UNIVAC 1101

Universal Automatic Scientific Computer 1101

MANUFACTURER

Remington Rand Univac Division
Sperry-Rand Corporation

Photo by Georgia Institute of Technology Engineering Experiment Station, Rich Electronic Computer Center

APPLICATIONS

Georgia Tech

Commercial and scientific data processing. Education and research in all fields of engineering and science. Provides research assistance to commercial and industrial sponsors.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	24
Binary digits/instruction	24
Instructions per word	1
Instructions decoded	48
Instructions used	43
Arithmetic system	Fixed point
Instruction type	One address
Number range	$1-2^{23}$ to $2^{23}-1$

Negative numbers used are in the ones complement arithmetic. +5 = 00000005 and -5 = 77777772 octal.

ARITHMETIC UNIT

	Exclud Stor Access Microsec
Add time	5
Mult time	260
Div time	324
Construction	Vacuum tubes
Basic pulse repetition rate	400 Kc/sec
Arithmetic mode	Parallel
Timing	Asynchronous
Operation	Sequential

STORAGE

Media	Words	Access Microsec
Magnetic Drum	16,384	32 - 17,000
Magnetic Core	4,096	10

Georgia Tech

A modified 1103A Magnetic Core System has been installed on the 1101. The computer has a 24 binary digit word which is transferred and operated on in a parallel mode.

INPUT

Medium
Paper Tape (35 words, 140 frames, 14 in)/sec

OUTPUT

Media	Speed
Paper Tape (Teletype)	60 char/sec
Typewriter (Flexowriter)	10 char/sec

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	2,695	(18 types)
Diodes	2,385	

CHECKING FEATURES

Improper command stops the machine.

PRODUCTION RECORD

Total number of Univac 1100 Series (all models) delivered is 45.

Photo by Georgia Institute of Technology Engineering Experiment Station, Rich Electronic Computer Center

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	16 KVA 0.95 pf
Power, air conditioner	1.2 KVA (Gas operated)
Space, computer	2,880 cu ft, 360 sq ft
Space, air conditioner	384 cu ft, 48 sq ft
Room size, computer	720 sq ft
Room size, air conditioner	192 sq ft
Floor loading	44 lbs/sq ft
Capacity, air conditioner	5 Tons
Weight, computer	16,000 lbs
Weight, air conditioner	1,500 lbs

False floor (plenum for A.C.). Separate room for M.G. and A.C. Distribution duct from A.C. to computer.

COST, PRICE AND RENTAL RATES

Machine donated to Georgia Institute of Technology (evaluated at $500,000).

Magnetic Core System	$39,000
Bull Equipment	4,000 (approx)

Maintenance performed by Georgia Tech staff.

PERSONNEL REQUIREMENTS

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Analysts	2	2
Programmers, Coders	4	6
Librarians	1	1
Operators	1	1
Engineers	1	1
Technicians	2	2

Operation tends toward open shop.

Technician training is conducted at scheduled times and programming courses are offered in the Mathematics Department.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Average error-free running period	5.6 Hours
Good time	34.5 Hours/Week (Average)
Attempted to run time	38.0 Hours/Week (Average)
Operating ratio (Good/Attempted to run time)	0.80

Above figures based on period 1 May 60 to 1 Aug 60

Passed Customer Acceptance Test Aug 55

Time is available for rent to outside organizations.

Rental is $75.00 per hour (including operator).

ADDITIONAL FEATURES AND REMARKS

Outstanding features include a large library of subroutines, including fixed point, floating point, function evaluation, etc., and stop address interrupt feature.

FUTURE PLANS

The addition of index registers and floating point hardware is being considered and modifications are in progress to add punch card input-output with the Bull Controlled Reproducer with independent input and output buffers.

