dept.</i>	
NO. OF DOCUMENTS 37	NUMBERED	
	FROM 12355	TO 12391
RECEIVED ATTACHED DOCUMENTS SPECIFIED ABOVE		
DATE	SIGNATURE	
PLEASE SIGN AND FORWARD THE COPY OF THIS BATCH CONTROL TICKET TO SENDING DEPT. WITHOUT DELAY.		

Figure 2. Batch Control Ticket

Transmittal and Route Slips

A letter of transmittal describing a group or batch of documents is frequently employed to establish control and transfer responsibility when documents move from one department or location to another. The transmittal slip is usually a printed form with spaces to indicate the variable information for the batch (see Figure 3).

When the volume of work or the number of people who may perform any given operation is large, it may be desirable to fix responsibility and account for documents passed from each operation to the next as well as from one department to another. In this case, a route

Cancellation and Time Stamps

As a document is received at a control point or passed through a given department, it may be "canceled" by a stamp to indicate that it has reached or passed through a certain stage in its processing. Any clerk or operator handling documents would automatically reject or return for checking any document not bearing the correct cancellation. The use of the time stamp for cancellation affords, in addition to document control, a method of achieving work time or production control, since it furnishes an accurate, unalterable record of elapsed time for handling (Figure 4).

CARD SHIPMENT TRANSMITTAL

TO		FROM	
LOCATION <i>new york</i>	DEPT. <i>A/R</i>	LOCATION <i>Jacksonville</i>	DEPT. <i>A/R</i>
INDIVIDUAL <i>H. Doe</i>		INDIVIDUAL <i>D. Lou</i>	

ROUTING SLIP

REPORT NAME <i>A/R Journal</i>	BATCH NO. <i>441</i>	DATE <i>10/16</i>	NUMBERED <i>17321</i>	<i>17385</i>	<i>65</i>
REPORT CODE <i>0032</i>	BOX NO. <i>1</i> OF <i>2</i>	DEPT. TO	DATE FWD.	INITIALS	REMARKS
CONTROL TOTALS <i>3000 cards</i> <i>\$25,643.21</i>		<i>Billing</i>	<i>10/16</i>	<i>JCR</i>	
		<i>ac Rec.</i>	<i>10/19</i>	<i>TLM</i>	
		<i>Order</i>	<i>10/26</i>	<i>a.l.</i>	<i>#17349 held for approval</i>
EXPLAIN ANY DIFFERENCES IN NO. OF DOCUMENTS FORWARDED AND RETURN TO CONTROL CLERK					

Figure 3. Transmittal and Route Slips

PURCHASE ORDER
NEW MEXICO COMPANY
HOUSTON, TEXAS

REQ. 56 DATE 10/12 ORDER No. 311

TO GENERAL MANUFACTURING COMPANY
ENDICOTT, N. Y.

SHIP TO ABOVE VIA BEST WAY F.O.B.

SHOW OUR ORDER NO. ON ALL INVOICES, PACKAGES AND SHIPPING PAPERS.
MAIL INVOICES IN TRIPLICATE UNLESS OTHERWISE SPECIFIED.

QUANTITY	DESCRIPTION	PRICE
40	SQUARE SHANK SWIVEL	11202
75	FLAT TOP RIGID	13102
5	EXT SHANK WITH BRK	17203
2	BOLT AND NUT SHANK	32105
4	RND SPR RING STEM	44104
40	BOLT AND NUT SHANK	62110

OCT 14 10 47 AM 19-

RECEIVING DEPARTMENT

NOTIFY DEPT.	ORD. BY DEPT.	DEL. TO DEPT.	APPROPRIATION	CLASS	CODE
--------------	---------------	---------------	---------------	-------	------

SUBJECT TO THE TERMS AND CONDITIONS ON THE BACK HEREOF WHICH ARE INCORPORATED AND MADE A PART HEREOF

W.C. Dawson
PURCHASING AGENT

Figure 4. Time Stamp Cancellation

Matching

The reassembly and matching of duplicate documents can be used to effect control. This technique is particularly useful when multiple copies are prepared, as with carbon copies, and each copy is then used to prepare records at a different location, e.g., purchasing department and receiving department. When all copies are reassembled and matched at the predetermined point, the presence of all copies indicates complete processing. If the documents are punched cards, matching and checking can be done automatically.

Control of Factors Subject to Change

Factors used for calculations and processing must be reviewed and changed from time to time. Examples of such factors are discounts, selling prices, credit limits, commission percentages, and inventory reorder levels.

Controls must be established which allow only authorized changes to be made. This is accomplished by requiring a signature with each request for change (see Figure 5). Changes are documented by printing a register (Figure 6). A copy of the report is routed back to the initiating department for review and approval.

