

HUGHES ADV AIRBORNE III

Hughes Advanced Airborne Computer Model III

Hughes Aircraft Company

MANUFACTURER

APPLICATIONS

Control of aircraft and aircraft equipment. In the specific application for which the computer was built, it performs navigation, flight control, and weapons control, receiving target and flight data as inputs and generating flight and weapons control signals as outputs. The system was developed for the U. S. Air Force for automatic control use in high speed aircraft.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	17
Binary digits/instruction	17
Binary digits/instruction not decoded	2
Instructions per word	1
Arithmetic system	Fixed point
Instruction type	Modified two address

Photo by Hughes Aircraft Company

ARITHMETIC UNIT

	Exclud Stor Access
	Microsec
Add time	200
Mult time	1,700
Div time	1,700
Construction	Vacuum tubes
Rapid access word registers	3
Basic pulse repetition rate	162 Kc/sec
Arithmetic mode	Serial
Timing	Synchronous with magnetic drum
Operation	Sequential

STORAGE

Media	Words	Access Microsec
Magnetic Drum	1,984	3,750 average
Magnetic Drum	8	400 average
Total capacity is 37,648 binary digits.		
All programs are coded for minimal latency.		

Photo by Hughes Aircraft Company

INPUT

Medium Speed
Analog D. C. Voltage 200 microsec 0-100V D. C.
Other analog inputs are available. This is used as a control computer with analog inputs and outputs; however, paper tape is used as an additional input medium.

OUTPUT

Medium
Analog D. C. Voltage 0-100V D. C.
Other analog outputs are available. Magnetic tape ultimately feeding a Flexowriter is used as an auxiliary output.

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	481
Crystal diodes	3,364

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	1.5 Kw
Volume, computer	5 cu ft

The arithmetic and control unit of the computer occupies approximately 0.6 cu ft and weighs 20 lbs.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Ratio of good time to unscheduled down time is approximately 9.

The computer is part of a complete control system. The characteristics of the computer is determined by the characteristics required by the system in which it is to be used.

The flip flops and diode matrices are mounted on individual plug-in wafers and standardized as much as possible so that the bulk of the computer is a multiplicity of a few basic components. Etched circuits and subminiature tubes are used throughout.

INSTALLATIONS

Hughes Aircraft Company
Culver City, California

HUGHES BM GUIDANCE MANUFACTURER

Hughes Ballistic Missile Guidance Computer

Hughes Aircraft Company
Digital Systems Department

APPLICATIONS

System is a special purpose computer for guidance of ballistic missiles. It performs steering and timing calculations for the missile.

STORAGE

Medium	No. of Words	No. of Digits	Access Microsec
Magnetic Cores	16	280	625 max.

Wired problem constants and programming.

INPUT

Media	Speed
Special Digital	81.6 Kilocycles/sec
Controlled by pre-launch digital computer	
Incremental Accelerometers	800 pulses/sec

Photo by Hughes Aircraft Company

OUTPUT

Media	Speed	
Digital	81.6 Kilocycle/sec	To pre-launch computer
Digital	50 Pulses/sec	To missile
Pulsed		To missile

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	0.030 Kw
Volume, computer	0.4 cu ft
Area, computer	1.1 sq ft
Weight, computer	23 lbs

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Estimated mean-time-to-failure is greater than 1000 hours.

Above figures based on period from Feb 59 to May 60.

Date this system passed Customer Acceptance Test:

Development Apr 59, Final Jan 60.

Time is not available for rent to outside organizations.

Development model was operated continuously for 2200 hours with no failures.

Photo by Hughes Aircraft Company

ADDITIONAL FEATURES AND REMARKS

Outstanding features include small volume, weight, power dissipation and high reliability. All solid state components, and replaceable subassemblies.

Adopted procedures for storage, shipping, and protection from humidity, temperature, and physical, electrical, fire, or other damages include molded polyurethane pads between subassemblies for shock absorption and thermal conductivity.

Special purpose digital differential analyzer, fixed programmed using "nor" logic elements. Consists of 21 logic cards, 2 clock cards, 2 input cards, 4 magnetic core cards, with redundant etching and connectors and 1 special "shift drive and oscillator" assembly.

HUGHES D PAT

Hughes Drum Programmed Automatic Tester

MANUFACTURER

Hughes Aircraft Company
Digital Systems Department

APPLICATIONS

System is used for automatic testing, checkout, fault isolation, sequencing and control of missiles, aircraft, vehicles, and electronic equipment.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	19
Binary digits/instruction	19
Instructions/word	1
Instructions decoded	40
Arithmetic system	Fixed point
Instruction type	Modified three address
Number range	(1 - 2 ⁻¹⁸) to - 1

Photo by Hughes Aircraft Company

Instruction word format

20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
NEXT CHANNEL							OPERATION AND ADDITIONAL SECTORS TO DELAY							SECTORS TO DELAY				
							DESTINATION			SOURCE								

Automatic built-in subroutines
 Operator's console scanning and branching
 Visual display output
 Printer output
 Input selection and measurement
 Frequency measurement
 Bulk loading from tape

Registers
 4 word register for frequency and time interval measurements
 32 word register for digital and analog outputs

ARITHMETIC UNIT

Operation	Exclud. Stor. Access
	Microsec.
Add	84
Mult	84/bit
Div	84/bit
Construction (Arithmetic unit only)	
Vacuum-tubes	0
Transistors	975
Diodes	6,300
Magnetic Cores	60
Arithmetic mode	Serial
Timing	Synchronous, Computer clock pulses recorded on magnetic drum memory
Operation	Sequential

All times given in table above exclude access time to command. There are three 1-word accumulators, two 4-word circulating registers, one 16-word circulating register, and two 32-word circulating registers. The two's complement system of arithmetic is used.

STORAGE

Media	No. of Words	Access Microsec
Magnetic Drum	40,640	84 - 26,880
Magnetic Core	3	84
Magnetic Drum	8	84 - 336
Magnetic Drum	16	84 - 1,344
Magnetic Drum	64	84 - 2,688

All stored words are 19 binary digits

INPUT

Media	Speed
Analog Voltages	6000 samples/sec
A-C and D-C voltages	
Pulse and Analog Volt	0.1 cps to 1 Mcps
Frequency measurements	
Off-On Signals	6000 samples/sec
Decimal Keyboard	Manual
Paper Tape Reader	400 char/sec
Magnetic Drum Loading	

OUTPUT

Media	Speed
Contact Closures	40 char/sec
1 to 10 bits/character	
Transistor switches	168 microsec/char
1 to 10 bits/character	
Decimal readout panel	25 millisecc/char
8 decimal digits plus sign	
Analog Voltages	
Programmable A-C or D-C	

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Tubes	0
Diodes (Crystal)	5,400
Transistors	1,800
Magnetic Cores	60

CHECKING FEATURES

Set of diagnostic test routines
Subunit checking facilities
Single order simulation with toggle switching
Partial program

Built-in test and maintenance equipment. Self-test program stored in memory to provide complete verification and fault isolation.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	0.3 Kw	0.3 KVA
Volume, computer	68 cu ft	
Area, computer	17 sq ft	
Weight, computer	1,800 lbs	
No special site preparations required. A 120/208, 3-phase, 4-wire, 400 cps power required.		

HUGHES DIGITAIR

Hughes Digital Airborne Computer

MANUFACTURER

Hughes Aircraft Company
Digital Systems Department

MA-1 CENTRAL COMPUTER

APPLICATIONS

Computer is used for real-time computing and control in complex aircraft systems. The computer includes extensive analog and digital input-output capability. In the application for which it was designed, the computer performs automatic aircraft control, navigation, attack steering, weapon control, intercept computation, data-link processing, and automatic system testing, for Air Force interceptors. In this application, the program and input-output are closely integrated with other electronic and mechanical portions of the system.

Photo by Hughes Aircraft Company

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Number binary digits/word	17
Number binary digits/instruction	17
Number instructions/word	1
Arithmetic system	Fixed point
Instruction type	Three address X-Modified
Number range	- 1 to $(+ 1 - 2^{-17})$

Instruction word format

9 bits - relative address of next order	4 bits-source for data transfer	4 bits-destination for data transfer
	8 bits - instruction other than data transfer	

Automatic built-in subroutines include input conversion (analog, digital, data link) and output conversion (analog, digital) (independent of program).

Automatic coding includes conversion from mnemonic code to memory-loading tapes and program documents, via punched-card machinery. System is normally programmed in minimum-latency fashion.

Registers and B-boxes include 3 one-word registers, 2 multiword circulating registers for fast-access storage, 1 multiword circulating register for outputs, and 1 multiword circulating register for data link.

ARITHMETIC UNIT

Operation	Incl. Stor. Access Microsec	Exclud. Stor. Access Microsec
Add	210	105
Mult	variable-105 + 105/bit	105 per bit-variable
Div	variable-105 + 105/bit	105 per bit-variable

Construction (Arithmetic unit only)

Vacuum-tubes	182
Transistors	None
Condenser-Diodes	1,926
Magnetic Cores	51
Arithmetic mode	Serial

STORAGE

Media	No. of Words	No. of Digits	Access Microsec
Magnetic Drum, Pre-recorded	13,000	17	Min latency(normal)-104 Max possible- 12,500
Magnetic Drum, Variable	360	Same	Same
Magnetic Drum Register	22	Same	Min latency - 104 Max - 1040 or 1250
Core Shifting Registers	3	104	

INPUT

Media	Speed
Voltages (ac and dc)	315 microsec conversion
24 inputs, electronically switched	
Pulses (Data Link)	5 KC
On-Off Signals	
54 inputs, electronically switched	
Inputs available to program on demand	

OUTPUT

Media	Speed
Voltages (dc)	0.5 sec full scale slew
16 simultaneous outputs	
On-Off Signals	10 microsec
Relay Contacts	

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Tubes	
6814	269 Flip-flops
6021	63 Triode Amps
5639	33 Write Amps
5703	18
5840	16
6110	10
Diodes	
90125	257
925002	147

925008	3,827
925010	6
925011	52
Diodes are Hughes type	
Transistors	0
Magnetic Cores	51

CHECKING FEATURES

Checking features include a fully automatic self-test program, remotely initiatable, making use of built-in self-test features. Semi-automatic diagnostic program diagnoses faults to one or two units. External equipment (ground-based) used for detailed diagnosis in conjunction with semi-automatic diagnostic program.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Volume, computer	3.2 cu ft
Volume, input-output	3.3 cu ft
Weight, computer	122 lbs
Weight, input-output	178 lbs
Weight, total	300 lbs
System mounted in aircraft electronics racks	

PRODUCTION RECORD

Computer is in large scale production
Several hundred have been produced
Several hundred are on order

PERSONNEL REQUIREMENTS

Designed for operation and maintenance in unfavorable environments by military personnel with relatively little training.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Total system time approximately 30,000 hours to date.
Mean time to failure approximately 60 hours, including input/output.

ADDITIONAL FEATURES AND REMARKS

Outstanding features include the utilization of vacuum tubes and semiconductor diodes, very high maintainability, modified 2-address code designed for minimum-latency programming, serial fixed-point arithmetic, programmer can control input selection.

INSTALLATIONS

Various U. S. Air Force Bases

HUGHES LRI X

Hughes LRI X Computer AN/ASG 18

MANUFACTURER

Hughes Aircraft Company
Digital Systems Department

APPLICATIONS

System is used for real-time computing and control in complex aircraft systems. Computer includes advanced displays and extensive analog and digital input-output capability. In the application for which it was designed, the computer performs inertial and non-inertial navigation, weapon control, attack computations, data-link processing, intercept computations, and automatic tests of over-all system, for Air Force interceptors. In this application, the program and input-output are closely integrated with other electronic and mechanical apparatus in the over-all system.

Photo by Hughes Aircraft Company

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	19
Binary digits/instruction	19
Instruction/word	1
Arithmetic system	Fixed point
Instruction	Modified three address
Number range	-1 to $(1 - 2^{-18})$

Instruction word format

9 bits relative address of next order	5 bits source of operand No. 1	3 bits source of operand No. 2 and destination	2 bits func- tion
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This structure applies to add, subtract, input, output, clear and absolute value. Other orders have slightly different structures.

Automatic built-in subroutines include input conversion (analog, digital, incremental, data link); output conversion (analog, digital, data link); real time count; frequency measurement (Independent of program).

Automatic coding includes conversion from simplified mnemonic code to memory-loading tapes and program documents, via IBM data processing machinery.

Registers include 4 one-word registers, 3 multiword circulating registers for fast-access storage, 2 multiword circulating registers for analog and digital outputs, 3 multiword circulating registers for data link processing, 1 multiword circulating register for frequency count, and 1 multiword circulating register for incremental inputs and real time count.

The system uses four-phase logic and is normally programmed in minimum-latency fashion.

ARITHMETIC UNIT

	Incl. Stor. Access Microsec	Excl. Stor. Access Microsec
Add	84	84 (3 address code)
Mult	variable-84 + 84/bit	variable-84 per bit
Div	variable-84 + 84/bit	variable-84 per bit
Construction (Arithmetic unit only)		
Vacuum tubes	none	
Transistors	810	
Arithmetic mode	Serial	

STORAGE

Media	No. of Words	Access Microsec
Magnetic Drum, Pre-recorded	40,960	Minimum Latency (normal) - 84 Maximum possible - 25,000
Magnetic Drum, Variable	1,280	Same
Magnetic Drum Registers	188	Minimum Latency - 84 Maximum varies 84 to 1,700

INPUT

Media	Speed
Voltages (ac and dc)	200 microsec/conversion
64 inputs, electronically switched	
Pulses (incremental and data link)	5 KC
On-Off Signals	
130 inputs, electronically switched	
Operator Controls (Analog and Digital)	
Frequencies	100 KC

Inputs available to program on demand.

OUTPUT

Media	Speed
Voltages (dc)	0.7 sec. full scale slew
On-Off Signals (Toggles)	
100 ma., 28 V.	
Shaft Positions	80 steps/second
Operator Displays (Analog and Digital)	

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Transistors	1,683

CHECKING FEATURES

Checking features include fully automatic self-test program including marginal test, remotely initiatable, making use of built-in self-test features. Automatic self-diagnosis to unit level. Diagnostic program to aid more detailed diagnosis. External ground-based test equipment for detailed diagnosis, in conjunction with diagnostic program.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	0.850 Kw
Volume, computer	2.1 cu ft
Volume, input-output excl displays	1.7 cu ft
Weight, computer	135 lbs
Weight, input-output	50 lbs
Weight, total	185 lbs
System is mounted in aircraft	

PERSONNEL REQUIREMENTS

System is designed for operation and maintenance in unfavorable environments by military personnel with relatively little training.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Total system time is approximately 3000 hours to date.
Mean-time-to-failure approximately 150 hours including input-output.

ADDITIONAL FEATURES AND REMARKS

Outstanding features include semiconductor circuits, very high maintainability, modified 3-address code designed to facilitate minimum-latency programming, serial fixed-point arithmetic, input-output flexibly accessible to program.

HUGHES M 252

Hughes M-252 Digital Computer

MANUFACTURER

Hughes Aircraft Company
Digital Systems Department

APPLICATIONS

The computer is currently being produced for use as a guidance computer to be used in a Minneapolis-Honeywell Inertial Guidance System for the Fairchild SD-5 Surveillance Drone. In this capacity, it aligns the platform, sets drift trims, performs the Schuler tuning of the platform, navigates the drone throughout the surveillance mission, turns sensors on and off, and feeds positional information to the data processor for proper identification of photographs.

A modified version of the computer is being designed for installation in a standard relay rack to be used as a ground based computer for space probe guidance.

Photo by Hughes Aircraft Company

PROGRAMMING AND NUMERICAL SYSTEM

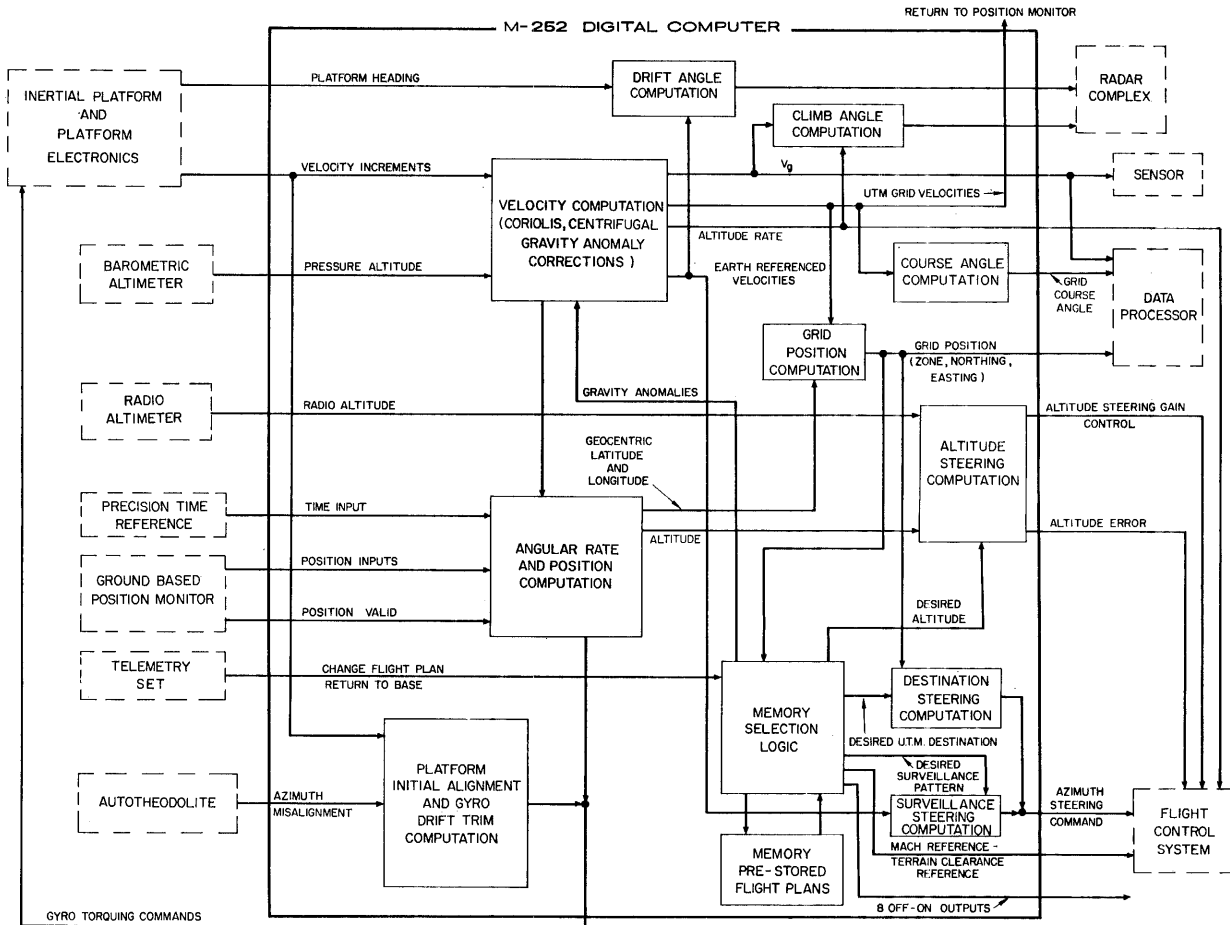
Internal number system	Binary
Binary digits/word	20
Binary digits/instruction	10
Number instructions/word	2
Arithmetic system	Fixed point
Instruction type	One-address
Number range	$-1 \leq N < 1$

Instruction word format

X X	X X X X X X	X X
W W	Operation Code	Next Channel

XXXXX	X	XXXX
WW	Left Right	Channel Group

(Second word of 2 word order when used)



M252 FUNCTIONAL BLOCK DIAGRAM

Chart by Hughes Aircraft Company

Registers include 3 - 1 word register for arithmetic operation, and 1 - 10 word register for short term temporary storage.

1 - 6 word register and 1 - 30 word register are used for Input-Output only.

4 temporary number storage channels are used.

ARITHMETIC UNIT

	Incl. Stor. Access Microsec.	Exclud. Stor. Access Microsec.
Add	264	88
Mult	1144	968
Div	2112	1936
Construction (Arithmetic unit only)		
Vacuum-tubes	0	
Transistors	750	Primarily 2N697, 2N1132, and 2N1253
Diodes	3000	
Magnetic Cores	66	
Arithmetic mode	Serial	

STORAGE

Medium	No. of Words	Access Microsec
Magnetic Drum	2,640	88

Access time is minimum

An additional 14 channels of 60 words are used for input-output registers, temporary storage, word-origin origin track, clock pulse tracks, and spare channels. A fixed head drum has been used in this application for maximum reliability.

INPUT

Media	Speed	Remarks
2 Serial Digital	250 KC	
3 Incremental	3600 sec (max.)	Pulses
6 Switching	Program Control	
2 A-C		0 to 8 V
3 D-C		-8V to +8V
Timing Reference	400 cps	
DC conversion accuracy ± 0.3 percent.		

OUTPUT

Media	Speed	Remarks
1 Serial Digital	250 KC	
3 Incremental	1800 sec	Torquing Commands
10 Switching	Program Control	
11 D-C	Continuous	-8V to +8V
D-C conversion accuracy		

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Tubes	0
Diodes	4,000
Transistors	1,100
Magnetic Cores	66

CHECKING FEATURES

Prior to use, the computer is checked by a self-test program of 70 seconds duration.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, system	0.37 Kw	0.46 KVA	0.8 pf
Volume, system	2.13 cu ft		
Capacity, air conditioner	2.3 lbs/min cooling in at 110°F		
Weight, system	85 lbs		

Above figures include power supply and input-output equipment. Central computer is 1.3 cu ft and 53 lbs.

Computer is designed for airborne installation. A test control unit and drum record unit are required for loading the drum and checking the computer prior to flight.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Date this system passed Customer Acceptance Test
14 April 60

Estimated mean-time-to-failure is greater than 400 hours. The limited experience to date tends to bear this out.

ADDITIONAL FEATURES AND REMARKS

Outstanding features include design for 5G vibrations without isolators. Operates over temperature range from -67°F to +185°F. All modules are repairable.

Unique system advantages includes high accuracy navigation performance in conjunction with a high quality inertial platform.

FUTURE PLANS

Versions of this computer have been proposed for several applications. A contract has been received for a relay rack version to serve as a ground based computer for space probe guidance.

INSTALLATIONS

System is for field use in the Fairchild SD-5 Drone.

IBM 305 RAMAC

IBM 305 RAMAC Data Processing System
Random Access Method of Accounting and Control

MANUFACTURER

International Business Machines Corporation

APPLICATIONS

Manufacturer

Inventory control, manufacturing control, billing (invoicing and order writing), parts substitution, payroll, hospital accounting, sales analysis, accounts receivable, fiscal accounting, and Air Force parts inventory and accounting.

The IBM RAMAC 305 (Random Access Method of Accounting and Control) is a complete, compact data processing system built around a disk memory unit which consists of 50 magnetic metal disks. The RAMAC 305 is designed to provide continuous, or "in-line", accounting for all types of businesses. Data is recorded on or read from each side of the disks in random order by a rapidly-moving access arm. The disk units are available with storage capacities of 5 million digits and 10 million digits and may be used either singly or in any combination of two to provide storage capacities of 5, 10, 15 and 20 million digits.

Control center of the IBM RAMAC 305 is the operator's console. The system also has arithmetical and logical ability, punched card input, and both punched

Photo by International Business Machines Corporation

card and printed output. Additional features which may be added to this basic RAMAC for further versatility include punched paper tape input, remote printing stations, dual disk files, dual access arms, dual system control, and faster, more flexible printing.

Letterkenny Ordnance Depot

Located in Building No. 3, Letterkenny Ordnance Depot, Chambersburg, Pa., the system is used to apply ADFS only to accomplishment of supply, stock management and related financial accounting functions with a view of expediting supply and providing a means of rapid expansion of activity without a proportionate increase in personnel and equipment. Experience and skills gained in these applications will facilitate progressive integration of other applications utilizing the same basic system by adding relatively inexpensive disk storage units. Such applications include payroll, cost accounting, etc.

U.S.A. Louisville Medical Depot

Located at the Louisville Medical Depot, Louisville 1, Kentucky, the system is used for stock accounting and inventory control (Navy Single Manager), for depot property accounting, and for Post Engineer property accounting.

U.S.A. Mt. Rainier Ordnance Depot
Under the Director for Services, the system is used for supply and inventory accounting and for financial and stock fund accounting.

U.S.A. Raritan Arsenal
System is used for distribution supply, availability editing, and F. I. A. updating and reporting.

U.S.A. Red River Arsenal
Maintenance of stock accounting and related financial records to include daily updating of all quantitative fields, periodic updating of pertinent data in each record, daily processing of all type transactions (issues, receipts, adjustments, etc.) and creating documentation for same in punched card form.

U.S.N. Charleston Shipyard
Located in the Supply Department, fields of application include expenditure processing (processing issues of all types, including availability tests, reorder initiation, and attendant funds control), receipt processing (all types of material receipts), stock record load/unload (loading and unloading stock records as required), obligation/planned requirement review (cyclic review of material obligations (back orders) and planned requirements), status read-off (to provide visible records for review as required), warehouse location load (to insert warehouse locations into stock records), stock status reporting (to report status of items in accordance with schedules established by supply demand control points), inventory cut-off to provide inventory cut-off and trial

Photo by Western Electric Company

balance cards for inventories of material, and other miscellaneous calculating programs.

USAF 78 Fighter Wing, Hamilton AFB
Located at Base Supply, Hamilton AFB, California, the system is used for automation of supply record keeping. Includes all transactions effecting balances, due-in and due-outs, item records, inventory control. Incompasses records for 46,000 line items (averages) with 72,000 transactions per month.

USAF Hq SAC Offutt AFB
With 19 locations in the command, (sites and program are similar), the 305 EDPS has been designed to increase dependability of supply activities in support of SAC combat readiness through an improved mechanized system. The design of the system provides for:

Instantaneous and positive response by on line processing.

The immediate and automatic availability of all interchangeable assets.

The immediate and automatic availability of like items in all weapons systems.

The immediate and automatic requisitioning of not-in-stock items.

Guaranteed increased required items availability.

Accurately computed stock levels after every appropriate transaction.

Automatic stock replenishment requisitioning.

Current and accurate stock balance consumption reports.

Provides an integrated item and monetary accounting

system simultaneously updating monetary balances at the same time item balances are updated.

The designing and programming of the EDPS features the accomplishment of supply transactions with a minimized possibility of human error. With this increased accuracy comes increased supply effectiveness for our combat organization.

USAF 328th Fighter Group, Richards-Gebaur AFB
Located in Building 619, Richards-Gebaur Air Force Base, Missouri, the system is used for base supply item and dollar accounting. Maintains the supply accounting and financial accounting records on a current basis by automatically updating in accordance with various transactions affecting these records in accordance with Volume XVIII, AFM 67-1. By-products of this system provide management documents containing information needed to satisfy requirements for consumption rates, supply requirements, transaction analysis, item location and expense distribution.

Boeing Airplane Company
Located in Boeing Warehouse No. 3, Wichita, Kansas, the system is used for maintenance of an inventory of government furnished parts located at Boeing-Wichita.

Ford Motor Company, Transmission & Chassis Div.
System is used for payrolls and related accounting, inventory control, production analysis and control, product cost and cost analysis reports.

Photo by U. S. Army Red River Arsenal

Ford Motor Company, Wayne
Located at the Wayne Assembly Plant, the system is used for inventory control of productive material, vehicle invoicing and price labels, manufacturer's certificate of origin, and pricing and calculations for payment to vendors.

Sun Oil Company, Philadelphia 3
Located at 1608 Walnut Street, Philadelphia 3, Pa., the system is used for payroll preparation, payroll accounting, and deduction and payroll tax accounting.

Sun Oil Company, Southland Center
Located at Southland Center, Dallas, Texas, the system is used for computation of volumes of natural gas produced, used, and disposed of and valuing, taxing, and accounting for proceeds for natural gas and natural gas liquids, including disbursement of proceeds to all interested parties.

Western Electric Company, Aurora
Located at the Montgomery Shops, Aurora, Ill., the system is used for inventory and production control of relay manufacture, including scheduling relays, components and raw material requirements, input, billing and investment control of relay accounting.

Western Electric Gen Prog Comm New York
Located at 222 Broadway, New York, the system is used to process customers' orders and enter such orders on appropriate sources of supply. It also maintains records of purchase contract balances.

Western Electric Co., Tel. Sales Div., New York
 Located at 61 Broadway, 4th Floor, New York 6, New York, this computer is used to develop programs prior to the installation of similar RAMAC Systems in the Distributing Houses (Regional Warehouses and repair shops). The primary application is inventory control including billing, maintaining stock balances, ordering, receiving and vouchering; all on an inline basis. Shop costing, shop scheduling payroll and headquarters reporting are batch processed. This computer has been used to develop and test the Dataphone III Transmission System. Monthly operating statistics from all the Distributing Houses are verified and summarized for printed monthly reports.

Western Electric, Winston-Salem
 The system is used for production control, including inventory control, machine load, material movement, order requirements and schedule, and shop orders.

Georgia State College of Bus. Admn.
 Located at 33 Gilmer St., S. E., Atlanta 3, Georgia, the machine is used in faculty research and in the teaching of programming methods.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded alphanum
Alphanumeric char/record	Up to 100
Alphanumeric char/instruction	10
Instruction/Process Drum Track	10
Instructions decoded	200 on 10 tracks, std.
Arithmetic system	Fixed point
ADD-SUBTRACT-MULTIPLY-DIVIDE	
Floating point	By program sub-routine
Instruction type	Two address
Control panel logic (stored program)	also.
Number range	Decimal 0 - 9
Instruction word format	

FROM	TO	NO. CHAR.	CONTROL

Automatic coding includes the RAMAC Symbolic Assembly Program.

ARITHMETIC UNIT

	Incl Stor Access
	Microsec
Add	30,000
Mult	60,000-190,000
Div	100,000-370,000
Construction (Arithmetic unit only)	
Type	Quantity
Tubes	
2D21	21
6211	169
6350	20
5919	124
7044	4
Diodes	
AM	12
Timing	Asynchronous
Operation	Sequential

STORAGE

Manufacturer	No. of Words	Access Microsec	
Media	Tracks	10,000	
Process Drum	100 char/record	600,000 avg.	
Disk File	50,000 records/file		
	10,000,000 char with 2 files		
Disk File	100 char/record	600,000 avg.	
	100,000 records/file		
	20,000,000 char with 2 files		
Magnetic Tape (Special Order)			
No. of units that can be connected		3 Units 729-I	
		4 Units 727	
No. of char/linear inch of tape		200 Char/inch	
Channels or tracks on the tape		7 Tracks/tape	
Blank tape separating each record		0.75 Inches	
Tape speed		75 Inches/sec	
Transfer rate		15,000 Char/sec	
Start time		10 Millisec	
Stop time		10 Millisec	
Average time for experienced operator to change reel of tape		90 Seconds	
Physical properties of tape			
Width		0.498 Inches	
Length of reel		2,450 Feet	
Composition		Mylar base	
Connects through 1901 Tape Control Unit (Special Order).			
USA LOD			
Medium	No. of Char	Access Microsec	
Disk Storage	30,000,000	30,000	
20 program tracks, 10 working tracks, 4 input-output tracks and 1 accumulator track per processing unit (two units); 3 type 350 double density files.			
USA Medical Depot			
Magnetic Disk	10,000,000		
Track to track access time same disk 100,000 - 25,000 microseconds.			
Disk to disk access time 400,000 - 800,000 microsec.			
USA Mt Rainier Ord D			
Medium	No. of Words	No. of Digits	
Magnetic Disk Memory	200,000	20,000,000	
5 - 10 seconds required per transaction.			
100 characters to a record, twenty 100 character records on each 100 tracks on each 50 disks.			
USA Raritan			
Medium	No. of Words	No. of Char	Access Microsec
Magnetic Disk (2)	100,000 ea	10,000,000 ea	600,000
Magnetic Drum (2)	200 ea	2,000 ea	
Magnetic drum used for storing program and processing data.			
Magnetic disk used primarily for bulk storage.			
Both disk units under control of console A and B.			
This is dual control and dual access.			
USA Red River Arsenal			
Disk Files	300,000	30,000,000	4,000 avg.
High Speed Magnetic Drum	300	3,000	300 avg.
Each record stored consist of 100 digits each.			

Media	Speed	
Boeing, Wichita		
Card	100 cards/min	
Printer	80 positions	30 lines/min
	20 positions	83 lines/min
Typewriter	100 char/line	6 lines/min
Ford Motor Company		
Cards	100 cards/min	
Printed Document (407)	150 lines/min	
Printed Document (Typewriter)	60 lines/min	
Ford, Wayne		
Card (Type 323)	100 cards/min	
Printer (Type 370)		
Printer (Type 407)	105 lines/min	
Summary Punch (Type 523)	2 cards/min	(Dependent upon application)
The 407 and 523 are added on line, but not used for all applications performed on the RAMAC.		
SUNOCO Philadelphia		
Printed Page	150 lines/min	IBM 407 on line
Typed Page		RAMAC 305 Typewriter
Punched Card	100 cards/min	
SUNOCO Southland Center		
Punched Cards	100 cards/min	
Stick Printer	30 to 80 lines/min	
Typewriter	10 char/sec	
WE Aurora		
Card	100 cards/min	
Printer (80 positions)	29 lines/min	
WE GPC New York		
Type 323 Card Punch	100 cards/min	
Type 370 Printer	29 lines/min	
Type 407 Printer	150 lines/min	
WE TSD New York		
797 Card Reader-Punch	120 cards/min	
323 Punch	100 cards/min	
380 Typewriter	10 char/sec	
Typewriter format control is possible, but infrequently used.		
WE Winston-Salem		
Cards	100 cards/min	
Printer	125 lines/min	
Georgia State		
Card	100 cards/min	
Printer	83 lines/min	(20 positions)
Printer	30 lines/min	(80 positions)
Typewriter	10 char/sec	

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Manufacturer	Quantity
Tubes		
6211		1,054
6350		81
5919		626
7044		72
2D21		205
5965		6
Diodes		
AB		13
AD		2
AM		112
AL		275
F		4
Magnetic Cores		
14		100
Selenium Rectifiers		360 (IBM P/N 315903 (For stacks of 10)
Germanium Rectifiers		28 IBM P/N's 2100111, 2100110, 2100119, 2114085, 2100108, 512073.

CHECKING FEATURES

Manufacturer
 Built-in checking features include parity (odd bit) on all internal data transfers and printing, input from cards by two readings, and input from paper tape by count of data punches by record (T.C.C.C.).
 Programmed checks include control to pre-establish totals, comparing addresses and part numbers in program, and arithmetic proof factors and reverse arithmetic in program.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer
 Power, computer 12.6 KVA
 Area, computer 370 sq ft
 Room size, computer 18 ft 1 in x 20 ft 4 in (min)
 Floor loading 50 lbs/sq ft
 Capacity, air conditioner 4 Tons
 Humidity not to exceed 80%. Two feet of headroom above 350 Unit. Physical Planning Manual and assistance are available.

USA LOD
 Power, computer 42.5 Kw 53.1 KVA
 Power, air cond 20 Kw 14 KVA
 Volume, computer 856.4 cu ft
 Volume, air conditioner 9,375 cu ft
 Area, computer 178 sq ft
 Area, air conditioner 400 sq ft
 Room size, computer 40 ft x 40 ft
 Room size, air conditioner 25 ft x 25 ft
 Floor loading 36.8 lbs/sq ft
 543 lbs concen max
 Capacity, air conditioner 62.5 Tons
 Weight, computer 18,484 lbs
 1,600 ft. (40 x 40 ft) were inclosed within the Machine Accounting Services area which in itself was an inclosure of 167 x 87. Although the entire area was air-conditioned, additional ducts and vents were concentrated in the computer area.