INSTALLATIONS

Georgia Institute of Technology
Engineering Experimental Station
Rich Electronic Computing Center
Atlanta, Georgia

UNIVAC 1102

Universal Automatic Scientific Computer 1102

MANUFACTURER

Sperry Rand Corporation
Remington Rand Univac Division

Photo by Arnold Engineering Development Center, ARDC, Tullahoma, Tennessee

APPLICATIONS

Arnold Engineering Development Center
Data reduction in Wind Tunnel and Engine Test Facilities. Three computers are used on-line during wind-tunnel and aerodynamic testing.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits per word	24
Binary digits/instruction	24
Instructions per word	1
Instructions decoded	Depends upon program
Octal digits/instruction not decoded	8
Arithmetic system	Left circular shift
Instruction type	One address
Number range	Accumulator holds 48 binary digits

ARITHMETIC UNIT

	Exclud Stor Access Microsec
Add time	17 max.
Mult time	264 max.
Div time	340 max.
Construction	Vacuum tubes
Rapid access word registers	1
Basic pulse repetition rate	500 Kc/sec
Arithmetic mode	Parallel

STORAGE

Media	Words	Access Microsec
Magnetic Drum	8,192	8,500 max.

INPUT

Media	Speed
Tape Reader	200 lines/sec
Raw Data Scanner	Scans 252 channels in 12.5 sec or 20/sec.

The raw data scanner is connected to transducers measuring test data.

OUTPUT

Media	Speed
Automatic Typewriter	10 char/sec
Automatic Plotter	

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	2,700
Diodes	3,000
Magnetic elements	700 relays
Number of separate cabinets	3
Number of different kinds of plug-in units	47

CHECKING FEATURES

Accumulator overflow indicator
"Oversize quotient" check
Improper operation code check
Address check on tape loading

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer	22 Kw
Volume, computer	772 cu ft
Area, computer	122 sq ft
Weight, computer	14,000 lbs
Power, air conditioner	9 Kw
Volume, air conditioner	80 cu ft
Area, air conditioner	12 sq ft
Weight, air conditioner	3,000 lbs
Capacity, air conditioner	25 Tons

PRODUCTION RECORD

Number produced	3
Number in current operation	3

COST, PRICE AND RENTAL RATES

Three computing systems were developed and manufactured under contract. Total cost was approximately $1,400,000.

PERSONNEL REQUIREMENTS

Daily Operation	No. of Eng.	No. of Tech.
One 8 Hour Shift	5	2

Above totals are for one computer.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Arnold Engineering Development Center

The following performance figures are given for the three computers for the period January through September 1956. The last of the three computers was accepted on 1 March 1956. Each column is for a separate engineering facility at the Arnold Engineering Development Center.

	ETF	PWT	GDF
Manned Time	57.0%	25.6%	30.1%
Utilization	51.4%	20.3%	24.8%
Computer Efficiency	87.5%	89.3%	84.4%
Reliability	96.8%	99.3%	97.9%
Scheduled Maintenance	9.5%	10.0%	13.9%
Unscheduled Maintenance	3.0%	0.7%	1.7%
Maintenance Factor	0.331	0.301	0.388

Terms and Definitions of Computer Performance

O - Operational Time - Productive computer hours used in data reduction, engineering problems, program checking, or other productive computations. It does not include hours used in running of check problems for maintenance purposes.

I - Idle Time - Computer hours during which the computer is manned and in condition for productive operation but not in use for such purposes.

U - Unused and Unmanned Time - Hours during which personnel are not scheduled for computer operation.

C - Marginal Checking - Daily routine testing prior to operation to determine that the computer is in operable condition.

P - Preventive Maintenance - Computer hours used for testing of the computer to improve its performance and which does not detract from scheduled operational time.

R - Unscheduled Maintenance - Hours consumed in restoring the computer to operating condition when failure occurs.

C.M. - Concurrent Maintenance - Hours spent in repair and testing of computer components which does not consume computer time.

E.M. - Engineering Modifications - Computer hours used in accomplishing engineering modifications to the computer and its circuitry.

T - Total Time = O + I + U + C + P + R + E.M.

On a daily basis Total Time is twenty-four hours.

Manned Time
100 (T-U)/T

Utilization
100 (O+E.M.)/(O+I+U+E.M.)

Computer Efficiency
100 (O+I+E.M.)/(T-U)

Reliability
100 (O+I+E.M.)/(O+I+R+E.M.)

Scheduled Maintenance
100 (C+P)/(T-U)

Unscheduled Maintenance
100 R/(T-U)

Maintenance Factor
(C+P+C.M.+R)/T-U+C.M.)

UNIVAC 1103 1103A

Universal Automatic Computer Model 1103 - 1103A

MANUFACTURER

Remington Rand Univac Division
Sperry Rand Corporation

Photo by Lockheed Aircraft Corporation

APPLICATIONS

Manufacturer
Scientific computation.