LOCATION	STATE	EMPL. SERIAL	DESCRIPTION	DESCRIPTION	CONTRACT NUMBER	DED. CODE	VALUE	EMPLOYEE NAME	DATE	AMOUNT	Y.C.
34	06	112			3430	3030			5405		00
EMPLOYEE'S AUTHORIZATION FOR PAYROLL DEDUCTION											
TYPE OF AUTHORIZATION - CHECK ONE <input type="checkbox"/> NEW <input checked="" type="checkbox"/> INCREASE <input type="checkbox"/> DECREASE <input type="checkbox"/> CANCEL				PURPOSE OF DEDUCTION - CHECK ALL ONE <input type="checkbox"/> HOSPITAL INSURANCE PREMIUM <input type="checkbox"/> ADDITIONAL FEDERAL TAX WITHHOLDING <input checked="" type="checkbox"/> PURCHASE OF U.S. SAVINGS BONDS <input type="checkbox"/> OTHER - (PLAN OR FIDELITY PLAN)							
EMPLOYEE NAME - LAST NAME	FIRST NAME	INITIAL	LOCATION	STATE	EMPLOYEE SERIAL	DEDUCTION AMOUNT	TO BE DEDUCTED	EFFECTIVE DATE	PAYROLL DEDUCTION AUTHORIZED		
DOE	JOHN	D	MFG	N.J.	1862	5.00	<input checked="" type="checkbox"/>	6-1			
COMPLETE THIS LINE FOR HOSPITALIZATION DEDUCTIONS ONLY. SHOW POLICY NUMBER AND CHECK APPLICABLE BLOCKS.		POLICY OR CONTRACT NUMBER	NEW ENROLLMENT	TRANSFER FROM OTHER ISM LOCATION	RETURN FROM MILITARY SERVICE	FROM DIRECT PAYMENT BASIS	SPONSORED BY PARENT	RATE CHANGE	TRANSFER FROM OTHER HOSPITAL PLAN	DISCONTINUE DEDUCTION FOR PRIOR PLAN YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>	
REMIT TO - LEAVE BLANK IF DEDUCTION IS FOR ADDITIONAL FEDERAL TAX WITHHOLDING OR U.S. SAVINGS BOND PURCHASE.						I HEREBY AUTHORIZE CORPORATION TO DEDUCT FROM MY SALARY THE AMOUNT SPECIFIED FOR PAYMENT AS INDICATED ABOVE UNDER 'PURPOSE OF DEDUCTION'					
						John Doe EMPLOYEE SIGNATURE			5/5/6- DATE		
TO BE REGISTERED IN THE REGISTRATION DATA FOR U.S. SAVINGS BOND (SERIES E ONLY)											
(CROSS OUT TWO) MR. JOHN D. DOE PRINT GIVEN NAME, MIDDLE INITIAL AND SURNAME 120 FIELD PL. STREET AND NUMBER ANYWHERE CITY, ZONE AND STATE											
COMPLETE THIS SECTION ONLY WHEN BOND DEDUCTION IS NEW OR REGISTRATION OR ADDRESS IS TO BE CHANGED. SHOW MARRIED WOMAN'S GIVEN NAME, I.E. MRS. MARY E.											
1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
LOCATION	STATE	EMPLOYEE SERIAL	DESCRIPTION								
TO: Machine Accounting Dept. DATE: 11/25 FROM: Marketing THE FOLLOWING PRICE CHANGES SHOULD BE MADE:											
ITEM NO.	DESCRIPTION	NEW PRICE									
12 2685	PEA SOUP	\$ 6.001									
12 3074	ORANGE JUICE	3.857									
13 1111	HAND SOAP	2.200									
13 2954	CONDENSED MILK	1.639									
13 4182	TOOTH PICKS	.353									
H. J. Manager AUTHORIZED SIGNATURE											

Figure 5. Change Authorizations

CHANGE REGISTER				
DATE	ITEM CODE	DESCRIPTION	FACTOR BEFORE CHANGE	FACTOR AFTER CHANGE
11-26	12 2685	PEA SOUP	5.956	6.001
	12 3074	ORANGE JUICE	3.132	3.857
	13 1111	HAND SOAP	2.253	2.200
	13 2954	CONDENSED MILK	1.652	1.639
	13 4182	TOOTH PICKS	.352	.353

Figure 6. Change Register

Controls Within the Data Processing Installation

Controls within the data processing installation should insure that all transactions are processed completely and accurately. The series of checks and balances which make up these controls must begin with the entry of transactions into the data processing installation and continue throughout processing.

Control Techniques and Devices

There follows a list of control devices and techniques, many of which can be incorporated into the procedure for any data processing system—unit record, tape or RAMAC®.

Serial Numbering: The serial numbering of orders, invoices, checks, etc., provides control while the data is in transit. Each item or document in the series or group is assigned a successive number; an indication of the beginning and ending numbers accompanies the group.

Batching with a Document or Item Count: In batching data with a document or an item count, the items or documents are counted instead of numbered; an indication of the count accompanies the group. This technique can be used to control data both before and after it is punched into cards, e.g., requisitions, changes, receiving reports and punched cards for various analysis reports.

Batching with a Control Total: In batching with a control total, some data field that is common to all items or documents is accumulated for the control total which then becomes the basis for balancing operations during processing. The control field may be an amount, a quantity, an item code, an account number, etc.; totals based upon an account number or

code are known as “hash” totals. An advantage of this technique is that balancing can often be performed during regular machine processing operations at no extra cost in time.

The IBM 56 Verifier: The IBM 56 Verifier is used to check and verify card punching before the cards are processed in another operation. Verification is very similar to a card-punching operation. Cards which have been punched are fed into the 56; the operator, using the original source documents from which the cards were punched, rekeys the data for each card. The 56 compares what is keyed against what is already punched into the card. When a discrepancy arises, the keyboard locks and the operator is required to rekey the character three times before an error condition is established.

Self-Checking Number Device: The Self-Checking Number Device is a device for the IBM 24 Card Punch and 26 Printing Card Punch that makes it possible to automatically verify the coding, and the punching of codes, in one operation. To use it, each code must have a check digit; this is calculated and recorded with the code. During punching, the device automatically recalculates the check digit and compares it against the one that the operator keys; if they do not agree, a 12 is punched automatically over the units position of that field and the keyboard locks. (For additional information on the device see *Self-Checking Number Device for Type 24-26 Card Punches*, form no. 224-6022.)