USA Medical Depot
 Power, computer 16.4 KVA at 208 volts
 44.9 amps at 208 volts
 Volume, computer 914.4 cu ft
 Volume, air conditioner 48,000 cu ft
 Area, computer 146.3 sq ft
 Area, air conditioner 3,200 sq ft
 Room size, computer 18 ft 1 in x 20 ft 4 in
 Floor loading 50 lbs/sq ft
 50 lbs concen max
 Capacity, air conditioner 20 Tons
 Weight, computer 8,432 lbs
 Space in same building with conventional EAM equipment was available. Wiring for 3-phase, 208 volt, 100 ampere power supply, including receptacles and a separate transformer was installed. Air conditioning was available; however, humidity control was added. Temperature range is maintained at 60° to 80°F and humidity is maintained between 40% and 60% relative. The following components of the 20-ton air conditioner with an evaporative condenser are operated from a 120/208 V, 3-phase, 4 wire grounded "Wye":
 Electrical system refrigeration compressor motor - 20 H. P.; supply air fan motor - 5 H. P.; evaporative condenser motor - 3 H. P.; 1 zone re-heat of 18 Kw; and 1 zone re-heat of 25 Kw.
 Unit is equipped with electric control system with humidistat controlling of coil temperature. Thermostat controlling re-heat. Operation is checked with recording thermometer and hygrometer equipped

with alarm facilities.

USA Mt Rainier Ord D

Power, computer 34.4 KVA 0.90 pf
Power, air conditioner 29.0 Kw 0.90 pf
Volume, computer 50.54 cu ft
Volume, air conditioner 103.68 cu ft
Area, computer 152.40 sq ft
Area, air conditioner 15.36 sq ft
Room size, computer 50 ft x 20 ft
Room size, air cond 12 ft x 12 ft (Area 2 in car decking 2nd floor)
Floor loading 109 lbs/sq ft (dist load)
1,800 lbs/sq ft (pressure under greatest load)
Capacity, air conditioner 15 Tons, total (2 sys)
Weight, computer 8,299 lbs
Weight, air conditioner 1,850 lbs

The RAMAC room is located in one end of a frame warehouse converted to office space. The room height is 11 ft 2 in. with a honeycomb false ceiling 9 ft from tile floor. The room is illuminated by 42 8 ft fluorescent tubes (strip) and has a distribution of approximately 60 ft/candles. A unique feature is the perforated hardboard wall which acts as the air distribution panel from the air conditioner mounted on the second floor. The air conditioner duct system has a 117 inch wide x 16 inch deep x 30 in high plenum chamber. Aerial services is provided from three (3) new 25 KVA XFMR's. Floor is 6 inch reinforced concrete on grade.

USA Raritan

Power, computer 40.1 Kw 44.2 KVA 0.90 pf
Power, air condi 18.9 Kw 21 KVA 0.90 pf
Volume, computer (2) 13,750 cu ft
Volume, air conditioner 960 cu ft
(Dunn & Bush Package - Water)
Area, computer (2) 1,375 sq ft
Area, air conditioner 80 sq ft
Room size, computer 25 x 55 x 10 ft
Room size, air conditioner 8 x 10 x 12 ft
Floor loading 1,000 lbs/sq ft
4,000 lbs concen max
Capacity, air conditioner 20 Tons
Weight, computer 17,500 lbs
Weight, air conditioner 2,100 lbs

Site preparations included existing building, masonry walls, concrete floor, and wood roof deck with automatic water sprinkler. Leveled and tiled floor and removed wood columns. Hung fire resistant insulated ceiling and installed duct work for air conditioning. Replaced partitions with fire resistant material. Installed electric lighting and power, and air conditioning unit.

USA Red River Arsenal

Power, air condit 52 Kw 59.1 KVA 0.87 pf
Volume, computer 800 cu ft
Volume, air conditioner 3,960 cu ft
Area, computer 160 sq ft
Area, air conditioner 330 sq ft
Room size, computer 1,200 sq ft
Floor loading 50 lbs/sq ft
Capacity, air conditioner 44 Tons
Weight, computer 19,540 lbs
Weight, air conditioner 14,000 lbs

Air conditioning services an additional 2,000 sq ft of machine area.

USN CNS

Power, computer 17.6 KVA 230 V. AC
Power, air conditioner 230 V. AC
Volume, computer 858 cu ft
Area, computer 143 sq ft
Room size, computer 21 ft x 25 ft
Room size, air conditioner Ceiling mounted

Floor loading 125 lbs/sq ft
Capacity, air conditioner 10 Tons
Weight, computer 11,065 lbs
False ceiling and walls, rewired for lighting, rewired for power distribution, refloored in tile.

Hamilton AFB

Power, computer 12.6 KVA 208V, 34.5 amps
60 cycle, 3 phase, 4 wire service
Power, air conditioner 220 V. 3 phase, 60 cycle
Volume, computer 375 cu ft
Volume, air conditioner 48 cu ft
Area, computer 18 ft x 20 ft
Area, air conditioner 8 sq ft
Room size, computer 24 ft x 24 ft
Floor loading 50 lbs/sq ft
Capacity, air conditioner 7 1/2 H. P.
Weight, computer 10,162 lbs (two disk storage unit (1730 lbs ea))
Weight, air conditioner 750 lbs

A total of \$17,616.00 was expended to prepare 24 ft x 24 ft room for the machine, a 324 sq ft room for key punchers, a 576 sq ft for programmers from existing facilities. Breakout of costs: Air condition unit - \$1,400, exhaust fan - \$285, cooling tower - \$500, electrical work - \$7,256, ductwork - \$325, material \$4,440, and labor for the balance.

Offutt AFB

Power, computer 16.4 KVA 208V
Power, air conditioner 220V
Volume, computer 8,000 cu ft
Volume, air conditioner 240 cu ft
Area, computer 800 sq ft
Area, air conditioner 24 sq ft
Room size, computer 20 ft x 40 ft
Floor loading 50 lbs/sq ft
50 lbs concen max
Capacity, air conditioner 5 Tons
Weight, computer 8,432 lbs
Weight, air conditioner 500 lbs

Must be enclosed in a dust free room with humidity control not to exceed 80% relative humidity at any time. Must have lightning arrestors, 2 4-wire branch circuits with voltage from either a 208 or 230, 60-cycle 3 phase 4-wire service line not to exceed + or -10%.

USAF Richards-Gebaur AFB

Power, computer 15.1 KVA
Power, air condit 12.7 Kw 25.8 KVA 0.5 pf
Volume, computer 3,240 cu ft
Volume, air conditioner 378 cu ft
Area, computer 1,536 sq ft
Area, air conditioner 54 sq ft
Room size, computer 20 ft 4 in x 18 ft 1 in
Room size, air conditioner 6 ft x 9 ft
Floor loading 55 lbs/sq ft
Capacity, air conditioner 15 Tons
Weight, computer 8,925 lbs
Weight, air conditioner 2,250 lbs
Air conditioning and soundproofing.

Boeing, Wichita

Power, 340 Power Unit 12.6 KVA 208 volts
Power, 350 Console 3.8 KVA 208 volts
Power, air conditioner 12.0 KVA
Volume, computer 380.46 cu ft
Volume, air conditioner 68.89 cu ft
Area, computer 142.67 sq ft
Area, air conditioner 13.77 sq ft
Floor loading 50 lbs/sq ft
Capacity, air conditioner 10 Tons
Weight, computer 8,432 lbs, all components
Weight, air conditioner 1,510 lbs

The room where the RAMAC is located is a partitioned, fireproofed division of a cement vault and provides

800 square feet of office space. The allowable temperature variation is from 50° to 90° with humidity not exceeding 80%.

Ford Motor Canton
 Power, computer 22,000 Kw 25 KVA 220V 3 phase
 Volume, computer 8,640 cu ft
 Area, computer 7,200 sq ft
 Room size, computer 28 ft x 42 ft
 Floor loading 1.3 lbs/sq ft
 100.0 lbs concen max
 Capacity, air conditioner 6 Tons Central System
 Weight, computer 9,000 lbs
 Electrical distributions, exhaust system and necessary fire preventive system.

Ford Wayne
 Power, computer 28.8 Kw 15.1 KVA
 Power, air condit 2.3 Kw 47.3 KVA
 Volume, computer 400 cu ft
 Volume, air conditioner 66.9 cu ft
 Area, computer 86 sq ft
 Area, air conditioner 20 sq ft
 Room size, comp & air cond 15 ft x 30 ft
 Floor loading 50 lbs/sq ft
 2,140 lbs concen max

Capacity, air conditioner 8 Tons
 Weight, computer 8,925 lbs
 Weight, air conditioner 1,050 lbs

SUNOCO Philadelphia
 Power, computer 15 KVA
 Volume, computer 4,000 cu ft
 Volume, air conditioner 140 cu ft
 Area, computer 400 sq ft
 Area, air conditioner 20 sq ft
 Room size, computer 24 ft x 42 ft
 Capacity, air conditioner 12 Tons

Weight
 Lbs.
 Key Punch 204
 Key Punch 208
 Key Punch 208
 Verifier 222
 Sorters 492
 Collator 840 approx.
 Reproducing 1,289
 Tab-off-line 3,286
 Tab-on-line 3,286+
 Interpreter 770 approx.
 RAMAC-Console 1,015
 Desk Unit 2,140
 Process Unit 1,945
 Power 1,810
 Punch (RAMAC) 760

Site preparation included sound absorbent tile on walls, air conditioning added, and power lines added with floor outlets.

SUNOCO Southland Center
 Power, computer 9.339 Kw 16.4 KVA 0.57 pf
 Volume, computer 3,200 cu ft
 Volume, air conditioner 248 cu ft
 Area, computer 400 sq ft
 Area, air conditioner 31 sq ft
 Floor loading 50 lbs/sq ft
 100 lbs concen max

Capacity, air conditioner 7 1/2 Tons
 Weight, computer 8,925 lbs
 Weight, air conditioner 750 lbs

Site preparation included electric outlets, supplemental air conditioning, and heat discharge plenums.

WE Aurora
 Power, computer 11.8 Kw 15.1 KVA 0.80 pf 208V
 Volume, computer 3,888 cu ft
 Area, computer 432 sq ft
 Room size, computer 18 ft 1 in x 20 ft 4 in
 Floor loading 50 lbs/sq ft
 150 lbs concen max

Weight, computer 8,925 lbs.
 Site preparation included glass and wall partitioning, and air conditioning controls in room itself.

WE GPC New York
 Power, computer 12.6 KVA
 Volume, computer 1,925 cu ft
 Area, computer 385 sq ft
 Room size Large room w/other equipment
 Floor loading 100 lbs/sq ft
 200 lbs concen max

Weight, computer 11,189 lbs
 Computer will be located in building now under construction - additional power and floor loading provided during construction.

WE TSD New York
 Power, computer 15.7 KVA
 Power, air cond 19.4 Overhead units
 (Two GE No. FCA-50)

Volume, computer 430.9 cu ft
 Volume, air conditioner 210 cu ft
 Area, computer 92.4 sq ft
 Room size, computer 24 ft x 28 ft
 Floor loading 150 lbs/sq ft
 1,362 lbs concen max

Capacity, air conditioner 10 Tons
 Weight, computer 9,370 lbs
 Weight, air conditioner 3,000 lbs

The computer is presently installed in leased space. A move to our new building is expected in about 6 months. The two air conditioning units of 5 tons capacity each, are suspended from the ceiling. A temporary wooden ramp has been provided to protect the exposed cables connecting the machines. A feeder cable was installed from the ground to the fourth floor.

WE Winston-Salem
 Power, computer 38.3 Kw 15 KVA
 Power, air conditioner 25 KVA
 Volume, computer 402.6 cu ft
 Volume, air conditioner 14,400 cu ft
 Area, computer 84.1 sq ft
 Area, air conditioner 1,200 sq ft
 Floor loading 164.5 lbs/sq ft
 631 lbs concen max

Capacity, air conditioner 12 Tons
 Weight, computer 13,835 lbs

Building perimeter heating removed and insulated sound deadening wall installed. Air handling unit utilizing existing steam and chilled water installed. Extensive rearrangement of personnel and electrical telephone facilities to provide the necessary space. Special plenums constructed over power units for heat outtake.

Georgia State
 Power, computer 9.34 Kw 16.4 KVA 0.57 pf
 Volume, computer 534 cu ft
 Area, computer 161 sq ft
 Room size, computer 17 ft x 21 ft
 Floor loading 52.4 lbs/sq ft
 Weight, computer 8,432 lbs

Installed in existing building modified only to the extent of partitioning the area so that the computer itself occupies a separate room. Two 100 ampere circuits for system and exhaust head with 3,000 cu ft/min fan installed.

PRODUCTION RECORD

Manufacturer
Time required for delivery 8 months

COST, PRICE AND RENTAL RATES

Manufacturer
Basic System
305 Processing unit \$189,950, or 3,200/month and
350 Disk Storage unit up, (printed output)
370 Printer
323 Card Punch \$167,850, or 2,875/month and
380 Console up, (punched card output)
340 Power Supply

Details available on request.
USA LOD

\$12,297 basic prime shift rental per month.
USA Medical Depot

305 Processing Unit
323 Card Punch
340 Power Supply
350 Disk Storage
380 Console
407 Printer
Total Monthly Rental Cost: \$4,510/month

Additional Equipment

3 024 Card Punches
3 056 Card Verifiers
2 083 Sorters
1 077 Collator
1 088 Collator
2 519 Document Originating Machines
1 557 Interpreter
2 407 Accounting Machines
Total Monthly Rental Cost: \$3,273/month

USA Mt Rainier Ord D

Basic System

Each system \$4,000/month.

Additional Equipment

Each system \$2,472/month.

USA Raritan

Lot No. 1 Basic System No. 1819

	Model	Type	Unit Price per Month	Amount/ Month
RAMAC Processing Unit	1	305	\$1,250	\$1,250
Card Punch	1	323	225	225
Card Punch	1	323	225	225
Disk Storage	14	350	1,600	1,600
Console	1	380	400	400
Power Unit	1	340	325	325
				<u>\$4,025</u>

Lot No. 1 Additional Equipment System No. 1819

	Model	Unit Price per Month	Amount/ Month
Addn Char Sel Pos	128	\$ 2	\$ 2
Addn Cycle Delay Units	244	10	10
Char Sel 1 Grp of 6 Spl Pos	130	5	5
Addn Latch Selectors	722	10	30
Addn Gp Dbl Dist	284	8	8
Addn Process Tracks	610	10	20
Prog Entry Isolation	613	25	25
Program Exit Split	614	15	15
Printer Output Track	607	5	5
Disk Storage Control (Model 14)	282	80	80
2nd Addn Gp Dbl Dist RPQ E90172		10	20

5 Addn Comp Pos, RPQ E90165	5	10
Character Sel Split, RPQ E90163	15	30
W/P Cycle Overlap, RPQ E90164	25	25
Latch Selectors, RPQ E90174	10	20
Single Dist 41 to 80, RPQ E90171	18	18
323 T Track, RPQ M86989	115	115
5 Blank Trans Sel Pos, RPQ 79638	5	10
Simult Rec Adv Pgm Adv, RPQ W86833	30	30
Tracks \$ and *, RPQ E94512	17	17
Dbl Punch Blank Col Detect	300	8
Grp 4 Five Pos Co Selectors	705	5
Digit Selector	275	5
Group 5 Two Pos Pilot Select	703	10
Digit Selector	275	5
Group 5 Two Pos Pilot Select	703	10
Dbl Punch Blank Col Detect	300	8
Grp 4 Five Pos Co Selectors	705	5
Dual Access, RPQ M90487	850	850
Auto Address Conv, RPQ E90170	35	35
Aux Card Counter, RPQ E90162	15	15

\$1,571

Lot No. 2, Basic System No. 1820

	Model	Type	Unit Price per Month	Amount/ Month
RAMAC Processing Unit	1	305	\$1,250	\$1,250
Card Punch	1	323	225	225
Card Punch	1	323	225	225
Disk Storage	13	350	1,550	1,550
Console	1	380	400	400
Power Unit	1	340	325	325
				<u>Total \$3,975</u>

Lot No. 2, Additional Equipment System No. 1820

	Model	Unit Price per Month	Amount/ Month
Addn Char Sel Pos	128	\$ 2	\$ 2
Addn Cycle Delay Units	244	10	10
Char Sel 1 Grp of 6 Spl Pos	130	5	5
Addn Latch Selectors	722	10	30
Addn Gp Dbl Dist	284	8	8
Addn Process Tracks	610	10	20
Prog Entry Isolation	613	25	25
Program Exit Split	614	15	15
Printer Output Track	607	5	5
2nd Addn Gp Dbl Dist, RPQ E 90172		10	20
5 Addn Comp Pos, RPQ E90165		5	10
Character Sel Split, RPQ E90163		15	30
W/P Cycle Overlap, RPQ E90164		25	25
Latch Selectors, RPQ E90174		10	20
Single Dist 41 to 80, RPQ E90171		18	18
323 T Track, RPQ M86989		115	115
5 Blank Trans Sel Pos, RPQ 79638		5	10
Simult Rec Adv Pgm Adv, RPQ W86833		30	30
Tracks \$ and *, RPQ E94512		17	17
Dbl Punch Blank Col Detect	300	8	48
Grp 4 Five Pos Co Selectors	705	5	25
Digit Selector	275	5	5
Group 5 Two Pos Pilot Selec	703	10	20
Digit Selector	275	5	5
Grp 5 Two Pos Pilot Select	703	10	20
Dbl Punch Blank Col Select	300	8	48
Grp 4 Five Pos Co Selectors	705	5	25
Dual Access, RPQ M90487 (E93455)	850	850	850
Auto Address Conv, RPQ E90168	35	35	35
Aux Card Counter, RPQ E90162	15	15	15
			<u>Total \$1,531</u>

USA Red River Arsenal

Type/Model or Device Code	RFQ#	Description	Qty	Unit Price	Total Rental
Basic Equipment for Red River Arsenal					
305 1		Processing Units	2	\$ 1250	\$ 2500
323 1		Card Punches	2	225	450
323 2		Card Punches	2	225	450
607		T Tracks	2	5	10
273511	M86989	323 on T Track	2	115	230
340 1		Power Units	2	325	650
350 13		Disk Storage	1	1550	1550
350 14		Disk Storage	1	1600	1600
350 14		Disk Storage (Third File)	1	1600	1600
282		Disk Storage Control	1	80	80
272781	W88425	Disk Storage Control (Third File)	1	115	115
380 1		Consoles	2	400	800
		Dual Systems Control	1	Included in Disk Storage price	
	M90487	Dual Access Arms for Model 13	1	850	850
	M90487	Dual Access Arms for Model 14	1	850	850
	M90487	Dual Access Arms for Model 14 (Third File)	1	850	850

Special Devices

Type 305 Computer

263601	79275	Automatic Inquiry Address Conversion	2	\$ 35	\$ 70
128		Character Selectors - 3 Additional Positions	2	2	4
244		Cycle Delays - 1 Group - 15 Additional	2	10	20
130		Character Selectors - 1 Group of 6 Special Positions X-No X, O-No O	2	5	10
722		Latch Selectors - 3 Groups - 10 @ \$10 per group	2	30	60
276401	73009	Latch Selectors - 2 Groups @ \$10 per group	2	\$ 20	\$ 40
284		Double Distributors - 1 Group of 20	2	8	16
270801	77106	Double Distributors - 2 Groups of 20 @ \$10	2	20	40
271601	77105	Single Distributors - 2 Groups of 20 @ \$9	2	18	36
610		Processing Tracks - 4 Additional (2 Groups @ \$10)	2	20	40
614		Program Exit Splits	2	15	30
613		Program Entry Isolation	2	25	50
266401	79639	Comparing Units - 10 Additional Positions @ \$5 per group of 5	2	10	20
275001	85259	Exit Cycle - To cycle overlap	2	25	50
277201	81468	Character Selector Splits	2	30	60
265601	79638	Blank Transmission Selectors - 2 Additional Groups @ \$5 per group of 5	2	10	20
	82365	Erase on Transfer	2	10	20
277001	W86833	Simultaneous Impulse of Record Advance and Program Advance	2	30	60
	W90592	W X Processing Tracks	2	25	50
	W90592	Y Z Processing Tracks	2	25	50
	W90592	/ U Processing Tracks	2	25	50
	W90592	\$ * Working Storage Tracks	2	17	34

Type 323 Card Punch

300		60 Additional DPBC @ \$8 each 10	4	48	192
703		2 Groups 5-2 Position Pilot Selectors @ \$10 per group	4	20	80
705		5 Groups 4-5 Position Co-Selectors @ \$5 per group	4	25	100
275		Digit Selectors	4	5	20

TOTAL RENTAL

\$ 13,807

USN CNS

Rental Rates for Basic System

Machine Name	Monthly Rental
305 Processing Unit	\$1,726.00
323 Card Punch	270.00
340 Power Unit	325.00
350 Disk Storage, Mdl 11	1,050.00
350 Disk Storage, Mdl 12	1,100.00
407 Printer	1,042.50
380 Console	495.00

Rental Rates for Additional Equipment

381 Remote Inquiry Station	208.00
1926 Remote Inquiry Station	250.00

Maintenance service included in rental contract.

Hamilton AFB

Actual Cost per month.

Component	Basic Use Charge	Basic Use
305 Processing Unit	\$1,564	176 Hrs.
323 Card Punch	333	176 Hrs.
340 Power Supply	325	176 Hrs.
350 Disk Storage	650	176 Hrs.
350 Disk Storage	700	176 Hrs.
370 Printer	360	176 Hrs.
380 Console	400	176 Hrs.
	<u>\$4,332</u>	

NOTE: Extra use charges average slightly over \$2,000 per month for a total rental of \$6,332 per month.

026 Printing Card Punch
056 Verifier
082 Sorter
089 Collator
407 Accounting Machine
519 Originating Machine
552 Interpreter

Machines are used jointly with Statistical Services, a total of \$1,442 per month is for supply use only.

Offutt AFB

The 305 Processing Unit, 323 Card Punch, 340 Power Unit, 350 Disk Storage, 370 Printer, 380 Console, cost \$199,550 and rents at \$3,600/month.

The additional equipment cost \$18,418 and rents at \$443/month. Maintenance cost \$494.75/month.

The additional equipment consists of:

2 Gps of 5 Addn Comparing Positions
2 Gps of 2 Addn Work Processing Tracks
2 Gps of Addn 20 Single Position Distributors
3 Gps of 20 Addn Double Distributors
4 Gps of 10 Addn Double Position Latch Selectors
1 Gp of 3 Addn Character Selectors
1 Gp of 15 Addn Cycle Delays
1 Program Exist Split
1 X No X Bit and Zero no Zero Bit Selectors
2 Gps of 5 Addn Blank Transmission Selectors
1 Character Selector Split
1 Division
1 Program Entry Isolation
1 Multiple Record Transfer
1 Checking Multiple Record Transfer
1 Compare Search
2 Gps of 5 Two Pos Pilot Selectors
1 Gp of 4 Five Pos Co Selectors
3 Gps of 10 Double Punch
1 Cipher to Replace Numeric Zero

USAF Richards-Gebaur AFB

IBM 305, 340, 380, 323, 350, and 370 rents at \$50,910 per year.

Boeing, Wichita

Basic System	
305 Processing Unit	\$74,270
340 Power Unit	24,700
380 Console	28,400
Total	\$127,370

Additional Equipment	
323 Card Punch	\$12,580
350 Disk Storage	34,500
370 Printer	22,100
Total	\$69,180

System is not purchased.

Basic System Hourly Rates		
305 Processing Unit	\$7.83	\$3.13 (off-shift)
340 Power Unit	1.85	.74 (off-shift)
380 Console	2.27	.91 (off-shift)

Additional Equipment Hourly Rates		
323 Card Punch	\$1.31	\$.52 (off-shift)
350 Disk Storage	3.69	1.48 (off-shift)
370 Printer	1.99	.80 (off-shift)

Ford Motor
Basic System
\$4,800 monthly contract, 176 hours/month.

Additional Equipment
\$1,600 monthly contract, 176 hours/month.

Ford, Wayne
Basic system \$3,900 per month, including Type 370 Printer, 323 Punch, 305 Process Unit, and 380 Type-writer and Reader.

Additional Equipment	
Type 407 Accounting Machine	\$1,135 per month
Type 523 Summary Punch	85 per month.

SUNOCO Philadelphia		
1 024 Key Punch	\$	40.00
1 026 Key Punch		60.00
1 026 Key Punch		63.00
1 056 Verifier		50.00
2 082 Sorters		55.00 ea.
1 085 Collator		125.00
1 514 Reproducing		149.00
1 407 Tab-off-line		835.00
1 407 Tab-on-line		1,067.50
1 548 Interpreter		100.00
1 380 RAMAC-Console		400.00
1 350 Desk Unit		1,050.00
1 305 Process Unit		1,555.00
1 340 Power		325.00
1 323 Punch (RAMAC)		245.00
Excise Tax		596.00
Penna. Sales Tax		270.82
Total		\$7,041.32

SUNOCO Southland Center

Basic System
305 Processing Unit, 323 Card Punch, 340 Power Supply, 350 Disk Storage, 370 Printer, and 380 Console rents at \$3,833/month.

Additional Equipment
083 Sorter, 077 Collator, 407 Printer, and 514 Summary Punch rents at \$1,432/month.

WE Aurora

Basic System		Per Month
305 Processing Unit		\$1,250
323 Card Punch		225
350 Disc Storage Unit		650
340 Power Supply		325
380 Console		400
370 Printer		350
		<u>\$3,200</u>

Additional Equipment		
284	(20) Double Distributor	\$ 8
609	Printer Output Track	5
610	Additional Processing Track	10
613	Program Isolation	25
722	Additional Selectors	10
614	Split Program Exits	15
128	Additional Character Selectors	2
	Additional Blank Transmission	5
		<u>\$80</u>

Plus 10% Federal excise tax.

WE GPC New York
305, 340, 380, 370, 232, and 407 rents at \$70,250 per year.

WE TSD New York
The 305 Process Unit, 350 File Unit, 380 Console, 340 Power Unit, and 323 Card Punch rent at \$3,554 per month plus 13% tax.

The 797 Reader Punch rents at \$1,100 per month, plus 13% tax.

WE Winston-Salem
The IBM 305, IBM 323, IBM 340, IBM 350, IBM 407 (on line), and IBM 380 rent at \$7,018.

The IBM 085 (2), IBM 558, IBM 514 (2), IBM 407, IBM 083, IBM 024 (2), and IBM 056 (2) rent at \$957 monthly.

Type	Description	Monthly Rental Cost
305	RAMAC	\$1,250
289	Direct Division Device	45
323	Card Punch	225
340	Power Supply	325
350	Disk Storage	650
370	Printer	350
380	Console	400

Additional Equipment		
402	Accounting Machine	195
514	Reproducing Punch	70
026	Printing Card Punch	60
082	Sorter	40

Monthly rates less 60%.

PERSONNEL REQUIREMENTS

Manufacturer

Number of people needed to define and develop a program depends on complexity of application. However, once programmed and running, one operator per shift can handle feeding of cards and removal of printed reports.

Training made available at Educational Centers and local branch offices in principal cities.

USA IOD

	One 8-Hour Shift
Supervisors	3
Programmers	7
Operators	3

Three additional operators are required for each additional 8 hour shift.

Analyst functions performed by programmers at present time as a means of developing analysts.

Data Processing Activity is to be reorganized to conform with needs as developed through actual operations.

Operation tends toward open shop.

3 weeks formal training furnished by contractor.
23 weeks on-the-job training.

USA Medical Depot

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	7	7
Programmers	2	2
Coders	2	2
Clerks	3	3
Operators	10	10
Engineers	1	1
In-Output Oper	1	1

Methods of training used includes IBM Customer Education Program and on-the-job training.

Louisville Medical Depot utilizes an integrated system of RAMAC 305 and conventional IBM electrical accounting machines. All major program applications are dependent on the availability of both types of equipment. Two (2) personnel only are assigned full time to operation of the RAMAC 305 and these are included in the figures. All other personnel are involved in operations as they pertain to RAMAC 305 and/or conventional electrical accounting machines. The engineer is furnished by IBM at no charge.

USA Mt Rainier Ord D

	One 8-Hour Shift		Two 8-Hour Shifts	
	Used	Recomm	Used	Recomm
Supervisors	2	2	2	2
Analysts	1	2		
Programmers	4	5		
Clerks	1	1		
Librarians	1	1		
Operators	2	3	2	3
Engineers	1	IBM Corp		
In-Output Oper	2	2	2	

Programmers and console operators are women, very capable.

Methods of training used includes aptitude tests, schooling three (3) weeks under direction of IBM, additional six (6) weeks on special features, and one (1) year on-the-job for productive programming, coding and control panel wiring.

USA Raritan

	Two 8-Hour Shifts	
	Used	Recommended
Supervisors	4	4
Analysts	5	5
Programmers	3	3
Clerks	2	2
Operators	4	4
In-Output Oper	2	2

Coding is an integral part of programming, therefore, coders are not shown as a personnel requirement.

Engineers and technicians are supplied by the manufacturer as required.

Tape handlers are not required with this equipment. Operation tends toward open shop.

Methods of training used includes manufacturer's schools, on-the-job training, and government sponsored schools.

USA Red River Arsenal

	Two 8-Hour Shifts	
	Used	Recommended
Supervisors	3	3
Programmers	10	10
Clerks	1	1
Operators	8	8
Engineers	2	2

Methods of training used includes class room and on-the-job training for programmers, operators, analysts, and key personnel of application.

USN CNS

	Two 8-Hour Shifts	
	Used	Recommended
Supervisors	1	1
Analysts	2	2
Programmers	4	4
Operators	3	3

Methods of training include manufacturer's training courses and on-the-job training.

Hamilton AFB

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Programmers	2	2
Coders	3	3
Clerks	7	7
Engineers	On call when operating	
In-Output Oper	2	2

Clerks are key punch operators (4) and input and output (3) clerks.

Customer Service Engineer is on call when operating. A full second 8-hour shift is not used.

Operation tends toward open shop.

Methods of training used includes formal on-the-job (OJT) and formal classroom when required by program or system changes.

Offutt AFB

	First 8-Hour Shift		Second 8-Hour Shift		Third 8-Hour Shift	
	U	R	U	R	U	R
	Supervisor	1	1	1	1	1
Coders	3	3	2	2	1	1
Librarian	1	1	1	1	1	1
Operator	2	2	1	1	1	1
Engineers	Contractor Personnel on call					
Technician	Contractor Personnel on call					

EDP program within SAC is controlled by the EDP Development Group assigned by SAC Hq. All programmers for supply application of EDP within SAC are assigned to this Development Group. No programmers are assigned base level. Engineers and techs are on call 24 hours a day from contractor service.

Methods of training includes 8 week formal classroom training for console supervisors and operators. 2 week course for high level supervisors and managers. No directed on-the-job training.

USAF Richards-Gebaur AFB

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	
Programmers	2	3
Coders	2	3
Operators	3	3
In-Output Oper	4	4

Operation tends toward open shop.

Methods of training used includes on-the-job training and IBM school.

Boeing, Wichita

	First 8-Hour Shift		Second 8-Hour Shift		Third 8-Hour Shift	
	U	R	U	R	U	R
	Supervisor					1
Programmer	4					
Operator					3	
In-Output Oper		2				

Six keypunch operators prepare the input cards from source documents. Up to 22 different transactions are handled in a normal day's processing.

Operation tends toward closed shop.

Methods of training used includes IBM schools and on-the-job training.

Ford Motor Canton

	First 8-Hour Shift	Second 8-Hour Shift	Third 8-Hour Shift
	Supervisors	1	
Analysts	1		
Programmers	1		
Coders	2	2	1
Clerks	2		
Librarians	1		
Operators	2	1	

Operation tends toward open shop.

Methods of training used includes International Business Machine Corporation specialized training and local programs.

Ford, Wayne

	One 8-Hour Shift		Two 8-Hour Shifts	
	Used	Recomm	Used	Recomm
Supervisors	1	1		
Programmers	2	2		
Coders	2	2		
Operators	1	1	1	1

Operation tends toward open shop.

Methods of training used includes IBM Specialized School.

SUNOCO Philadelphia

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Operators	2	2

4 analyst-programmers prepared original system and program. They are not part of the department operating RAMAC.

Operation tends toward closed shop.

Methods of training used includes a 2 week IBM school and on-the-job instruction.

SUNOCO Southland Center

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Analysts	1	2
Programmers	1	2
Clerks	1	1
Operators	1	1

Operation tends toward open shop.

Methods of training used includes Equipment Supplier Schools and on-the-job training.

We only contemplate single shift operations at this time.

WE Aurora

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Analysts	1	1
Programmers	1	1
Operators	1	1

Operation tends toward open shop.

Methods of training used includes selected employees with previous EAM experience and/or aptitude, attendance at IBM Educational Centers, and extended de-bugging recording of common errors.

Views may change. Above based on four months of "machine" experience.

WE GPC New York

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Analysts	2	2
Programmers	1	1
Clerks	16	16
Operators	2	2

Methods of training used includes IBM schools and two week class conducted by supervisor.

WE TSD New York

	One 8-Hour Shift
Supervisors	2
Analysts	5
Programmers	8
Operators	2

The computer is normally used on a single shift basis. The size of the staff is due to the high percentage of development work done on the computer.

Operation tends toward open shop.

Methods of training used includes staff training program (learn Distributing House Operation). Time required is up to one year. IBM Program School for 305 RAMAC is two weeks. Apprentice period is from 6 months to a year.

WE Winston-Salem

	One 8-Hour Shift
Supervisors	1
Analysts	2
Programmers	3
Operators	1
In-Output Oper	5

Methods of training used includes manufacturer's school and on-the-job training.

Georgia State

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Programmers	1	2
Clerks	1	1
Operators	0	1

Operation tends toward closed shop.

Methods of training used includes IBM schools and on-the-job training.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

System features and construction techniques utilized by the manufacturer to insure required reliability includes internal machine checking for correct character transfers. Arms retract during data alterations, disk heads float on air and lift off surface with power failure, designed to operate correctly with marginal voltage, selected components, final testing during manufacturing, and by customer engineers. Availability is better than 85% average for installed systems.

USA LOD

Passed Customer Acceptance Test 15 Jun 60
Time is not available for rent to outside organizations.

USA Medical Depot

Good time 34.5 Hours/Week (Average)
Attempted to run time 35 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.98
Above figures based on period 1 Jul 59 to 31 Mar 60
Passed Customer Acceptance Test Apr 58
Time is not available for rent to outside organizations.

System has operated without mechanical error during the period on which figures are based.

USA Mt Rainier Ord D

Average error-free running period Fair during 1st two weeks
Good time 60 Hours/Week (Average)
Attempted to run time 60 Hours/Week (Average)
Operating ratio Good after five weeks in operation
Above figures based on period 27 Jun 60 to 5 Aug 60
Passed Customer Acceptance Test 24 May 60
Time is not available for rent to outside organization

After six (6) weeks of operation programmers and off-line operational errors were decreasing, likewise machine down time and errors due to machine.

USA Raritan

Good time 59 Hours/Week (Average)
Attempted to run time 70 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.84
Above figures based on period 23 Mar 60 to 5 Apr 60
Passed Customer Acceptance Test 5 Apr 60
Time is available for rent to qualified outside organizations.

The above time is based on a 16 hour shift because two computers are involved. They are tied together with dual control, dual access devices making one system.

The period designated is for the standard of performance GSA contract.

Latest information on reliability, operating experience and time availability:

Good time 209 Hours/Week (Average)
Attempted to run time 255 Hours/Week (Average)
Operating ratio 0.82

Above figures based on period 1 Apr 60 to 30 Apr 60

The above information is based on two computers scheduled for 24 hours during the testing and debugging, file load and conversion period. No operational experience to date.