White Sands Missile Range
Integrated Range Mission-DRD, N. M.
Located in Building 1512, White Sands Missile Range, the primary use of the ERA 1103A, is for computations incident to conversion of range flight test data to engineering formats and computations of problems associated with flight simulation and a small amount of general purpose computing for range customers.

3208th Test Gp (TF), APGC (PGVMC)
Eglin AFB, Florida
Located in Building 625, Eglin AFB, Florida, the 1103A is used for impact predictions (real time), slew testing of radars and ballistics.

Air Force Missile Development Center
Holloman AFB, New Mexico
Both systems are used for reduction of data obtained during high speed track tests of inertial guidance systems, e.g. gyro error coefficients, vibration analysis, acceleration and velocity translation to tangent plane coordinates, satellite orbit calculations, and missile performance analysis. Systems are integrated into the Real Time Data Assimilator.

Digital Computation Branch (WWDCD) WADD, W-P AFB
Located in Building 57, WADD, W-P AFB, Ohio, the system is used in the solution of scientific and other R&D problems, in conducting research in numerical analysis and digital computer programming techniques.

National Aeronautics & Space Administration,
Lewis Research Center
Located at the NASA-Lewis Research Center, 21000 Brookpark Road, Cleveland 35, Ohio, the system is used for reduction of experimental data from wind tunnels, test stands, rocket stands, etc., engineering and scientific analysis-type problems.
Experimental data is recorded on automatic recorders of our own design. The punched paper tapes and/or magnetic tapes are fed into the computer, calibrated,

Photo by Lockheed Aircraft Corporation

and mathematical operations carried out to produce the quantities specified by the test engineer. Scientific problems of all types are punched into paper tapes by a Flexowriter, fed into the computer, and the mathematical operations specified by the programmer are performed.

Lockheed Missile and Space Division
Located at Palo Alto, California, the 1103AF (2 computers) systems are primarily used for trajectory calculations and real time orbital predictions.

Johns Hopkins University, Applied Physics Lab.
Located at Johns Hopkins Road, Scaggsville, Howard County, Maryland, the 1103A is used for scientific computations in support of the Laboratory's research and development programs.

Johns Hopkins Univ., Operating Research Office
Located at the Computing Laboratory Division, 6935 Arlington Road, Bethesda 14, Md., the 1103A is used for operational simulation, including war gaming, and scientific data processing.

Computing Laboratory, Southern Methodist Univ.
Located at 3175 Yale, S. M. U. Campus, Dallas, the 1103 is used for education and research.

Numerical Analysis Center, University of Minnesota
Located in Room 230, Exp. Engineering Building, University of Minnesota, the 1103 is being used in statistical work to do such things as factor analysis (16 variables), multiple regression, analysis of variance, item analysis of tests, product moment correlations, linear and quadratic discriminant finctions, reciprocal average analysis, and several specialized projects. It is used in crystallography to determine atomic structure of crystals from X-ray diffraction data; in aerodynamics to analyse transonic flow boundary layers, buckling of sandwich panels, detonation wave structure; in electrical engineering to study acoustic coupling, micromagnetics, and ferrmagnetic microstructure; in mathematics to do continued fraction expansions, analyse the four-color map problem; in mechanical engineering to study mass transfer cooling, non-circular duct flow, to design a probe for measurement of flame temperature, to study the transport properties of helium-air mixtures; in chemistry to study the kinetics of chemical reactions, light scattering, and energy levels of linear molecules; in chemical engineering to study nuclear reactor simulation and control, kinetics of polymerization, stability of loop processes, optimum design of a chemical reactor, perturbation transients in a distillation tower, kinetics of a nuclear reactor; in physics to compute instrument corrections for data on

Photo by NASA Lewis Research Center

black body radiation taken from numerous balloon flights, to compute cosmic ray orbits in the earth's magnetic field and proton trajectories in an optical potential, analysis of nuclear stripping reactions, compute the IGY cosmic ray index, analyse the Van Allen zones; in agronomy and plant genetics to analyse hybrid corn performance; in animal husbandry to study breeding programs involving large populations and many generations; and in physical chemistry to determine normal coordinates of molecular vibration.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	36
Binary digits/instruction	36
Instructions per word	1
Instructions decoded Model 1103	41
Model 1103A	50
Arithmetic system	Fixed and floating point
Instruction type	Two address
Number range Fixed point	$(1-2^{35}) \leq n \leq (2^{35}-1)$
Floating point	$-2^{127} \leq n \leq 2^{127}$