IBM 101 Electronic Statistical Machine: As an aid in balancing transaction cards and editing program load cards after they have been punched, the IBM 101

Electronic Statistical Machine will perform the following functions: count cards, accumulate an amount from each card and print the total for batch balancing, sequence-check the cards, sort them, check for consecutive numbering, and perform double punch and blank column detection.

IBM 108 Card Proving Machine: Similar in application to the 101 but with greater speed, the 108 Card Proving Machine can be wired to:

- Edit cards for special characters, double punches, blank columns, field sign, code validity and proper sequence.
- Examine a particular card field to determine that the data in it falls within a specified range.
- Accumulate an amount from each card and balance the total against a predetermined one found in the last card.

Dual Recordings: The dual recording of critical data makes it possible to machine-compare the two for verification. It is more commonly used in mark-sense recording operations and those card punch operations in which it is necessary to verify only one or two fields.

Crossfooting: Crossfooting is the addition and/or subtraction of factors in a horizontal spread to prove processing accuracy. It can be used on a payroll register (Figure 7) to prove that the final totals of net pay and deductions equal the final total earnings; this provides control on report preparation as well as calculating and card-punching operations. In posting transactions to records that are stored in a computer (e.g., accounts receivable), crossfooting is used to prove the accuracy of posting either as each transaction is posted, or collectively at the end of the run, or both.

PAYROLL REGISTER											
LOC. TAX CL.	F. I. D.	EMR NO.	NAME		TOT. EARN.	W/H TAX	CY. OR ST. TX	F.I.C.A.	MISC. DED.	NET PAY	CK. NO.
			YEAR TO DATE EARN.	W/HOLD							
4		85556	STEWART	JD	10000	1220		150			
3		294000	33960						300	8330	66173
4	245	562	GRAHAM	EW	7777	1300		117		6360	66174
1		200104	33060								
4	135	564	GUERRA	TB	4872	720		73		4079	66175
1		145542	20040								
4	105	574	BOSWELL	HL	11000	1420		165		9415	66176
3		330000	42680								
4	235	612	HUMPHREY	T	7647	1260		115		6272	66177
1		191712	31380								
4	235	645	SIMMS	C	7582	1000		114		6468	66178
2		200319	26900								
4	235	709	ASHWORTH	VC	6702	560		101		6041	66179
3		187535	16500								
4	235	749	ROBERTSON	WD	7727	1280		116		6331	66180
1		120647	19480								
6		80046								2632	66199
7	111	060	COBB JR	CS	28847	4739				24108	66200
4		576940	94780								
7	151	062	NORBERG	R	4600	920	46	69		3565	66201
		91875	18380								
		5498470	746920		240579	32899	1135	2777	596	203172	

$$(2,405.79 = 328.99 + 11.35 + 27.77 + 5.96 + 2,031.72)$$

Figure 7. Crossfooting a Payroll Register

Total Transfer: Total transfer is used during report preparation when more than one class of totals (minor, intermediate and major) are accumulated. If the cards are in sequence, it insures that minor and intermediate totals are correct if the major total is correct. In performing total transfer, only the minor total is accumulated directly from the card field; the intermediate total is an accumulation of minor totals and the major total an accumulation of intermediate totals.

Zero Balancing: Zero balancing is an effective method of verification when both detail items (e.g., accounts payable distribution cards or records) and their summary (e.g., an accounts payable disbursement card or record) are processed together. Each detail item is accumulated minus and the summary plus. The result is a zero balance if both are correct. Figure 8 illustrates the use of zero balancing on a report; nothing prints beside the asterisk in the NET column since each group zero-balanced when the counter was cleared.

Parallel Balancing: Parallel balancing, another method of verification when both detail items and their summary are processed together, is illustrated also in Figure 8, in the column titled NET. During printing, each amount read from an item card is added into a counter; amount read from the discount card is subtracted. The difference is printed below the net amount read and printed from the summary card. Discrepancies are revealed by a visual check of the column.

Double Punch and Blank Column Detection: Double Punch and Blank Column Detection is a feature available on certain machines which perform punching. It is frequently used after punching to check numerical mark-sense fields for any columns which were poorly marked or double-marked. In summary-punch and gang-punch operations it can be used to recognize any multiple punching or lacing which might occur in numerical fields. Its use does not require a separate pass. This feature also permits some checking of alphabetic fields.

Double or Reverse Calculation: Double or reverse calculation is the calculation, recalculation and then comparison of the two results to prove accuracy. It is commonly used in payroll and other calculations for which no predetermined control total can be developed. In the recalculation, factors are reversed—the original multiplier becomes the multiplicand and the original multiplicand becomes the multiplier. When processing with unit record equipment, if the recalculation is performed in a separate run, then punching of the result can also be verified.

Overflow Check: Overflow check, a feature associated with arithmetic operations, is a means of immediately recognizing results which exceed the capacity of the counter or accumulator in which they are developed. In order to recognize an overflow and associate it with the proper calculation, the check should be performed immediately after the arithmetic operation. A machine or system which employs this feature can be programmed to detect and signal the condition.