USA Red River Arsenal

Good time 147 Hours/Week (Average)
Attempted to run time 157 Hours/Week (Average)
Operating ratio 0.936

Above figures based on period 1 Mar 60 to 31 Mar 60

Passed Customer Acceptance Test 29 Feb 60

Time is not available for rent to outside organizations.

USN CNS

Average error-free running period 20 Hours
Good time 112 Hours/Week (Average)
Attempted to run time 118 Hours/Week (Average)
Operating ratio 0.95

Above figures based on period 1 Jan 60 to 30 Jun 60
Time is not available for rent to outside organizations.

Original machine with 5,000,000 characters of random access storage was installed February 1958. Storage was expanded to 10,000,000 characters in November 1958.

In March 1960 a new, double density machine with 20,000,000 characters random access storage was installed and accepted to replace original equipment.

Hamilton AFB

Average error-free running period No average error-free period known. Machine is so reliable that it will not make any errors for weeks at time and then one or two errors could happen at any time.

Good time 95 Hours/Week (Average)
Attempted to run time 102 Hours/Week (Average)
Operating ratio 0.93

Above figures based on period from Jul 59 to Apr 60

Passed Customer Acceptance Test Feb 58

Time is not available for rent to outside organizations.

Offutt AFB

Good time 72 Hours/Week (Average)
Attempted to run time 78 Hours/Week (Average)
Operating ratio 0.927

Above figures based on period 1 Jan 60 to 31 Jan 60

Passed Customer Acceptance Test May 58

Time is not available for rent to outside organizations.

USAF Richards-Gebaur AFB
 Average error-free running period 48 Hours
 Good time 48 Hours/Week (Average)
 Attempted to run time 48 Hours/Week (Average)
 Operating ratio 1.0
 Above figures based on period 1 Feb 60 to 30 Apr 60
 Time is not available for rent to outside organizations.

Boeing, Wichita
 Average error-free running period 28.18
 Good time 121.20 Hours/Week (Average)
 Attempted to run time 139.43 Hours/Week (Average)
 Operating ratio 0.8693
 Above figures based on period 1 Mar 60 to 31 Mar 60
 Passed Customer Acceptance Test 10 Jun 58
 Time is not available for rent to outside organizations.

Ford Motor Canton
 Average error-free running period 72 Hours
 Good time 37 Hours/Week (Average)
 Attempted to run time 42 Hours/Week (Average)
 Operating ratio 0.88
 Above figures based on period 4:00 am Monday to 8:00 am Saturday
 Passed Customer Acceptance Test 1 Oct 59
 Time is not available for rent to outside organizations.

Ford, Wayne
 Good time 50 Hours/Week (Average)
 Attempted to run time 52 Hours/Week (Average)
 Operating ratio 0.96
 Above figures based on period 15 Mar 60 to 15 Apr 60
 Passed Customer Acceptance Test Nov 59

SUNOCO Philadelphia
 Good time 40 Hours/Week (Average)
 Attempted to run time 40 Hours/Week (Average)
 Operating ratio 1.0
 Above figures based on period 1 Jul 60 to 26 Aug 60
 Passed Customer Acceptance Test Nov 59
 Time is not available for rent to outside organizations.

WE Aurora
 Good time 12 Hours/Week (Average)
 Attempted to run time 12.25 Hours/Week (Average)
 Operating ratio 0.979
 Above figures based on period 1 May 60 to 31 Jul 60
 Passed Customer Acceptance Test 1 May 60
 Time is not available for rent to outside organizations.

Reliability of above figures may be questionable. Machine experience limited to eleven weeks of "on hands" operation.

WE TSD New York
 Operating ratio 0.91
 Above figure based on period 16 Jun 59 to 30 Jun 60
 Time is not available for rent to outside organizations.

WE Winston-Salem
 Good time 46 Hours/Week (Average)
 Attempted to run time 51 Hours/Week (Average)
 Operating ratio 0.903
 Above figures based on period from Jun 60 to present
 Passed Customer Acceptance Test Mar 52
 Time is not available for rent to outside organizations.

Georgia State
 Good time 37 Hours/Week (Average)
 Attempted to run time 40 Hours/Week (Average)
 Operating ratio 0.925

Above figures based on period 1 Jun 60 to 30 Jun 60
 Passed Customer Acceptance Test 1 Jan 60
 Time is available for rent to qualified outside organizations.

As a new installation dedicated to education, our current policy restricts use of the machine to teaching and research. This policy is subject to change.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Outstanding features include random access to large capacity disk storage of up to 20 million alphanumeric characters, variable record length, and stored program coupled with control panel logic.

Unique system advantages include the ability to process data in-line as transactions occur and maintain current records for examination by inquiry at any time.

Procedures for magnetic tape labelling, storing, shipping, and protection from humidity, temperature, electrical, fire, or other damage are the same as for 700-7000 Systems using magnetic tape.

Many special features have been engineered to make RAMAC a flexible machine for in-line processing. It can be tailored to all applications as a result.

USA LOD

Outstanding features include compatibility with present punch card applications and random access.

Acquisition of IBM 305 RAMAC Systems for Ordnance distribution depots is identified as an interim program. If so, it is a unique method of transition from basic punch card concepts to more sophisticated equipment which enable installations to grow into it rather than experience the turmoil that usually accompanies the installation of radically new systems.

USA Medical Depot

Outstanding features include faster, more accurate reporting; provides up-to-the-minute supply control data on stocked items as required, provides for considerable expansion without the need for additional personnel or equipment. Provides complete flexibility of operations.

USA Mt Rainier Ord D

Outstanding features include storage of records, quick access, self checking accurate output, faster access time, accurate record keeping, and accurate processing of input.

Humidity and temperature control according to specifications are provided for magnetic tape.

Configuration of Equipment

34C	305	Compres	380	Com	380	340	305
		sor		pres			
323				sor			323
323			350	350			323
			Master	Slave			

305 Processing Unit
 350 Disk Storage Unit
 380 Console
 340 Power Unit
 323 Card Punch

USA Raritan

Outstanding features are random access machine, stock transactions and financial inventory accounting updated concurrently, and system permits immediate inquiries of data held in bulk storage files.

IBM RAMAC 305 System Configuration

Overall System

Two identical IBM RAMAC 305 Processing Units are interconnected through the Dual Processing Feature.

Two Double Density RAMAC Disk Storage Files are accessible to each Processing Unit for a total file capacity of 20,000,000 alphanumeric characters in 200,000 separately addressable locations.

Two access arms are available to each Processing Unit for addressing each RAMAC file. Thus, each RAMAC file unit contains four access arms.

Two IBM 323 Card Punch Units are attached to each Processing Unit instead of the usual combination of one 323 Card Punch and one 370 Printer.

Drum Tracks

Stored Program or Processing (20 tracks): 0 through 9 and A through I

Processing (10 tracks):

W X Y Z U / . # \$ *

Input, Output, or Processing (4 tracks): K S T Q

One 323 Card Punch on each 305 will be associated with the "S" output track and the other, with the "T" output track.

Accumulator Track (addressable as L or M)

Multiplicand Track (addressable as V)

Process Control Panel Features

Split Program Exists feature has control hubs at co-ordinate C, 23-26.

Dual Processing Interlock Suspend hubs are located at co-ordinates A, 37-38.

Dual access control hubs are located at C, 27-31.

Character Selectors:

Number 1 (48 exits)

Numbers 2-13 . (13 exits each)

Special X, No-X (3 test positions)

Special 0, No-0 (3 test positions)

Comparing Units: 20 (Total)

Blank Transmission Test Selectors: 15 (Total)

Units Counter. This is a visible counter located within the Process Control Panel enclosure and reset manually. Hubs S, 8-9 labelled "CTR" will accept program exit impulses to cause an advance of 1 in the counter.

Cycle Delays: 30 (Total)

Latch-type selectors (2-position): 60 (Total)

Group A : Selectors 1-10

B : 11-20

C : 21-30

D : 31-40

E : 41-50

F : 51-60

(NOTE: Each selector group has a corresponding RESET hub.)

Double Distributors: 120 (Total)

40, Numbered 1 through 40

40, Numbered 81 through 120

40, Numbered 121 through 160

Single Distributors: 80 (Total)

40, Numbered 41 through 80

40, Numbered 161 through 200

Automatic Inquiry Address Conversion.

Related hubs are located at AX, 39-40

Program Entry Isolation feature isolates Program Advance hubs as well as Hundreds, Tens, and Units Program Entry hubs.

Differentiating Punches.

The Punch hubs located at co-ordinates AX, 33-36 are associated exclusively with the "S" output track. Those located at AW, 33-36 are associated exclusively with the "T" output track.

Communication with the punch panels.

The Punch Communication hubs located at Y-AF, 1 are associated with the "T"-track punch, and those at Y-AF, 5, with the "S"-track punch.

Other Features on Central Processing Units

Exit Cycle-To-Cycle Overlap ("W/P Overlap")

Simultaneous Record Advance/Program Advance

The Record Advance In-Delayed hub at AH, 3 is associated with this feature. The other two Record Advance in hubs (AH, 1-2) are used for normal record advancing.

323 Card Punch Control Panel

Double Punch-Blank Column Detection: 80 positions (Total)

Pilot Selectors (2-position): 10 (Total)

Co-Selectors (5-position): 20 (Total)

Digit Selectors: 2 (Total)

NOTE: The 323's are not equipped with the Offset Stacking Device.

USA Red River Arsenal

Outstanding features include dual process, double density, extra processing tracks. Unique system advantages include additional plugboard functions, erase on transfer, simultaneous record advance and program advance.

USN CNS

Outstanding features are fast random access to a large volume of stored records, and in-line processing which involves the access, use and updating of several records in one pass rather than several separate, sequential operations.

Hamilton AFB

The outstanding features are that the Processing Section has the ability to read or write in storage unit, transfer information between machine units, compare information and perform arithmetic functions. There is random access to any record. Uses stored program instructions and wired control panel logic. Additional storage units may be added to increase memory capability.

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage include:

Vibration: withstand vibration up to 0.25G. (G is gravitational acceleration)

Stray Magnetic Field: Stray magnetic field in excess of 50 oersteds will affect the magnetic flux on the disk surfaces.

Temperature and Humidity: Must be maintained between 50 and 90 degrees F. entering the RAMAC unit. The humidity of the air in the RAMAC area must be maintained under 80% relative at all times.

Air Filtration: Normal filtration of the area for dust control can be met with filters that have an efficiency rating of 20% by the National Bureau of Standards discoloration test method.

Offutt AFB

Outstanding features are alphanumeric capability with variable word length up to 100 digits with binary coded decimal character code and random processing of transactions by direct addressing.

USAF Richards-Gebaur AFB

The unique system advantage is the random access memory.

Boeing, Wichita

Outstanding features are that it allows for true random access of any record at an average speed of 600 milliseconds per record and general purpose programming makes possible an in-line system of processing.

A 10-ton all-season air conditioning unit automatically controls humidity and temperature. Hourly inspection by a member of the Fire Marshall's Office during third shift, weekends and holidays is added protection from physical, electrical, fire and other damage.

Ford Motor Canton

Outstanding features are random access to disc storage and limited files - high storage content.

Ford, Wayne

Outstanding features include a large storage capacity, very rapid availability of stored data, and a number of output documents and/or cards obtainable from one input card.

SUNOCO Southland Center

Outstanding features include large capacity random access storage and in-line data processing.

WE Aurora

Outstanding features are disc file, with direct record access.

Disc file is punched into tab cards occasionally as a disaster file.

WE TSD New York

The outstanding features are that the random access magnetic file permits each transaction effecting an item in stock to be processed in line, i.e., as the transaction occurs and the 797 Reader Punch permits punching and punch checking of data in the input card, which saves cards.

Georgia State

Outstanding features are quick access to large storage unit and random access storage.

WE Winston-Salem

Outstanding features are increased processing speeds, 407 on line printer, additional 10,000,000 digits of disk storage, and dual process (two arms).

FUTURE PLANS

USA Medical Depot

Future applications include fiscal accounting, cost accounting (ACMS) and civilian payroll and personnel accounting.

USA Raritan

It is proposed by this installation to install an RCA 501 Computer for two complex and high volume applications, Ordnance Supply Analysis Agency (Statistical Analysis) and Field Service Division (National Inventory Control Point). This is independent of the present installation (IBM 305).

The successful assimilation of logistic requirements by the present computer installation may permit the extension of this system to include some finance and accounting applications, (Ordnance Corps Management System, Stock Fund Accounting) and/or the development of personnel statistics.

Plans are being formulated to improve data collection and data transmission facilities.

USA Red River Arsenal

Plans for the present RAMAC System include addition of tape units for utilization of tape input-output and for possible utilization of Type 1401 equipment to process tape output. Feasibility studies on 1401 equipment have just begun. It is anticipated that RAMAC will be used for several years for availability

editing purposes and with tape output for 1401 processing, a completely integrated system will be possible.

USN CNS

Plans for system improvement include increased processing speed through improved programming, output redesigned to use Standard Navy forms, and reduction in clerical/filing areas through redesigned output.

Hamilton AFB

A new program is under development at the present time that will more fully utilize the capabilities of the 305. The new program will contain the following:

Automatic recomputation of stock control levels at re-order point.

In-line special levels computation.

Establishment and management of inviolate levels. Intra-account transfers and automatic selection of interchangeable items.

Internal inventory accounting monetary (IAM) with assignment of IAM transaction codes and functional expense and general ledger code.

Output of cards for cost distribution.

Output of obligation cards for stock fund and local purchase items.

Self balancing daily transaction register.

Internal stock balance and consumption reports.

In addition, a new 305 will be installed with the latest configuration components that increase processing speed and logic capability.

USAF Richards-Gebaur AFB

It is planned to convert to a new system in accordance with Section 23, Volume II, AFM 67-1.

Boeing, Wichita

We are planning for installation of double density (10,000,000 characters).

WE Aurora

Planned applications include payroll, complete production control of all elements of relay manufacture, departmental and shop summary of payment and accounting results, and production control of commercial screw manufacture.

WE GPC New York

Future plans include performance of linear programs and multiple correlations for forecasting and maintenance of item and price catalogues.

WE TSD New York

An IBM 305 System with 20 million characters of magnetic file storage and the 797 Reader Punch is installed at the Illinois Distributing House in West Chicago, Illinois. This system will replace a standard IBM 305 System operated by the Illinois Bell Telephone Company at the Illinois Distributing House.

The initial application is the preparation of the customers' orders and billing. Approximately half of the volume of the input data will be punched using the Dataphone III system of transmission. The customers supply employee has been equipped with the Dataphone III Card Reader and a set of item cards at his normal work location. To place an order, he telephones the Data Center at the Distributing House, which is equipped with Dataphone III receiving equipment. He feeds the card reader one card at a time, which duplicates this data at the Data Center. Then he keys in the variable data such as the desired quantity which punches variable data in the card at the Data Center. This receiving equipment normally operates unattended. The remaining orders are telephoned to keypunch operators equipped with headsets, are mailed in, or received by teletype.

All phases of material ordering control and customer return material procedures effecting the warehousing, repair shop and the customer are expected to be pro-

cessed through the computer. The emphasis is to establish operational limits which eliminate the necessity for management to review transactions falling within the acceptable limits. A broader objective is to plan the operations of our computers so that the data is available and compatible with data processing equipment in other organizations in the Bell System.

A similar installation with smaller file capacity has been ordered for the Westchester Distributing House in Yonkers, New York.

An in-line printer such as the IBM 407 is desirable on certain applications, and is expected to be added to our IBM 305 System.

For the future, a study is underway to determine the feasibility of using an IBM 1401 System equipped with a large random access file.

Georgia State
Future plans call for eventual replacement of existing equipment with an IBM 1620 - 1401 System (or its equivalent), with the possible addition of a Royal McBee LGP 30.

Computer On Order	Qty	WE Winston-Salem Application	Remarks
IBM 305 RAMAC	1	Production and Storeroom Inventory Control	To be located at Burlington Plant
IBM Card 1401	2	Payroll and Accounting records, Production Control records, Quality Assurance, Apparatus Type Test	To be located in Winston-Salem, and will replace one 650 computer presently installed. Scheduled delivery - Card 1401 - 3rd Qtr. 1961 Card 1401 - 1st Qtr. 1962 Tape 1401 - 2d Qtr. 1962
IBM Card 1401	1	Payroll and Accounting records, Merchandising Spare Parts Documentation, Zeus R & D Production Wiring Layout, Engineering Bill of Materials, and Tool Records	To be located in Burlington Plant. Scheduled delivery - Card 1401 - 1st Qtr. 1962 Tape 1401 - 3rd Qtr. 1962
Monrobot XI (Paper Tape operated with teletype and Flexowriter equipment and Princeton designed data collection devices)	1	Job status, delivery performance and load report for each of some 15 operating groups, using in part Operation Research techniques.	To be installed in Printed Circuit Board Department, Greensboro,

Under consideration is one card 1401 computer for Field Engineering and Technical Publication records currently processed on conventional equipment.

INSTALLATIONS

U. S. Army Letterkenny Ordnance Depot
Chambersburg, Pennsylvania

U. S. Army Louisville Medical Depot
Louisville 1, Kentucky

U. S. Army Mt. Rainier Ordnance Depot
Tacoma, Washington

U. S. Army Raritan Arsenal
Metuchen, New Jersey

U. S. Army Red River Arsenal
Texarkana, Texas

U. S. Navy Charleston Shipyard
Charleston, South Carolina

78th Fighter Wing, Base Supply
Hamilton Air Force Base, California

Headquarters, Strategic Air Command
Offutt Air Force Base, Nebraska

328th Fighter Group (Air Defense)
Richards-Gebaur Air Force Base, Missouri

Boeing Airplane Company
Wichita, Kansas

Ford Motor Company
Transmission and Chassis Division
Canton, Ohio

Ford Motor Company
37625 Michigan Avenue
Wayne, Michigan

Sun Oil Company
1608 Walnut Street
Philadelphia 3, Pennsylvania

Sun Oil Company
Southland Center, P. O. Box 2880
Dallas 21, Texas

Western Electric Company, Inc. - Montgomery Shops
Aurora, Illinois

Western Electric Company, Inc.
General Program and Commercial Manager
195 Broadway
New York 7, New York

Western Electric Company, Inc.
Telephone Sales Division
195 Broadway
New York 7, New York

Western Electric Company, Inc.
3300 Lexington Road, S. E.
Winston-Salem, North Carolina

Georgia State College of Business Administration
Computer Center
33 Gilmer Street, S. E.
Atlanta 3, Georgia

Prudential Insurance Company of America
Newark, New Jersey

General Insurance Company of America (Anticipated)
4347 Brooklyn Avenue
Seattle 5, Washington

U. S. Air Force, 327 Fighter Group (Air Defense)
Truax Field, Madison 7, Wisconsin

IBM 604

IBM 604 Electronic Calculating Punch

MANUFACTURER

International Business Machines Corporation

APPLICATIONS

Manufacturer

Business and scientific.

Management Services Office,

White Sands Missile Range, New Mexico

System is used by Comptroller for business-type data processing; civilian payroll, cost accounting, stock accounting, etc.

U. S. Naval Ordnance Test Station, China Lake

Located in Room 1035, the system is primarily used for the calculation of payroll, both civilian and military, also for the calculation of material and labor costs. Because of the flexibility of the machine, it is also used for other tasks such as gang punching, intersperse punching, verification of cards for blank column and double punch tection.

Los Angeles County Engineer

Located at 108 West Second Street, Los Angeles 12, California, the system is used for distribution of costs (Time - Miles - Blueprints) by division, function, job no., etc. Payroll reporting (Mark Sense Cards). Blueprint plant - production and accounting and invoicing. Utilities (water districts) - billing, accounting, stock inventory. Statistics - building and safety, survey parties, industrial waste inspections - overtime, absences, traversing, etc. - error of closure and areas. Geodetic triangulation matrix (simultaneous equations). Street improvement districts: calculating - frontages (estimated and actual assessments, debt limit). Principal and interest on 10-year

Photo by International Business Machines Corporation

coupon bonds, unit bids. Printing various notices, name and address lists, envelopes, reports, assessment roll, bills, bonds, bond registers, bond payment notices, sewer location post cards, etc. Capital projects cost distribution and progress reports. Capital outlay and M. & O. (equipment and furniture) inventory. (Sewer design tables) Miscellaneous engineering applications (wind rose for Aviation Div.) (trend line data) etc.

The use of I.B.M. 604 Calculator and 407 Tabulator for computing 10 or 20-year principal and interest payments on street bonds and printing said bonds (with 30 or 60 coupons), a Bond Register and 10 annual Notice of Payments due is a new application, never attempted before, anywhere.

Bankers Life Insurance Company of Nebraska

Located at the Home Office, at Cotner and "O" Streets, Lincoln, Nebraska, the system is used for commission extensions, dividend extensions, premium paid to-up date, premium rate making, dividend schedules, mortality studies (ratios), mortgage loan accounting, policy reserve calculations, and mean reserve schedules.

Harvey Aluminum Sales, Inc., Defense Plants Div.

Located at Milan Arsenal, Building T-1, the system is used for payroll - checks, register, timecards, tax records, etc., accounts payable, cost compilations, direct materials - stock records and reports, general stores (indirect materials) - stock records and reports, plant equipment records, toolroom records,

annual inspection and lot number reports on direct materials, and salvage inventory records.

Manning, Maxwell and Moore, Inc.

Located at 414 Broadway, Muskegon, Michigan, the system is used for payrolls (calculations of wages earned, taxes applicable, net earnings), labor distribution (calculation of labor and burden amounts utilizing master cards), material distribution (calculation of material costs utilizing Master Unit Cost Deck), inventories (calculation of inventories costs utilizing Master Unit Cost Decks), and orders (extending and discounting).

National Airlines, Inc.

Located at the Airport Mail Facility, Miami, Florida, the system is used for payrolls, accounts payable, labor and material cost, accounts receivable, cargo accounting, government transportation billing, revenue statistics, ledger, and sales distribution.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits per word	3 or 5
Instructions used	9
Arithmetic system	Fixed point
Instruction type	One or two address code
Number range	Variable

ARITHMETIC UNIT

	Exclud Stor Access
	Microsec
Add	500
Mult	14,000 avg
Div	17,000 avg
Construction	Vacuum tubes
Basic pulse repetition rate	50 Kc/sec
Arithmetic mode	Parallel
Timing	Synchronous
Operation	Sequential

STORAGE

Manufacturer		
Medium	Words	Access Microsec
Electronic Tubes	9	500

INPUT

Manufacturer	
Medium	Speed
Card Reader-Punch	100 cards/min

OUTPUT

Manufacturer	
Medium	Speed
Card Reader-Punch	100 cards/min
LA County	
Card speed drops to 25 cards per minute, minimum, for calculating cosine and sine.	

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	1,250
Tube types	4

CHECKING FEATURES

Checking is possible through control panel wiring.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer		
Power, computer	7.59 KVA	
Volume, computer	73.9 cu ft	
Area, computer	19.4 sq ft	
Weight, computer	1,949 lbs	
WSMR		
Power, computer	5.1 Kw 7.59 KVA	
Volume, computer	79.9 cu ft	
Area, computer	19.4 sq ft	
Capacity, air conditioner	5 Tons	
Weight, computer	1,949 lbs	
Weight, air conditioner	500 lbs	
Exhaust fan required.		
LA County		
Power, computer	230 Volts	19,000 B.T.U.
Power, air conditioner	Exhaust fan 1/8 HP	
Area, computer	24 sq ft	
Weight, computer	2,100 lbs	
Exhaust fan and hood vented to outside through window.		
Bankers Life		
Power, computer	33.1 Amps 6.9 KVA	0.6 to 0.8 Inductive Load
Volume, computer	53"x33"x58"	58.5 cu ft
Volume, computer	40"x26"x50"	29.9 cu ft
Area, computer	20 sq ft	
Room size, computer	12 ft x 12 ft	
Weight, computer	2,041 lbs	
Conventional type building - reinforced concrete floor, central air conditioning with area humidity controlled. Separate power circuit for computer.		
Manning, Maxwell & Moore		
Power, computer	6.0 Kw	7.5 KVA
Volume, computer	73.9 cu ft	
Volume, air conditioner	45.5 cu ft	
Area, computer	19.4 sq ft	
Area, air conditioner	7.6 sq ft	
Floor loading	105 lbs/sq ft	
	105 lbs concn max	
Capacity, air conditioner	5 Tons	
Weight, computer	2,041 lbs	

PRODUCTION RECORD

Number produced Over 2,993
Delivery on an availability basis.

COST, PRICE AND RENTAL RATES

Manufacturer	
Approximately \$550/month and up.	
WSMR	
604 Electronic Calculator and 521 Card Reader Punch rent at \$645/month.	
US NOTS	
\$550 monthly rental rate.	
Service time averages 70 hours per month.	
LA County	
604, 521, and 407 rent at \$1,491/month.	
407, 2-514's, 2-077's, 083, 082, 552, 5-024's, 2-056's rent at \$1,912/month.	
Maintenance included in rental.	
Bankers Life	
604 and 521 cost \$26,000.	
Rental is \$550..	
Maintenance/service contract is \$153/month.	
Manning, Maxwell & Moore	
604 Electronic Calculator \$430/month (+ 10% excise tax)	
521 Card Reader Punch \$150/month (+ 10% excise tax)	
Service contract contained in rental charges.	

National Airlines
 3-402, 2-083, 1-552, 6-024, 2-514, 1-604, 2-077 and
 2-056 cost \$40,000.
 Maintenance service is \$400/month.

PERSONNEL REQUIREMENTS

WSMR

	One 8-Hour Shift
Supervisors	1
Analysts	1
Programmers	1
Clerks	1
Operators	3

IBM customer courses and local on-post courses are given.

US NOTS

	One 8-Hour Shift
Supervisors	2
Operators	3

Method of training used is on-the-job training.

LA County

	One 8-Hour Shift
Clerks	1
Operators	4
Input Opera	5 6 Recomm

Operation tends toward closed shop (civil service).

Methods of training used include some IBM manuals and machine operation - on job, and evening extension courses.

Chief Tabulating Machine Operator acts as supervisor, analyst, programmer, form designer, systems, and procedure man.

Bankers Life

	One 8-Hour Shift
Supervisors	1
Programmers	1

Methods of training used includes IBM School and on-the-job training.

Manning, Maxwell & Moore

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Operators	1	1

Operation tends toward open shop.

Methods of training used includes on-the-job training supplemented by manufacturer's training schools.

National Airlines

	Two 8-Hour Shifts
Supervisors	2
Operators	17
Technicians	1

Operation tends toward closed shop.

Operators are trained by supervisors.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

Average service time for all installed machines is approximately 10 hours per month.

WSMR

Good time	14 Hours/Week (Average)
Attempted to run time	16 Hours/Week (Average)
Operating ratio (Good/Attempted to run time)	0.875

Above figures based on period from 1956 to present.
 Time is not available for rent to outside organizations.

US NOTS

Time is available for rent to outside organizations.

LA County

Good time	40 Hours/Week (Average)
Attempted to run time	43 Hours/Week (Average)

Passed Customer Acceptance Test 1954

Time is not available for rent to outside organizations.

We do street improvement work for various cities in Los Angeles County.

Employees are assigned different lunch periods, so we often operate equipment more than 8 hours per day.

Bankers Life

Good time	14.4 Hours/Week (Average)
Attempted to run time	15.4 Hours/Week (Average)
Operating ratio (Good/Attempted to run time)	0.935

Above figures based on period 1 Jul 59 to 30 Jun 60
 Time is available for rent to qualified outside organizations.

Manning, Maxwell & Moore

Average error-free running period	2 Weeks
Good time	32 Hours/Week (Average)
Attempted to run time	33 Hours/Week (Average)
Operating ratio (Good/Attempted to run time)	0.97

Above figures based on period 1 Jan 57 to 31 Dec 59
 Passed Customer Acceptance Test 1 Jan 55
 Time is not available for rent to outside organizations.

National Airlines

Time is not available for rent to outside organizations.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

The IBM 604 Electronic Calculator is a general purpose electronic digital computing machine which is helping solve problems in science, engineering, business and government.

Reading problem data from IBM punched cards at a constant speed of 100 problems (cards) a minute, it can go through as many as 60 separate steps, such as multiplications and divisions, to obtain the solution to a single problem. Answers are recorded in the same cards which carry the problem data, or they can be punched in specially designated cards.

The smaller of the two cabinets is the electrical card reading and punching unit. The larger cabinet is the all-electronic unit which includes the following sections: power, timing, arithmetic, storage and switching.

Many built-in features make this electronic calculator easy to operate and service. These include interchangeable control panels for changing from one type of operation to another, and testing devices and pluggable subassemblies which facilitate rapid maintenance and service.

These machines have been produced on the assembly line at IBM's plant in Poughkeepsie, New York, since early 1949.

Bankers Life

Double punch, blank column detection on the 521.

FUTURE PLANS

WSMR

Proposal for Univac Solid State "80" forwarded through command channels.

LA County

Should be able to shift to IBM 1401 (punched card configuration) for costing, utilities, etc. in about 18 months.

Acquisition of an IBM 1620 (with hookup to 1401) would permit complex high speed calculations for engineering - such as traversing, earthworks, calculations (cut and fill), least squares adjustments, etc.

Contemplate use of aperture film cards for maps.

Could then have a complete set of maps in each regional office (surveyor's maps - street no. maps - special district maps - architectural drawings - storm drain maps, etc.)

Bankers Life

IBM Type 1401 Card Input on order.

INSTALLATIONS

Management Services Office
White Sands Missile Range, New Mexico

U. S. Naval Ordnance Test Station, China Lake
China Lake, California

Los Angeles County Engineer
108 West Second Street
Los Angeles 12, California

Bankers Life Insurance Company of Nebraska
Cotner & "O" Streets
Lincoln, Nebraska

Howard Savings Institution
Newark 1, New Jersey

Harvey Aluminum Sales, Inc.
Defense Plants Division
Milan Arsenal
Milan, Tennessee

Manning, Maxwell & Moore, Inc.
414 Broadway
Muskegon, Michigan

National Airlines, Inc.
P. O. Box NAL
Airport Mail Facility
Miami 59, Florida

IBM 607

IBM 607 Electronic Calculator

MANUFACTURER

International Business Machines Corporation

Photo by International Business Machines Corporation

APPLICATIONS

Manufacturer

Business and scientific calculating.

Rossford Ordnance Depot

Located at Rossford Ordnance Depot, Toledo 1, Ohio, the system is used for inventory control and cost accounting (Comptroller).

U. S. Naval Ordnance Test Station, China Lake
Located at the Analysis Branch, Code 4535, China Lake Pilot Plant, China Lake, California, the system is used for theoretical propellant evaluation, rocket performance evaluation, and statistical analysis.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits/word	3 or 5
Instructions used	10
Arithmetic system	Fixed point
Instruction type	One or two address
Number range	Variable

ARITHMETIC UNIT

	Exclud Stor Access
	Microsec
Add	520
Mult	12,940
Div	15,700
Construction	Vacuum tubes
Basic pulse repetition rate	50 KC
Arithmetic mode	Parallel
Timing	Synchronous
Operation	Sequential

STORAGE

Medium	Words	Access Microsec
Electronic Tubes	37	520
	Rossford	
Total storage is	37 words or 293 decimal digits.	
	US NOTS	
Total storage is	14 words or 66 decimal digits.	

INPUT OUTPUT

Medium	Speed
Card Reader-Punch	100 cards/min

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	2,584
Tube types	7

CHECKING FEATURES

Check possible through control panel wiring.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

	Manufacturer
Power, computer	13.5 KVA
Volume, computer	178.9 cu ft
Area, computer	36.5 sq ft
Weight, computer	4,330 lbs
	Rossford
Power, computer	13.5 KVA
Volume, computer	178.9 cu ft
Area, computer	36.5 sq ft
Weight, computer	4,330 lbs
No significant requirements.	

US NOTES

Power, computer	10 KVA
Volume, computer	78 cu ft
Volume, 529	38 cu ft
Area, computer	13.8 sq ft
Area, 529	9.2 sq ft
Room size	120 sq ft
Floor loading	25 lbs/sq ft
	121 lbs concen max
Weight, computer	2,780 lbs

Hood with exhaust fan over computer, 26,000 BTU heat load exhausted.

PRODUCTION RECORD

Number produced	Over 267
Delivery time	Availability basis

COST, PRICE AND RENTAL RATES

Manufacturer
 Rental rates of basic system approximately \$800 per month and up. Rental rate includes engineering maintenance and parts.

Rossford
 Basic System

607 Electronic Unit	\$550/month
529 Punch Unit	250/month

Additional Equipment

942 Electronic Storage Unit	\$200 to \$800/month
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Maintenance/service is included in rental contract.

US NOTES

\$940 per month (IBM 607 and IBM 529)
 \$1,295 per month, includes equipment for data preparation for 709 (2-IBM 026, 1-IBM 077, 1-IBM 082, 1-IBM 519, 1-IBM 523, 1-IBM 557, and 1-IBM 407).
 Maintenance/service is included in rental contract.

PERSONNEL REQUIREMENTS

Rossford
 Used in conjunction with other card punch equipment.
 No special handling is required.

US NOTES

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Analysts, Programmers & Coders	4	4
Operators	2	2
Tape Handlers		2
Total	7	9

Operation tends toward closed shop.
 Methods of training used are in-house plus IBM training.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Rossford
 Time is not available for rent to outside organizations.

ADDITIONAL FEATURES AND REMARKS

Manufacturer
 The IBM 607 Electronic Calculator is designed for use by business and industry. Because of its expanded capacity, the overwhelming majority of business calculations requiring multiple machine operations are performed and checked in a single operation. It is capable of performing and checking 14,000 computing operations a minute.
 The memory capacity of the 607 makes it possible to use intermediate calculated results as well as original data in solving a problem. Other necessary information not punched in cards, such as tax percentages, discount rates, and overtime factors, may be entered as required.

Rossford
 It is possible to use intermediate calculated results as well as original data in solving problems.

US NOTES
 A unique system advantage is its availability for static test data reduction. It should be noted that this computer (IBM 607) is located 5 miles distant from the Station's IBM 709 system.

FUTURE PLANS

US NOTES
 Proposal for 1401 System to replace present system. Proposal for micro-wave hook-up with IBM 709 and Polaris test stand-digital data processor (to write 709 binary tape).

INSTALLATIONS

Rossford Ordnance Depot, Machine Records Division
 Toledo 1, Ohio

U. S. Naval Ordnance Test Station
 China Lake, California

Shell Oil Company

New York Life Insurance Company

Consolidated Edison Company
 New York, New York

Bausch & Lomb Optical Company
 Scientific Bureau
 Rochester 2, New York

IBM 608

IBM 608 Transistorized Calculator

MANUFACTURER

International Business Machines Corporation

APPLICATIONS

Manufacturer
Business and scientific computing

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits/word	9
Instructions used	12
Arithmetic system	Fixed point
Instruction type	One or two address
Number range	Variable, depending on program

ARITHMETIC UNIT

	Exclud Stor Access
	Microsec
Add	220
Mult	11,000 average
Div	13,420 average
Construction	Transistors and cores
Basic pulse repetition rate	100 KC
Arithmetic mode	Parallel
Timing	Synchronous
Operation	Sequential

Photo by International Business Machines Corporation

STORAGE

			Access
Medium	Words	Digits	Microsec
Magnetic Cores	40	360	220

Each word may be split into a 3 digit and 6 digit word with separate signs.

INPUT

Medium	Speed
Card Reader-Punch	155 cards/min

OUTPUT

Medium	Speed
Card Reader-Punch	155 cards/min

CHECKING FEATURES

Checking possible through control panel wiring.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	2.3 KVA
Volume, computer	160 cu ft
Area, computer	30 sq ft
Weight, computer	2,400 lbs

Photo by International Business Machines Corporation

PRODUCTION RECORD

Models have been produced and are in customer service. Production has been discontinued.