The instruction consists of a 2-character operating code (command), a 5-character First Address and a 5-character Second Address.
The floating point system utilizes nine instructions. Fixed point operation utilizes 41 instructions.
There are two 15 bit addresses per word. This facilities writing of programs, since less instructions are required, less storage is consumed in storing program, and a smaller repertoire of instructions has to be learned by the programmer.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	32-60	12-28
Mult	116-410	92-386
Div	482-490	466-474

Construction	Vacuum tubes
Basic pulse repetition rate	500 Kc/sec
Arithmetic mode	Parallel
Timing	Synchronous
Operation	Sequential

Operation times given above are average values. Add time includes transmitting result to V address. Multiply time is for product to form in accumulator with multiplier in "0" register. Divide time includes quotient in "0" register and positive remainder in the accumulator. The arithmetic unit is constructed of Eccles-Jordan flip-flop type circuits triggered by pulses from pentode "gate" circuits which are "enabled" by either other flip flops or signals from "AND" or "OR" circuits. The flip flops may be manually controlled from the console. Although the arithmetic mode is parallel, all operations pass through the exchange register "X". The "X", "0", and "A" registers separately and in combination are used to form eleven distinct logical and arithmetic sequences.

STORAGE

Photo by WWDCD Wright Air Development Division

Manufacturer

Media	No. of Words	No. of Digits	Access Microsec
Magnetic Core	4,096	147,456	8
Magnetic Core	4,096	147,456	8
Magnetic Core	4,096	147,456	8
Magnetic Drum	16,384	589,824	17,500

The magnetic core matrix is 64 x 64 bits. The matrices are stacked in groups of 36. Up to three stacks may be used as high speed storage. The magnetic drum is a medium speed storage system. The magnetic tape Uniservos store 326,000 words of low speed storage. Up to 10 Uniservos can be accommodated.

WSMR IRM

Magnetic Core	8,192		8
Magnetic Drum	16,384		

0 to 34 milliseconds for 1st word, 32 microsec/word thereafter.

Magnetic Tape 326,000 words/tape

Computer is equipped with 10 Uniservo I's up to 8 of which may be used for information storage at programmer's discretion.

Eglin AFB

Drum	16,384		
Core	4,096		

Holloman AFB

Magnetic Core	4,096	147,456	8
Magnetic Drum	16,384	589,824	17,500

Media	No. of Words	No. of Digits	Access Microsec
W-P AFB			
Drum	16,384		
Core	12,288		
NASA Lewis			
Magnetic Core	4,096		6.0
Magnetic Drum	16,384		17,000 avg.
Lockheed			
Magnetic Core	8,192	294,912	8
Magnetic Drum	16,384	589,824	17,000
Magnetic Tape	1,500,000	54,000,000	20,000
Internal Registers	3	108	4

Tape access time depends on the position of the tape. In most cases, however, the access time is 20 milliseconds.

Johns Hopkins APL

Core	8,192	284,912	8
Drum	16,384	589,824	17,500

Floating point a feature.

Johns Hopkins ORO

Magnetic Core	4,096		
Magnetic Drum	16,384		

Southern Methodist

Magnetic Core	1,024		8
Magnetic Drum	16,384		33,000
Magnetic Tape	65,536		

Photo by Air Force Missile Development Center, Holloman AFB

Media	No. of Words	Access Microsec
Electrostatic (CRT)	1,024	8
Magnetic Drum	16,384	17,000 (avg)
Magnetic Tape	262,144	2 min (avg)

INPUT

Manufacturer Media	Speed
Magnetic Tape	2,130 words/sec
Tape Reader	200 frames/sec
Card Reproducer	120 cards/min

The magnetic tape speed is given for the continuous input mode. The tape reader senses 2 octal digits/frame. The card reproducer uses 80-column cards, placing 24 words on a card. Special equipment, such as analog-to-digital converters can be used as optional equipment. By means of input-output buffer registers, a variety of input or output equipment can be accommodated by the computers.