ACCOUNTS PAYABLE REGISTER															
ENTRY DATE	INV. DATE	VENDOR NAME	VENDOR NO.	INVOICE NUMBER	VOUCHER NUMBER	ENTRY	ACCOUNT NUMBER	DEPT NO.	JOB NO.	PAID	DATE DUE	GROSS	DISCOUNT	NET	
8/31	8/28	TIDE CHEM	74292	2048	12162	30	412 530	72	4253		9/04	\$ 66.95-	\$	\$	
8/31	8/28	TIDE CHEM	74292	2048	12162	30	211				9/04	66.95	1.34	65.61	
												*	1.34 *	65.61 *	
8/31	8/28	W B ARCHER	91004		12163	33	411 863	934			8/31	41.20-			
8/31	8/28	W B ARCHER	91004		12163	33	411 862	934			8/31	33.05-			
8/31	8/28	W B ARCHER	91004		12163	33	211				8/31	74.25		74.25	
												*		74.25 *	
8/31	8/28	EL PRINT CO	29542	120675	12164	30	913 741	43	4756		9/04	625.00-			
8/31	8/28	EL PRINT CO	29542	120675	12164	30	913 740	43	4756		9/04	11.93-			
8/31	8/28	EL PRINT CO	29542	120675	12164	30	211				9/04	636.93	12.74	624.19	
												*	12.74 *	624.19 *	
8/31	8/28	TRI CIT GL	78009	MF1718	12165	30	123 330				9/04	105.56-			
8/31	8/28	TRI CIT GL	78009	MF1718	12165	30	123 335				9/04	12.79-			
8/31	8/28	TRI CIT GL	78009	MF1718	12165	30	123 340				9/04	112.34-			
8/31	8/28	TRI CIT GL	78009	MF1718	12165	30	123 355				9/04	593.98-			
8/31	8/28	TRI CIT GL	78009	MF1718	12165	30	211				9/04	824.67	17.16	807.51	
												*	17.16 *	807.51 *	
8/31	8/28	MASK SUPP	36512	421	12166	30	123 360				9/04	13.10-			
8/31	8/28	MASK SUPP	36512	421	12166	30	124 405				9/04	61.75-			
8/31	8/28	MASK SUPP	36512	421	12166	30	124 410				9/04	63.50-			
8/31	8/28	MASK SUPP	36512	421	12166	30	211				9/04	138.35	2.77	135.58	
												*	2.77 *	135.58 *	

Figure 8. Zero Balancing and Parallel Balancing

Sign Check: It is possible to detect a change in sign during arithmetic operations and either stop the machine or signal the condition for subsequent review. In payroll applications, the sign check is used to indicate the condition in which deductions exceed gross pay; in accounts receivable, accounts payable, inventory and general ledger applications it can be used to recognize any balance which becomes negative.

Blank Transmission Test: This feature allows the checking of any data field for all blank positions. As a computer control, it can be used to prevent the destruction of existing records in storage, indicate when the last item from a spread card has been processed, skip calculation if a rate or factor field is blank, etc.

Use of Proof Factor in Multiplication: The proof factor in multiplication is a group type control and is therefore used to verify a number of calculations in one operation. In using this technique, it is necessary that the proof factor be larger than any one of the multipliers with which it is used. During each multiplication, the multiplicand is multiplied once by the multiplier and again by a factor which is the difference between the multiplier and the proof factor. A total of these products and a total of the multiplicands are accumulated for the run or group. At the end, the total of multiplicands is multiplied by the proof factor and the result is compared against the final total of the products. An example follows:

Multiplications to be performed:

1. 4x7
2. 8x9

Proof Factor: 10

Multiplications:

1. 4x7 = 28; (proof 1) 6x7 = 42
2. 8x9 = 72; (proof 2) 2x9 = 18

Total of Multiplicands:	Total of Products
7	28
9	42
<u>16</u>	72
	<u>18</u>

Proof: 10x16 = 160 ← EQUAL → 160

Reasonableness Tests: Reasonableness tests provide a means of detecting a gross error in calculation or, while posting to an account, a balance that exceeds a predetermined limit. Typical examples include payroll calculations and credit limit checks in accounts receivable. In some cases both an upper and a lower limit are established; each result then is machine-compared against both limits to make certain that it falls between the two.

Comparing: Comparing, as a control technique, permits data fields to be machine-checked against each other to prove the accuracy of matching, merging, coding, balancing, reproducing, gang punching, record selection from magnetic drum, disk and tape storage. In wired control panel machines this is accomplished with comparing magnets and in a stored program machine it is accomplished with a compare instruction.

Sequence Checking: A sequence check is used to prove that a set of data is arranged in either ascending or descending order before it is processed. It is generally a mechanized operation and may be performed in a separate machine run or simultaneously with another operation in one run.

Matching: The matching technique is generally used to verify coding. Individual codes are machine-compared against a group of master codes to select any which are invalid.

Recording Purge and Entry Dates: Purge and entry dates may be recorded in punched cards as well as on magnetic tape and disk storage records. A purge date is used to prevent the deletion of data prior to a certain date.

An entry date is used to categorize a transaction time-wise, and thus provide a means of tracing the transaction as far back as the original source document for answering inquiries or initiating corrective action.

Tape Labels (Leader and Trailer Records): A tape label appears on each reel of magnetic tape in the form of a leader and/or a trailer record; its contents will be determined to some extent by the application and the type of data found on the tape. The leader record appears as the first and the trailer record as the last on the tape. Together they provide the means for machine-performed accounting control of tape operations. Types of information which may be included in a tape label are: a name or code for the tape which identifies the application and tape data type, reel number or sequence number if there is more than one, frequency of use, record format, date of preparation or date last used, purge date, operation in which the tape was written (generally a code), name of individual chiefly responsible, output number if there are several tapes, record count, control totals, any instructions to be typed out to the operator as well as an end-of-reel or end-of-file code.

End-of-Tape or End-of-File Routines: Such a routine is part of a tape system's program and is executed when the last record on a reel has been read and processed. It should update the control totals found in the tape label or trailer record, balance and record the record count and any other control totals, rewind the tape, perform any necessary instruction modification, and

type from the console typewriter a message indicating status of the run and instructing the operator in any further machine setup operations.