COST, PRICE AND RENTAL RATES

Rental rates of basic system \$1,600/month and up. Rental rate includes engineering maintenance and parts.

The machine's internal storage, or "memory", is made up of magnetic cores—minute, doughnut-shaped objects that can "remember" information indefinitely, and recall it for use in calculations in a few millionths of a second.

For IBM, the 608 marks the achievement of production techniques for the manufacture, on a large scale basis, of computing and data processing equipment combining transistors, printed circuits and other forms of miniaturization.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

IBM's "608", the first completely transistorized calculator for commercial applications, operates without the use of a single vacuum tube.

Transistors—tiny germanium devices that perform many of the functions of conventional vacuum tubes—make possible a 50% reduction in computer-unit size and a 90% reduction in power requirements over a comparable IBM tube-model machine. They are mounted, along with related circuitry, on banks of printed wiring panels in the 608.

IBM 609

IBM 609 Calculator

MANUFACTURER

International Business Machines Corporation
Monterey and Cottle Roads
San Jose, California

APPLICATIONS

Commercial and scientific applications, especially where IBM cards are used presently with IBM 604, 607 and 608 calculators. This machine is a modular, solid state, one-unit calculator designed to expand the area of applications performed by the above machines. The 609 is a numerical card in-put, card out-put calculator offering a substantial increase in internal operating and arithmetic speeds.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits/word	12
Decimal digits/instruction	Control panel
Control panel logic wired	

Photo by International Business Machines Corporation

Arithmetic system	Yield on card - arrangement by control panel wiring
Instruction type	Two addresses per program step (Control panel wiring)
Instruction word format	Control panel wiring

Not a stored program machine. 2nd cycle subtract or conversion to true number in storage.

Maximum 384 positions of core storage. All positions may be used. Operation is of the add-to-memory-type.

Read words	Max. - 144 pos.
Punch words	Max. - 96 pos.
Process words	Max. - 144 pos.

ARITHMETIC UNIT

	Incl Stor Access	
	Microsec	
Add	6-digit fields:	224
Mult	6-digits x 6 digits:	13,860
Div	6-digit dividend & quotient:	17,640
Arithmetic mode	Serial	
Timing	Synchronous	
Operation	Non-sequential	

Approximately 95% of all the transistors used in the system are considered as being in the arithmetic function. Condenser-quantity 1,354, nineteen different values.

STORAGE

Media	No. of Words	No. of Digits
Core Storage		
Basic - Model A-1	Read 8; Punch 8; Process 4	96, 96, 48
Max. - Model A-1	Read 12; Punch 8; Process 12	144, 96, 144
Basic - Model B-1	Read 4; Punch 3; Process 0	48, 36, 0
Max. - Model B-1	Read 7; Punch 6; Process 3	84, 72, 36

INPUT

Medium Cards	Speed
	200 cards/min

The card input has 3 card stations: a first reading station, a punch station, and a second reading station. Cards are placed in a 1,200-card-capacity hopper face down, 12-edge first. The cards feed continuously from one station to the next at the rate of 200 cards per minute. Thus, while one card is being read for calculation, another is being punched, and a third card may be read for checking, gang punching, etc., or for recalculation. Input and output (double-punched blank-column) are checked.

OUTPUT

Medium Punched Cards	Speed
	200 cards/min (max)

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Diodes	5,194 (Various types)
Transistors	1,887 (Various types)
Magnetic cores	2,500
Selenium rectifiers	130
Condensers	1,354 (19 different values)

Approximately 95% of all the transistors used in the system are considered as being in the arithmetic functions.

CHECKING FEATURES

All input, calculated, and output information is tested for error conditions. Output (DPBC detection) and additional position checking is optional. The 609 Calculator uses a unique type of matrix-analysis adder which includes the checking bit in its arithmetic operation.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	1 Kw
Volume, computer	50 cu ft
Area, computer	12.08 sq ft
Floor loading	116 lbs/sq ft
	1,400 lbs concn max
Weight, computer	1,400 lbs
	A 15 ampere, 115 volt, 60 cycle/sec, single phase AC line is required.

PRODUCTION RECORD

Time required for delivery	12 months
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COST, PRICE AND RENTAL RATES

	Basic System	Cost	Monthly Rental
Model A-1 (complete system)		\$55,500	\$1,175
Model B-1 (complete system)		36,000	735

Additional Equipment

Number of groups for each model

A-1	B-1			
4	3	Program Steps - each group	1,200	30
4	3	Storage - each group	1,200	30
4	3	Each decision feature	1,200	30
2	2	Digit Test	600	
2	1	Digit Selector	240	
2	2	Adder overflow selector	200	
4	3	DPBC, each group	370	

Maintenance contract available.

PERSONNEL REQUIREMENTS

One operator/shift is required. Training made available by the manufacturer to the user at IBM Education Centers and at some local branch offices.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Modular standard packaging and solid state hardware.

ADDITIONAL FEATURES AND REMARKS

Outstanding features include non-sequential branching logic, fast access magnetic core storage, direct add storage words, 200 cards per minute, no special voltage requirements (115 volts), no air conditioning, 3 radial stackers, solid state, modular, one-unit calculator.

System advantages include fast access magnetic core storage, 12 and 16 digit words, direct-add storage word - every word addressable, and high speed reading and punching.

INSTALLATIONS

International Business Machines Corporation
Monterey and Cottle Roads
San Jose, California

IBM 610

IBM 610 Autopoint Computer

MANUFACTURER

International Business Machines Corporation

APPLICATIONS

Manufacturer

Applications of the 610 Autopoint Computer include heat transfer calculations, analysis of mass spectrometric data, formulae evaluations, calculation of aeroelasticity, stress analysis, flutter and vibration analysis, data reduction, highway design, bridge design, surveying problems, matrix arithmetic, correlation and regression analysis, sales forecasting, actuarial calculations, analysis of variance, curve fitting, experimental design, and many other applications.

Ordnance Missile Laboratories Division

Army Rocket and Guided Missile Agency

Located at the Design and Development Lab and Systems Analysis Lab, OML Division, ARGMA, the computer is used for data reduction and theoretical investigation.

Photo by U.S. Naval Ammunition Depot, Crane, Indiana

Mathematical Sciences Division, Research Directorate, U.S. Army Transportation Research Command Located at USA TRECOM, Building 401, Fort Eustis, Virginia, the system is used for curve fitting, data reduction, regression analysis, analysis of variance, correlation analysis, evaluation of analytic expressions, including effects of neutron radiation on cargo, effects of nuclear weapons on Army aircraft, helicopter control system analysis, and helicopter design, and matrix arithmetic.

Control Office, Ordnance Mission, White Sands

Missile Range

Located at the Guidance Laboratory, Building 1676, Electro-Mechanical Labs., Ordnance Mission, White Sands Missile Range, New Mexico, the system is used for data evaluation, technical support of engineering evaluation studies, etc. Users are primarily

from the Ground Guidance Branch, Missile Borne Guidance Branch, Structures Branch and Propulsion Branch.

Weapons Dept., U. S. Naval Academy

Located in Ward Hall, U. S. Naval Academy, Annapolis, Md., the system is used to demonstrate to Naval Academy Faculty and Midshipmen, semi-automatic and automatic calculations using a small scientific type digital computer. Application to date includes two dimensional target relative motion studies, ballistic trajectory studies, and sound in water studies.

U. S. Naval Ammunition Depot

The system is located at U. S. NAD, Q. E. Laboratory. The major problems for which this activity uses the IBM 610 Computer are statistical and engineering. Statistical uses include mean and standard deviation, two and three way correlation, regression analysis, pqx analysis of variance, many specific factorial analysis of variance, and response surface analysis. Engineering calculations vary from tabulation of simple equations in two and three variables to relatively complex problems such as the solution of second order differential equations which must be solved numerically.

Tennessee Valley Authority, Computing Center

Located in the Chemical Engineering Building, Wilson Dam, Alabama, the 610 is used in the general area of chemical research. Specific problems include chemical

Photo by E. I. DuPont de Nemours and Company, Inc.

kinetics, thermodynamics and some structure work.

E. I. DuPont de Nemours & Co.

Located in Room 224, Laboratory Building, the system is used for material balances, thermal efficiency calculations, heat transfer calculations, return on investment calculations, equipment design, process control correlations, statistical analyses, including multiple linear regression, simple linear correlation, and analysis of variance, preparation of process operating tables, calculation of finished product intermediate requirements, and pressure drop calculations for plant application.

General Tire and Rubber Company

Located at 1708 Englewood Avenue, Akron, Ohio, the system is used for tire development, quality control, research and development. Engineering and scientific uses only.

Military Systems Div., Lockheed Electronics Co.

Located on U.S. Highway No. 22, Plainfield, New Jersey, the system is used for the solution of engineering problems such as radar coverage diagram, curve fitting of experimental data, and numerical analysis.

Carleton College

Located at Carleton College, Northfield, Minnesota, the system is used for undergraduate programming instruction, undergraduate numerical analysis instruction, student independent study, and faculty research.

Computing Laboratory, University of Louisville
 Located at the Speed Scientific School, University of Louisville, Louisville 8, Kentucky, emphasis has been on the introduction of digital computer as an effective tool of numerical analysis. Both graduate and undergraduate students are permitted time to work their problems on the computer.

Computation Lab., University of Rhode Island
 Located at Taft Laboratory, University of R. I., Kingston, R. I., the system is used for the solution of problems in such areas as mathematics, physics, civil engineering, electrical engineering, agricultural economics, agronomy, horticulture, marine biology, industrial management, and poultry husbandry.

Computation Facility, Worcester Polytechnic Institute
 Located in Room 3, Stratton Hall, Worcester Polytechnic Institute, the system is used primarily for education in the use of digital computation in engineering and science and secondarily, for research requiring digital computation.

PROGRAMMING AND NUMERICAL SYSTEM

Manufacturer	
Internal number system	Decimal or Octal
Decimal digits/word	15 plus sign
Arithmetic system	Fixed and floating point
Instruction type	One address

ARITHMETIC UNIT

Manufacturer		
Arithmetic speed - Seconds		
Operation	Flo Point	Fixed Point
Add or Subtract	0.28	0.28
Multiply	1.37	1.155
Divide	1.43	1.155
Divide-Multiply	1.54	1.155
Square-root	2.23	1.90

STORAGE

Manufacturer		
Medium	No. of Words	Dec Digits/Word
Magnetic Drum	84	31 plus sign

INPUT OUTPUT

Manufacturer
 Program Tape Reader and Punch
 Reads at 18 characters per second, approximately 1.18 seconds to complete read in, tape is prepared while keying in program and can be read back for automatic processing.

Data Tape Reader and Punch
 Reads at 18 characters per second, approximately 1.06 seconds to complete read out, original data or intermediate results can be punched and read back.

Manual Keyboard
 Complete manual control of machine, control lights to indicate internal operations, instruction keys for program tape preparation, manual data entry and problem solution, and visual display of all machine registers.

Electric Typewriter
 Typed output at 18 characters per second, manual operation to permit alphabetic headings for reports, typewriter up to 10 feet from machine, and automatic carriage return and tab instruction.

Cathode Ray Tube Display
 Two inch tube for display, and 32 x 10 grid defines register contents. Decimal point and sign displayed.

Control Panel

Convenient method of handling sub-routines, 200 program hubs for additional programming, 12 balance test hubs for logical either-or decisions, 15 program skips for program transfer, and 10 selectors for program alteration.

USNAD

The ratio of input time to computing time for most statistical problems of any complexity is less than one. The ratio of output time to computing time for most statistical and engineering problems is small except for large problems where intricate programming requires temporary storage of large quantities of data on the data tape. Small internal storage makes programming of large problems intricate.

CHECKING FEATURES

Manufacturer

Checking features include circuit and components designed for reliability, validity check of each tape character read in and read out, all information transfer within 610 validity checked, auto-point sums, products and quotients checked not to exceed machine capacity, all clear operations checked to insure complete reset to zero, and all register addresses validity checked.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer

105-130 volts, single phase, 60 cycle, AC, 16-20 amperes. Heat dissipation is 5,000 BTU/hour. 60° to 95°F temperature range, 95% maximum humidity.

ARGMA

Power, computer	1.5 Kw	1.5 KVA	1.0 pf
Volume, computer		42 cu ft	
Area, computer		14 sq ft	
Room size, computer		8 ft x 10 ft	
Floor loading		54 lbs/sq ft	
		190 lbs concen max	
Weight, computer		750 lbs	
		30 amp fuse on separate line. No special air conditioner required.	

USA TRC

Power, computer	2.4 KVA	105-130V, 60 cycle, 16-20 amp
Volume, computer		26.5 cu ft
Area, computer		8.8 sq ft
Room size, computer		Small
Floor loading		8.6 lbs/sq ft
		800 lbs concen max
Weight, computer		750 lbs
		Installed a separate 120V, 60 cycle, 30 amp line.

WSMR

Power, computer	120V single phase, 17.1 Amperes
Area, computer	5x3.5x2.5 ft
Weight, computer	800 lbs
	Adequate power plus ventilation. Built in blower.

US NA

Power, computer	110V, single phase, 20 amp, 60 cycle
Volume, computer	33.5 cu ft
Area, computer	10.2 sq ft
Room size, computer	20 ft x 40 ft (Classroom)
Floor loading	80 lbs/sq ft
	800 lbs concen max
Weight, computer	800 lbs

USNAD

Power, computer	1 Kw	2 KVA	0.5 pf
Volume, computer		30.7 cu ft	
Area, computer		9.2 sq ft	
Room size		200 sq ft	
Floor loading		10 lbs/sq ft	
		87 lbs concen max	

Weight, computer 800 lbs
 No air conditioner is required. Special individual computer power supply wiring. Heat removal blower.

TVA
 Power, computer 1.65 KVA
 Volume, computer 50 cu ft
 Area, computer 15 sq ft
 Weight, computer 1,100 lbs
 No air conditioner needed.

DuPont
 Power, computer 2.34 Kw
 Power, air condi 1.75 Kw 0.21368 KVA 0.91 pf
 Volume, computer 15.9 cu ft
 Volume, air conditioner 5.63 cu ft
 Area, computer 14.7 sq ft
 Area, air conditioner 3.11 sq ft
 Room size 19 ft 1 in x 9 ft 3 in
 Floor loading 140 lbs/sq ft
 1,200 lbs concen max

Weight, computer 1,150 lbs
 Weight, air conditioner 178 lbs
 Separate 20 ampere, 117 volt service.

General Tire
 Volume, computer 800 cu ft
 Area, computer 100 sq ft
 Room size 10 ft x 10 ft

Lockheed Electronics
 Power, computer 1.44 Kw 1.44 Kw
 Volume, computer 31.5 cu ft
 Area, computer 9.2 sq ft
 Room size 9 ft x 14 ft
 Floor loading 6.35 lbs/sq ft
 87 lbs concen max

Weight, computer 800 lbs
 Site preparation included soundproof room 9 ft x 14 ft, false ceiling, 80 watt fluorescent lighting, electric fan, and 115 volt - 60 cycle - single phase-20 ampere electrical line.

U of Louisville
 No special preparation was required. The room has concrete block walls and acoustic ceiling, tile and concrete floor.

Worcester Poly
 Power, computer 2.3 Kw
 Volume, computer 24 cu ft
 Area, computer 8 sq ft
 Room size 15 ft x 20 ft
 Floor loading 100 lbs/sq ft
 200 lbs concen max

Weight, computer 800 lbs
 New partitions, acoustic ceiling, fluorescent lighting, redecorating, one special power circuit, regular electrical outlets.

PRODUCTION RECORD

Manufacturer
 System has been dropped and is no longer available.

COST, PRICE AND RENTAL RATES

Manufacturer
 Unavailable from manufacturer
 ARGMA
 Rental rate is \$1,100 per month.
 USA TRC
 Console, keyboard, and typewriter rent at \$1,150/mo.
 WSMR
 \$1,150 per month for all 610 equipment.

US NA
 \$460 per month - computer, keyboard, typewriter (includes academic contribution of 60%).
 USNAD
 \$1,283 per month for basic system.
 Remington Rand Synchro Tape is rented for \$142/mo.
 Maintenance/service contracting is included in rental rates.

TVA
 The 610 console, 869 typewriter, 973 keyboard cost \$55,000.
 System rents at \$1,150/month.

DuPont
 Computer cost \$55,000 and rents for \$1,150 per month, including console, keyboard, and typewriter.
 The off-line punch rents at \$125 per month.
 Maintenance/service contract

	0-36 Months	37-72 Months	73-108 Months
Console	\$112/Mo	\$142/Mo	\$191/Mo
Typewriter	11	15	-
Keyboard	2	3	4

General Tire
 Approximately \$1,100 per month is paid.
 Lockheed Electronics

	Monthly Rental
Console	\$1,065
Typewriter	35
Keyboard	50
Tax	115
	\$1,265

U of Louisville
 \$460 monthly (basic system costs about \$50,000).
 Maintenance is included in rental.

U of R. I.
 The IBM 610 rents \$460 per month.
 026 card punch, 402 accounting machine, 101 electronic statistical machine, and 514 reproducing punch rent at \$500 per month.

Worcester Poly
 IBM 610: \$460/month (educational contribution rate), including maintenance.

PERSONNEL REQUIREMENTS

ARGMA
 10 engineers and 4 technicians utilize machine on an as needed basis. No full time personnel assigned or needed.
 Operation tends toward open shop.
 USA TRC
 One supervisor and 2 or 3 programmers. One operator is required for each shift.
 Operation tends toward open shop.
 Methods of training used includes in-house instruction to members of the command conducted by members of the Mathematical Sciences Division.

WSMR
 One Theoretical Physicist (BA) does all programming, etc. (IBM maintains equipment).
 Operation tends toward closed shop.
 IBM has run several one week courses (4 hrs per day) on operation of 610.

US NA
 One operator required.
 Operation tends toward open shop.
 Methods of training used includes classroom instruction.

USNAD

One 8-Hour Shift
 Supervisors 1/4
 Analysts 1/2
 Programmers 1/2
 Operators 1
 In-Output Oper 1

Mathematical aptitude was determined by qualifying tests and other criteria and further training was on-the-job in nature.

TVA

There is no one person designated in a supervisory capacity for the 610. The computer is used a great deal by about six or eight chemical engineers, and is periodically used by about six or eight more.

Two-day training classes, taught by IBM personnel, are offered periodically as needed.

DuPont

Four engineers use the system. Operation tends toward open shop.

IBM conducted 2 day class for training - this included "hands-on" training.

General Tire

Used by engineering and research personnel who do their own programming and operating.

Lockheed Electronics

One 8-Hour Shift

Supervisors 1
 Programmers 2
 Engineers 10

Operation tends toward closed shop.

Methods of training used include the instruction manual, brief lecture, and demonstration. Typical personnel able to operate and program the computer one day training and experience.

U of Louisville

Operation tends toward open shop.

Formal course work: Math 400 Machine Computing, 1 credit hour (1 hr lecture and 2 hr lab each week for 10 weeks).

Worcester Poly

One 8-Hour Shift

	Used	Recommended
Supervisors	1/3	1
Clerks	1/15	1/2
Operators	(Users)	1/2

Operation tends toward open shop (exclusively).

Methods of training used includes short special courses as required and training is included in several regular academic courses.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

ARGMA

Good time 30 Hours/Week (Average)
 Attempted to run time 30 Hours/Week (Average)
 Operating ratio (Good/Attempted to run time) 1.0
 Above figures based on period from Nov 59 to May 60
 Passed Customer Acceptance Test Nov 59
 Time is not available for rent to outside organizations.

USA TRC

Good time 38 Hours/Week (Average)
 Attempted to run time 40 Hours/Week (Average)
 Operating Ratio (Good/Attempted to run time) 0.95
 Above figures based on period 17 Mar 60 to 27 Jul 60
 Passed Customer Acceptance Test 17 Mar 60
 Time is not available for rent to outside organizations.

WSMR

Time is available for rent to outside organizations. The computer has been down for repair less than 5% of time in past year.

USNAD

Good time 39.2 Hours/Week (Average)
 Attempted to run time 40.7 Hours/Week (Average)
 Operating ratio (Good/Attempted to run time) 0.962
 Above figures based on period 26 Apr 59 to 31 Jul 60
 Passed Customer Acceptance Test 12 Apr 60
 Time is not available for rent to outside organizations.

The IBM 610 has been very reliable and has had an excellent good time record. The time availability has in general been based on a 40 hour week.

TVA

Average error-free running period 4 or 5 days
 Passed Customer Acceptance Test Nov 59
 Time is not available for rent to outside organizations.

Down time is sporadic and for the most part insignificant.

DuPont

Average error-free running period 20 Hours
 Good time 33 Hours/Week (Average)
 Attempted to run time 35 Hours/Week (Average)
 Operating ratio (Good/Attempted to run time) 0.94
 Above figures based on period 5 Jan 60 to 5 May 60
 Passed Customer Acceptance Test 5 Jan 60
 Time is not available for rent to outside organizations.

General Tire

Time is not available for rent to outside organizations.

Lockheed Electronics

Average error-free running period 3 1/2 hours/week
 Good time 4 to 5 Hours/Week (Average)
 Attempted to run time 4 & 5 Hours/Week (Average)
 Operating ratio 0.99
 Above figures based on period 13 Nov 54 to 14 Apr 60
 Passed Customer Acceptance Test 12 Nov 59
 Time is available for rent to qualified outside organizations. Duration time of job must be long enough to justify moving the computer to an unclassified area.

Carleton

Average error-free running period 3 Months
 Good time 40 Hours/Week (Average)
 Attempted to run time 40 Hours/Week (Average)
 Operating ratio 1.0
 Above figures based on period 1 Feb 60 to 31 Aug 60
 Passed Customer Acceptance Test Nov 59
 Time is not available for rent to outside organizations.

U of Louisville

Time is available for rent to outside organizations.

U of R. I.

Good time 38 Hours/Week (Average)
 Attempted to run time 40 Hours/Week (Average)
 Above figures based on period from Aug 59 to present
 Passed Customer Acceptance Test 17 Jul 59
 Time is available for rent to qualified outside organizations.

Worcester Poly

Good time 30 Hours/Week (Average)
 Attempted to run time 35 Hours/Week (Average)
 Operating ratio 0.85
 Above figures based on period from Jan 59 to Jun 60
 Passed Customer Acceptance Test 21 Jan 59
 Time is available for rent to qualified outside organizations.

Use by outside organizations has been possible only via sponsored research and educational uses. IBM contract (dated 1 Jun 60) permits sale of time to outside organizations.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Tape Characteristics

Automatic adjustment to 5 or 8 channel size, 5 channel teletype tape, and 8 channel includes: 5 for code symbols, one for even-order redundancy check, and two for class marks (for operating use).

The IBM 610 is tailored to needs of engineering and science, mobile desk-size unit with typewriter and keyboard, handles 5 or 8 channel punched paper tape, 15 digit number plus decimal and sign, automatic control of decimal point, 84 registers of magnetic drum storage, each 31 digits, plus sign, octal or decimal arithmetic, single instruction square root, single instruction divide-multiply (x/y)z, program control from-keyboard, program tape and control panel, automatic program tape preparation while solving problem, built-in self-checking for reliability, and multiple-command instructions.

Keyboard Lights

KEY BD	Keyboard in control
OPE	Machine executing a step when automatic program stops
INT	Indicates interruption of a program
PCH CLASS	Punch class switch (1,2,3) ON
CLEAR	Register has failed to clear to zeros
PUNCH	Invalid character punched into tape
REG	Invalid register address
DIG ENT	Invalid Numerical Code entered
RDN	Invalid character read in or out
DIG CH	Signals or digits from or to drum are invalid
OFLO	Number in SEL REG exceeds allowable magnitude or division by zero attempted

USA TRC

Outstanding feature is ease of programming.

US NA

Outstanding features include automatic decimal point, each memory drum register capable of storing 31 decimal digits plus sign and decimal point, and option of octal or decimal mode of operation. System is easy to program and operate.

USNAD

Outstanding features include auto-point (floating point) calculations, good reliability, and ease of programming.

TVA

Since this computer is used by a relatively small integrated group, tape storage is no problem. Each operator takes care of his own special tapes, while standard tapes are labelled and filed close to the computer.

DuPont

Outstanding features include automatic decimal point, easy programming, and programming in engineering language.

Lockheed Electronics

Outstanding features include computes and prints-out in floating point notation, very fast and easy to program, and air conditioning not required. Duration time of arithmetic operation too long especially those for trigonometric function, i.e., multiply - 0.78 sec., square root - 0.67 sec., and sine (cosine) at least 20 sec.

Carleton

Outstanding features are ease of programming (simple command structure) and use as desk computer.

U of Louisville

Unique system advantages are automatic positioning of decimal point and simplicity in coding.

Worcester Poly

Outstanding features includes low cost, bringing it within the range of a limited, small college budget,

simplicity in learning to use it, and minimum personnel requirements.

Additional computing equipment available on campus includes two small analog computers and one home-made demonstration digital computer in various engineering departments. For large scale digital computing applications W.P.I. has limited access to the MIT Computation Center.

FUTURE PLANS

USA TRC

It is proposed that the system be replaced by an IBM 1620.

USNAD

The rental of the IBM 1620 Digital Computing System has been approved by the Bureau of Naval Weapons. The IBM 1620 has much faster input and computing times (input of 180 char/sec and access time of 20 microsec). In addition the 1620 has core storage of 20,000 digits with variable word length. The rental of the IBM 1620 will be approximately \$1,600 per month.

TVA

The workload is increasing rapidly and may require some change in the future. Present plans are indefinite.

DuPont

To date, primary usage of the IBM 610 has been in the development and research areas for engineering calculations and evaluation and analysis of experimental data. Continued use in this field is anticipated. More complex applications in the statistical field will be pursued in the plant process and product areas. Increased activity in the production and cost accounting department is expected. At this time, no plans for an expansion or modification of the present computer system has been made. However, the adequacy of the present system for current and future demands will be studied within the next six months. Results and recommendations of this study will determine the need for expansion or acquisition of a new system.

Lockheed Electronics

IBM 610 to be replaced by IBM 1620.

Worcester Poly

Eventual acquisition of some other computer as addition to or replacement for present one, possibly to meet administrative as well as educational and research needs.

INSTALLATIONS

Army Rocket & Guided Missile Agency, Redstone Arsenal, Alabama

U. S. Army Transportation Research Command, Mathematical Sciences Division, Fort Eustis, Virginia

Ordnance Mission, White Sands Missile Range, N. Mexico

U. S. Naval Academy, Weapons Dept., Annapolis, Md.

U. S. Naval Ammunition Depot, Crane, Indiana

Tennessee Valley Authority, Computing Center, 116 Old Post Office, Chattanooga, Tennessee

E.I. DuPont de Nemours & Co., P.O. Box 1378, Louisville 1, Kentucky

General Tire & Rubber Co., 1708 Englewood Ave., Akron 9, Ohio

Lockheed Electronics Co., Military Systems Div., U.S. Highway No. 22, Plainfield, New Jersey

Carleton College, Northfield, Minnesota

University of Louisville, Louisville 8, Kentucky

University of Rhode Island, Kingston, Rhode Island

Worcester Polytechnic, Computation Facility, Worcester 9, Massachusetts

IBM 632

IBM 632 Electronic Typing Calculator

MANUFACTURER

International Business Machines Corporation
Electric Typewriter Division

Photo by International Business Machines Corporation

APPLICATIONS

The IBM 632 is designed primarily for invoicing. It is available in four models, including models with card punch, printing card punch, and punched paper tape output. The 632 combines calculating and typing in one unit. It automatically adds, subtracts, and multiplies the information keyed into the companion keyboard. It also automatically inserts decimal points, computes taxes, discounts and accumulates information for daily totals. The accuracy of electronics and magnetic core "memory" give the IBM 632 Electronic Typing Calculator the ability to handle a variety of business applications. This model, incorporating punched card output, punches desired information into IBM punched cards simultaneously with the typing action. The cards may then be further processed in an accounting system.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits/word	12
Instructions decoded	12
Arithmetic system	Fixed point
Instruction type	One address

1 buffer register and 1 companion keyboard is used.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	110,000	21.5/word
Mult	2,500,000	430,000 (average)

Construction (Arithmetic unit only)

Vacuum tubes	150
Magnetic cores	164
Ferrite cores	352
Switch cores	28

Arithmetic mode
Timing
Operation

Serial
Asynchronous
Sequential

	Cost	Monthly Rental
Model VII-Typewriter unit, calculator unit w/printing punch & companion keyboard & card reader	\$17,500	\$395

STORAGE

Medium	No. of Words	No. of Digits	Access Microsec
Magnetic Cores	8	12	21.5/word

Maintenance/service is included in all monthly rental prices.

Maintenance/service for purchase machines is as follows:

Model I	\$300
Model II	420
Model III	440
Model IV	535
Model V	472
Model VI	592
Model VII	612

INPUT

Medium	Speed
10 Key Unit	12 digits/sec Binary coded input

OUTPUT

Media	Speed
Typewriter	10 char/sec
Cards	10 char/sec
Paper Tape	10 char/sec

PERSONNEL REQUIREMENTS

One operator is required per 8 hour shift.
Training made available by the manufacturer to the user includes operator training at time of installation.

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Tubes	
6887	48
5965	41
5844	45
2D21	5
6350	11
Diodes	
1N152	11
-	117
1N480	24
-	12
Magnetic Cores	352

ADDITIONAL FEATURES AND REMARKS

Outstanding features are a program reading device, which houses a mylar program belt, containing all of the instructions for a particular application, and a companion keyboard, which has a familiar 10-key pattern, facilitating indexing of numerical information, increasing speed and accuracy, and also aiding in error detection and correction. Unique programming device makes the equipment compatible with most systems.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	0.75 Kw	1.035 KVA
Volume, computer		9.5 cu ft
Area, computer		4.5 sq ft
Weight, computer		600 lbs

INSTALLATIONS

International Business Machines Corporation
Electric Typewriter Division
590 Madison Avenue
New York 22, New York

PRODUCTION RECORD

Time required for delivery	4-9 months
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COST, PRICE AND RENTAL RATES

Basic System	Cost	Monthly Rental
Model I-Typewriter unit, calculator unit and companion keyboard	\$6,000	\$175
Additional Equipment		
Model II-Typewriter unit, calculator unit w/non-printing punch & companion keyboard	8,700	235
Model III-Typewriter unit, calculator unit w/printing punch & companion keyboard	9,800	260
Model IV-Typewriter unit, calculator unit w/tape punch & companion keyboard	11,900	295
Model V-Typewriter unit, calculator unit & companion keyboard	13,700	310
Model VI-Typewriter unit, calculator unit w/non-printing punch & companion keyboard & card reader	16,400	370

IBM 650 RAMAC

IBM RAMAC 650 Data Processing Machine

MANUFACTURER

International Business Machines Corporation

APPLICATIONS

Manufacturer

General purpose, applicable to scientific and business data processing. "In-line" processing with IBM RAMAC 650.

The IBM 650 is a basic magnetic drum data processing machine with an IBM 355 random access memory unit. This memory is a storage medium in which any group of data may be reached quickly and directly, despite the fact that the data is stored in the memory in a random fashion.

The RAMAC 650 was one of the first of IBM's line of machines designed for high-volume, in-line processing of business data. Instead of accumulating data to be processed in batches, each transaction is processed as it happens and, at the same time, every related record in the memory unit is adjusted.

U. S. Army Engineer District

Located in the Faidley Building, 121 South 16th Street, Omaha, Nebraska. The system with drum storage and card input-output is used for earthwork cut and fill, survey computations, stability analyses (spillway weirs, walls, powerhouse and spillway chutes), flood routing, reservoir regulation, grain size computations, and sediment load studies.

U. S. Army Engineer Research & Develop. Lab.

Located at Fort Belvoir, Virginia. The system with drum storage and card input-output, is used for the computation of problems in all fields of engineering in connection with Research and Development of military items for the Corps of Engineers, plus a small amount (less than 5%) of data processing in connection with labor distribution costs and similar reports.

U. S. Army Engineer Waterways Exper. Station

Located at Vicksburg, Mississippi. The system with drum storage and card input-output, is used exclusively for engineering and scientific applications. The

Photo by International Business Machines Corporation

Computer Center is a joint facility of the Waterways Experiment Station (WES) and the Lower Mississippi Valley Division (IMVD) of the Corps of Engineers, U. S. Army. It operates as a central (center-type) facility to provide electronic data processing and computation services to six (6) using field offices of the Corps of Engineers.

U.S. Army Corps of Engineers, U.S. Army Engineer Division.

Located at North Pacific Custom House, Portland 9, Oregon, the system is used primarily for scientific and engineering work arising in conjunction with the Corps of Engineers construction program in the North Pacific Division. Some typical programs are: Program computes grounding mat resistance vs. cost per number of ground rods for selected resistivities, ground rod spacings and ground rod lengths.

Program derives information for plotting the flux distribution in core form transformers for non-symmetrical coil arrangements or non-uniform current densities.

Program computes the neutral axis of a reinforced concrete section of any shape subjected to any combination of axial load, P , and bending moments, M_x and M_y and computes the concrete and steel stresses. The program can be used for stability analyses and base plate stress analyses, etc., with proper formulation of input data.

Computes backwater or water surface profile in an open channel by the standard-step method for velocities less critical. The program computes water surface elevations and balances energy equation to the desired accuracy.

Program derives the streamflow from snowmelt and/or rainfall over various segments of the Columbia River Basin, by routing water thru basin, lake, and channel storage, thereby determining streamflow at gaging stations for reservoir regulation of design

Photo by U.S. Army Anniston Ordnance Depot

flood studies.

Monthly forecasts of water year and residual volumes of river flow are prepared for 132 river stations in the Columbia Basin and coastal areas, for purposes of power, irrigation, flood forecasting and control. The program computes forecasts and prepares page formats for publication.

The program simulates a basin-wide hydroelectric system of up to 60 projects, giving power output, storage and regulated streamflow data for the projects. Input to the routines are project characteristics, streamflow network, periodic unregulated streamflows, and storage changes at the projects. A sequence of up to six storage projects may be designated for use in firming the system to a pre-specified energy load for each period. Program 1050.4 is for a 650 with 4000 words of internal storage memory.

This program simulates a hydroelectric system of up to 20 projects on a given river and its tributaries. The program output gives total discharge, spill, turbine discharge, forebay and tailwater elevations, head on power plant, and actual station generation, number of units on the line for each of the projects, and the total system generation. Variable input data are as follows: desired generation, local inflow, required spill and miscellaneous water use. Time interval for input data is variable and time interval for output data is variable; however, hourly data will ordinarily be computed. Flows are routed between

projects, either through reservoirs or open channel reaches. Routing constants and power plant characteristics are included in the program along with minimum and maximum pool elevation but may be changed as desired.

Program determines the total energy in kw-months, mean monthly capability in kw, average number of operating units and mean head associated with a sequence of mean monthly flows at a hydro-generating plant. Plant performance is based on turbine unit performance characteristics and generator losses contained in tables in memory and a constant value of transformer efficiency.

Computes cut and fill, adjusted cut, accumulated cut and fill, mass ordinate and slope stake reference data where required, based upon original ground and finished ground conditions.

The computation of earthwork quantities and preparation of design roadway templates and profile grades are processed. The stations and elevations of the verticle P.I.'s together with the length of verticle curves, and the station of the points of spiral and horizontal curves, the roadway typical section data and original ground data are used as information including a five line profile. The design template information may in turn be used in the quantity computations program above, to compute volumes and slope stake reference information.

The program computes the profile grade for a highway including verticle curve corrections. The input data consists of the P.I. stations, elevations, and length of verticle curves.

U.S. Army Engineer Supply Control Office

Located at 410 North Broadway, St. Louis, Missouri, the system with drum, tape and cards, is used for integrated stock and fiscal accounting.