WSMR IRM	
Uniservos	1,800 words/sec
IBM Card Punch	48 words/sec
High Speed Paper Tape Reader	35 words/sec
BRL High/O Magnetic Tape Reader	555 words/sec

Media	Speed
Eglin AFB	
Control Reproducer	120 80 column IBM cards/min (on-line)
Uniservo Magnetic Tape	2,137 words/min (on-line)
Ferranti Paper Tape Reader	220 frames/sec (on-line)
Milgo	
Holloman AFB	
Magnetic Tape (Uniservo) Continuous read.	2,130 words/sec
Paper Tape	200 frames/sec
Punched Cards	120 cards/min
Magnetic Tape (IBM Format) Continuous read.	5,000 words/sec
Magnetic Tape Ampex FR 316.	450,000 bits/sec
W-P AFB	
Magnetic Tape	100 in/sec 12,000 char/sec
Paper Tape	200 frames/sec 400 char/sec octal
Punched Card	120 cards/min
NASA Lewis	
Magnetic Tape (2 channel)	320 char/sec (data tape)
Magnetic Tape (7 channel)	8,000 32,000 char/sec (data tapes)
Magnetic Tape (Buffered)	33,000 char/sec (I/O or intermediate tape)
Paper Tape	200 char/sec (programs and/or data)

Media	Speed
Lockheed	
Paper Tape	400 octal dig/sec
Magnetic Tape	25,600 octal dig/sec
Punched Cards (80 column)	120 cards/min
Johns Hopkins APL	
Card	120 cards/min
Magnetic Tapes (8 units)	12,500 char/sec
Paper Tape	200 char/sec
Johns Hopkins ORO	
Punched Cards	
Paper Tape	
Magnetic Tape	
Southern Methodist	
Paper Tape (Ferranti)	200 char/sec
Card Reader (Bull)	120 cards/min
U of Minn	
Paper Tape (7 channel) (Ferranti Mark II Photoelectric)	200 frames/sec
Cards (80 col.) (Bull controlled reproducer)	120 cards/min

Photo by White Sands Missile Range, New Mexico

OUTPUT

Manufacturer Media	Speed
Magnetic Tape (Uniservo) Continuous write.	2,130 words/sec
High Speed Printer	600 lines/min 130 char/line
High Speed Punch	60 frames/sec 2 char/frame
Card Reproducer (80 Col.)	120 cards/min 24 words/card
Flexowriter	Supplied as monitor
WSMR IRM	
Uniservo I Magnetic Tape	1,800 words/sec
IBM Card Punch	48 words/sec
Paper Tape	10 words/sec
Eglin AFB	
High Speed Punch	120 frames/sec (on-line)
Charactron Display & Manual Intervention Sys.	10,000 times/sec (on-line)
High Speed Printer	600 lines/sec (off-line)
Flexowriter	10 char/sec (on-line)
Variplotter	

Media	Speed
Holloman AFB	
Magnetic Tape (Uniservo)	2,130 words/sec
Continuous write.	
Paper Tape	60 frames/sec
Punched Cards	120 cards/min
Magnetic Tape (IBM Format)	5,000 words/sec
Continuous write.	

The system contains special buffers, so-called loading platforms, for real time input of test data, a common memory for communication between two Univac Scientifics and on-line equipment for output, like digial, analog converters, display.

Photo by White Sands Missile Range, New Mexico

Media	Speed
W-P AFB	
Magnetic Tape	100 in/sec
	12,000 char/sec
Paper Tape	60 frames/sec
	120 char/sec, octal
Punched Cards	120 cards/min
On Line Monitor Flex	10 char/sec

Off-line tape to printer is main output method, using the Univac High Speed Printer (600 lines/min).