Checkpoint and Restart Procedures: Checkpoint and restart procedures, which are techniques associated with computers, make it possible, in the event of an error or interruption, to continue processing from the last checkpoint rather than from the beginning of the run. These techniques are included in applications which require many hours of processing time, since heavy machine scheduling and deadlines generally do not permit a complete rerun.

To establish checkpoints, processing intervals are determined, each being based upon a certain number of items, transactions or records processed. At each interval or checkpoint, the stored program identifies input and output records and then records them along with the contents of important storage areas such as counters and registers; at the same time, accuracy of processing up to that point is established. Restart procedures are the means by which processing is continued after an error or interruption. Each set of restart procedures includes the necessary operator and stored-program instructions for (1) locating the last checkpoint, (2) readying the machine for reprocessing, and (3) entering the main routine at that point.

Procedural and Exception Tests: Procedural and exception tests are designed to check machine control and operation before processing. They consist of test data (generally punched into cards) covering all or most conditions which can arise during the run, as well as a control panel and/or program which will process the test data and check out machine components.

The control panel is inserted, or the program loaded, or both; the test data is then read into the machine and processed. The results are compared against predetermined ones. If they are satisfactory, actual processing can begin.

In some installations these tests are made only at the beginning of each working day; in others they are made before specific runs.

Error Routine: An error routine provides a means of automatically initiating corrective action when errors occur such as TAPE READ AND WRITE OR DISK SEEK, READ AND WRITE. It is executed after the programmed check establishes an error.

The error routine should cause the operation to be performed at least one more time (in some cases several). If the error persists, processing is interrupted and the condition is signaled on the console. The operator's instruction manual should include procedures for correction and resumption of processing.

Sampling: Sampling provides a random method of checking and control. In using it, a transaction or item is selected and the processing that it undergoes is checked in detail. This provides an indication of accurate and complete processing.

Analytical Comparison of Present and Past Performance: Analytical comparisons are based primarily upon experience, past performance and a knowledge of trends which have intervened. By knowing status as of a certain time and observing trends since that time, it is possible to determine to some degree whether or not present records represent a complete and accurate picture. For example, present period payroll is often compared against last period payroll to spot any questionable variations.

Controls On Processing Operations

The number of available techniques indicates the need for a thorough study of the application and equipment in order to come up with a system of controls which is adequate but which does not overcontrol and delay processing. In so doing, it is desirable to mechanize as many controls as possible. Mechanized controls are always performed at a constant, rapid speed; manual ones are not.

A study of the application will reveal:

- How closely the application is to be controlled.
- Points in the procedure at which controls must be placed.
- The correcting and restart procedures to be employed at each point, should the operation not balance. If the procedure is a manual one, it should be clearly documented for operator reference and training purposes.
- How accounting control responsibilities are to be divided.

A study of the equipment to be used for processing will reveal:

- The control techniques which are most suitable.
- Those controls which can be mechanized by control panel wiring or stored programming and the extent.
- The built-in controls that are available on the equipment.

The basis for control during processing must be established as data enters the installation. This is generally done when transactions are edited and may consist of assigning a system of serial numbers or developing a document count, a transaction count, an item count, a tape listing and total of some field such as quantity, amount, or code, etc., or a combination of these. When these preliminaries are taken care of, the transactions are ready for processing.

There follows a discussion of some control techniques which can be used in certain processing operations. The

reader will, no doubt, discover others.

Card Punching: For card punching a number of techniques are available. The Self-Checking Number Device can be used to verify certain code punching on the IBM 24 or 26. With the 56 Verifier it is possible to verify any portion or all of the 24-26 punching directly from the original document. The IBM 101 Electronic Statistical Machine and the 108 Card Proving Machine are useful for edit or validity checking as well as for balancing and sorting operations. Card reproduction and gang punching can be verified by the use of comparing magnets to compare the original data against the re-created data; the Double Punch Blank Column Detection device can be employed for additional control on these operations.

Sorting and Merging: The use of the Card Counting Device during sorting will indicate any missing cards if the operator has a card count to which he can balance. The accuracy of sorting or merging can be verified by a sequence check on the collator or a visual sequence check of the data when a report is printed.

Control of magnetic tape sorting is accomplished by the stored program; in each pass the sum of the control totals from incoming tapes is balanced against the sum of those developed for the outgoing tape or tapes. On the final pass, sequence is verified.

Summarizing: For control of operations in which data is summarized and then recorded in summary form, a final total of a key field or fields can be accumulated from the summarized data and balanced to one accumulated from the detail data. In card-to-card and tape-to-card summary runs the summary cards themselves may be tabulated for the final totals. For card-to-tape and tape-to-tape runs, the stored program should develop the necessary final totals of the summary data when it is recorded on the output tape; it should also balance it at the end of the run to a control total read from a control card or the tape label.

Report Preparation: During report preparation, the primary control objective is proving that all items (accounts or transactions, etc.) are included in the processing and that arithmetic is performed accurately. It can be assumed that the data itself is correct since punching, summary and posting operations should be proved when they occur.

To insure the inclusion of all items in the report, a final control total is developed during processing and balanced at the end of the run to a predetermined one. In cycle billing operations, the control may be an account number hash total of those accounts which are in the cycle; for other reporting operations it may be a control total based upon an amount, a quantity, or another code field. For control of arithmetic func-

tions which occur during report preparation the following techniques should be investigated: crossfooting, total transfer, zero balancing, parallel balancing, reasonableness tests, or a combination of these.