Stock Accounting

Processing world wide customer demands and supply transactions in such a manner as required to maintain individual item stock balances, on a consolidated accountable property record, on all Engineer items stored within the continental United States.

Financial Inventory Accounting

Provides the monetary values of issuance, receipts and adjustments, as recorded against stated inventory balances of the accountable property records into a directed pattern of reports.

Stock Fund Accounting

Compiles computed dollar values of Stock Fund inventory balances and transactions into a designated chart of accounts as required to maintain a "balance sheet type record" of the Engineer Section of the Army Stock Fund.

Customer Billing

The preparation of printed bills to customers for all reimbursable issues of inventory items. Computed requirements of organizations and units as prescribed

Photo by U.S. Army Engineer District, Omaha

in TOE's, T/A's or other governing directives. This involves file maintenance routine of constantly changing requirements by addition and deletion action.

Mobilization Reservation Requirements

A process of compiling projected inventory requirements of individual item needs based on various degrees of mobilization.

World Wide Asset Data

An accumulation of statistics relative to the quantity, location, condition and net worth of all inventory items.

Integrated Supply Control of Minor Secondary Items

The process of measuring requirements against known assets for purposes of projecting a supply position and signifying actions required such as procurement, excesses, etc.

Item Identification and Cross Reference Files

Describing for Supply Control purposes, the item name, description and characteristics in the detail necessary to adequately inform potential customers of items available.

U. S. Army Ordnance
Located in Bldg. 109-1, Inventory Control Division, Field Services Group, Philadelphia, Pa. The system with drum, core, and tape storage and tape and cards input-output, is used for daily updating National Availability Inventory Records, requests for material, catalog changes, determination of requirements, computation of digital levels, distribution and redistribution of stock, financial inventory accounting report, demand, issue and returns summaries, stock status reports, computation of basic loads, maintenance and usage of application file, in stock, technical service excess and disposal reports, file maintenance, and procurement status.

U. S. Army Ordnance
Located in Bldg. 353, Feltman Res. & Engineering Laboratories, Picatinny Arsenal, Dover, N. J. The system with drum and cards, is used for Interior Ballistics (burning-rate studies and projectile-propellant dynamics), (3-degree of freedom trajectories, inertial fuzing studies, and stability calculations), (lethal area calculations and systems analyses), design calculations, and use terminal ballistics data reduction.

U. S. Army Ordnance
Located in Bldg. 10, Watervliet Arsenal, Watervliet, New York. The system with drum and cards is used for research and engineering, labor control, payroll and leave accounting, and cost accounting.

Photo by U.S. Army Engineer Research & Dev. Laboratories

U. S. Army Ordnance
Located in Bldg. 362, Anniston Ordnance Depot, Anniston, Alabama. The system with drum, disc, cards, tapes, cores, and typewriters is used for Ordnance Corps Distribution Depot, general supplies secondary items stock control (availability edit and item accounting) and related Financial Inventory Accounting Activities.

U. S. Army Philadelphia QM Depot
Located at 2800 S. 20th Street, Philadelphia, Pa. The systems are used for drum, card, tape, RAMAC, typewriter systems, payroll, cost reporting, factory production, procurement on-order, national inventory control, inventory updating, sales and billings, requisition and extract processing, cataloging, supply management, and retail requirements studies.

U. S. Army Richmond QM Depot
Located at Richmond, Virginia. The systems are used for card, tape system, the card, tape, RAMAC, fund accounting, depot maintenance program, army field stock control system, memorial, motor vehicle, special application, FIA Stock Fund, supply control, civilian payroll, stock accounting, national stock control, supply catalog, cost accounting, troop requirements.

U. S. Army Signal Corps School, ADPS
Located at Squier Hall, Room 178, Fort Monmouth, N. J. The drum, core, disc, tape cards, typewriter, is used for the training of Staff Officers,

instruction to all Signal Corps Officers, demonstrations to all classes showing capabilities of ADPS, training of Enlisted Programmers and Console Operators, and for the testing of possible programs to be used in the Army.

U. S. Navy Service Center

Located on the 2nd Floor of the Navy Service Center, Washington 25, D. C., the drum and card system is used for payroll, work measurement, labor distribution, lunar dynamics for the Naval Research Laboratory, and electronic production capabilities statistics.

U. S. Naval Air Development Center

Located at the Aeronautical Computer Laboratory, Johnsville, Pa., the drum, core, tape and card system is used for scientific computations and scientific data processing.

U. S. Naval Avionics Facility

Located in Indianapolis, Indiana, the drum, core, card and tape system is used for systems studies, error analyses, calibrations and data reduction.

U. S. Navy Bureau of Naval Weapons

Located in Temporary "W" Bldg. Rm. 1W09, 18th & Constitution Ave., N.W., Washington 25, D. C., the drum, card, tape system is used for production control, engineering calculations, research calculations,

Photo by U. S. Army Engineer Supply Control Officer.

and statistical analysis.

U. S. Navy, New York Naval Shipyard

Located at Brooklyn 1, New York, the drum and card system is used for payroll, direct labor budget, interim cost, budget vs actual, daily report of costs, weekly and cumulative performance report, pipe stress analysis, tank capacity tables, propulsion shafting.

U. S. Navy, Portsmouth Naval Shipyard

Located at Portsmouth, New Hampshire, the drum card system is used for payroll, personnel, cost accounting and control, production planning and control, and scientific and engineering.

U. S. Navy, Puget Sound Naval Shipyard

Located in the Puget Sound Naval Shipyard, Bremerton, Washington, the drum card system is used for payroll (both hourly and per annum rates) including leave (sick and vacation absences) and savings bonds, direct labor budget (man-hour estimates versus actual), design and engineering, and workload forecasting (both short and long range).

U. S. Naval Supply Center

Located in Bldg. 211-3, Data Processing Dept., Oakland, Cal., the drum card system is used for updating, stock status balance cards for inventory control system, civilian payroll, U. S. Savings Bond

accounting for civilian personnel, calculation of EAM rental payment, and sundry management reports.

USAF, Headquarters, OCAMA

Located at Tinker AFB, Oklahoma, the drum-tape system is used for: commodity class property accounting, method of controlling material by AMC supply depots to worldwide AF activities, maintenance contractors, and other military services. Provides data which enables AMC to administer a timely, accurate and effective supply logistics system. Encompasses item accounting, providing inventory position and various products for effective management of serviceable, repairable, and excess material. Provides by-products which are the basis for dollar accounting and management of AF assets, inputs to other systems for requirements computations etc.

Base class property accounting - method for controlling material to support AMC internal depot functions and tenant organizations. System provides data required to enable supply components to administer timely, accurate, and effective material support. Otherwise same as commodity class property accounting application.

Maintenance engineering management material control - integrated management system based upon data which

Photo by U.S. Army Philadelphia Quartermaster Depot ,

measures and evaluates actual performance against predetermined standards for labor, material and overhead. Consists of (1) work measurement system under which engineered labor standards are developed and maintained and which provides for comparison of standard hours with actual labor hours used to perform the work; (2) production control system which provides for planning, scheduling and controlling the application of manpower, material and facilities for the accomplishment of given workload requirements in the depot maintenance shops; and (3) the standard cost-accounting system, which provides for the accumulation and analysis of both standard and actual dollar costs for labor, material, and overhead identified to the organizational unit which best exercises direct control over the cost elements.

USAF Air Material Command

Located at Bldg. 33, Bay C, Olmsted Air Force Base, Penna., three drum-core-tape-card systems are used for: prime and base class stock control and distribution.

All items stored at Hq MAAMA are recorded on tape in Class Code, stock number and account sequence. These tapes are called Master Balance Tapes. Action processed through the Supply System such as; shipment,

Photo by U. S. Army Watervliet Arsenal

receipts, inventory adjustments, transfers, etc., are processed daily to up date the master balance records. The following output products are generated when processing supply actions: transaction registers, shipping documents (104P1 & 104P3), inventory accounting monetary, material cost, stock fund, balance cards (category I & II only), inventory adjustment registers.

Each month the daily transaction registers are consolidated and consumption for each item is recorded. At stock balance reporting time (every 90 days for Hi-Valu and every 180 days for Category II & III) consumption qty is consolidated and selected from tape by item. Also at stock balance reporting time the assets stored at MAAMA are selected from the master tapes. The consumption cards and assets cards are used to prepare the stock balance and consumption report.

Every week stock list changes are processed against the master balance tape. This includes stock number changes, unit price changes, procurement source code and expendability-repair cost code changes and unit of issue changes. These changes are generated from USAF stock list catalogues.

IAM Reconciliation: This program utilizes M/B tape as input. The output is A/F and/or FSC 20 word record

by item, with dollar value extended, total dollar value by account and PSC and overall total dollar value by class.

USAF, Air Materiel Command, Asst. for Data Services, Comptroller, these are used to compute the 90 day requirements and 30 day supportability. Products from this tape are: file maintenance to the master tape such as additions, deletions, changes, special requests and stock list changes, purge and transfer list, unidentified item list, AMC 550 Requisition cards, 30 day supportability list, parts shortage list.

A quarterly report to show maintenance if their replacement percent in the material standards is a realistic figure. Report consists of actual material, end item production, production count and material standards.

A master tape compiled daily to make a monthly report on the cost of all material used by maintenance.

A master tape inventory balance which is updated daily by transactions. Stock list changes are processed weekly against this tape. Transaction registers, 550, 550, a card etc., are made daily from this tape.

A tape made quarterly to update the unit cost in the material standard master tape. Re-price tape

Photo by U.S. Air Force Directorate of Statistical Services

USAF Mobile Air Material Area

Located at Brookley AF Base, Mobile, Alabama, the drum-core-tape-card system is utilized for: stock control and distribution system, maintenance management system, inventory accounting (monetary) system, unit authorization listings, mechanized civilian payroll system, PCAM utilization reporting program, test validation system. These include the processing of Air Force property records for which MOAMA has world-wide responsibility, the processing of MOAMA's maintenance-engineering management system, a program developed for controlling equipment material to operate the base, a program that computes civilian pay and leave for preparation of civilian leave and earning statements, checks, and printing of bonds, a program that computes the PCAM machine utilization, and a program for validating test scores for civilian personnel.

USAF Air Materiel Command

Located at Bldg. 33, Bay C, Olmsted AFB, Penna., the system is used for implementation of a mechanized payroll system, providing for preparation of civilian payroll checks, bond issuance program and leave and earning statement is scheduled for December 1960.

Fields of application include: this program utilizes the IAM daily corrections for IAM daily transactions as input cards. The output cards are daily summary cards and financial detail cards. The summary cards dollar value condition is controlled by the posting control; the group number by weapons code, IAM code, account code.

This program utilizes the daily summary cards as input. The output cards are IAM periodic summary cards. The dollar value is summarized by PSC within account, within IAM for each class.

This program utilizes the IAM periodic summary cards as input. The output cards are IAM monthly summary cards and IAM monthly line cards. The monthly summary dollar value is summarized by IAM within account, within PSC, within class symbol sequence. The monthly IAM line card is summarized by IAM.

From IAM opening balance cards and IAM monthly summary cards, this program prepares the closing balance cards for the month. The opening and closing dollar values are summarized by condition and by condition within PSC for each class and storage site.

From monthly summary cards for the quarter, this program prepares one card showing dollar value for

Photo by U.S. Air Force Mobile Air Materiel Area

the quarter for all items which have common class symbol, PSC, ownership account, condition code and IAM code

This program utilizes IAM opening balance and IAM monthly summary cards, for the quarter, as input cards. The output cards are quarterly supply summary cards and AMTE summary cards. The quarterly supply summary dollar value is summarized by condition, within IAM, within account, within reporting depot, within controlling depot, within class symbol. AMTE summary dollar value is summarized by fields controlled by account and condition.

This program utilizes MPA balance cards as input. The output is IAM reconciliation cards by item, with dollar value extended, all "Q" accounts have only service value extended.

This application governs the accurate accumulation and reporting of on-hand assets and consumption data to provide essential information to AMA's, depots, and bases under the AF logistics concept. These reports determine the gross future needs of the Air Force, the items the Air Force can expect from repair, and the stock availability. The information provided by SB&CR's is as follows: Actions that have occurred

during a reporting period (issues, condemnations, reparable generations, serviceable returns from overhaul, etc); quantity of assets on hand and their condition; and, location of assets (on-work-order, intransit, reparable shipments, etc).

This program takes projected programming data from Hq., USAF (received on classified computer tape) and produces Management reports for the Plans and Program Office at Hq., MAAMA (MAFD). That office, in turn, reflects the aircraft flying hours and engine flying hours by type, model, series of MAAMA prime aircraft and MAAMA prime engines for three fiscal years on a projected basis.

This program deals with items as related to specific types, models, and series of aircraft. It applies the quantity per assembly (quantity of this item which is installed on a specific aircraft) to the percentage of application to compute a factor. The percentage of application is the percentage of this particular type, model, and series of aircraft which uses this item, as related to the total number of this type, model, and series of aircraft in the Air Force. The factor is applied to the past and present projected flying hour program data to arrive at the installed

Photo by U. S. Air Force Patrick AFB

flying hour programs for each particular requirement, i.e., stock level hours, repair cycle hours, etc. In a later program various factors are applied to these hours in determining the requirements for cost category III recoverable items.

USAF Mobile Air Materiel Area

Located at Brookley AFB, Alabama, the drum-core-tape-card system is utilized for: stock control and distribution system, maintenance management system, inventory accounting (monetary) system, unit authorization listings, mechanized civilian payroll system, PCAM utilization reporting program, test validation system. These include the processing of Air Force property records for which MOAMA has world-wide responsibility, the processing of MOAMA's maintenance-engineering management system, a program developed for controlling equipment material to operate the base, a program that computes civilian pay and leave for preparation of civilian leave and earning statements, checks, and printing of bonds, a program that computes the PCAM machine utilization and a program for validating test scores for civilian personnel.

USAF San Bernardino Air Materiel Area

Located at Norton AFB, California, the drum-card system is used for: Maintenance Support and Main-

tenance Management, includes data processing for flow of material programming data; for the computation and forecasting of items of supply required to support current operations and programs; for inventory, utilization, and status of aircraft engines and missiles, for such functions as stock control, inventory warehousing, transportation, requisitioning and back order procedures; for all identifying and cataloging operations such as Federal Conversion Program, AF stock lists, D/A cross reference index, etc; for inventory, utilization, accounting and status of such property as medical-dental, clothing, ammunition, petroleum, oils and lubricants.

Maintenance Support and Maintenance Management. Includes data processing concerned with the collection and reporting of labor and production statistics involving work measurement, labor distribution materiel standards and projection; includes data processing for product improvement system such as material failure and "UR" reporting.

Financial Management and Accounting System (includes Mechanized Civilian Payroll System), includes data processing concerned with reports developed for the purpose of projecting budget requirements and financial plans; preparation and maintenance of reports pertain-

Photo by U. S. Air Force Patrick AFB

ing to monetary value of items in stock and in use; maintenance and operating costs of real estate facilities; preparation and maintenance of reports reflecting cost data for both labor and material for all functions; preparation and maintenance of reports reflecting obligation, commitment, expenditure, and status of funds; cost of public work programs and construction activities; preparation of expense report, punched card check program, check reconciliation and other similar processing and reporting activities; and processing of other reports reflecting accounting or financial data for such functions as general accounting, expense accounting, clothing and commissary accounting.

Mechanized Civilian Payroll System (Authority: AMC Manual 171-1, Volume II, Chapter 369-51 and AMC Letter 25-112, dated 29 October 1957). This system provides for the maintenance of punched card pay records for all employees at Norton AFB and within the Hq., SBAMA. Bi-weekly time and leave records are processed against this master file and time and leave records are updated, employees' pay is computed and pay checks and leave and earning statements are published for each employee. As additional system benefits, year-to-date records of payments are kept and labor distribution data is created for cost accounting purposes.

Equipment Management and Data Processing Production

Control: includes data processing required in the compilation of unit allowance list and base allowance list; effort required in maintaining the files and preparation of the actual lists and reports; data processing for inventory, utilization and status of vehicles other than aircraft, electronics and communications equipment, and data processing equipment.

USAF, Hq., AFSWC, Kirtland AFB

Located at Kirtland AFB, Bldg. 499, New Mexico, the drum-card system is used for inventory accounting monetary, appropriations accounting, supply inventory control and maintenance exception time accounting.

USAF AFGC (PGCS) Eglin AFB

Located in Bldg. 100, Room 108, Eglin AFB, Florida, the drum-card system is used for: automatic processing of supply transactions, equipment control, personnel, financial services, and miscellaneous applications.

USAF Hq. Directorate of Statistical Services,
APO 633, N. Y., N. Y.

Located in Wiesbaden, Germany, the drum-core-tape-card system is used for enlisted military personnel accounting and reporting, officer military personnel accounting and reporting, civilian personnel accounting and reporting, manpower authorization system, intelligence data analysis, ground electronics installations, and medical stock fund reporting.

Photo by U. S. Air Force Special Weapons Center

USAF Hdqs., MATS

Located in Bldg. S-920, Scott AFB, Illinois, the drum-core-tape-card-typewriter system is used for personnel accounting, manpower and organization, materiel, and operations and traffic.

USAF Hdqs., Pacific Air Force

Located in APO 953, San Francisco, Cal., the drum-core-tape-card system is used in Statistical Services for: personnel application (Military) maintenance of complete personnel data on all military personnel assigned to PACAF organizations. Programs include updating of files, error determination, preparation of all mechanized personnel reports required by USAF and PACAF. CMOP application. Maintenance of complete authorization data for unit manning documents of units assigned to PACAF. Programs include updating of files, error determination, preparation of authorization reports required by USAF and PACAF. Miscellaneous. Programs in accounting, UAL and MRAL. These prepare cost reports required by USAF and PACAF. Intelligence applications.

USAF Hdqs., PACAF A-3 Directorate of Control

Located in APO 953, San Francisco, Cal., the tape-drum-core-card-typewriter system is used in Directorate of Control for operations and intelligence.

USAF ROAMA Griffiss Air Force Base

Located in the Depot Supply Bldg. No. 1, East Wing, Griffiss AFB, the drum-card system is used for payroll, personnel, mechanized property accounting and inventory accounting management.

USAF Hdqs., Strategic Air Command

Located in the Offutt AFB, Nebraska, the drum-tape-disc-card system is used for command military personnel accounting (detail command personnel files are centrally maintained and all USAF and SAC required reports and information products are developed there from) and command manpower and organization authorization accounting (command authorization information files are

centrally maintained and used to develop all reports and information products, including publication of all unit manning documents).

USAF 2709th AF Vehicle Control Group

Located at 3300 Jackson Ave., Memphis 2, Tenn., the drum-card system is used for stock control and distribution - inventory management, in support of vehicle reporting and control, mechanized 650 payroll system, in support of project count - wall to wall inventory, and in support of work measurement.

NASA Flight Research Center, Box 273

Located at Edwards, Cal., the drum-card system is used for aircraft flight data reduction, missile trajectories, theoretical heat transfer and supersonic flow, and cost accounting.

U.S. Dept. of Agriculture, Commodity Stabilization Service, USDA

Located at the Evanston CSS Commodity Office, Evanston, Ill., the drum-card-tape-printer system is used for the processing of price support loan and purchase transactions for the 19 states served by this office. This application includes computation of loan and purchase transactions, preparation of settlement statements with farmers and producers, and recordation of accountability for these transactions - approximately 111,000 transactions are processed annually. It is also used for the preparation of precomputing invoices covering warehouse charges due to grain elevators - approximately 4,000 invoices are prepared monthly, and for the preparation of settlement statements of warehousemen covering quantity and quality differences on grain delivered as opposed to ordered for delivery also covers final settlement for warehousing charges - approximately 2,000 settlements are processed per month.

Photo by U.S. Air Force 2709th AF Vehicle Control Group

California Division of Highways

Located at 1120 "N" Street, Sacramento, Cal., the drum-card system is used for engineering computations, statistical applications, and traffic routing and assignment.

U.S. Dept. of Commerce, Coast and Geodetic Survey

Located in Room 3009, Dept. of Commerce Bldg., Washington, D. C., the drum-card system is used for scientific applications, including adjustment of surveys (triangulation and traverses), reduction of magnetic observations, adjustment of aero-triangulation, gravity vector components, calculation of flight bearings for check VOR facilities, and for fiscal and budget applications, including payroll and cost accounting.

U.S. Department of the Interior

Located at Denver Federal Center, Bureau of Reclamation, Denver, Colorado, the drum-card system is used for engineering and scientific computations for problem arising in the investigation, design, construction, and operation of reclamation projects.

U.S. Treasury Dept., Internal Revenue Service

Located 10th and Constitution Avenues, Washington, D. C., there are three identical systems at Lawrence, Mass., Kansas City, Mo and Ogden, Utah. These are drum-card systems used for mathematical verification of income tax returns, computation of account balances and interest, computation of installments of estimated tax, payroll computations, computation of personnel and machine utilization reports, and computation of man-hour distribution reports.

American Airlines

Located at 100 Park Avenue, New York, New York, the drum-card system is used for commercial payroll

accounting, general accounting, statistical studies, and operations research problems.

Bridgeport Brass Company

Located at the Ground Floor, 30 Grand Street, Bridgeport 2, Conn., the drum-card system is used for payroll and payroll statistics; sales statistics, including customer sales reports, cost of sales reports, and tax reports; inventory, including mill products finished goods, Housatonic Avenue plant process, venetial blind strip and components finished goods; and cost accounting at the Housatonic Avenue Plant.

Convair, A Division of General Dynamics

Located at Convair, Fort Worth, Texas, the system is used for Material Project Status - Semi-weekly File Maintenance. Requires approximately 35 hours of 650 time weekly. Semi-weekly material transaction activity, together with applicable material item balance summary cards at the project level, are processed into the 650 to produce:

category and contract transfer detail activity cards, procurement notice detail activity cards, procurement change notice detail activity cards, procurement notice balance reporting cards, contract code error detail activity cards, purchase parts below minimum reporting cards, internally initiated project transfer activity updates the item balances at the project level without producing output detail activity cards, daily transaction activity detail cards priced at standard unit price, updated material item balance summary cards representing effect of input transaction and also internally initiated transactions. Material Project Status Report - Dollars, Monthly:

Requires approximately 21 hours of 650 time monthly.

Photo by U.S. Bureau of Reclamation Denver

Material item balance summary cards at the project level, together with applicable master material cards containing standard unit price, realization factors, and class/DMS codes, are processed as of accounting closing to produce priced detail output deck reflecting standard value of the on hand, on order, open requirements (or order point), and status balances. Commercial/Production Consumption Minimum -Order Point and Economic Order Quantity Calculation, Monthly.

Requires approximately 28 hours of 650 time monthly.

Card decks representing current material item status, minimum - order point master data, and prior six month's usage are combined at the material item level and processed into type 650 to produce: update usage history, order point quantity adjustment detail cards, procurement notice detail activity cards, as applicable, reflecting recommended quantity to procure, procurement notice balance reporting card, on-call sub-purchase order detail activity cards, special notification detail cards, updated material item balance summary cards, commercial project status dollars cards, priced at standard unit price. Material On-Call Sub-Purchase Order, Monthly.

Requires approximately 2 hours of 650 time monthly.

Material on-call sub-purchase order detail cards, together with applicable on-call vendor name and address masters are processed to produce material on-call sub-purchase order vendor name and address detail cards. Material Sub-Stores Project Status, Monthly File Maintenance. Requires approximately 6 hours of 650 time monthly, material transaction activity pertaining to sub-stores, together with applicable material sub-stores item balance summary cards at the sub-stores level, are processed into the 650 to produce:

Sub-stores transfers, detail activity cards to replenish sub-stores, sub-stores zero stock notice detail cards, sub-stores special notification detail

cards, cashed sub-stores transfer detail activity cards, updated material sub-stores item balance summary cards representing effect of input transactions and also internally initiated transactions. Material Detail Parts, Shop Order Requisition Allocation, Monthly: Requires approximately 2 hours of 650 time monthly, card decks representing material cashed requisitions and shop order work order details, cashed requisition and shop order work order group summaries, and requisition master header card data are combined and processed into Type 650 to produce allocated work order summaries cards. Coding Final Labor Distribution, Weekly: Requires approximately 1-1/2 hours of 650 time weekly, this application assigns account numbers and sub-account numbers based on work order numbers and charged department. It also accumulates tenths of hours to develop "Whole Hours" totals. Common Cost Allocation, Monthly. Requires approximately 1 hour of 650 time monthly. Unidentified hours worked are allocated to work order numbers assigned to common cost distribution. Allocations are made based on the percentage of unidentified hours to the total hours charged to common cost work order numbers. Hourly Retirement Calculations, Yearly. Requires approximately 5 hours of 650 time yearly. Current year's retirement benefits (base and excess) are calculated based on hourly rate, hours worked, birth date, and hire date. Total retirement benefits are calculated to date. Master FR/PEO Schedules, Bi-weekly. Requires approximately 1/2 hour 650 time per schedule. Schedules show the estimated start and completion dates as forecasted by the Facilities Department in comparison to the actual dates recorded by the various departments responsible for completion. The schedules serve management as a guide to sequencing the start of jobs and close follow-up.

Photo by Bridgeport Brass Company Jack Stock Studio

The 650 is used for this job in order to take advantage of the "Selective Field" key punching technique, whereby only the individual changes need be key punched rather than a complete line entry.

Vendor Quality Performance Rating, Quarterly. Data regarding material and/or parts received from vendors, plus inspection rejection data, are accumulated perpetually. Every three months the previous twelve months's data is calculated, using probability factors to produce: ratings by vendor within a material group, ratings by product type, quality ratings based on effectiveness. The ratings developed by 650 are used as a guide to buying from vendors.

Quality Control Engineering Statistics, as Required. Requires approximately 1-1/2 - 2 hours of 650 time per week. Statistics are calculated using IBM 650 library programs and the "Bell Interpretive System." These programs are used in areas of process development, process analysis, process modification, process control, and departmental quality analysis. Calculations include: simple correlation analysis, multiple correlation analysis, frequency distribution, averages, and standard deviations, significance tests, average range charts, special analysis using "Bell" programming. Sub-Assembly Shop Ordering-Preparing of Travelers, as Required. Cards are pulled from manufacturing parts list deck by segment and lot as required. These cards are merged with a major component schedule (in punched card form) by item and indenture. The 650 determines and punches into sub-assembly travelers: manufacturing span time, start and completion dates, total quantity ordered, work order number, ship number. Control Assembly Parts List - Engineering Release, Daily. This system employs the "Selective Field" key punching method of up-dating a file of over 650,000 cards on a daily basis. Red pencil changes are entered on parts lists by engineering parts list group. Only the red pencil entries are key punched into "Change" cards and are

matched to the particular line entry by a line serial number. In some cases, a single change card may be used to correct several or even several hundred line entries. Debit and credit material cards are punched where the change affects material ordering. Control totals are prepared manually and balanced mechanically.

Tennessee Eastman Company

Located in Kingsport, Tennessee, the drum-core-card system is used for equipment design (includes pipe stress analysis, B.W.R. equation of state, network flow analysis, pressure vessel and shell head, heat exchanger, plate to plate analysis, and vapor liquid equilibrium), analysis of control laboratory, experimental, and historical data (includes evolutionary operation, time trend box method, Yates analysis of variance, forecasting by exponential smoothing, interplaner spacing of HKL plane, differential fourier synthesis, etc.), and commercial uses (includes construction work load, sales analysis exception basis, sales accounting summaries, operating labor scheduling).

The Emerson Electric Mfg. Co.

Located at 1567 Salzman Ave., Wellston, Mo., the system is used for engineering and scientific calculations together with data processing related to engineering tasks. Some specific items are missile trajectory calculations, heat transfer, aircraft-missile intercept, prediction of failure rates of complete electronic system and maintaining files of failure reports for reliability evaluation.

Cleveland Engine Plants, FOMOCO

Located in Cleveland Engine Plant No. 2, Brookpark, Ohio, the system is used for Payrolls and Labor, timekeeping records, hourly payroll reports, salary payroll reports, labor distribution, overtime equalization, personnel records, statistics. Production Control, computation of net requirements

Photo by Ford Motor Company APS and ERO

releasing, receipts, shipments, cycle count adjustments, inventory planning, cycle count control, productive mat. inventory, perished tooling. Cost Accounting, scrap analysis, Mfg. expense ledger, perpetual inventory, accounts payable, accounts receivable, accountable document control, purchase priority variances, direct labor performance, cost of sales production reporting.

Controllers's Office, Ford Motor Company

Located in the Controller's Office, Box 494, Dearborn, Michigan, the system is used for accounting, production control, quality control, plant engineering, and personnel.

Ford Motor Company, Advanced Product Study and Engineering Research Office

Located in the Scientific Laboratory and Research Bldg., Engineering & Research Staff, Dearborn, Mich, the system is used in computation relating to engineering design studies, largely in the field of mechanical engineering, and concerned with projection of system performance, stress analysis, vibration studies, gear design, vehicle suspension design analysis, structural rigidity, test data reduction, etc. Various "Basic Research" programs in atomic structure, heat transfer, magnetic properties also use this computer.

Harrison Radiator Division, General Motors Corporation

Located in Lockport, New York, the system is used for heat exchanger design program (main program). Representative sub-routines of this program are, plate fin geometry for cross flow, temperature check, core weight and volume, and regenerator and oil cooler modifications. Curve fit-quadratic (a series of six quadratic equations to plot the points of a curve). Analysis program, (a series of geometric programs to allow for computation from basic data to finished result of from finished result back to basic data).

Institute for Defense Analyses

Located in Room 1E871, Pentagon, Washington, D.C. The system is used for war-gaming procedures for evaluating weapons systems, cost accounting, and damage assessment problems.

Littauer Statistical Laboratory

Located at 94 Prescott Street, Cambridge, Mass. the drum-core-card-tape system is used for statistical problems such as frequency distributions, correlations, regressions, factor analyses, (principal axis, verimax, and oblimin rotations) sociograms, etc.

Michigan Bell Telephone Company

Located on the 1st Floor, 23500 Northwestern Hwy., Southfield, Michigan, the system is used for payroll (24000 employees), util. and cost reports of IBM equip., non-management wage survey, com'l work vol. meas. plan, annual mortality studies, general sales results, general planning forecasts (trunk est., etc.), shifting seas. var. and calendar shifts, linear correlation of time series, traffic point to point study, directory sales results and commissions, traffic Detroit Area Trunk Estimates, trunk adm. weekly results, dial loading report, message unit detail billing study, coil collection scheduling, and traffic observing results.

Olin Mathieson Chemical Corporation

Located at 275 Winchester Ave., New Haven, Conn., the system is used for fuels performance calculations, multi-component equilibria, free energy, isentropic expansion, flame temperature, mollier diagram, mechanical and thermal stresses, statistical analyses, regression analyses, planned experiments, least squares curves, theoretical crystal growth, heat transfer, production machine speed tables, thermo-couple temperature tables (Callendar Equipment).

Photo by Ohio Oil Company

The Prudential Insurance Company of America,
Electronics Research Division

Located at Newark, New Jersey, the system is used for ordinary insurance billing and accounting, agency records and debit insurance, district agencies payroll, mortgage loan accounting, valuation-actuarial, actuarial - statistical calculations.

RCA Service Company, EMEWS Project

Located at Griffiths Air Force Base, Rome, New York, the drum-card system is used for inventory control, reliability, monetary accounting, procurement, transportation, and engineering.

New York Stock Exchange

Located at 18 Broad Street, New York 5, N. Y., the system is used for verification, clearance and settlement of security transactions executed on the New York Stock Exchange. The operations facilitate the physical delivery of securities and payments of money related to security transactions. Services of S. C. C. are rendered to Clearing Members of the New York Stock Exchange and Member Banks of New York Clearing House Association.

Sun Oil Company

Located at the Marcus Hook Refinery, Marcus Hook, Penna., the system is used for refinery simulation to determine optimum method of operation, process calculation to establish operating conditions, chemical engineering design calculations, analysis instrument data reduction, and marketing statistical analysis.

Western Electric Company

Located at 77 South Wacker Drive, Chicago, Ill., the drum-core-disc-card-tape system is used for the preparation of payroll checks, distribution of payroll, analysis of deductions from pay, processing of cost and billing procedures, preparation of quarterly and year-end State, City and Federal Tax Reports, Pension

Pension Statistics and related payroll and deduction report data.

Colorado State University Computing Center

Located at Fort Collins, Colorado, plans to get an IBM 650 Summer 1960.

Columbia University

Located at Dobbs Ferry, New York, the drum-card system is used to assist theoretical and experimental research and for the processing of scientific data.

Cornell University

Located at the Dairy Records Processing Laboratory, Ithaca, New York, the computer and peripheral equipment are used to process monthly DHIA records for about 250,000 cows from 11 northeastern states. The computer is used about 50% of the time processing this material, 20% of it's time is spent doing routine analyses such as evaluating sires used in artificial insemination and preparing other research material to be distributed to the DHIA membership involved in the program. The remaining time is utilized in basic and applied research in quantitative genetic, this effects environment and management on dairy production and other analyses of a statistical nature.

Indiana University

Located at the Research Computing Center, Bloomington, Indiana, the system is used for almost all phases of University Research make use of the Center's facilities. The following are some of the major fields of research using the computer: astronomy: stellar interiors and stellar atmospheres. Chemistry: quantum mechanics, x-ray diffraction. Business and Economics: surveys of markets, executive games. Mathematics: numerical analysis. Psychology: mathematical model studies. In addition, the

departments of Political Science, Sociology, and the School of Education make great use of the Center.

Marquette University

Located in the Computing Center, Milwaukee, Wis., the drum-card system is used for research problems from all fields of university endeavor and for student education in programming.

Stanford University

Located at the Computation Center, Stanford, Cal., the drum-card system is used for the range of interests of an academic community.

Syracuse University

Located at the Computing Center, 112 Hinds Hall, Syracuse University, Syracuse 10, New York, New York, the system is used for Mathematics: procedures for solving high order complex polynomial equations. Chemical Engineering: explosion pressure calculation. Economics: evaluation of Cobb-Douglas Production for USA and USSR Data. Industrial Engineering: shop scheduling study (Thesis). Industrial Engineering: Statistical Quality Control Study (Thesis). Education: prediction of reading skills. Civil Engineering: analysis of errors in aerial photogrammetry. Electrical Engineering: effect of the presence of ferrite posts in waveguides (sponsored). Psychology: study of new ability measuring index (Thesis). Industrial Engineering: calculation of interest factors. Industrial Engineering: reliability of estimates in economics problems (Thesis). General Elect.: Probability of radar tracking of missiles (sponsored by General Electric). Chemical Engineering: study of the Van Laar Equation (Thesis). Niagara Mohawk: study to find optimum operation of a hydroelectric plant (sponsored by Niagara Mohawk). Business Statistics: study of production indices. Physics: relaxation rates. Mathematics: analysis of cosmic ray data (Thesis). Psychology: study of non-linear discriminant functions (Thesis).

Photo by Socony Mobil Oil Company, Incorporated

Elect. Engineering: mutual impedance between individual elements in a large antenna array (sponsored by Rome Air Development Center). Sociology: prediction of hospital prognosis from social factors. Niagara Mohawk: study of gas distribution and transmission systems (sponsored by Niagara Mohawk). Radio-Television: analysis of audience characteristics of viewers and non-viewers of an educational television program series, "Books and Ideas"-----Determination of factors predicting television program success (sponsored by Schwerin Research Corp. of NYC). Psychology: juvenile delinquency study (sponsored by U. S. Office of Education). Smith Corona: Determination of sales quotas (sponsored by Smith-Corona). Bacteriology and Botany: wholesomeness of irradiated foods (sponsored by Army Surgeon General's Office). Education: verbal problem skills in arithmetic (Thesis). Sociology: analysis of community influence systems. Preventive Med. College of Med.: Toxoplasmosis study (sponsored by State of New York). Elect. Engineering: power loss study (sponsored by Niagara Mohawk). Elect. Engineering: study of examination techniques in electrical engineering. Elect. Engineering: study of interpretive coding scheme with reference to electrical engineering requirements.-----preliminary study of linear arrays with non-uniform spacing. Elect. Engineering: Fourier Integral Transform Study (Thesis). Education: relation of selected non-intellectual factors to Over - and Under-Achievement in Several College Groups (Thesis). Pediatrics Dept. College of Med.: characteristics of autonomic nervous system function in new born and young infants (sponsored by the State of New York). Elect. Engineering: transformer rating (sponsored by Niagara Mohawk). Psychology: juvenile delinquency study (Thesis).