NASA Lewis	
Paper Tape Punch (3)	60 char/sec, each
Magnetic Tape (Buffered)	33,000 char/sec

Media	Speed
Lockheed	
Paper Tape	400 digits/sec
Magnetic Tape	25,600 octal digits/sec
Punched Cards (80 Column)	120 cards/min
Flexowriter	60 char/min
Johns Hopkins APL	
Cards	100 cards/min
Magnetic Tape	12,500 char/sec
Paper Tape	60 char/sec
On Line Printer	600 lines/min
	120 char/line
Johns Hopkins ORO	
Punched Cards	
Paper Tape	
Magnetic Tape	
Off-line High Speed Printer	
Southern Methodist	
Paper Tape	3,500 char/min
Cards (Bull)	120 cards/min
Flexowriter (On-line)	160 char/min
U of Minn	
Paper Tape (7 channel) (Teletype Punch)	60 frames/sec
Cards (80 Col.) (Bull controlled reproducer)	120 cards/min

Photo by Eglin Air Force Base, Florida (APGC)

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	3,907
Tube types	12
Crystal diodes	8,956
Magnetic cores	147,456
Uniservo Magnetic Tape Units	77 tubes, each add'l
Card Reproducer Unit	211 tubes, add'l

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer	
Power, computer	82 KVA 0.9 pf
220 volt, 3 phase, 100 KVA min, including cooling blower.	
Space, computer	946.3 sq ft Minimum room size 58 ft 6 1/4 in x 30 ft 6 in
Weight, computer	38,543 lbs
Floor loading	40.7 lbs/sq ft
Capacity, air conditioner	Required equivalent capacity is 20 Tons.

Two voltage regulators, 3 phase, 45 KVA, required.

Customer furnished cooling water 50°F 65 gal/min, required.

Separate maintenance area approximately 14 x 24 ft, required.

WSMR IRM

Power, computer & air conditioner	100 KVA	0.90 pf est.
Area, computer & peripheral equipment	1,047 sq ft	
Area, air conditioner	55 sq ft	

Area does not include roof space for cooling towers

Room size, maint area & computer proper	40 ft x 80 ft (approx)	
Floor loading	35 lbs/sq ft	
	80 lbs concen max	
Capacity, air conditioner	50 Tons	
Weight, computer & peripheral equipment	51,610 lbs	

Air conditioner is water cooled type. Heat exchangers may be located remotely from computer.

No special provision is required since plenums, false floors, etc. are included as part of the system. Also motor alternator for providing constant voltage power to pulsing circuits is provided. Preparation is confined to 2 inch pipe lines for delivery of chilled water from computer to heat exchanger and from heat exchanger to room cooling towers and provision for power distribution. Separate transformer vaults are provided from post primary system for computer in order to stabilize voltage. Separate voltage alternator is provided by manufacturer for pulsing circuits. 50 hp. If newly designed room should provide a minimum of 30 ft clear span with no columns; however, machine can be installed around columns if required.

Eglin AFB

Power, computer	60 Kw	55 KVA	0.92 pf
Power, air cond	28 Kw	26.6 KVA	0.95 pf
Volume, computer		9,360 cu ft	
Volume, air conditioner		432 cu ft	
Area, computer		1,560 sq ft	
Area, air conditioner		72 sq ft	
Room size		10 ft (height)	
		60 ft (length)	
		33 ft (width)	
Floor loading		21.5 lbs/sq ft	
Capacity, air conditioner		30 Tons	
Weight, computer		33,600 lbs	
Weight, air conditioner		10,790 lbs	

False floor 15 1/2 in. above sub-floor level. Requires a motor room to house the motor-alternator which is supplied with 208 v, 60 cycles/sec, three phase, four wire arrangement for power to the computer and air conditioning system. Shielded room or screen room used to keep out the electromagnetic radiations of nearby electronic equipment.

Holloman AFB

Power, computer approx	50 Kw	55 KVA 0.90 pf
Volume, computer		3,000 cu ft (approx)
Area, computer		925 sq ft (approx)
Room size	56 ft 6 1/4 in x 31 ft 2 1/2 in min.	
Floor loading		40.7 lbs/sq ft
		500 lbs concen max

Chilled water supply: 65 gallon/minute maximum at 50°F maximum. Condensation drain. Installation and wiring of motor alternator.

W-P AFB

Power, computer	100 KVA
Volume, computer	10,700 cu ft
Volume, air conditioner	575 cu ft
Area, computer	1,780 sq ft
Area, air conditioner	82.5 sq ft
Room size	70 ft x 40 ft
Floor loading	40.7 lbs/sq ft
Capacity, air conditioner	30 Tons
Weight, computer	38,540 lbs

Provided partitions to enclose room for humidity control.