Calculations: In some applications, calculations are verified in the same pass in which they are performed; in others, verification requires a separate pass. This will affect the selection of controls. Some suggested techniques for verification are crossfooting, zero balancing, double or reverse calculation, overflow check, use of a proof factor, double punch blank column detection if it is available, and the reasonableness test, particularly for payroll calculations. If, in a computer, one or several factors are selected from tables in disk storage, the stored program may include instructions which compare the address or code recorded with the table against the one used to locate it; this insures selection of the proper table.

Posting to Balance-Forward Accounts: The manner in which posting controls are incorporated in a RAMAC system differs from that in which they are incorporated in a magnetic tape or punched card system. Regardless of system, a crossfoot operation is an effective control when total debits, total credits and a balance-forward amount are maintained in each account; total debits and total credits can be crossfooted to prove that the difference equals the balance forward. For discussion purposes, assume an accounts receivable application.

In posting to accounts in disk storage, the stored program must select for each transaction the proper account record, read it into a working storage area, update it there, and, if posting is correct, write it back in the same disk storage location; in the final phase of posting the old account record is replaced by the updated one.

The accuracy of posting should be proved between the last two steps; this is the last point at which the old account record is still available. For proof, total debits and total credits are crossfooted and the net result compared to the new balance-forward amount; they should be equal. If they are not, the last step is skipped and the updated record is not returned to disk storage until the error is corrected. For those records that balance and are returned to disk storage, a built-in machine check insures that each is recorded correctly.

To insure selection of the proper account record from disk storage, the address or account number recorded in disk storage should be compared by the stored program against the one used to select it. In order to prove that all transactions have been posted, the stored program should accumulate during the run a control total which is balanced to a predeter-

mined one at the end of the run. The control may be based upon a transaction count, an item count or an accumulated total of a quantity field, an amount field, or a code field, etc.

In posting transactions to accounts maintained in a punched card file or on magnetic tape, the accuracy of posting can be proved in a single operation at the end of the run or at periodic checkpoints during long runs. It is possible to wait until the end because the original account data is not destroyed during posting. In the first case it is available from the old balance-forward cards; in the latter it is available from the input tape. Control is accomplished by accumulating a final total of debits, credits, and the balance-forward amount during the run. At the end of the run, total debits and total credits are crossfooted manually or automatically; the difference should equal the final total of balance-forward amounts.

Built-In Checks and Controls

Built-in checks should be taken advantage of and not duplicated by wired, programmed or manual controls. They function as a result of internal machine circuitry and are, therefore, performed automatically. Some of these checks are common to all machines. For example, all machines have checks which stop the machine for a timing error, a blown fuse, or an operation that is impossible or in conflict with another.

The IBM 407 Accounting Machine has an echo check which automatically stops the machine if the print wheels are set up to print a total that differs from the one appearing in the counter. The 602 Calculating Punch will stop before punching if skip stops are not set properly in the skip bar. The 604 Electronic Calculating punch automatically stops and indicates an unfinished program condition if all program steps are not executed in the time allotted.

Computers utilize input/output checks, instruction checks and parity checks. The input check insures that all data is read and coded correctly into machine language; the output check insures that the output characters are correctly set up for punching and printing. The instruction check permits the execution of only those instructions having a valid operation code and instruction format. The parity check verifies each character in the computer on the basis of an odd or even bit configuration. To insure accuracy in disk storage write operations, internal circuitry automatically compares the written record against the one from which it was written or requires that a compare instruction doing this be executed before another disk storage operation. In magnetic tape operations each character and each channel within a record must pass a validity check for an odd or even number of bits; the system determines whether the bit count is odd or even.

This prevents loss of data. The 729 and 7330 tape units utilize a two-gap head so that validity checking is performed immediately after writing.

This discussion does not include all built-in checks; for more information regarding a specific piece of equipment, refer to the reference manual describing the machine.

The Audit Trail

An audit trail must be incorporated into every procedure; provision for it should be made early so that it becomes an integral part. In creating an audit trail it is necessary to provide:

1. Transaction documentation which is detailed enough to permit the association of any one with its original source document.

2. A system of accounting controls which proves that all transactions have been processed and that accounting records are in balance.

3. Documentation from which any transaction can be re-created and its processing continued, should that transaction be misplaced or destroyed at some point in the procedure.

Figure 9 illustrates an audit trail which might be found in an accounts receivable application. The original or entry sales register is prepared by date of entry immediately after the cards have been punched or activated from a file. For a tape or RAMAC system, preparation of this report would probably be an off-line operation. All punched information is listed on the register in detail, so that if a transaction has to be re-created at some later time, reference to the source document will not be necessary. To prove the accuracy of the register's preparation, its final total is balanced to a predetermined one; if they are equal, the final total is also posted to the control sheet. It is the sum of these individual totals on the control sheet which establishes the final control total to which all accounts receivable operations for the period must balance.

Cards for the cash receipts book are either punched or activated from a holding file. After being prepared in detail, the cash receipts book is balanced to a predetermined total. If it is in balance, the final total from it is posted to the control sheet and the receipts are posted to accounts receivable. (For a tape or RAMAC system, this report, more than likely, would be prepared in an off-line operation.)

When the aged trial balance is run, the final total should equal the difference between total debits and total credits to accounts receivable; this difference is available from the control sheet. If the totals do not agree, all the transactions for the accounting period can be sorted into entry date sequence, summarized and checked against the daily entry totals on the control sheet to isolate the entry date that is out of balance.