Photo by Socony Mobile Oil Company, Incorporated

Psychology: background factors and correlates of achievement motivation (Thesis). Elect. Engineering: near-zone antenna field synthesis (sponsored by General Electric). Traffic Commission: ordering of information provided by student traffic cards at S.U. Society of American Foresters, College of Forestry: study of education in forestry and related fields of natural resources management (sponsored by Society of American Foresters). College of Lib. Arts, Office of the Dean: study of the transfer student in the College of Liberal Arts. Elect. Engineering: antenna arrays (sponsored by Rome Air Development Center). Eckerlin and Klepper: study of moment distribution in connection with the design of new dormitory construction at Syracuse University (sponsored by Eckerlin and Klepper). Physics: optical modes in calcite and arafonite crystals (Thesis). Electrical Engineering: computation to obtain graphical representation of equipotential lines outside an elliptical electron beam (sponsored by NSF). Civil Engineering: photographic coordinate measurement errors and their effect on tilt and resection (Thesis). Special Education: Statistical study of results of series of verbal and non-verbal tests given to school children (sponsored). Dept. of Microbiology, College of Med.: population genetics study (sponsored by State of New York). Forest Management, College of Forestry: the predictive validity of two tests with forestry students at Oregon State College (Thesis). Physics: study of bubble chamber tracks (sponsored by AEC). Economics: income distribution (Thesis). Youth Development Center: a study of the characteristics of apprehended juvenile delinquents in Onondaga County (sponsored). Business Administration: management games. Univ. of Hawaii: analysis of sugar cane growth (sponsored by Hawaiian Commercial Sugar Company).

Mathematics: study of prime numbers. Dept. of Chemical Engineering, College of Forestry: dilute solution properties of polymers (sponsored by Soc. of Am. Foresters). Mathematics: computational experiments with the conjugate gradient method and other related methods for the solution of systems of linear equations. Niagara Mohawk: evaluation of the place of nuclear power among the power-generating resources (sponsored by Niagara Mohawk). The term "sponsored" indicates financial aid in part or in full from a source outside of Syracuse University.

Problems listed for Niagara-Mohawk, General Electric and Smith Corona indicate a cooperative arrangement between the Syracuse University Computing Center and the Syracuse Community as a whole. Computing time on our machine is provided occasionally for such companies for problems of a research (non-production) nature if time is available at no sacrifice to University users.

University of Houston

Located at the Computing and Data Processing Center, University of Houston, Houston 4, Texas, the drum-card system is used for education and research in all areas where a computer is useful.

Vanderbilt University

Located in Wesley Hall, Vanderbilt University, Nashville, Tennessee, the system is used in the research field by the physics, chemistry and astronomy and engineering students for calculations to be used in their theses. Various members in the science departments have used it for problems pertaining to private research work. The medical school has made some use of it, in particular the radioisotope section which uses a routine to interpret the information from their analyzer and calculate the amount of potassium in the human body.

The machine has been utilized more for statistical work than any other type of calculations. The psychology, sociology, and economics departments have been most active in this way.

For education the machines have been used in the conducting of classes in programming and computing for any interested members of the university community.

Yale University

Located at the Computing Center, 135 Prospect Street, New Haven, Connecticut, most of the work is done in physics and social sciences by staff members of these departments and by graduate students in these departments doing work toward their degrees. A drum-card system is used.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system Decimal
 Decimal digits/word 10 plus sign
 Instructions/word 1
 Instructions decoded 89
 Arithmetic system Fixed point (standard)
 Floating point is an optional feature (2 digit character, 8 digit mantissa and sign)
 Instruction type One address
 Modified to include location of next instruction
 Number range $-10^{10} < a < 10^{10}$

Instruction word format

1	2	3	6	7	10
Sign	Oper	Code	Data Address	Location of Next Instruction	

Photo by Western Electric Company, Omaha

Soap, Fortran, assorted customer programs for general problems (utility routines, etc.) and programs for specific industry needs (engineering, petroleum, etc.).

Registers and B-boxes include distributor, upper and lower accumulators, and three index registers.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	Variable	288(Optimized)
Mult	Variable	2,210-19,600 10,000(Optimized)
Div	Variable	6,000-23,400 12,000(Optimized)
Construction (Arithmetic unit only)		
Vacuum Tubes Type	Quantity	
6350	208	
5965	122	
6211	132	
5687	7	
Diodes Type		
AP	499	
Transistors	0	
Condensers	231	
Arithmetic mode	Serial by character	
Timing	Synchronous	
Operation	Sequential	

STORAGE

Manufacturer		
Media	No. of Words	Access Microsec
Magnetic Drum	2,000 or 4,000	96 min 4,800 max
Magnetic Core	60	96
Magnetic Tape	500,000 per unit	800,000 max/60 words
Magnetic Disk RAMAC (650)	600,000	
Magnetic Tape		
No. of units that can be connected		6 Units
No. of char/linear inch of tape		200 Char/inch
Channels or tracks on the tape		7 Tracks/tape
Blank tape separating each record		1.5 Inches
Tape speed		75 Inches/sec
Start time		10.8 Millisec
Stop time		10.8 Millisec
Average time for experienced operator to change reel of tape		180 Seconds
Physical properties of tape		
Width		0.5 Inches
Length of reel		2,400 Feet
Composition		Ferrous coated acetate or mylar
Mylar is DuPont's registered trademark for its polyester film.		

INPUT

Manufacturer	
Media	Speed
Cards	200 or 250 cards/min
Magnetic Tape	15,000 char/sec
150 cards/min may be read from read feed of Type 407 Accounting Machine when attached. A 10-word input buffer is provided which allows computation to proceed for 272 millisec of the 300 millisec necessary to reach a card. A 60-word magnetic core buffer is available between magnetic tape and the magnetic drum. Each of these words of core is addressable between	

Photo by U. S. Army Engineer Supply Control Office

the magnetic tape and the magnetic drum. Each of these words of core is addressable and can be used for rapid access storage when not reading or writing magnetic tape (96 microsec per word access). Tape from IBM 702, 704 or 705 Systems can be read by this tape unit. Rewind time for 2,400 feet of tape is 1.2 minutes. The IBM 650 (RAMAC) (355) and the IBM 650 (Tapes) utilize a 537 Read-Punch Unit operating at 155 cards/minute.

OUTPUT

Manufacturer	
Media	Speed
Cards	100 or 250 cards/min
Magnetic Tape	15,000 char/sec
Line Printer (wheel type)	150 lines/min 120 char/line

A 10-word output buffer is provided which allows computation to proceed for 565 milliseconds of the 600 milliseconds necessary to punch a card. A 60-word magnetic core buffer is available between the magnetic tape and the magnetic drum. Each of these words is addressable and can be used for rapid access storage when not reading or writing magnetic tape (96 microseconds per word access). Printer connected directly to main frame of computer through a 10-word print buffer. Printer connected to magnetic tape frame, independent of computer. The IBM 650 RAMAC and IBM 650 Tape Systems utilize a 537 Read Punch Unit with a speed of 155 cards/minute.

DEMONSTRATION - Dr. James E. Scroggs, computing center supervisor at the University of Arkansas, shows Larry David of Beebe, an engineering student, how the new IBM 650 Computer works. The computing center at the University is the only one in Arkansas. (Caption furnished by U. of Arkansas)

Photo by University of Arkansas

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Tubes	
6350	545
5965	269
6211	296
5726	107
5687	148
12AY7	11

Type	Quantity
Diodes	
F	3,302
AP	639
J	2
Transistors	0
Magnetic Cores	3,600

For a RAMAC 650 with 4 disk units and 6 magnetic tape units, the total system requirement is tubes 5,467; diodes 11,428; transistors 211; and magnetic cores 3,600.

CHECKING FEATURES

Manufacturer

Validity character check (data and instructions), non-existent addresses and order codes, double punch and blank column, overflow of accumulator, divide check, horizontal and vertical parity checks on magnetic tape, magnetic tape to card check.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer

Power, computer	17.7 KVA
Volume, computer	270 cu ft
Area, computer	45 sq ft
Weight, computer	5,656 lbs
USA SCO	
Power, computer	77.8 KVA
Power, air conditioner	15.0 KVA
Volume, computer	15,030 cu ft
Area, computer	1,503 sq ft
Room size, computer	17 ft x 69 ft plus 15 ft x 22 ft
Floor loading	19 lbs/sq ft
	200 lbs concen max
Capacity, air conditioner	25 Tons
400 ampere, 4 wire, 3 phase, 60 cycle, 208 volt power supply. Exhaust hoods and ducts on 650, 655, 652, 653, 774. Filter bank. Ductwork connecting	

Photo by Georgia Institute of Technology RECC

existing two ten ton air conditioners to computer room. Two internal partitions removed.

USA Phila QM Depot

Power, computer Tape 650	52.6 KVA
Volume, computer	1,902 cu ft
Volume, air conditioner	21,000 cu ft
Area, computer	317 sq ft
Area, air conditioner	15,000 sq ft
Room size, computer	40 ft x 80 ft
Room size, air conditioner	100 ft x 50 ft
Floor loading	54 lbs/sq ft
	186 lbs concen max
Capacity, air conditioner	60 Tons chilled water
Weight, computer	17,070 lbs
Computer Room Floor	\$ 7,591
Air Conditioning	46,340
Installing I Beams	1,518
Plate Glass Windows	450
Preparation	4,733
Ceiling	1,442
Lighting	3,351
Power	7,498
Cables & Fittings	1,100
Plumbing	170
Plaster	1,022
Total	\$75,215

Air conditioner used to cool computer room is a 60 ton chill water unit using a 60 HP motor to drive compressor, 15 HP motor to drive condenser and several

3 HP units to drive water pumps. This air conditioner is located in a room with a 75 ton unit used to cool the EAM Division. The size of the air conditioning room is approx. 50 ft. x 100 ft. The floor is concrete. The computer air conditioner is designed in such a way that should it fail, the 75 ton unit will cut off from the EAM room and convert conditioning to the computer room.

USN AF

Power, computer	39.4 KVA	
Volume, computer	408 cu ft	
Area, computer	71.8 sq ft	
Room size, computer	552 sq ft	
Floor loading	24 lbs/sq ft	
	900 lbs concen max	
Weight, computer	13,370 lbs	

Hood and blower system constructed and installed in ceiling for heat take-off.

USAF San Bernardino AMA

Power, computer	23 Kw	16.8 KVA	0.86 pf
Power, air cond	40 Kw	50 KVA	0.80 pf
Volume, computer	196.4 cu ft		
Area, computer	36.4 sq ft		
Room size, computer	300 sq ft		
Floor loading	290 lbs/sq ft		
Capacity, air conditioner	50 Tons		
Weight, computer	6,263 lbs		
Weight, air conditioner	10,500 lbs		

Site preparation included modification of approximately 1,320 sq. ft. of a permanent type warehouse. The modification consisted of installation of ceiling height partitions, voltage regulators, distribution panels, 50 TR air conditioner on roof of building and necessary duct work. Air conditioning system used jointly with Burroughs 205 Computer System.

Photo by Indiana University

USAF Hq SAC

Power, computer	36.1 Kw	62.7 KVA	0.85 pf
Volume, computer	9,600 cu ft		
Area, computer	1,200 sq ft		
Room size, computer	28 1/2 ft x 42 ft		
Floor loading	22.5 lbs/sq ft		
	2,972 lbs concen max		
Weight, computer	21,720 lbs		
Weight, air conditioner	1,500 lbs		

Installation of a pedestal floor. Air conditioning plenum. Extension and distribution of existing building power source. Installation of two wall panels of power circuit breakers in the computer area. Installation of a small "air handler" to augment the regular main building air conditioning system. Air conditioner is the main building system.

American Airlines

Area, computer	400 sq ft
Weight, computer	6,198 lbs

Motor driven ventilating fan with exhaust hoods.

Bridgeport Brass Co.

Power, computer	17.6 Kw	17.7 KVA
Volume, computer	194.7 cu ft	
Volume, air conditioner	48 cu ft	
Area, computer	36.1 sq ft	
Area, air conditioner	6 sq ft	
Room size, computer	50 sq ft	
Floor loading	100 lbs/sq ft	
	1,000 lbs concen max	
Weight, computer	5,491 lbs	

Power outlets provided and air conditioner installed.

Tennessee Eastman Co.

Power, computer	29.4 Kw	35.9 KVA	0.82 pf
Power, air cond	6.5 Kw	7.34 KVA	0.88 pf
Volume, computer		271 cu ft	
Volume, air conditioner		3,000 cu ft	
Area, computer		49 sq ft	
Area, air conditioner		250 sq ft	
Room size, computer		450 sq ft	
Room size, air conditioner		400 sq ft	
Floor loading		200 lbs/sq ft	
		1,000 lbs concen max	
Capacity, air conditioner		37 Tons	
Weight, computer		9,135 lbs	
Weight, air conditioner		8,500 lbs	

Installed in existing office building. Added a raised floor, separate air conditioning equipment with air supply from ceiling and from floor. Also separate power panel.

Ford Motor Co.

Volume, computer		348 cu ft	
Volume, air conditioner		80 cu ft	
Area, computer		53 sq ft	
Area, air conditioner		10 sq ft	
Room size, computer		500 sq ft	
Floor loading		150 lbs/sq ft	
		160 lbs concen max	
Capacity, air conditioner		7 1/2 Tons	
Weight, computer		8,200 lbs for the 650, 655, 533, and 407	
Weight, air conditioner		600 lbs	

Photo by University of California LRL

Prefabricated steel and glass partitions to enclose 500 sq. ft. area. Power lead in. Fresh air intake to implement the closed - circuit air conditioner. Water intake and outlet for air conditioner. Air conditioner is a standard York 7.5 Ton unit.

Littauer Stat. Lab.

Power, computer	15 Kw	17.7 KVA	0.840 pf
Volume, computer		218 cu ft	
Area, computer		38 sq ft	
Room size, computer		37 ft x 17 ft	
Floor loading		165 lbs/sq ft	
		1,500 lbs concen max	
Capacity, air conditioner		5.25 Tons	
Weight, computer		6,263 lbs	
Weight, air conditioner		400 lbs	

Western Electric Co.

Power, computer	71.8 Kw	90 KVA	0.8 pf
Power, air cond	40 Kw	50 KVA	0.8 pf
Volume, computer		12,000 cu ft	
Volume, air conditioner		3,000 cu ft	
Volume, total		15,000 cu ft	
Area, computer		1,500 sq ft	
Area, air conditioner		300 sq ft	
Area, total		1,800 sq ft	
Room size, computer		30 ft x 50 ft	
Room size, air conditioner		15 ft x 20 ft	
Room size, total		36 ft x 50 ft	
Floor loading		27 lbs/sq ft	
		100 lbs/sq ft concen max	
Capacity, air condition		28 1/2 Tons	

Weight, computer 32,930 lbs
 Weight, air conditioner 5,500 lbs
 Raised flooring, wood and glass partitioned room,
 air conditioner room; constructed in a brick and
 steel building.

Columbia Univ.
 Installed on existing reinforced-concrete floor.
 Marquette Univ.

New power line distribution installed.
 Stanford Univ.

Volume, computer 300 cu ft
 Volume, air conditioner 1,225 cu ft
 Area, computer 50 sq ft
 Area, air conditioner 175 sq ft
 Room size, computer 225 sq ft
 Room size, air conditioner 250 sq ft
 Capacity, air conditioner 40 Tons

Renovate existing 70-year-old stone building; re-
 move partitions; poured slab floor with raceways;
 no structural modifications. Air conditioner is
 shared with a Burroughs 220 and EAM.

Univ. of Houston
 Nothing special, except power supply. (System is
 located in a room originally designed for a small
 TV studio.)

Yale Univ.
 Power, computer 16.8 KVA
 Volume, computer 196 cu ft
 Volume, air conditioner 120 cu ft
 Area, computer 36 sq ft
 Area, air conditioner 20 sq ft
 Room size, computer 800 sq ft
 Floor loading 150 lbs/sq ft
 Capacity, air conditioner 20 Tons
 Weight, computer 5,400 lbs
 Weight, air conditioner 1,000 lbs

PRODUCTION RECORD

Manufacturer
 Time required for delivery 8 months

COST, PRICE AND RENTAL RATES

Basic	Manufacturer Rent/Month (Incl Maintenance)	Purchase	Maint. Per Month
650 Console	\$2,400	\$115,000	\$185.00
655 Power Supply	800	42,400	34.25
533 Card Read Punch	550	25,000	52.75
Additional Equipment			
652 Tape and/or File Control Unit (7 Models)	\$ 975-\$1,950	\$46,800-\$93,600	\$46.75-\$97.50
653 Core Storage Unit (11 Models) (With or w/o Index Register and Floating Point)	1,050- 2,425	57,750-133,400	28.50- 81.75
727 Magnetic Tape Units (6 maximum)	550	18,200	119.00
355 Disk Storage (4 maximum) - 2 models	975	62,200	194.00
	1,500	74,800	306.00
838 Inquiry Station (10 maximum)	175	7,500	28.00
654 Auxiliary Alphabetic Unit (4 models)	470- 950	28,700- 57,300	23.50- 54.75
537 Card Read Punch	700	40,000	53.50
407 A/C Machine (with Sync.)	1,000	51,000	132.00
543 Card Reader	325	14,650	29.25
544 Card Punch	475	20,250	31.50
655 Power Supply (2 additional models)	1,100	58,300	46.00
	1,400	74,200	58.00

USA ESCO
 Basic System
 The 650, 655, 543, 544, 797, 653, 652, 727 (7), 654,
 774, 747, 407, and 519 rent at \$16,548/month.

Additional Equipment
 The 024, 026, 056, 066, 068, 082, 083, 077, 087, 407,
 519, 523, 528, 548, and 602 rent at \$8,000/month.

Maintenance is included in rental.
 USA Richmond QM Depot
 Type 650 Machine No. 800
 Components special devices and total approximate cost

Type 650 Basic System	\$2,400
1 table lookup on equal at \$25 ea.	25
1 basic minus circuitry at \$16 ea.	16
1 set format at \$70 ea.	70
1 modified branch on distributor at \$9 ea.	9
Type 533 Card Read Punch w/special devices	868
Type 652 Control Unit	1,350
Type 653 H. S. Storage Unit	1,975
Type 655 Power Unit w/Alph. Synchronizer	875
4 Type 355 Disk Storage at \$975 ea.	3,900
5 Type 727 Tape Unit at \$550 ea.	<u>2,750</u>

Total monthly rental for components and devices \$14,238

Type 650 Machine No. 700
 Components and special devices and total approximate cost

Type 650 Basic System	\$2,400
1 table lookup on equals	25
1 basic minus OP code	16
1 set format	70
1 modification branch on distributor	9
Type 652 Tape Control and Power Unit	1,050
Type 653 High Speed Buffer Storage (with RAMPC circuits)	1,990
Type 655 Power Unit w/Alph. Synchronizer	875
4 Type 727 Tape Units at \$550	2,200
Type 533 Card Read Punch-w/devices	868
Total monthly rental	<u>\$9,503</u>

Additional Equipment and Total Approximate Cost	
Type 774 Tape Data Selector w/file search	\$2,500
Tape Data Selector Power, Type 747	500
Type 727 Tape Unit	550
Type 407 Accounting Machine w/devices	1,010
Doc. Orig. Machine	<u>210</u>
Total monthly rental	<u>\$4,770</u>

USN AF
 Basic System
 650 Mdl. 2, 653 Mdl. C2, 727 Mdl. 1 (2), 533 Mdl. 1,
 652 Mdl. a1, and 655 Mdl. 1 rent at \$7,925/month.

Additional Equipment
 Alpha. Device, Addn. Special Characters and Alpha.
 Device Synch. rent at \$350/month.

USN Bureau of Naval Weapons
 Basic System Monthly Rental
 650 Magnetic Drum Processing Unit \$2,486
 655 Power Unit 875
 533 Card Read Punch 946
 652 Tape Control Unit 1,050
 653 Storage Unit 2,425
 654 Alphabetic Unit 690
 727 Magnetic Tape Unit 550
 727 Magnetic Tape Unit 550
 727 Magnetic Tape Unit 550
 727 Magnetic Tape Unit 550
 727 Magnetic Tape Unit 550
 727 Magnetic Tape Unit 550
 \$11,772

Additional Equipment Monthly Rental
 774 Tape Data Selector \$2,500
 747 Tape Data Selector, Power Unit 500
 407 Accounting Machine, Model B3 1,030
 519 Document Originating Machine 234
 727 Magnetic Tape Unit 550
 \$4,814

USAF Hq MAAMA, Olmsted AFB
 Component Basic Rental Add Equip Cost Total Rental
 Console, Mdl 2 w/t \$2,400 \$100 \$2,500
 Control Unit for Tapes, Mdl A1 1,050 - 1,050
 Stor Unit Mdl C3 1,975 - 1,975
 Aux Alpha Unit, Mdl 4 950 13 963
 Power Unit, Mdl 2 1,100 150 1,250
 Tape Unit, Mdl 1 550 - 550
 Tape Unit, Mdl 1 550 - 550
 Tape Unit, Mdl 1 550 - 550
 Tape Unit, Mdl 1 550 - 550
 Tape Unit, Mdl 1 550 - 550
 Card Read Punch 550 353 903
 Card Read Punch 550 353 903

System No. 2 Total Basic Rental Cost \$4,293
 Rental rates for additional equipment

Additional Equipment Rental Cost
 Aux. Synchronizer \$100
 Total Console Add Equip Cost \$100
 12 Word Switch 13
 Total Aux Alpha Add Equip 13
 Alph Dev Synchronizer No. 1 75
 Alph Dev Synchronizer No. 2 75
 Total Power Unit Add Cost 150
 Alphabetic Device 175
 6 dhl punch blk col detection 48
 2 grps Rd, Pch cards selectors 20
 2 grps 5-2 Pos Pilot selectors 20
 Half-time emitter Rd & Pch Feed 10
 2 grp 4-5 Pos Co-selectors 10
 Special Char 11 & 12 only 25
 Aux. Alpha Modification 45
 Total Card Rd Pch Add Equip Cost 353
 6 grps double pch blank col detection 48
 2 grps 5-2 Pos Pilot selectors 20
 2 grps 4-5 Pos Co-selectors 10
 Half-time emitters, Rd & Pch Field 10
 2 grps Rd and Pch Selectors 20
 Alphabetic Device 175

Aux. Alpha Modification 45
 Special Char 11 & 12 only 25
 Total Card Rd, Pch Add Equip Cost 353
 USAF San Bernardino AMA Monthly Rental
 Type Description Prime Shift
 650 Central Processing Unit \$2,400
 655 Power Unit 990
 533 Input Output Unit 883
 \$4,273

USAF Hq SAC
 The system consists of:
 650 Console Model 2
 652 Control Unit Model C1
 653 Storage Unit Model C3
 654 Aux. Alpha Unit Model 2
 655 Power Unit Model 1
 727 Mag. Tape Unit Model 1
 747 Tape Data Selector Power
 774 Tape Data Selector
 The monthly rental is \$17,293.
 American Airlines
 The computer, card read-punch, and power unit rent
 at \$4,000.10/month.

Bridgeport Brass Co.
 Basic System Cost Monthly Rental
 650 Model 2 Console \$150,000 \$2,400
 533 Read-Punch 25,000 780
 655 Power Unit 42,400 875
 Total \$217,400 \$4,055

Additional Equipment
 652 Model A1 Control Unit \$50,400 \$1,050
 727 Model 1 Magnetic Tape 18,200 550

Tennessee Eastman Co.
 Basic System
 The 650 Console Unit, 655 Power Unit, 533 Card Read-Punch sells for \$217,400 and rents at \$4,600/month.
 Additional Equipment
 The 653 Storage Unit, immediate access storage, automatic floating point, index accumulators and mode switch, 533-655 Alpha Device, extra selectors and special features cost \$154,900 and rents at \$2,944 per month.
 Maintenance is included in rental contract - approximately \$536/month.
 Ford Motor Co.
 The IBM 650, 533, 407, and 655 rents at \$5,800/month.
 Littauer Stat. Lab
 The IBM 650 rents at \$1,662/month. All other machines from key punch to tabulator rent at \$528/month.

RCA Service Co., BMEWS Project
 Model Description Monthly Charge
 650 Console \$2,400
 655 Power Unit 800
 14 Synchronizer 75
 E91844 Min. works 11 & 12, 7 & 8 115
 533 Read Punch Unit 550
 13 Alpha Feature 175
 300 DPBC Detection (6) 48
 705 Co-Selectors (2) 10
 729 Read and Punch Code Selectors (2) 20
 323 Emitter (Read Feed) 5
 776 Spec. Char. Feature 25
 E91844 Input 30
 407 Accounting Machine 920
 54 Automatic Control (2) 10
 899 Zero & Spec. Char. Control (4) 40
 514 Reproducing Punch 125
 328 Punch Emitter 3
 201 Class Selectors (2) 8
 551 M/S Punch Feed 50
 807 Collator 245
 RPQ88506 75
 83 Sorter 110

26	Alpha Sorting	15
65	Card Counter	7
774	Sort Suppression	2
557	Alpha Interpreter	165
628	Proof Device	30
606	Print Entry Control	5
325	Emitter	3
780	Spec. Char. Printing	10
		<u>\$6,096</u>

Western Electric Co.

The 650 (1) - \$2,400; 655 (1) - \$1,250; 533 (1) \$833; and 407 (1) - \$1,240 are rented.
 The 653 (1) - \$1,975; 355 (1) - \$975; 774 (1) - \$2,400; 519 (1) - \$258; 407 (1) - \$1,023; 727 (6) - \$3,300; 652 (1) - \$1,350; 747 (1) - \$500; and 727 (1) - \$550; are rented.

Columbia Univ.

The 650, 533, 655, Floating Point, Indexing, Alphabetic, and Special Character rent at \$67,200/year, total.

The 407, 026, 026, 080, 077, 519 rent at a total of \$14,500/year.

Marquette Univ.

The IBM 650, 533, 2 keypunches, reproducer, and printer rent at \$1,850/month.

Stanford Univ.

The 650, 655, and 533 rent at \$2,400 + 875 + 780 per month less 60% educational contribution.

The 402 rents at \$430 per month, less 60% educational contribution.

Maintenance is included in rental.

Univ. of Houston

IBM 650 with alphabetic and special characters, 026 collator, 407 reproducer.

Yale Univ.

4 keypunches (026), 1 reproducer (519), 1 tabulator (407), 1 collator (087), 1 interpreter (557), 1 sorter (082), and 1 statistical sorter cost \$39,000 (including 60% discount).

The 650 drum unit, power unit, read punch unit rents at \$4,000/month (less 60% educational discount).

\$938/month less discount for special character device, additional selectors, half time read emitter, digit set punch feed, additional double punch detection units.

Maintenance included in rental.

PERSONNEL REQUIREMENTS

Manufacturer

Complete programming and advanced programming training available as well as individual installation assistance.

USA ESCO

	1st 8-Hour Shift	2nd 8-Hour Shift	3rd 8-Hour Shift
Supr & Adm	16	2	1
Analysts	5		
Programmers	32		
Clerks & Sec.	13	3	2
Librarians	1		
Operators	21	19	10
Engineers IBM			
In-Output Oper	2	2	2

Operation tends toward open shop.

Methods of training includes IBM schools and on-the-job training.

USN AF

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Analysts	7	7
Programmers	2	2
Operators	1	1

Operation tends toward closed shop.

Methods of training used includes manufacturer's training classes, on-the-job training, and special "on station" classes for symbolic coding.

USAF San Bernardino AMA

SBAMA EDP personnel requirements support the logistical mission. Additional personnel support the PCAM effort. PCAM is utilized in an integrated data processing system to provide extra off-line capability. Coders are included in the programmer category.

Because of the varying quantitative effect and diverse character of the workload in the AMC logistical support, an inflexible recommendation of personnel was not attempted. Cross-trained personnel qualified to employ techniques in various computer configurations provide system flexibility.

Engineers and technicians to service and maintain the EDP equipment are provided on a contractual basis by the manufacturer concerned.

Extra shift time for analysts, programmers and clerks is not on a regularly scheduled basis. Whenever the workload demands, personnel hours are specially scheduled.

System analysis, development and programming staff operate on one 8-hour daily shift, 5 days per week. Computer operations staff work on three 8-hour daily shifts, 7 days weekly. Supervision is included under Burroughs 220 Computer System operations staff.

Operation tends toward closed shop.

Methods of training used includes formal training by manufacturer and on-the-job training.

USAF Hq SAC

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	2	2
Analysts, Programmers & Coders	11	10
Clerks	-	1
Librarians	-	2
Operators	5	10
Engineers	2	3

Operation tends toward closed shop.

Methods of training used includes manufacturer's instruction classes, on-the-job training, and internally conducted instruction classes.

U. S. Dept. of Interior

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	
Analysts	5	
Operators	1	
Engineers		IBM

Operation tends toward combination open and closed shop. Some engineers in design branches write their own programs with assistance from the Engineering Applications Section of the Automatic Data Processing Branch. The Engineering Applications Section also prepares programs and makes production calculations on a closed shop basis for many design and project offices.

Design engineers of some years experience in the Denver office are detailed to the Engineering Applications Section for 90 days to learn computer capabilities, problem formulation, and programming and coding techniques. Younger engineers spend 90 days in the Section on Rotation Schedules. Filed personnel are detailed to the Section to learn requirements for the preparation of field data as well as basic computer techniques.

American Airlines

One 8-Hour Shift
 Programmers 1
 Operators 1
 Operation tends toward open shop.
 Methods of training used are on-the-job training supplemented by classroom, and instruction provided by the vendor.

Bridgeport Brass Co.

One 8-Hour Shift
 Used Recommended
 Supervisors 2 2
 Analysts 3 3
 Programmers 2 2
 Clerks 2 2
 Operators 1 1

Operation tends toward open shop.
 Methods of training used includes on-the-job, equipment manufacturer's schools, and college courses.
 Tennessee Eastman Co.

One combined EAM and computer operations supervisor, one machine methods supervisor, one applied mathematics supervisor. It is hoped that translators will be developed to the state that coders will not be required. The clerk controls data and schedules use. Three operators trained so we can operate 24 hours per day if necessary. Service is supplied by manufacturer. We operate and pay rental based on 176 hours per month as one shift rather than the standard 8 hours per day shift.

We do not feel that the present size of our staff is ideal for us or anyone else. It would not be practical to obtain as large a staff as would be needed to study all problems simultaneously.

One 8-Hour Shift
 Supervisors 3
 Analysts 4
 Programmers 4
 Coders 2
 Clerks 1
 Operators 3

Operation tends toward closed shop.
 Methods of training used includes manufacturer training courses and on-the-job training.
 Littauer Stat. Lab

Two 8-Hour Shifts
 Used Recommended
 Supervisors 2 2
 Analysts 3 5
 Programmers 10 8
 Clerks 2 2
 Librarians 1 1
 Operators 2 2
 In-Output Oper 1 -

Operation tends toward open shop.
 Methods of training used includes on-the-job training along with some introductory SOAP and FORTRAN classes at IBM.

Western Electric Co.

One 8-Hour Shift
 Used Recommended
 Supervisors 1 1
 Programmers 4 4
 Clerks 1 1
 Librarians 1 1
 In-Output Oper 2 2

Methods of training used include IBM 650 class, systems analysis, industrial engineering, and work simplification.

Columbia Univ.

Two 8-Hour Shifts
 Used Recommended
 Supervisors 1
 Programmers 5 6
 Operators 1

Operation tends toward open shop.
 Methods of training used includes IBM sponsored classes and practical experience.

Marquette Univ.

One 8-Hour Shift
 Used Recommended
 Supervisors 1 1
 Analysts 1 1

Operation tends toward open shop.
 Univ. of Houston

One 8-Hour Shift
 Supervisors 1
 Analysts 1.5
 Programmers 1
 Clerks 2
 Operators 1

Operation tends toward open shop.
 Yale Univ.

One 8-Hour Shift
 Used Recommended
 Supervisors 1 -
 Analysts - 1
 Programmers 3 2
 Coders - 3
 Clerks (student aides) 3 3
 Librarians 0 1
 Operators 0 1
 Engineers Supplied by IBM

Methods of training used includes classroom instruction by manufacturer, classroom instruction by staff of University, and occasional individual instruction.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

USA ESCO

Average error-free running period 40 Hours
 Good time 440.7 Hours/Mo. (Average)
 Attempted to run time 454.3 Hours/Mo. (Average)
 Operating ratio (Good/Attempted to run time) 0.97
 Above figures based on period from Oct 59 to May 60
 Passed Customer Acceptance Test Jul 57
 Time is not available for rent to outside organizations.

USN AF

Good time 33.5 Hours/Week (Average)
 Attempted to run time 34.3 Hours/Week (Average)
 Operating ratio (Good/Attempted to run time) 0.977
 Above figures based on period 1 Feb 60 to 31 Mar 60
 Passed Customer Acceptance Test 1 Jan 58
 Time is available to other government agencies and their contractors.

USN Portsmouth Naval Shipyard

Good time 77 Hours/Week (Average)
 Attempted to run time 81 Hours/Week (Average)
 Operating ratio (Good/Attempted to run time) 0.95
 Above figures based on period 1 Apr 60 to 30 Jun 60
 Passed Customer Acceptance Test Apr 56
 Time is not available for rent to outside organizations.

Average running period in which no machine failures are experienced is 38 hours. There has been no experience where the computer has produced erroneous data that has not been detected through machine check points. Scheduled preventive maintenance by the manufacturer's customer engineer amounts to 6 hours

weekly. The attempted to run time indicated above does not include test and debug time.

USAF SB AMA

Passed Customer Acceptance Test 1 Apr 60
Time is not available for rent to outside organizations.

USAF Hq AFSWC, Kirtland AFB

Good time 36 Hours/Week (Average)
Attempted to run time 40 Hours/Week (Average)
Operating ratio 0.90

Above figures based on period 1 Jan 60 to 1 May 60
Passed Customer Acceptance Test 1 Dec 55
Time is not available for rent to outside organizations.

USAF Hq SAC

Average error-free running period 100 Hours
Good time 134 Hours/Week (Average)
Attempted to run time 138 Hours/Week (Average)
Operating ratio 0.97

Above figures based on period 1 Jan 60 to 31 Mar 60
Passed Customer Acceptance Test 23 Dec 58
Time is not available for rent to outside organizations.

Equipment is regularly scheduled 24 hours per day, 7 days per week.

U. S. Dept. of Interior

Average error-free running period 81.0 Hours
Good time 37.4 Hours/Week (Average)
Attempted to run time 38.7 Hours/Week (Average)
Operating ratio 0.968

Above figures based on period 1 Jan 60 to 30 Jun 60
Passed Customer Acceptance Test 8 Dec 59
Time is available for rent to qualified outside organizations.

Scheduled preventive maintenance: 3 hours per week
Unscheduled down time:

1.25 hrs/week for period 1 Jan 60 thru 30 Jun 60

0.35 hrs/week for period 1 Mar 60 thru 30 Jun 60

American Airlines

Good time 33 Hours/Week (Average)
Operating ratio 0.989

Above figures based on period from Jan 59 to Mar 60
Passed Customer Acceptance Test Jan 59
Time is not available for rent to outside organizations.