NASA Lewis

Power, computer	50 KVA
Power, air conditioner	18 KVA
Volume, computer	12,500 cu ft
Volume, air conditioner	3,000 cu ft
Area, computer	1,250 sq ft
Area, air conditioner	300 sq ft
Room size, computer	65 ft x 30 ft
Room size, air conditioner	20 ft x 15 ft
Floor loading	100 lbs/sq ft
Capacity, air conditioner	25 Tons

Platforms used as plenum chamber and cable space. Separate power feeder. Insulated water lines from basement to second floor. Concrete pad for water chiller. Existing building construction was reinforced concrete.

Lockheed

Power, computer	60 Kw	60 KVA	1.0 pf
Power, air cond	4.05 Kw	5.05 KVA	0.8 pf
Volume, computer		9,000 cu ft	
Area, computer		1,500 sq ft	
Room size		60 ft x 26 ft	
Capacity, air conditioner		15 Tons	
Weight, computer		34,000 lbs	

False floor, motor generator and alternator for each computer, air conditioning unit for each computer, and room air conditioning.

Johns Hopkins APL

Power, computer	130 Kw	130 KVA	0.9 pf
Power, air cond	60 Kw	60 KVA	0.9 pf
Volume, computer		10,500 cu ft	
Volume, air conditioner		1,500 cu ft	
Area, computer		1,500 sq ft	
Area, air conditioner		250 sq ft	
Room size, computer		2,000 sq ft	
Room size, air conditioner		400 sq ft	
Floor loading		36.6 lbs/sq ft	
Capacity, air conditioner		50 Tons	
Weight, computer		55,000 lbs	
Weight, air conditioner		8,000 lbs	

Prefabricated metal Butler building.

Johns Hopkins ORO

Power, computer	60 Kw	45 KVA	0.9 pf
Power, air cond		30 KVA	
Area, computer		1,200 sq ft	
Area, air conditioner		300 sq ft	
Room size		58 ft x 30 ft	
Floor loading		40.7 lbs/sq ft	
Capacity, air conditioner		3 - 20 Ton units	
		40 Tons required	
Weight, computer		38,543 lbs	

Present 1103A Computing System replaced an ERA 1103 Computer; therefore, installation costs and building modifications were minor - amounting only to installing 2 additional 20 ton water chillers and additional electric power. Total cost of present installation was less than $30,000. Cost of initial 1103 installation was also under $30,000 since the 1103 series equipment is provided with a raised floor plenum and air handler.

Southern Methodist

Power, computer	41.5 Kw	0.9 Lag pf
Volume, air conditioner	126 cu ft	
Area, computer	755.5 sq ft	
Area, air conditioner	21 sq ft	
Room size, computer	26 ft x 60 ft	
Room size, air conditioner	6 ft x 7 ft	
Floor loading	46.1 lbs/sq ft	
Capacity, air conditioner	20 Tons	
Weight, computer	34,747 lbs	

3 phase, 220 volt, 60 cycle and 115, single phase, 60 cycle power to building. Cooling tower is required with building to supply water for air conditioner.

U of Minn

Power, computer	44.0 Kw	0.9 induct. pf
Power, air conditioner	22.0 Kw	
Area, computer	710 sq ft	
Area, air cond & motor gen.	280 sq ft	
Room size, computer	58.5 ft x 25.75 ft min	
Room size, air conditioner	14 ft x 20 ft	
Floor loading	46.1 lbs/sq ft	
Capacity, air conditioner	20 Tons min.	
Weight, computer	34,747 lbs	

The required space on the second floor of a laboratory building was given a false ceiling and a strengthening sub-floor, and partitions were erected to form three offices and an off-line input-output preparation room for three Flexowriters and a card punch. Partitions in the basement were erected to form a room for the motor-generators and the air conditioning chiller and a room for the air conditioning condenser.

COST, PRICE AND RENTAL RATES

WSMR IRM

Computer with card input output from 10 Uniservos and floating point with two cores approx. cost $32,115.

Card-to-tape converter, tape-to-card converter, high-speed printer (600 lines/min with plotting feature) $8,815.

Service is provided with basic rental rate.

Eglin AFB

Total cost $922,000.