SHEET 1 of 2
GENERAL MANUFACTURING COMPANY
SALES REGISTER

REPORT NO. 1
DATE December 31

DESCRIPTION	COMMOD. NO.	BR.	CUST.	MAN.	MO.	DY.	YR.	INV. NO.	PRICE	QTY	GROSS SALES	COST OF GOODS	FRT.	INV. AMT.
EXT SHANK WITH BRK	1 72 03	221	1234	0791	231			12351	162	15	2430	1950		2430
SQ SHANK RIGID	2 11 03	221	1234	0791	231			12351	177	5	895	467		895
BOLT AND NUT SHANK	3 21 03	221	1234	0791	231			12351	269	50	13450	10360		13450
RND SPR RING STEM	5 41 07	221	1234	0791	231			12351	498	20	9960	8168		9960
FREIGHT								12351					61	61
								12351						26796
											26725*	21145*		*
SQ SOCKET RIGID	1 61 02	163052	30761	231				12352	153	10	1590	1225		1530
CUSTOM BUILT	2 51 05	163052	30761	231				12352	328	5	1640	1173		1640
RND SPR RING STEM	4 41 04	163052	30761	231				12352	261	15	5265	4220		5265
FLAT TOP RIGID	5 32 08	163052	30761	231				12352	465	50	24250	18220		24250
FREIGHT								12352					438	438
								12352						33123
											32685*	24638*		*
EXTENSION SHANK	2 33 02	778050	0691	231				12353	197	3	985	759		985
ADJ ADAPTER ROUND	5 36 05	778050	0691	231				12353	529	25	13225	10188		13225
BOLT AND NUT SHANK	6 21 10	778050	0691	231				12353	725	35	25375	18148		25375
FREIGHT								12353					84	84
								12353						39669
											39585*	29095*		*
RT ANGLE HEAD	1 42 02	163054	10761	231				12354	88	20	1760	1418		1760
STD PIPE STEM	3 17 03	163054	10761	231				12354	267	50	13350	10260		13350
CUSTOM BUILT	6 51 12	163054	10761	231				12354	2352	50	119600	89700		119600
FREIGHT								12354					438	438
								12354						135148
											134710*	101398*		*
FLAT TOP RIGID	1 31 02	257355	70441	231				12355	84	75	6300	5048		6300
CUSTOM BUILT	1 51 02	257355	70441	231				12355	121	75	9075	7260		9075
FLAT TOP SWIVEL	5 32 08	257355	70441	231				12355	485	45	21825	16398		21825
FLAT TOP RIGID	6 31 08	257355	70441	231				12355	748	35	26180	19635		26180
CUSTOM BUILT	6 51 10	257355	70441	231				12355	1177	45	52965	42404		52965
FREIGHT								12355					148	148
								12355						116493
											116345*	90745*		*
EXT SHANK WITH BRK	1 72 03	221	491005	71	231			12356	162	75	12150	9750		12150
SQ SOCKET SWIVEL	2 63 02	221	491005	71	231			12356	269	45	12105	8658		12105
FLAT TOP SWIVEL	3 32 05	221	491005	71	231			12356	250	40	11600	8940		11600
RND SPR RING STEM	4 41 06	221	491005	71	231			12356	391	50	19250	14400		19250
CUSTOM BUILT	6 51 10	221	491005	71	231			12356	1177	75	88275	70673		88275
FREIGHT								12356					52	52
								12356						143432
											143380*	112461*		*
											774723	594302	1721	776444

Incoming transactions listed in detail for permanent audit reference

ACCOUNTS RECEIVABLE
CONTROL SHEET

MONTH OF *December*

DATE	INVOICES BILLED	INVOICES PAID	CASH RECEIVED	DISCOUNT ALLOWED	RETURNS	ALLOWANCES	MISCELLANEOUS		
	DEBIT A/R	CREDIT A/R	DEBIT	DEBIT	DEBIT	DEBIT	EXP	DR A/R	CR A/R
BALANCE LAST MO.	62 565 16								
12 1	10 468 06	4 528 60	4 473 19		55 41				
2	8 487 27	6 818 93	6 774 08		44 85				
3	9 296 20	2 055 48	1 981 50		12 18				61 80
6	6 435 33	3 654 82	3 633 57		21 25				
7	5 061 40	2 413 97	2 358 45		55 52				
8	9 091 84	751 28	749 87		1 41				
9	5 438 39	2 782 15	2 751 84		30 31				
10	6 695 23	7 194 04	6 749 70		127 69				316 65
13	5 927 66	11 892 44	11 753 61		138 83				
14	7 289 61	3 084 44	2 772 32		50 65				261 17
15	6 908 23	8 680 86	8 544 03		136 83				
16	7 165 16	7 153 88	7 037 95		115 93				
17	7 642 18	12 386 07	12 264 78		96 04				25 25
20	7 468 82	20 088 25	19 259 84		302 66				525 75
21	9 608 77	2 607 06	2 442 70		25 86				138 50
22	6 950 16	3 230 90	2 996 10		71 33				163 47
23	8 211 62	3 178 43	3 109 98		68 45				
24	7 679 56	15 572 69	14 862 58		308 28				401 83
27	9 301 84	10 876 39	10 822 15		54 24				
28	7 574 57	9 556 07	9 444 94		111 13				
29	7 925 28	9 888 62	9 708 97		179 65				
30	7 402 15	15 697 80	15 484 02		213 78				
31	7 764 44	6 975 07	6 904 21		70 86				
BALANCE	67 290 99								