Bridgeport Brass Co.

Good time 35 Hours/Week (Average)
Attempted to run time 35 Hours/Week (Average)
Operating ratio 1.0

Above figures based on period 1 Jan 59 to 1 Jan 60
Passed Customer Acceptance Test Oct 58
Time is available for rent to outside organizations.

Tennessee Eastman Co.

Average error-free running period 104 Hours
Good time 49.5 Hours/Week (Average)
Attempted to run time 50 Hours/Week (Average)

Above figures based on period from Aug 58 to Mar 60
Passed Customer Acceptance Test Jun 58
Time is available for rent to qualified outside organizations. Operating ratio - 0.99

With six exceptions, all machine failures have been in the 533 card read and punch unit. The computer has made only one error which it failed to detect.

Ford Motor Co.

Average error-free running period Two Weeks
Good time 40 Hours/Week (Average)
Attempted to run time 41 Hours/Week (Average)
Operating ratio 0.975

Above figures based on period 1 May 60 to 31 May 60
Passed Customer Acceptance Test 1 Aug 59
Time is not available for rent to outside organizations.

Littauer Stat. Lab.

Average error-free running period One Month
Good time 40 Hours/Week (Average)
Attempted to run time 40.5 Hours/Week (Average)
Operating ratio 0.99

Above figures based on period 1 Feb 60 to 29 Feb 60
Passed Customer Acceptance Test 1957
Time is not available for rent to outside organizations.

Western Electric Co.

Good time 37 Hours/Week (Average)
Attempted to run time 40 Hours/Week (Average)
Operating ratio 0.925

Above figures based on period 16 May 60 to 17 Aug 60
Passed Customer Acceptance Test Aug 59
Time is not available for rent to outside organizations.

Columbia Univ.

Average error-free running period Intermittent - as long as a week
Good time 60 Hours/Week (Average)
Attempted to run time 75 Hours/Week (Average)
Operating ratio 0.80

Above figures based on recent period
Passed Customer Acceptance Test Jul 58
Time is not available for rent to outside organizations.

Marquette Univ.

Good time 39 Hours/Week (Average)
Attempted to run time 40 Hours/Week (Average)
Operating ratio 0.98

Passed Customer Acceptance Test Aug 58
Time is available for rent to qualified outside organizations.

Stanford Univ.

Time is not available for rent to outside organizations.

Usage of this system is erratic, since it is largely by students whose demands tend to peak at ends of quarters.

Univ. of Houston

Good time 48 Hours/Week (Average)
Attempted to run time 56 Hours/Week (Average)
Operating ratio 0.857

Above figures based on period from 56 to 60
Time is available for rent to outside organizations.

Yale Univ.

Good time 95 Hours/Week (Average)
Attempted to run time 100 Hours/Week (Average)
Operating ratio 0.95

Above figures based on period from Jul 57 to Aug 60
Time is available for rent to educational institutions only.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Outstanding reliability and performance. Large amount of customer experience and interchange of programming approaches and techniques.

USA ED, Omaha

Outstanding features are the machine is extremely reliable, card drive is well suited for solution of engineering problems, easy to program, debug and operate, and is well suited for scientific computations.

Several new machines have been announced which appear to offer equal speed and reliability with the IBM 650 at a lower cost. These machines are being analyzed in an effort to provide this office with the best machinery, compatible with our workload, at the lowest possible cost.

USA ER & DL

Outstanding features include self checking features of IBM 650 makes results more reliable and card system facilities program debugging and development changes.

USA EWES

Outstanding features include internal validity checking of all data and instructions, ease of programming, and availability of large program library.

Unique system advantages include input/output by punched cards allows maximum flexibility in data and programming.

USA CE USAED, North Pacific

Outstanding features are system is very dependable and relatively easy to program.

USA ESCO

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage include the use of press-on labels. The reels are placed in plastic containers. The plastic containers are kept in metal files. Shipping is in plastic cases within 35 mm film metal containers within boxes. Tapes are stored in the air conditioned computer room.

USA Ord Frankford Arsenal

Outstanding features include random access ability to do a great deal of in-line processing while updating inventory records on a daily basis and ability to provide substitute items in one pass by use of chaining all substitutes in Ramac with the preferred items.

Unique system advantages include ease of file maintenance by utilizing the federal S/N only once throughout the 4 Ramac units. The key to additional trailer records is the 5 digit Ramac address. No tape sorting is used by utilizing Ramac to the utmost advantage.

Contents of Ramac is dumped on magnetic tape weekly and stored in another location in the arsenal. Inventory and other records are exchanged at an alternate site on a monthly basis.

USA Ord Feltman Res. & Eng. Labs.

Outstanding features are alphabetic - special character device (useful in symbolic and automatic programming), automatic floating decimal arithmetic and index registers.

USA Ord Anniston Ord Depot

Unique system advantage is random access to stored data.

The procedures established by the manufacturer for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage are followed by this depot.

USA Richmond QM Depot

The labelling of magnetic tapes is a permanent reel number and they are filed in numerical sequence. The tape librarian collaborates with supervisors and establishes a temporary title for the tape. A file of cards is maintained by reel number and they are arranged in numerical sequence within tapes in use, tapes in reserve, permanent tapes and available tapes. The tapes in use are also filed in numerical sequence within the date they will again be available. This enables the librarian to take a daily inventory of tapes available, and tapes to be available. The librarian checks all returned tapes for damage or report of faulty operation.

The tapes are stored in metal filing cabinets and the room which contains them satisfies the temperature and humidity control set up by the tape manufacturers.

No smoking is allowed while handling the tapes as a fire precaution.

For a 650 System with magnetic tape and/or disk storage, a suitable area for use by the customer engineers, maintaining the installation, should be provided by the customer. Minimum 50 sq. ft. 10 ft x 5 ft. A Pass and Seymour No. 7250 receptacle (or equivalent) should be installed for powering the tape drive tester.

USN Air Dev. Cen.

Outstanding features include Ramac, tapes, alphabetic, floating point, index registers, and scientific applications.

USN Avionics Facility

For the storage of magnetic tape, the humidity is regulated between 20% and 80%. The temperature is held between 70° and 80°F. Tapes are protected by dust covers.

USN Bureau of Naval Weapons

Reels and cans are labeled by job number. Tape library is in separate air conditioned room and consists of tape racks and shelves.

USN Portsmouth Naval Shipyard

Consider the accuracy of the computer as outstanding and no serious delay due to downtime has been experienced during a period exceeding four years.

USAF Mobile AMA

Outstanding feature is range of hardware from small to large scale permits automatic data processing of workloads of varying scope, complexity, and sophistication.

Unique system advantage: Standardization of equipment configurations within the Air Materiel Command, USAF, provides for processing of centrally designed and programmed systems, command wide.

Tape procedures: Tape storage is accomplished in secure storage vault with the same temperature and humidity controls required for the ADPE. Personnel traffic control is emphasized in machine processing and tape storage areas. Each tape reel is permanently labelled with a tape serial number when it enters the tape inventory. In addition to a label on the magnetic tape itself, each reel is labelled to identify information on magnetic tape. Perpetual inventory and tape history, including incidence of error conditions, is maintained for each reel of magnetic tape. Fire hazards and electrical interference are strictly controlled in the machine processing and tape storage area. Standard cardboard tape shipping containers have been used with minor incidence of breakage to plastic reel containers, and negligible tape or tape reel damage or distortion of data.

USAF APGC (PGCS), Eglin AFB

Unique system advantages are accuracy, moderate cost, sub-routine availability, central air conditioning system. System has two additional alpha words.

USAF Hq Europe

Outstanding features are equipment very reliable and high level of production is maintained.

Tapes have both physical external label and internal tape header and trailer records. Programs automatically check internal labels. Tapes stored in fire proofed air conditioned vault and shipped in manufacturers' containers.

EDPS is used on varied applications ranging from business type record keeping to pseudo-scientific computations. EDPS functions as part of headquarters data processing center equipped with conventional punched card equipment (PCAM), auditing staffs & etc.

USAF Hq MATS, Scott AFB

Tapes are identified with a label which indicates program which generated the tape, as of date, tape number, and number of tapes in the series. All tapes are stored in a fireproof vault. The humidity and temperature are controlled by the central air conditioner.

USAF Hq SAC

The outstanding feature is the random access, large capacity storage.

Entire tape library is located within the computer room. Shipping tapes is generally by mail - packaged in original plastic envelope and carton. Tapes are labelled by machine recording and affixing a standard format adhesive label to the exterior of the reel.

USAF 2709th AF Vehicle Control Gp.

An outstanding feature is the alphabetic device. Unique system advantages include speed, reliability, efficient storage, ability to re-code, and word size emitter.

Tape storage is under a water sprinkling system and enclosed in an air conditioned room.

U. S. Dept. of Interior

System used is basic IBM 650 with alphabetic device, half-time emitter on read feed, additional pilot selectors, co-selectors, read and punch code selectors, and double punch and blank column detection. Additional equipment was added to permit use of SOAP, SIR, and FORTRANSIT.

US Treasury Dept., Internal Revenue Service

Outstanding features (as compared to previous equipment (IBM Type 604s)) include stored programs, one computer instead of a battery of computers, and variable, rather than fixed, speed.

Unique system advantages include a wider range of applications is now feasible and experience has been gained in the use of stored-program equipment.

Bell Telephone Labs., Inc.

An outstanding feature is accuracy and speed.

Bridgeport Brass Co.

Duplicate program decks and procedures stored in separate, distant area.

Chase Manhattan Bank

Outstanding feature is that the system is completely self-checking.

A unique system advantage is the availability of tape driven tabulator known as tape data selector.

Air conditioning and humidity controls are employed. Records required for reconstruction of magnetic tape data stored at Records Center at Granite Springs, New York.

Combustion Engineering, Inc.

Outstanding feature include three index accumulations; six tape units, and floating decimal operation.

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage are monitored by tape librarian, who is responsible for maintaining, storing, and shipping tapes. The Computer Center was designed with the above described hazards in mind.

Educational Testing Service

An outstanding feature is the reliability of system - minimum of down time with limited amount of scheduled preventive maintenance time.

Emerson Electric Mfg. Co.

Paper inserted into slots on the reel and gummed tape are used for visual identification of magnetic tape reels. Magnetic labels are inserted in tape files at the beginning of a reel for computer program identification of the reel.

Cleveland Engine Plants, FOMOCO

An outstanding feature is that computer includes alphabetic devices.

Lincoln-Mercury Div., FOMOCO

A unique system advantage is more and better data at less processing cost.

Tractor & Implement Div., FOMOCO

Tapes are stored in fire-resistant safe located in computer room, which is temperature and humidity controlled.

Adv. Prod. Study & Engrg. Res. Office, FOMOCO

Equipment used with this system also includes a punched-card to curve point plotter (Benson-Lehmer) and a B-L Model "K" OSCAR, Oscillogram-to-Punched Card Data Transcription Device.

In addition to the IBM 650 Digital Computer, this activity also operates a 120-amplifier analog computer installation, using equipment manufactured by Electronic Associates and Goodyear Aircraft Corporation. This equipment is used primarily for solution of problems in vibration, vehicle stability and servo system design.

A. C. Spark Plug Div., General Motors Corp.

Outstanding features include automatic floating decimal device, index registers, and core storage.

Tape records are kept on IBM cards and a report submitted weekly on tapes stored. Tapes are stored in air conditioned room in metal cabinets. No need to ship tapes.

Littauer Stat. Lab.

Outstanding features are low rates for university research, immediate machine scheduling, and small staff and personalized service.

Metropolitan Life Ins. Co.

A unique system advantage is the in-line method of processing reduces processing time.

Olin Mathieson Chemical Corp.

Outstanding features are better than 90% utilization, 100% use of storage on most work gives strong competitive position, no control board changes; all programs written by computer center; they use one board, index accumulators, and floating decimal point hardware, enabling more rapid programming and computing of scientific problems.

Republic Aviation Corp.

Outstanding features are read punch, floating point arithmetic, index registers, and auxiliary core storage.

Socony Mobil Oil Co., Inc., New York

Outstanding features are floating point arithmetic and 700 series compatibility.

All tapes are stored in computer room. No special precautions taken in relation to protection from humidity, temperature and physical, electrical, fire, or other damage.

Standard Oil Co. of California

A unique system advantage is its self-checking capability.

New York Stock Exchange

A unique system advantage is reduction of card handling to a minimum.

United Gas Corp.

An outstanding feature is accuracy through validity check points.

Western Electric Co.

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage, include tape librarian, system for purging tapes, open files in library room, and temperature and humidity control.

Western Electric Co., Allentown Works
Outstanding features are dual card read feeds (through IBM 533 and IBM 407 Units) and elimination of the need to collate master and detail card decks.

Western Electric Co., Indianapolis

An outstanding feature is index registers, which allow address modifications thereby reducing program size and programming effort. Random access plus building block feature to provide for flexibility for required memory capacity.

Labelling - tape reels are externally labeled; in addition a tape mark is written containing the purge date.

Storage - Current tapes are stored in the computer room in wright-line tape cabinets.

Protection - Previous generation tapes are placed in plastic bags and stored in a vault located in another area of the plant.

Western Electric Co., Omaha

Machine is equipped with following features:

Alphabetic Device

Special Character Device Group I

20 Pilot Selectors

16 Co-Selectors

Digit Emitter on Read and Punch

Half Time Selectors on Read and Punch

Western Electric Co., Winston-Salem

Outstanding feature is the on-line IBM 407 Printer.

Georgia Institute of Tech., Rich ECC

Outstanding feature is the large library of subroutines and simplified programming systems (i.e. B.G.P.S., Fortran).

Indiana Univ.

A unique system advantage is ease of programming was important in the open shop operation.

Iowa State Univ.

This 650 is used on an open shop basis, 24 hours a day if and when desired by the users. The users consist of all departments on the campus who have computing needs. The 650 is located in the Statistical Laboratory which in turn consults, teaches and uses the 650 in the normal course of its daily activities.

Johns Hopkins Univ.

An outstanding feature is the alphabetic attachment.

Louisiana State Univ.

Outstanding features are index registers and automatic floating point device.

Oklahoma State Univ.

Outstanding features are special characters groups 1 and 2, floating point, index registers, and core storage.

Univ. of Mississippi

The system is a commercially available one, with no modifications made or proposed.

Univ. of Southern Cal., Aeronautic Lab. Dept.

A unique system advantage is the ability to reduce test data on-line without disadvantages of direct connection of computer to instrumentation.

Univ. of Wisconsin

General-purpose system suited to very wide variety of problems.

Tapes are kept in machine room. No special procedures or precautions.

Virginia Polytechnic Institute

The wide-spread use of this system provides excellent opportunities for interchange of programs.

See "ILLIAC" file for 650 information.

FUTURE PLANS

USA ED, Omaha

Projected Equipment Procurements

Retain the installed IBM 650 Card-operated Electronic Computer in its present form through FY 1961.

Provide a second shift computer operation when computer utilization exceeds a continuous 100%.

Provide a tape drive, floating decimal and index accumulators when the capacity of the present machine is exceeded. This should become necessary during FY 1962 or 1963.

Continue to evaluate new equipment in order to provide the best and most modern equipment consistent with cost and district requirements.

Projected Plans for Increasing Computer Utilization

Provide top level direction of the computer operation.

Encourage all district organizations to utilize the computer facilities and to provide technical assistance where needed.

Teach all scientific and engineering personnel to perform computer programming.

Provide a computer staff with engineering and scientific technical ability.

Continue the training of computer specialist in order to provide an adequate staff.

USA Eng. Res. & Dev. Lab.

A digital plotter has been added. This is a high resolution point and line plotter for up to 30 x 30 inches, symbols, or continuous photo.

USAE. Waterways Exp. Sta.

Consideration is being given to the addition of automatic floating point arithmetic and index registers as extra features to the present machine in order to provide capability sufficient to meet present and foreseeable needs.

USA CE, USA ED, North Pacific

Our complex reservoir system planning and operational analyses requirements indicate a larger system is necessary for comprehensive analyses wherein optimization of reservoir regulation on a system basis can be accomplished. Currently the restrictions on memory capacity and computing speed limit the amount of work which can be accomplished in this connection. This need, together with our increasing computer work load on other engineering studies and possible extension of the work into the comptroller field, has led to the investigation of possibilities of extending the present system and of utilizing a larger scale computer system. It appears feasible in the future to extend our present 650 system to include a 653 Immediate Access Storage which includes 60 additional words of high speed memory, floating point (decimal locating) accumulators, and indexing registers or replace the 650 system with one of approximate or greater capabilities of the expanded system at possibly lesser cost. This would give us an effective increase of speed and memory which would assist in meeting our foreseeable immediate requirements. An IBM 407 Accounting Machine, which is on an average 50 cards per minute faster than the installed 402, would facilitate listing, tabulating and summarizing data. There is some evidence that a system other than the 650 system with on line printing capabilities may better serve the requirements of this Division.

USA ESCO

Proposed systems changes are currently deferred pending decision on Single Manager for Construction assignment within the Corps of Engineers which will, in some areas require larger computer systems in accordance with the volume received. However, data processing systems as produced, are constantly being investigated and evaluated. Currently, a study of the IBM 1401 Data Processing System is being performed.

USA Ord Frankford Arsenal

It is planned to replace 3 Model 1 Ramac Units by 2 Model 2 (Double Density Units). This will provide a needed additional 10,000 of random access storage for an additional \$75.00 per month.

A request is in process to replace our present tape data selector and all its components by an IBM 1401. This replacement will provide much more speed in printing reports and will enable us to use the 1401 for small projects requiring computation. It will be used for specific tape jobs now being accomplished on the 650. This replacement is practically the same rental but will provide a much more flexible ADP operation.

USA Ord Feltman Res. & Eng. Labs.

Installation of a large-scale digital computing system is under consideration. Present large-scale problems are run by local personnel and contractors on machines available off the Arsenal. Present applications are increasing rapidly and new applications of major proportions are anticipated. Target date for installation of an IBM 709 on a rental basis is tentatively set for January 1961. An IBM 1401 will be used for auxiliary off-line operations. The IBM 650, which is now used for the major part of two shifts on problems which can be accommodated within its speed and storage capacity, will be returned to the manufacturer upon installation of the large-scale system.

USA Ord Watervliet Arsenal

As soon as studies can be completed the following additional applications will be placed on the computer:

Supply inventories, personnel statistics, nationwide gage inventory, planning and estimating, material control, appropriation accounting, general accounting, tooling inventory, machine loading and scheduling, and preventive maintenance program.

USA Ord Anniston Ord Depot

It is anticipated that an IBM 1401 Data Processing System will be acquired to replace the present tape data selector system.

At present there are studies being made of some 13 areas of data processing for possible mechanization.

USA Richmond QM Depot

Future plans are now being taken into consideration by a planning group composed of programmers and analysts. Future plans call for the integration of the IBM 7070. This will be augmented by the 1401. This will most likely modify our present system by replacing the one 650 system (with disk storage). Work volume under the new single manager will eventually determine our proposed systems.

USA Signal Corps School

Installation of militarized computer to be used for educational purposes.

Expansion of computer laboratory and facilities (proposal).

USN Service Center

Analysis is now in progress to replace the IBM 650 with either an IBM 1401 or RCA 301 Card System. Both systems have the capacity for expansion and installation of either would result in an overall savings to

Navy. Those savings would be both tangible and intangible.

USN Air Development Center

Research and development program on ACL Digital Data Center which gives added capability to data handling capabilities.

USN Bureau of Naval Weapons

This system is due to be removed soon, to be replaced with a later model system.

USN New York Naval Shipyard

This activity has recently recommended the acquisition of an intermediate size tape computer. Proposed applications, i.e., payroll, supply, cost, scheduling, are more readily adaptable to tape systems as against EAM card systems. The computer considered to meet this shipyard requirement is the National Cash Register NCR 304 Machine.

USN Portsmouth Naval Shipyard

A study is under way regarding replacement of the IBM Type 533 Card Read Punch Unit by an IBM Type 543 Card Reader and an IBM Type 544 Card Punch to increase computer availability time through these faster input-output units. Indications at this time point to such action.

Plans are under way to develop an integrated data processing system for the shipyard and when finally developed, and if approved, will require a larger scale computer system.

USN Puget Sound Naval Shipyard

Design of integrated system (procedures) currently being performed in connection with proposed installation of an IBM 7070 Data Processing (magnetic tape) System.

USN Supply Center, Oakland

NSC, Oakland is presently analyzing and programming for Philco 2000 Computer. This equipment is slated for delivery. The equipment on order includes the following components:

Quantity	
1	Model 210 Arithmetic & Control Unit, Console and Typewriter, including 8 index registers.
1	Model 2204 Magnetic Core Storage Unit (4096 words)
11	Model 234 Magnetic Tape Units, 2 units, on line/off line
1	Model 235 Input-Output Processor (16X1)
1	Model 256 Printer System (900 lpm), on line/off line
1	Model 258 Punched Card Reader (2000 lpm), on line/off line
1	Model 259 Punched Card Control Unit
1	Model 260 Card Punch (100 lpm), on line/off line
2	Model 280 Universal Buffer Control Units

Initial applications for the 2000 will be inventory control for 670,000 stock items, both quantitatively and financially; requisition status for all inputs; civilian payrolls; labor distribution; and employees savings bond accounting.

USAF Hq MAAMA, Olmsted AFB

Implementation of a mechanized payroll system providing for preparation of civilian payroll checks, bond issuance program, and leave and earning statement is scheduled for December 1960.

USAF Mobile AMA

Applications: Expansion, integration, and sophistication of current systems will saturate computer capabilities for the immediate future.

Equipment: Transistorized equipment is on order (IBM Type 1401) to replace currently installed auxiliary equipment for card to tape, tape to card, printing, and data selection functions. The use of this equipment for edit and sort operations, simple

main frame runs, and possible PCAM applications is being explored. Long range plans include the acquisition of large scale, solid state data processing equipment.

USAF San Bernardino AMA

Future developments involving EDPE in AMC activities are generated at Hq AMC, Wright-Patterson AF Base, Dayton, Ohio.

USAF Hq AFSWC, Kirtland AFB

A change of systems is anticipated during FY 62. Determination of system to be utilized has not been made at this time.

USAF APGC (PGCS), Eglin AFB

543 Card Reader and 544 Card Punch scheduled to replace 533.

USAF Hq, Europe

An increase in utilization is anticipated due to an expansion of a present data analysis application. Future plans indicate a requirement for larger capacity equipment within two years.

USAF Hq MATS

Because of the increasing demands of the MATS staff for more and varied statistical information necessary for proper management, this installation is planning on a transition to a "second generation" computer during 1961. The application in which the greatest expansion is expected to occur is the field of operation and traffic.

USAF Hq, Pacific

Request has been made for a larger capacity computer to permit advancement in electronic data processing.

USAF Hq PACAF

Requirements for a system with greater capacity and speed to meet demands for weather applications and other classified programs will be undertaken shortly with a projected installation date of 1 July 1961.

USAF ROAMA, Griffiss AFB

One 650 being retired.

USAF Hq SAC

The 650 Tape RAMAC System will be replaced by an NCR 304 EDP System. The primary application will remain in the personnel accounting and authorizations area. The processing will be extensively altered, however, to include "machine decisions" on most manning actions and personnel transfers throughout the command.

USAF 2709th AF Vehicle Control Gp.

Retirement of stock control and distribution (inventory management) application is contingent upon implementation on Type 705 EDPE.

New application is to be monetary property management.

California Division of Highways

We are continually developing new applications, however, overall usage has leveled off.

New equipment will be obtained when faster compilation and additional storage are available at approximately the same price.

U. S. Dept. of Interior

Additional applications will be put on computer in future as need develops and after it is known they are proper problems for the equipment.

U. S. Treasury Dept., Internal Revenue Service

Future plans fall into two categories:

Short range: Internal Revenue will convert present processes to an IBM 7070 System at Lawrence, Mass., Kansas City, Mo., and Ogden, Utah. Each 7070 System will perform the work now done by a 650 and the sizeable battery of EAM equipment which supports it. Each 7070 System will use magnetic tape as the principal medium of computer input and output. IBM 1400 series equipment will be employed for card-to-tape conversion and printing and, in addition, each system

will include Type 408 Printers. Operations on these systems will begin 1 January 1961 at Lawrence and 1 January 1962 at Kansas City and Ogden.

Long range: Internal Revenue is developing plans for an automatic data processing system which will be centered around a master file of U.S. taxpayers' accounts and which will incorporate the bulk of the present returns processing and other clerical and accounting processes. The planned installations are a computer center which will maintain the master file, and peripheral service centers which will send data to, and receive data from, the computer center. The system is scheduled to begin operational tests 1 January 1962 in the computer center and one service center. Present schedules call for phased extension of the system over the period from then until 1969.

American Airlines

Proposed replacement by IBM 7070.

Crosley Div., Avco Corp.

We plan to increase our digital computing capacity during the last half of 1961. The equipment being considered are the IBM 7070 with 1401, and the Honeywell 800 with the 400. No definite decision will be made on these machines until all studies are complete. Present tentative plans call for using the equipment for such commercial applications as: production scheduling, inventory control, and personnel time allocation, as well as for all the scientific computations.

Bell Telephone Labs., Inc.

Planning for either an additional IBM 650 Machine or an IBM 1401 Machine.

Bendix Aviation Corp., Res. Labs. Div.

Will replace present systems with following system in the Fall of 1961.

Bendix G20 Computer, 8K Core Memory, line printer, card input-output, and auxiliary card handling equipment.

Braniff Airways, Inc.

Now making study of tape system to replace present computer. New applications being considered are flight crew scheduling and utilization, and flight equipment maintenance scheduling.

Bridgeport Brass Co.

Possible acquisition of more powerful computer for new or expanded applications.

The Chase Manhattan Bank

An RCA 501 is to be installed for demand deposit accounting. A Univac Solid State 80 is to be installed for corporate trust accounting. An IBM 1401 is to be installed for payroll and employee benefits work.

Combustion Engineering, Inc.

We anticipate receiving a IBM 7070 to replace the 650 unit. Also, we will lease an IBM 1401. No alteration in the computer site will be necessary.

With the addition of the above described units present program and systems will be converted. These units will permit us to install an effective long range scheduling system to cover the major portion of our manufacturing business. Also, a system is being developed which will indicate the state of our contracts.

More comprehensive programs will be developed for equipment design, stress and thermal analysis problems.

Convair-Pomona, General Dynamics

We will install new card input/output equipment.

The 533 will be replaced with an IBM 543 and IBM 544. This will increase input speed 25% and output speed 150%.

Convair-Fort Worth

High speed input-output 543 and 544 on order.

Tennessee Eastman Co.

By assigning a project team to each of our three manufacturing areas we hope to coordinate all work in each area toward a master plan using the total systems approach.

A separate section, Applied Mathematics, was recently established to serve as consultants and to apply scientific techniques to equipment and process design problems, management problems, and analysis of experimental data. This group will also do research on computer and mathematical methods.

We are in the process of evaluating our future computer needs. The addition of immediate access storage, index accumulators and automatic floating point will increase speed and capacity to the point we can grow for one year.

Educational Testing Service

Plan to install an RCA 501 Computer System to replace our IBM 650 Computer System. The RCA 501 will include:

Model 503 Computer
561-2 Hi-Speed Storage
581 Tape Stations (6)
533 On-line Printer
528 Card Reader
538 Card Punch
547-6 Tape Switching Unit

El Paso Natural Gas Co.

An IBM 7070 Tape Oriented System and two 1401 Tape Systems will be delivered.

Emerson Electric Mfg. Co.

Studies are being made for the procurement of a more powerful computer to replace our present equipment.

Firestone Tire & Rubber Co.

The computer system was retired as of 30 April 1960 due to lack of work load.

Tractor & Implement Div., FOMOCO

New applications include production control (computation of parts requirements, production progress reporting, direct labor performance reporting, and stock status and inventory control) and sales analysis (order status reporting and sales statistics by product by customer).

Ford Motor Company

Intended acquisition of IBM 1401 Data Processing System.

Adv. Prod. Study & Engrg. Res. Office, FOMOCO

General intention to replace complete 650 installation with large-storage, high speed computer as work requirements develop.

Steel Div., FOMOCO

Future plans include continued programming in areas of production control, applied research, and accounting. Larger systems are being examined, probably tape, for replacement of the present card system.

General Electric Co.

Expect to eliminate the IBM 650 Tape Computer System and consolidate all tape applications on an IBM 7090 Computer located in another department. Will retain 650 Drum Type System and acquire an IBM 1401 Data Processing System.

A.C. Spark Plug Div., General Motors Corp.

Both 650 Tape Systems to be replaced by IBM 7070.

A.C. Spark Plug Div., GMC

Presently considering installation of IBM Type 7070 Tape System. Also two Type 1401 Systems. These will modify existing EAM area and replace 650 System now in use.

Harrison Radiator Div., GMC

Future plans call for retirement of present system and the acquisition of a solid state magnetic tape system.

Institute for Defense Analyses

The 650 System will be replaced by a Control Data Corporation 1604 Computer. A brief summary of the 1604 characteristics are stored program, general purpose; digital computer; 48-bit word length; six index registers; magnetic core storage, 32,768 48-bit words; 4.8 microseconds effective cycle time; 6.4 microseconds total cycle time; indirect addressing; and single address logic, 2 instructions per word.

Kaman Aircraft Corp.

In the process of doing a feasibility study for a transistorized tape-oriented system.

Martin Co.

Plan to discontinue 650's and install an IBM 7070 and 1401 Systems.

Metropolitan Life Ins. Co.

The work will probably be absorbed eventually by a large-scale system; of a type that has not yet been determined.

Mutual Benefit Life Ins. Co.

It is intended to install an IBM 7070 System which will eventually replace the two card 650's.

Newport News Ship & Dry Dock Co.

We are evaluating an IBM 1401 System.

Ohio Oil Company

One IBM 7070 and 2 IBM 1401 Systems are to be installed.

Olin Mathieson Chemical Corp.

Current computer programs are exceeding storage capacity to the point where we are negotiating for a 4,000 word drum. It is recognized that this is a stop gap measure since the magnetic drum is fast becoming obsolete. We will evaluate the newer computing facilities with the intention of replacing the present IBM 650 with a more up to date computer.

Prudential Ins. Co. of America

Future plans are being constantly evolved and include: consideration of new computers; advantages of consolidating data processing in a central location; data and document transmission systems; information retrieval in connection with file and data storage problems; addition of functions to our major data processing systems (case work, random file reference, and increased processing frequency); and the use of IBM 1401 Data Processing Systems.

RCA Service Company, BMEWS Project

Expect to switch to Univac 1105.

Shell Development Co.

Release of this equipment is planned.

Socony Mobil Oil Co., Inc.

The IBM 650 will be replaced by an IBM 7090 and an IBM 1401.

Standard Oil Co. of California

System will be retired, with programs converted to IBM 7090 or 1401.

United Gas Corp.

Future plans are to install a magnetic tape oriented system. The configuration of equipment consists of the following:

Qty	Item	Machine Number	Monthly Rental
1	Console Control Unit	7150	\$ 300
1	Core Storage	7301-2	7,025
1	Arith. Unit w/Float. Point	7601	4,350
1	Core Storage Control	7602-2	2,000
1	Magnetic Tape Control	7604-1	2,700
10	Magnetic Tape Units	720-4	9,000
1	Console Card Reader	7501	75
2	Processing Units Model C-3	1401	6,910
2	Card Read Punch Model 1	1402	1,100
2	Printers Model 2	1403	1,550
			<u>\$35,010</u>

This order for equipment was placed 27 January 1960 with the understanding that it may be cancelled or changed by us at any time, with no obligation on our part, to conform to our future data processing equipment requirements and with the understanding that the IBM organization will work with us on conversion and that delivery schedule of the equipment will be arranged to coincide with our requirements.

Upon delivery and installation of this equipment, we will expect to release a substantial part of the equipment now in use in our Shreveport, Louisiana and Houston, Texas offices.

Universal Oil Products Co.

Entire system will be replaced in 1961 by a purchased IBM 7070 System with card input-output, 5,000-word core storage, floating point instructions.

Western Electric Co., New York

Constant study for new developments and improvement of present applications. Also study of new machine systems for potential ability to improve systems, capacity and cost. For example, we are studying substitution of 1401 and/or 7070 System for 650 Tape System. Present indications are that 1401 System will give more favorable capacity to cost relationship and improve present systems.

Western Electric Co., Allentown Works

Anticipated modifications include installation of new card read and punch units to obtain faster card speeds. IBM 543 and 544 units will replace IBM 533 unit. Acquisition of new systems - planning on starting feasibility study to replace existing system with newer equipment.

Western Electric Co., Indianapolis

An additional IBM 650 Tape-Ramac System, to be employed for mechanization of shop scheduling and process inventory control, is on order, consisting of:

- 1 Type 650 Console
- 1 Type 655 Power Unit
- 1 Type 652 Control Unit
- 1 Type 653 I. A. S. Unit
- 2 Type 727 Tape Units
- 1 Type 355 Disk Storage
- 1 Type 407 On-line Printer
- 1 Type 543 Read Unit
- 1 Type 544 Punch Unit

The existing Type 533 Read Punch Unit is to be replaced by a Type 543 Read Unit and Type 544 Punch Unit.

Western Electric Co., Omaha

Proposed complete system on production control in the manufacture of telephone switching equipment, including explosion of assemblies into component parts, scheduling of production facilities taking into consideration economical quantities and reorder points, feed back to maintain control and associated accounting and managerial reports. Scientific inventory control and the latest techniques on control of production will be used to produce a completed integrated system.

We are currently conducting a feasibility study to determine what size and type of a latter generation of machine will be required. Present indications point to a core storage machine with tapes in the medium size area. Probable on the air date: Early 1962.

Auburn Univ.

An order has been submitted for one 077 series 50 collator and one 548 interpreter.

Brigham Young Univ.

We now plan to purchase IBM 650 with 4,000 word drum. No other changes currently anticipated for near future.

Colorado State Univ.

Plan to get an IBM 650 the Summer 1960.

Columbia Univ., Elect. Res. Labs.

Proposal for an expanded system includes addition to present system of: floating point capability; index registers (3 units); rapid access storage (60 words total); tape units (2 units).

Facility improvement by providing a self-contained air conditioner for the computing equipment to enable stable temperature and humidity control.

Cornell Univ.

Since the program in which this system is a part is still growing, it will be necessary to obtain larger and faster equipment in the not too distant future. In all probability a system with magnetic tape facilities will be obtained.

Florida State Univ.

Acquisition of a 700 or 7000 series computer is planned for October 1961. New computing center is currently under construction and negotiations for a larger computer are in progress.

Indiana Univ.

It is anticipated that sometime soon after 1 July 1961 the Center will replace the 650 Tape System with an IBM 7070 System. The approximate configuration will be:

- 7150 Console (Model 1)
- 7600 Input-output Control (Model 1)
- 7601 Arithmetic & Program Control (Model 1)
- 7602 Core Storage Control (Model A2)
- 7603 Input-output Synchronizer (Model 4)
- 7301 Core Storage 10K (Model 2)
- 7604 Tape Control (Model 1)
- 7400 Printer (Model 1)
- 7550 Card Punch (Model 1)
- 2 7500 Card Readers (Model 1)
- 7 729 Magnetic Tape Units (Model 4)

Iowa State Univ.

Will add a 4,000 word drum.

Johns Hopkins Univ.

IBM 7090 Computer System with 1401 C3 planned for installation.

Marquette Univ.

Adding floating decimal, indexing registers, and special characters group.

Montana State College

To be acquired are a 653 unit and a 407 unit.

North Carolina State College

Plan to replace 650 System with Rem. Rand Univac Solid State 80 with 4 tape units.

Syracuse Univ.

Expanded system to be installed.

Texas Engineering Experiment Station

The 704 will be replaced with a 32K - 2 channel - 8 tape IBM 709.