Totals are posted to the control sheet from both daily registers

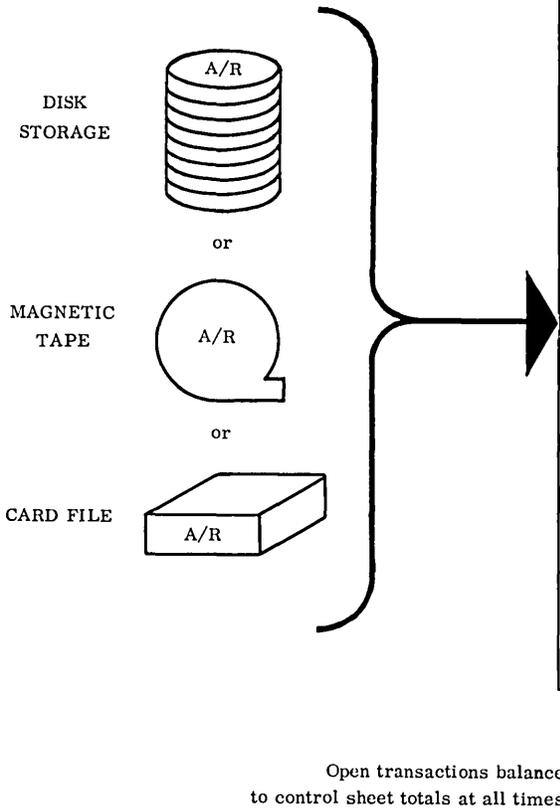
Check to Trial Balance

Figure 9. Audit Trail

The transactions for that date are relisted; an entry-by-entry comparison on the duplicate and original entry registers will reveal the discrepancy so that a correcting entry can be initiated.

The sales register and cash receipts book provide documentation that is sufficient for reconstructing a

transaction or associating it with the original source document. Balancing each register to a predetermined total proves that all transactions in the group have been processed through that point. The entries on the control sheet provide the means for balancing accounting records at the end of the accounting period.



SHEET 1 OF 5 GENERAL MANUFACTURING COMPANY AGED TRIAL BALANCE REPORT NO. 3 DATE December 31

CUSTOMER NAME	CUST. NO.	INV. DATE	INV. NO.	TOTAL	CURRENT	30 DAYS	60 DAYS	90 DAYS
AMERICAN STEEL CO	12811123		11666	64031				
	12811230		12336	90504	90504	64031		
APALACHIN LUMBER CO	21791114		9852	46920				46920
	21791230		12335	143930	143930	25461		
				216311	143930	25461		46920
B J E SERVICE CORP	22851229		12332	147478	147478			
BARRETT MACHINE	30761123		11717	58715				
	30761231		12347	61023	61023	58715		
BENSON MFG CO	41231018		10864	758				758
	41231114		11452	21749				
	41231228		12319	119165	119165	21749		758
BROWN AND WILLIAMS	61951111		11234	41440				
	61951228		12321	194905	194905	41440		
CASTLE HARDWARE CO	80621230		12338	34043	34043			
				34043	34043			
CENTRAL UNION SUPPLY	82571122		11643	13280				
CENTRAL VALLEY CORP	107231015		10514	62963				62963
	107231110		11603	38925				
				101688				62963
CHALLIS ALMERS	119051018		10901	2763				2763
	119051222		12290	63707	63707			
				66470				2763
CHANEL WHOLESALE	112341228		12324	80208	80208			
	112341228		12324	50000CR	50000CR			
	112341231		12351	26786	26786			
	112341234		99588	26117CR	26117CR			
WHITE STEEL BENCH CO	86281215		12244	32398	32398			
WINTERDALE RAILWAY	876521213		12228	59895	59895			
WISELOMANN INC	882131215		12240	90396	90396			
				6729099	3798233	1690319	1022632	217865

Check to Control Sheet

CASH RECEIPTS REGISTER

CUSTOMER NAME	CUSTOMER	BR	SALES MAN.	ENTRY	INVOICE DATE		ACCOUNTS RECEIVABLE CREDIT	CASH DEBIT	DISCOUNT ALLOWED DEBIT
					NUMBER	MO DAY			
CASTLE HARDWARE CO	80622513	11	11506	11	8	492117	492117		
CENTRAL UNION SUPPLY	82573471	11	12300	12	3	369003	361165	738	
CHANEL WHOLESALE	112342279	11	12324	12	28	500000	490000	10000	
COVENTRY OIL	19285195	11	12292	12	3	950979	931195	1902	
HASKEL IND SUPP CO	36512116	11	12318	12	28	415333	407022	831	
KELVINAIRE CORP	45035107	11	11686	11	23	381666	381666		
MAIZE REFINING CO	580912279	11	12285	12	22	252566	24751	505	
NEWTON PARK AND CO	61043418	11	11239	11	1	761311	761311		
NEW MEXICO COMPANY	597511367	11	11993	11	30	100000	100000		
N Y GAS AND ELEC CO	612212246	11	12325	12	28	105503	1033193	2110	
VESTAL STEEL CO	78050769	11	10452	10	8	146161	146161		
WINTERDALE RAILWAY	876521676	11	9562	9	1	650140	650140		
							697507	690421	7086

Making Controls Work

In setting up controls that will operate successfully, the following should be kept in mind:

1. Only those controls which satisfy a need should be included.
2. The overall system of controls should be conceived and arranged for at the time procedures are being planned. In so doing, they will be an integral part of each procedure and those areas which may have a tendency to be overcontrolled or undercontrolled will be spotted.
3. Personnel who maintain the controls should be familiar with machine functions so as to be able to locate, determine the cause of, and correct out-of-balance conditions.
4. Controls should be simple and easy to maintain so that work flow is not disrupted.
5. A description of control operations should be documented and assembled for reference and training purposes.
6. Whenever possible, control operations should be mechanized.
7. When documents to be processed are batched, batch size should be such that work will continue to flow steadily.



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