Univ. of Arkansas

Needless to say, we hope to add to our basic 650 installation. It is hoped that at the end of about a year of operation that we can add index registers, 60 words of core storage, and floating point arithmetic.

Univ. of Georgia

Plan to add 600 position core storage, 3 indexing registers, and floating decimal arithmetic device.

Univ. of Kentucky

Plan to obtain 101 Statistical Sorter in near future.

Univ. of Rochester

A larger high-speed system is needed. Several solid state systems, such as IBM 7070, are under consideration for installation within the next 12 - 18 months. This will replace present system.

Univ. of Southern California

Expect to replace 650 with IBM 1620 when card I/O becomes available.

Univ. of Wisconsin
CDC 1604 and 160 Computers planned to replace 650.
No major changes planned in peripheral equipment.
Staff increases of around 100% planned during next
two-year period.

Washington State Univ.
Washington State University plans to replace the
present 650 with an IBM 704 System including 4K core
storage, 8K magnetic drum and 4 magnetic tape drives
in July 1961.

Yale University
A new computing center with an IBM 7070 and IBM 1401
System by 1 July 1961, with 10,000 words of core
storage, floating point arithmetic, and 10 magnetic
tapes, two of which are shared by the 1401.

INSTALLATIONS

U. S. Army Engineer District, Omaha, 1709 Jackson
Street, Omaha, Nebraska
U. S. Army Engineer Research and Development Lab-
oratories, Data Processing and Statistical Services,
Fort Belvoir, Virginia
U. S. Army Engineer Waterways Experiment Station,
Vicksburg, Mississippi
U. S. Army Corps of Engineers, U. S. Army Engineer
Division, North Pacific, 210 Custom House, Portland
9, Oregon
U. S. Army Engineer Supply Control Office, Corps
of Engineers, 410 North Broadway, St. Louis 66,
Missouri
U. S. Army Ordnance Frankford Arsenal, Field
Service Group, Philadelphia, Pennsylvania
U. S. Army Ordnance Feltman Research and Engineer-
ing Laboratories, Picatinny Arsenal, Dover, New
Jersey
U. S. Army Ordnance Watervliet Arsenal, ADPS Branch,
Watervliet, New York
U. S. Army Anniston Ordnance Depot, Machine Account-
ing Services Division, Anniston, Alabama
U. S. Army Philadelphia Quartermaster Depot, Mil-
itary Clothing and Textile Supply Agency, 2800 South
20th Street, Philadelphia 45, Pennsylvania
U. S. Army Richmond Quartermaster Depot, Richmond,
Virginia
U. S. Army Signal Corps School, Automatic Data
Processing Section, Fort Monmouth, New Jersey
U. S. Navy Service Center, Washington 25, D. C.
U. S. Naval Air Development Center, Johnsville,
Pennsylvania
U. S. Naval Avionics Facility, Indianapolis,
Indiana
U. S. Navy Department, Bureau of Naval Weapons,
18th & Constitution Ave., N. W., Washington 25, D.C.
New York Naval Shipyard, Brooklyn 1, New York
Portsmouth Naval Shipyard, Comptroller Department,
Portsmouth, New Hampshire
Puget Sound Naval Shipyard, Bremerton, Washington
U. S. Naval Supply Center, Oakland, Oakland 14,
California
U. S. Air Force, Headquarters OCAMA, Tinker Air
Force Base, Oklahoma
U. S. Air Force, Headquarters MAAMA, Comptroller,
Olmsted Air Force Base, Pennsylvania
U. S. Air Force, Mobile Air Materiel Area, Office
of Comptroller, Brookley Air Force Base, Alabama
U. S. Air Force, San Bernardino Air Materiel Area,
Norton Air Force Base, California
U. S. Air Force, AFSWC, Statistical Services
Division, Kirtland Air Force Base, New Mexico
U. S. Air Force, APGC (PGCS), Directorate of
Statistical Services, Eglin Air Force Base, Florida
U. S. Air Force, Headquarters Europe, Directorate
of Statistical Services, APO 633, New York, N. Y.
U. S. Air Force, Headquarters, Military Air Trans-
port Service, Scott Air Force Base, Illinois
U. S. Air Force, Headquarters Pacific, Statistical
Services, APO 953, San Francisco, California
U. S. Air Force, Headquarters Pacific, A-3 Direc-
torate of Control, APO 953, San Francisco, California
U. S. Air Force, ROAMA, Griffiss Air Force Base,
New York
U. S. Air Force, Headquarters Strategic Air Command,
Statistical Services Division, Offutt Air Force Base,
Nebraska
U. S. Air Force, 2709th AF Vehicle Control Group,
3300 Jackson Avenue, Memphis 2, Tennessee
N.A.S.A. Flight Research Center, box 273, Edwards,
California
U. S. Department of Agriculture, Commodity Stabil-
ization Service, Evanston, Illinois
California Division of Highways, 1120 "N" Street,
Sacramento, California
U. S. Department of Commerce, Coast and Geodetic
Survey, Washington 25, D. C.
U. S. Department of Interior, Bureau of Reclamation,
Denver Federal Center, Denver, Colorado
U. S. Treasury Department, Internal Revenue Service,
Collection Division, 10th & Constitution Avenues,
Washington, D. C.
American Airlines, 100 Park Avenue, New York, New
York
Advanced Technology Laboratory, American Standard,
Mountain View, California
Crosley Division of Avco Corporation, 1329 Arlington
Street, Cincinnati 29, Ohio
Battelle Memorial Institute, 505 King Avenue,
Columbus, Ohio
Bell Telephone Laboratories, Incorporated, 3300
Lexington Road, S.E., Winston-Salem, North Carolina
Bell Telephone Laboratories, Incorporated, Allen-
town Laboratory, 555 Union Boulevard, Allentown,
Pennsylvania
Bell Telephone Laboratories, Incorporated, 463 West
Street, New York 14, New York
Bell Telephone Laboratories, Incorporated, Murray
Hill, New Jersey
Bendix Aviation Corporation, Research Laboratories
Division, P. O. Box 5115, Detroit 35, Michigan
Braniff Airways, Incorporated, Exchange Park,
Dallas, Texas
Bridgeport Brass Company, 30 Grand Street, Bridge-
port 2, Connecticut
The Chase Manhattan Bank, 57 William Street, Room
200, New York, N. Y.
The Chesapeake & Potomac Telephone Company of
Maryland, 5711 York Road, Baltimore 12, Maryland
Clark Brothers Company, Division of Dresser Opera-
tions, Incorporated, Olean, New York
Combustion Engineering, Incorporated, 200 Madison
Avenue, New York 16, New York
Convair, Division of General Dynamics, Pomona,
California
Convair, Division of General Dynamics, Fort Worth,
Texas
Douglas Aircraft Company, Department B7-250, El
Segundo, California
Dow Chemical Company, Texas Division, B-2402, Plant
B, Freeport, Texas
Tennessee Eastman Company, Division of Eastman
Kodak Company, Kingsport, Tennessee
Educational Testing Service, 20 Nassau Street,
Princeton, New Jersey
El Paso Natural Gas Company, Administrative Services
Department, P. O. Box 1492, El Paso, Texas

The Emerson Electric Manufacturing Company, 1567
Salzman Avenue, Wellston, Missouri
The Firestone Tire & Rubber Company, Guided Missile
Division, 2525 Firestone Boulevard, Los Angeles 54,
California
Cleveland Engine Plants, Cleveland Computer Center,
FOMOCO, P. O. Box 191, Berea, Ohio
Ford Motor Company, Lincoln-Mercury Division,
3000 Schaefer Road, Dearborn, Michigan
Ford Motor Company, Tractor & Implement Division,
2500 E. Maple Road, Birmingham, Michigan
Ford Motor Company, Dearborn Stamping Plant, Con-
troller's Office, Box 494, Dearborn, Michigan
Ford Motor Company, Advanced Product Study & En-
gineering Research Office, 20000 Rotunda Drive,
Dearborn, Michigan
Ford Motor Company, Steel Division, 3001 Miller
Road, Dearborn, Michigan
General Electric Company, Large Jet Engine Depart-
ment, Building 800, Evendale 15, Ohio
A. C. Spark Plug Division, General Motors Corpora-
tion, 7929 S. Howell Avenue, Milwaukee 1, Wisconsin
A. C. Spark Plug Division, General Motors Corpora-
tion, 1300 N. Dort Highway, Flint, Michigan
Harrison Radiator Division, General Motors Corpora-
tion, Lockport, New York
Institute for Defense Analyses, Weapons Systems
Evaluation Division, Room 1E871, The Pentagon,
Washington 25, D. C.
The Kaman Aircraft Corporation, Old Windsor Road,
Bloomfield, Connecticut
Littauer Statistical Laboratory, 94 Prescott
Street, Cambridge 38, Massachusetts
The Martin Company, Baltimore 3, Maryland
Metropolitan Life Insurance Company, 1 Madison
Avenue, New York 10, N. Y.
Michigan Bell Telephone Company, 23500 North-
western Highway, Southfield, Michigan
Mutual Benefit Life Insurance Company, 520 Broad
Street, Newark 1, New Jersey
Newport News Ship & Dry Dock Company, Tabulating
Department, Washington Avenue, Newport News, Virginia
The Ohio Oil Company, 539 South Main Street,
Findlay, Ohio
Olin Mathieson Chemical Corporation, Liquid Fuels
Computer Center, 275 Winchester Avenue, New Haven,
Connecticut
The Prudential Insurance Company of America,
Electronics Research Division, Prudential Plaza,
Newark, New Jersey
RCA Laboratories, Princeton, New Jersey
RCA Service Company, BMEWS Project, Griffiss Air
Force Base, Rome, New York
Republic Aviation Corporation, Farmingdale, New
York
Shell Development Company, E and P Research,
Computing Section, 3737 Bellaire Boulevard, Houston,
Texas
Socony Mobil Oil Company, Incorporated, 150 East
42nd Street, New York 17, N. Y.
Standard Oil Company of California, Western
Operations, Incorporated, 225 Bush Street, San
Francisco, California
New York Stock Exchange, Stock Clearing Corpora-
tion, 18 Broad Street, New York 5, N. Y.
Sun Oil Company, Marcus Hook Refinery, Marcus
Hook, Pennsylvania

United Gas Corporation, 1525 Fairfield Avenue,
Shreveport, Louisiana
Following sub-divisions of United States Steel
Corporation, 525 William Penn Place, Pittsburgh 30,
Pennsylvania also operate IBM 650 Computers:
American Bridge
American Steel and Wire
Columbia-Geneva
Consolidated Western
Oliver Iron Mining
New York Data Processing Center
Pittsburgh Data Processing Center
Central Operations
U. S. Steel Supply
Universal Oil Products Company, 30 Algonquin Road,
Des Plaines, Illinois
Western Electric Company, 77 South Wacker Drive,
Chicago, Illinois
Western Electric Company, Allentown Works, 555 Union
Boulevard, Allentown, Pennsylvania
Western Electric Company, Data Processing & Methods
Development Department, 2525 Shadeland Avenue,
Indianapolis, Indiana
Western Electric Company, Omaha Works, Box 1400,
Peony Park Station, Omaha, Nebraska
Western Electric Company, 3300 Lexington Road, S.E.,
Winston-Salem, North Carolina
Auburn University, Computer Laboratory, Auburn,
Alabama
Brigham Young University, Computer Center, Provo,
Utah
Watson Scientific Computing Laboratory, 612 W. 16th
Street, New York 27, N. Y.
Colorado State University, Computing Center, Fort
Collins, Colorado
Columbia University, Electronics Research Labora-
tories, 632 West 125th Street, New York 27, N. Y.
Columbia University, Hudson Laboratories, Dobbs
Ferry, New York
Columbia University, Nevis Cyclotron Laboratory,
Box 137, Irvington on Hudson, New York
Cornell University, Dairy Records Processing
Laboratory, Ithaca, New York
Florida State University, Computing Center,
Tallahassee, Florida
Georgia Institute of Technology, Rich Electronic
Computer Center, Atlanta, Georgia
Indiana University, Research Computing Center,
Bloomington, Indiana
Iowa State University, Statistical Laboratory,
Ames, Iowa
Johns Hopkins University, Applied Physics Labora-
tory, Johns Hopkins Road, Scaggsville, Howard County,
Maryland
Louisiana State University, Computer Research
Center, Baton Rouge, Louisiana
Marquette University, Computing Center, 1515 W.
Wisconsin Avenue, Milwaukee, Wisconsin
Miami University, Computing Center, Laws Hall,
Oxford, Ohio
Montana State College, Computer Laboratory,
Bozeman, Montana
New York University, Computation and Statistical
Laboratory, Research Building 3, 233 Fordham Landing
Road, New York 68, New York
North Carolina State College, Experimental Statis-
tics Department, Patterson Hall, Raleigh, North
Carolina

Oklahoma State University, Computing Center,
Stillwater, Oklahoma
Polytechnic Institute of Brooklyn, 333 Jay Street,
Brooklyn 1, N. Y.
Rensselaer Polytechnic Institute, Computer Labora-
tory, Troy, New York
Stanford University, Computation Center, Stanford,
California
Syracuse University, Computing Center, 112 Hinds
Hall, Syracuse 10, New York
Texas Engineering Experiment Station, Data Process-
ing Center Building, College Station, Texas
Tulane University, Computer Center, New Orleans 15,
Louisiana
University of Arizona, Numerical Analysis Labora-
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University of Arkansas, Fayetteville, Arkansas
University of California, Radiation Laboratory,
Box 808, Livermore, California
University of Florida, Statistical Laboratory,
P. O. Box 3568, University Station, Gainesville,
Florida
University of Georgia, Department of Experimental
Statistics, Lumpkin House, Athens, Georgia

University of Houston, Computing and Data Process-
ing Center, Houston 4, Texas
University of Kentucky, Computing Center, Lexing-
ton, Kentucky
University of Mississippi, Computer Center, Carrier
Hall, University, Mississippi
University of Rochester, Computing Center, Rochester,
New York
University of Southern California, Aerodynamic Test
Laboratory, Building 75, U. S. Naval Missile Center,
Point Mugu, California
University of Wisconsin, Numerical Analysis Labora-
tory, Sterling Hall, Madison 6, Wisconsin
Vanderbilt University, Computer Center, Wesley
Hall, Nashville, Tennessee
Virginia Polytechnic Institute, Temporary Building
365, Blacksburg, Virginia
Washington State University, Computing Center,
Pullman, Washington
Wayne State University, Computing Center, 4841 Cass
Avenue, Detroit 2, Michigan
Yale University, Computing Center, 135 Prospect
Street, New Haven, Connecticut

IBM 701

IBM 701 Data Processing System

MANUFACTURER

International Business Machines Corporation

APPLICATIONS

Manufacturer

Scientific, commercial, and engineering data processing.

U. S. Naval Ordnance Test Station, China Lake

Scientific data processing

Douglas Aircraft Company, Tulsa

Located at the Douglas Aircraft Company, Inc., 2000 North Memorial Drive, Tulsa, Oklahoma, and at A-250, Santa Monica, California, the systems are used for strength analysis, trajectories, aerodynamic stability, aerodynamic performance, dynamic response, thermo dynamic analysis, weight control, and propulsion analysis.

United Aircraft Corporation

The United Aircraft Corporation provides a central computing facility located at the Research Department for the solution of engineering and research problems. It services the three UAC Divisions: Pratt and Whitney Aircraft, Sikorsky Aircraft, and Hamilton Standard which are engaged in the design and manufacture of aircraft engines, helicopters, propellers and other aircraft equipment.

Photo by International Business Machines Corporation

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	18 or 36 per data word
Binary digits/instruction	18
Instructions per word	2
Instructions decoded	33
Arithmetic system	Fixed point
Instruction type	One address
Number range	$-(2^{35} - 1) \leq N \leq (2^{35} - 1)$

Instruction word format

+	Operation		Operand	
0	1	5	6	17

Symbolic routines and floating point interpretive codes are available.

There are 3 arithmetic registers, accumulator, multiplier-quotient, and memory register.

ARITHMETIC UNIT		
	Incl Stor Access	Exclud Stor Access
	Microsec	Microsec
Add	60 or 36	48 or 24
Mult	456	444
Div	456	444
Construction (Arithmetic unit only)		
Vacuum tubes	4,000	
Diodes	12,800	
Arithmetic mode	Parallel	
Timing	Synchronous	
Operation	Sequential	

STORAGE			
Manufacturer	No. of	No. of	Access
Media	Words	Digits	Microsec
Magnetic Core	4,096	40,960	12
Magnetic Drum	8,192 or 16,384		50,000
Magnetic Tape	Up to 900,000 words		10,000
			serially
No. of units that can be connected		10 Units	
No. of char/linear inch of tape		200 Char/inch	
Channels or tracks on the tape		7 Tracks/tape	
Blank tape separating each record		0.75 Inches	
Tape speed		75 Inches/sec	
Transfer rate		15,000 Char/sec	
Start time		10 Millisec	
Stop time		10 Millisec	

Photo by General Motors Corporation

Average time for experienced operator to change reel of tape	30 - 60 Seconds
Physical properties of tape	
Width	0.5 Inches
Length of reel	200 - 2,400 Feet
Composition	Acetate or mylar
Mylar is DuPont's registered trademark for its polyester film.	
Douglas Santa Monica and Douglas Tulsa	
Media	No. of Words No. of Digits Access Microsec
Magnetic Core	4,096 36 12
Magnetic Drum	8,192 36 1,280
Magnetic Tape	6 reels

INPUT	
Manufacturer	Speed
Media	
Card Reader	150 cards/min
Magnetic Tape (IBM 726)	6,000 char/sec
This speed corresponds to 10,000 digits/sec.	
Magnetic Tape (IBM 727)	15,000 char/sec
This speed corresponds to 25,000 digits/sec.	
Cards to Magnetic Tape	250 cards/min
Douglas Santa Monica and Douglas Tulsa	
Cards	150 cards/min
Magnetic Tape	100 char/in, 75 in/sec

Photo by University of California Radiation Laboratory

OUTPUT

Manufacturer	Media	Speed
	Card Punch	100 cards/min
	Line Printer	150 lines/min
	Cathode Ray Tube Display	8,300 points/sec
	Magnetic Tape 726	6,000 char/sec
	Magnetic Tape to Card	100 cards/min
	Magnetic Tape to Line Printer	150 lines/min
	Douglas Santa Monica and Douglas Tulsa Printer	150 lines/min
	Cards	100 cards/min
	Magnetic Tape	100 char/in, 75 in/sec

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Quantity
Tubes	4,000
Diodes	12,800
Magnetic Cores	147,456 (Core Storage)

CHECKING FEATURES

Tapes (727) - Longitudinal & transverse parity check
 Line Printer - Echo checking for each character
 Card Reader - Reads card twice
 Card Punch - Checks columns for double punch & blank column
 Arithmetic & Logical Unit - Overflow, divide check, parity checks.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer	Power (KVA)	Area (sq ft)	Room size (sq ft)	Capacity, air condit (Tons)	Weight, computer (lbs)	Physical planning manual made available.	Weight (lbs)	KVA
	84.0	1,200 to 3,000	1,600 - 3,400	20 - 40	20,516			
Main Frame					2,850		34.4	
Punched Card Recorder					720		0.7	
Line Printer (Wheel Type)					2,795		3.1	
Magnetic Drum					1,480		9.9	
Cathode Ray Tube					2,445		11.8	
Power Frame No. 1					2,810		5.8	

Power Frame No. 2	2,750	5.8
Power Distribution Unit	1,230	1.2
Magnetic Tape Unit (726)	1,270	4.6
Magnetic Tape Control Unit	1,636	6.0
Punched Card Reader	530	0.7

U. S. Naval Ordnance Test Station, China Lake System requires 80 Kw, 136 KVA, 1,404 cu ft, 1,400 sq ft. The system area is 44 by 27 ft and weighs 40,050 lbs, including peripheral equipment. The above power, space and weight does not include supporting machines such as key punches, reproducers, and sorters. This equipment would add 8 KVA and 8,000 lbs.

Douglas Santa Monica and Douglas Tulsa		
Power, computer	65.3 Kw	87.6 KVA
Volume, computer		729.4 cu ft
Area, computer		143.6 sq ft
Room size, computer		1,368 sq ft
Room size, air condi		1,100 sq ft
Floor loading		16 lbs/sq ft
		200 lbs concen max
Capacity, air conditioner		38 Tons
Weight, computer		21,690 lbs

Built-up air handling system - two units, 40 hp each, capable of approximately 38 tons cooling.

Sealed area; a/c ducts installed with 500 RCFE/sink for each component; raised floor (steel platform); a/c unit and airfilter installed; motor-generator set with transformer and controls installed.

PRODUCTION RECORD

Manufacturer

Number produced to date Over 18

There are no 701 systems in production at the present time. Available for new orders only when released from present user.

COST, PRICE AND RENTAL RATES

Manufacturer

	Monthly Charge	Base Purchase Price
701 Central Processing Unit	\$5,000	\$230,000
711 Card Reader	400	16,350
716 Printer	1,200	54,200
721 Card Punch	600	25,000
726 Magnetic Tape Unit	850	42,100
727 Magnetic Tape Unit	550	18,200
731 Magnetic Drum Storage	1,400	87,450
736 Power Supply	1,000	57,400
737 Magnetic Core Storage	3,700	192,400
740 CRT Recorder	2,450	96,000
741 Power Supply	1,000	57,400
746 Power Distribution Unit	1,100	52,000
753 Tape Control	2,350	80,000
780 CRT Display	400	16,000

Since this machine is no longer in production, the Base Purchase Price is used in computing the Discounted Purchase Price based on the age of the installed machine. A published discount schedule is available from IBM.

Maintenance contract details available.

U. S. Naval Ordnance Test Station, China Lake Rental rate for basic system is \$21,500/month. Rental rate for additional equipment \$8,550/month.

Douglas Tulsa

Standard 701 components \$17,220/month. Third 726 Tape Unit (two reels) \$850/month. Maintenance/service is included in rental.

Douglas Santa Monica Main frame, 6 magnetic tape units, 1 reader, 1 punch, and 1 printer \$17,220/month. Maintenance/service is included in rental.

PERSONNEL REQUIREMENTS

Manufacturer

Education training, program testing, technical assistance on all phases is available from manufacturer.

U. S. Naval Ordnance Test Station, China Lake For three 8-hour shifts 6 engineers and 19 technician-operators are utilized. Approximately 9 mathematics aides, 10 mathematicians and 20 to 25 persons from outside the branch, program and run their own problems.

Douglas Tulsa

	One 8-Hour Shift
Supervisors	1
Analysts	6
Clerks	1
Operators	1

Operation tends toward closed shop.

Own course stresses understanding of existing programs and new programming under close supervision.

Douglas Santa Monica

	One 8-Hour Shift
Supervisors	1
Analysts	2
Clerks	1
Operators	2

Operation tends toward closed shop.

Own course followed by on-the-job training.

United Aircraft Company

Two IBM Type 704 and one IBM Type 701 Computers are operated on a 24 hour, six-day week. Three CFC's and three Burroughs E101's are operated on an 8 hour, five-day week.

The Laboratory is staffed by 51 analysts, 11 operators, and 24 aides. Non-computing personnel also program for all calculators.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Atomic Energy Commission, University of California Radiation Laboratory System accepted 26 Apr 54; the average error-free running period is 6.2 hours; good time is 3,032 hours and the attempted to run time is 3,587 hours, resulting in an operating ratio of 0.85; the average error free running time is calculated by dividing the total hours less the total scheduled maintenance less total unscheduled maintenance less the loss time claimed by operator all by the total number of hours of down and lost time reported. The above figures are for the period January 55 to June 55 when operating 24 hours/day.

General Motors Corporation

System accepted in Apr 54; average error free running period is 4.5 hours derived from the records for 1 month; good time of 1,067 hours and attempted to run time of 1,154 hours yielding an operating ratio of 0.92 for a four month period.

Douglas Tulsa

Average error free running period	8 Hours
Good time	39.16 Hours/Week (Average)
Attempted to run time	39.96 Hours/Week (Average)
Operating ratio (Good/Attempted to run time)	0.98
Above figures based on period	1 Jan 60 to 31 Mar 60
Passed Customer Acceptance Test	8 Mar 60
Time is available for rent to outside organizations.	

Douglas Santa Monica
 Average error free running period 8 Hours
 Good time 40 Hours/Week (Average)
 Attempted to run time 42 Hours/Week (Average)
 Operating ratio (Good/Attempted to run time) 0.95
 Above figures based on period from Jan 59 to Jul 60
 Passed Customer Acceptance Test Apr 56
 Time is available for rent to outside organizations.

Lockheed Aircraft Corporation
 Systems accepted on 14 May 53 and 15 Jul 54; average error free running periods of 3-4 hours on one and 1 1/2 hours on the other; good time of 74.4% and 80% where good time is considered as actual production and the remaining 25.6% and 20% respectively, consists of preventive maintenance, breakdown, machine re-work and idle time. The average error free running period is reduced considerably when tapes are used frequently. Short runs are made wherever possible (1-5 hours), but the same program is run for as long as 12 hours and would run longer if time permitted.

United Aircraft Corporation, Research Dept.
 Average error free running period 2 Hours
 Good time 2,667 Hours
 Attempted to run time 3,475 Hours
 Operating ratio (Good/Attempted to run time) 0.77
 Figures based on period 1 Feb 56 to 30 Sep 56
 Passed Customer Acceptance Test 5 Oct 53

Attempted to run time includes calculation, check-out, machine error, unscheduled maintenance, and scheduled maintenance time. The scheduled maintenance for the above period was 367.96 hours and the unscheduled maintenance was 290.75. These two figures should be subtracted from the above "Attempted to run" figure.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Outstanding features include high arithmetic speed and low cost. Unique system advantages are two instructions stored per word and 18 and 36 bit data words.

Tape Storage

Acetate Base Tape

Storage for frequent usage. Relative humidity 40 to 60%. Temperature 65 to 80°F.

Should the tape be exposed to atmospheric conditions outside the above limits for more than four hours, the following item specifications would apply:

Storage for infrequent usage. Temperature 40 to 120°F.

The tape must be placed in a dust proof container and hermetically sealed in a plastic bag. Before re-using, the tape must be reconditioned by allowing it to remain in the conditioned atmosphere for a length of time equal to the time it was away. Twenty-four hours reconditioning is necessary if the tape is removed for longer than twenty-four hours.

Mylar Base Tape

Storage for frequent or infrequent usage. Relative humidity 0 to 80%. Temperature 40 to 120°F.

The tape should be stored in a dust proof container. Should the tape be exposed to atmospheric conditions outside the above limits for more than four hours, it must be reconditioned by allowing it to remain at the given condition for a length of time equal to the time it was away. Twenty-four hours reconditioning is necessary if the tape is removed for longer than twenty-four hours.

The upper limit on humidity is given to prevent the formation of fungus and mold growth. This limit may be exceeded by hermetically sealing the tape in a plastic bag.

General Precautions

The tape should not come in contact with magnetic material at any time and should never be subjected to strong magnetic fields. Either of these can cause the loss of information or the introduction of noise.

When shipping magnetic tape, the reel should be placed in a dust proof container and hermetically sealed in a plastic bag. Additional support should be obtained by enclosing in an individual cardboard box.

A limited number of 701 Systems were produced for specific requirements, many installations of which have changed to the IBM 704 System.

General Motors Corporation

Two interpretive systems are used, Speed Co and ACOM. Speed Co is 3-address while ACOM is 2-address. Both provide for floating point arithmetic, transcendental functions, In-Out operations, B-boxes, and tracing all of which aid in coding and checkout.

Lockheed Aircraft Corporation

A general purpose system called FLOP, a contraction of Floating Octal Point, was developed at Lockheed by members of the Digital Computing Staff. FLOP converts the 701 into an entirely different machine, one which performs all its operations in a "floating octal" system, but also permits all the normal 701 operations to be executed in fixed binary. The floating octal operations performed by the system are add, subtract, multiply, divide (all with real or complex numbers), $\log_3 x$, 8^x , $\sin x$, $\sin^{-1}x$, and square root. The system also provides certain logical operations and control of the input-output devices in three number systems: binary, octal, and floating decimal.

This system was developed in order to obtain a minimum of elapsed time from when a new problem first enters the department to when answers are obtainable.

FUTURE PLANS

U. S. Naval Ordnance Test Station, China Lake
 A modification has been made to the system to allow asynchronous digital data to fill the entire storage unit at one time. Such data are fed from magnetic tape containing the digitalized version of analog information originating at the test equipment. The analog to digital conversion is done as a separate step, prior to entering the data into the computer.

INSTALLATIONS

U. S. Naval Ordnance Test Station
 China Lake, California

United States Weather Bureau
 Washington, D. C.

Boeing Aircraft
 Wichita, Kansas

Douglas Aircraft Company, Incorporated
 El Segundo, California

Douglas Aircraft Company, Incorporated
 2000 North Memorial Drive
 Tulsa, Oklahoma

Douglas Aircraft Company, Incorporated
 3000 Ocean Park Blvd.
 Santa Monica, California

General Motors Corporation
 Detroit, Michigan

Glenn L. Martin Company
Baltimore 3, Maryland
Lockheed Aircraft Corporation
Burbank, California

United Aircraft Corporation
East Hartford 6, Connecticut
University of California
Radiation Laboratory
Berkeley 4, California

IBM 702

IBM 702 Electronic Data Processing Machine

MANUFACTURER

International Business Machines Corporation

APPLICATIONS

Manufacturer

System is used for commercial (cost, inventory, production, accounting, sales, billing, etc) and for scientific (engineering design, mathematical models) applications.

U. S. Navy Aviation Supply Office

Commercial, inventory control.

Bank of America

Located at 500 Howard Street, San Francisco, the system is used for real estate loan accounting, installment loan accounting, accounts receivable accounting, corporate trust accounting, bond investments accounting, branch clearings (inter-branch debit and credit accounting), and branch activity surveys (personnel requirements).

Chrysler Corporation Service Parts Warehouse

Invoicing, cost of sales and inventory control.

Commonwealth Edison Company of Chicago

Customer billing and accounting.

General Electric Company, Hanford Atomic Products

Provide general data processing and computing service

Photo by International Business Machines Corporation to entire plant, both commercial and scientific work.

PROGRAMMING AND NUMERICAL SYSTEM

Manufacturer

Internal number system	Binary coded decimal and alphabetical
Digits per word	Variable
Digits per instruction	5 characters
Instructions per word	No words
Instructions decoded	32
Arithmetic system	Fixed point
	Floating point is programmable.
Instruction type	One address
Number range	± 256 decimal digits
Instruction word format	

X	X	X	X	X
Operation	Address			

Automatic built-in subroutines include store for print.

Automatic coding consists of the Autocoder System.

There are two 256 - character accumulators.
 The machine is not a fixed word length system. It is possible to have both variable field and variable record lengths. Consequently there are no "words". The characters are alphanumeric. Five characters are required to make up an instruction.

ARITHMETIC UNIT

The time required to add is 23 microseconds, excluding the storage access time. The time required to multiply is given by

$$23 [N_p (N_c + 4) + 1] + 115 \text{ microseconds.}$$

The time required to divide is given by

$$23 [10 + N_d + (N_d - N_r)(7.5K + 15)] + 115 \text{ microseconds.}$$

Where

N_p = number of multiplier digits

N_c = number of multiplicand digits

N_d = number of dividend digits

N_r = number of divisor digits

$K = N_r$ if $N_r > 8$ and $K = N_r + 0.005(8 - N_r)$ if $N_r < 8$.

The arithmetic unit is constructed of vacuum tubes, crystal diodes and magnetic cores and operates serially by binary coded decimal character and parallel by bit.

Photo by International Business Machines Corporation

Arithmetic mode	Serial
Timing	Synchronous
Operation	Sequential

STORAGE

Manufacturer	Alphanumeric Characters	Access Microsec
Media	10,000	17
Magnetic Core	60,000	8,120+40N
Magnetic Drum	Magnetic drum has 300 sections of 200 characters each. N = number of characters.	
Magnetic Tape	5,760,000	10,140+67N
No. of units that can be connected	10 Units	
No. of char/linear inch of tape	200 Char/inch	
Channels or tracks on the tape	7 Tracks/tape	
Blank tape separating each record	0.75 Inches	
Tape speed	75 Inches/sec	
Transfer rate	15,000 Char/sec	
Start time	10 Millisec	
Stop time	10 Millisec	
Average time for experienced operator to change reel of tape	60 Seconds	
Physical properties of tape		
Width	0.5 Inches	
Length of reel	200-2,400 Feet	
Composition	Acetate or Mylar	
Mylar is Dupont's registered name for its polyester film.		
U. S. Navy Aviation Supply Office System has magnetic core storage unit in lieu of electrostatic.		

Photo by International Business Machines Corporation (Poughkeepsie)

Bank of America

Medium	No. of Words	No. of Digits	Access Microsec
Magnetic Core Memory	Variable	20,000	17

Not a fixed word length system. Variable field lengths and variable record lengths are possible. Characters are alpha-numeric.

Chrysler Corporation Service Parts Warehouse System has magnetic core and magnetic drum.

General Electric Company, Hanford Atomic Products System has magnetic core, magnetic drum, and magnetic tape storage.

Bank of America

Media	Speed
Magnetic Tape	75 inch/sec 1/2" 7-channel tape
Punched Card	250 cards/min 80 char/card

Card to magnetic tape conversion done on "off-line" basis.

General Electric Company, Hanford Atomic Products Operation
Card reader at 250 cards/min with off-line card to tape conversion. Magnetic tape speed is $(10,000 + 67N)$ microseconds, where N is the number of characters.

INPUT

Manufacturer	Media	Speed
	Magnetic Tape	
	Card Reader	250 cards/min
	Operator Console	Manual
	Magnetic	25,000 char/sec

U. S. Navy Aviation Supply Office
Magnetic tape unit operates at 200 char/inch and 75 inches/sec. Card reader operates at 250 cards/min at 80 char/card.

OUTPUT

Manufacturer	Media	Speed
	Magnetic Tape	
	Card Punch	100 cards/min
	Line Printer	150 lines/min
		500 lines/min
	Typewriter	1,000 lines/min
		600 char/min
	Magnetic Drum	25,000 char/sec

The IBM 1401 Data Processing System may be used for peripheral operations such as card-tape, tape-printer, and card editing at speeds of: card reading- 800 cards/min, card punching-250 cards/min and printing-600 lines/min.

U. S. Navy Aviation Supply Office
System has all above output systems.
Bank of America

Media	Speed	
Magnetic Tape	75 inch/sec	1/2" 7-channel tape
Punched Card	100 cards/min	80 char/card
Typewriter	600 char/min	
Printer	500 lines/min	120 print positions

Magnetic tape to card and tape to printer conversion
done on "off-line" basis.

General Electric Company, Hanford Atomic Products
Magnetic tape to card and tape to printer conversion
done on "off-line" basis.

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Manufacturer	
Tubes	10,000
Tube types	10
Crystal diodes	17,000

Complement changes with configuration.
Bank of America

In addition to the above, the system has 165,000
magnetic cores. It utilizes tube types 6211, 5965
and 5687.

Photo by General Electric Company Richland

CHECKING FEATURES

Instruction

During the execution of an instruction, a character code error, an invalid operation part transfer, or an operation part interpretation, may be detected and indicated.

Machine

The machine check indicator is turned on when a character code error is detected during the execution of all instructions (except write, write and erase, read, and read check) in which information is read from accumulator storage or memory. Read-Write -- checks the transmission of data from all input units to memory. It also checks the transmission of all output data from memory to the drum, tape unit, card punch record storage, printer record storage, and typewriter.

Printer-Punch

This indicator reflects any error when information is punched in a card or when printed on the printer.

Overflow

The overflow check indicator is turned on during an add or subtract operation when the number of digits in the result is greater than the number of digits in the longer of the original fields. An overflow is indicated as a result of a round off operation if a