Magnetic Core Storage (4,096 words)
Magnetic Drum Storage (16,384 words)
Magnetic Tape Control
Power Supply
Desk Console
Arithmetic Section
Main Control Section
Air Conditioning Section
The direct connected input/output units are:
(1) Photo-electric punched paper tape reader
(2) High Speed Paper Tape Punch
(3) Monitoring Flexowriter

Additional Equipment	Cost
Controlled Reproducer	$ 55,000
High Speed Printer	185,000
Charactron Display & Manual Intervention System	325,000

6 Uniservo Tape Units and 1 Unityper II (without maintenance) rents for $27,000/year.

Vitro maintenance engineer plus spare parts is $115,000.

Holloman AFB

Basic system

Computer including one core bay (4,096 words, 5 Uniservos, one punched card input-output unit $1,029,500.

Additional equipment

One Uniservo	$18,000
One additional core bay, approx.	$200,000
High Speed Printer	$3,890/month

$4,370.50/month for eight-hour shift.

W-P AFB

1103A w/float point, 12K core, 16K drum, 10 Uniservo I, Bull Card I/O (80 col), Univac HS Printer rent at $41,000/month.

Maintenance service included in rental.

NASA Lewis

Basic system cost $920,094.

Additional equipment cost $313,939, including Flexowriters, input-output equipment and circuitry, buffered tape installation, new memory.

Lockheed

Type	Unit	Serial No.	Monthly Rental	Hourly Rate	Extra Shift per Hour
	Univac	22	$20,980.00	$119.20	$59.60
	Core Storage		4,500.00	25.57	12.79
	Floating Point		1,545.00	8.78	4.39
	Variable Block		290.00	1.65	.83
	Total Main Frame		27,315.00	155.20	77.61
	Uniservo (10)		3,200.00	18.18	9.09
	Read Punch		890.00	5.06	2.53
	Total On Line		4,090.00	23.24	11.62
	Total EDP No. 22		31,405.00	178.44	89.23
	Univac	27	20,980.00	119.20	56.60
	Core Storage		4,500.00	25.57	12.79
	Floating Point		1,545.00	8.78	4.39
	Variable Block		290.00	1.65	.83
	Total Main Frame		27,315.00	155.20	77.61
	Uniservo (10)		3,200.00	18.18	9.09
	Read Punch		890.00	5.06	2.53
	Total On Line		4,090.00	23.24	11.62
	Total EDP No. 27 (C+D)		31,405.00	178.44	89.23
	High Speed Printer		3,300.00	18.75	9.38
	High Speed Printer		3,300.00	18.75	9.38
	Card to Tape		2,605.00	14.80	7.40
	Total Off Line		9,205.00	52.30	26.16
	Total EDP Systems		72,015.00	409.18	26.16
026	Key Punch	19133	77.00	.43	.22
026	Key Punch	30566	71.50	.41	.20
026	Key Punch	30624	71.50	.41	.21
056	Verifier	40595	60.50	37	.19
	Total Key Punch		280.50	1.62	.82
077	Collator	36399	126.50	.72	.36
082	Sorter	36338	68.20	.39	.20
407	Acctg. Mach.	16001	915.75	5.20	2.60
519	Reproducer	17299	178.20	1.01	.51
552	Interpreter	25483	99.00	.56	.23
	Total Auxiliary		1,387.65	7.98	3.90
	Total EAM		1,668.15	9.60	4.72
	Total system		73,683.15		

Monthly rental includes 10% F.E.T.where applicable.
Hourly rate is 1/176th of monthly rental.
Extra shift per hour is 50% of 1/176th of monthly rate.

Johns Hopkins APL

$35,135 per month for basic system on prime shift and at 50% rate for extra shift use.

Maintenance service, included in monthly rental shown above.

Johns Hopkins ORO

Basic system

4,096 magnetic core, 16,384 magnetic drum, 6 magnetic tape units, Fixed point arith., punched card in-out, and high speed printer (off-line). Single shift cost $24,838/month.

Additional equipment

Three 026, one 024, one 082, one 519, one 552, one 077, and one 407 rents for $1,709.00.

Maintenance service included in rental rates.

Southern Methodist

Rental traded for building space.

U of Minn

$250,000 for complete 1103 (Serial 4).

$100,000 for installation and air conditioning.

$60,000 for REAC installation (Reeves Electronic Analog Computer).

$40,000 for ADDALINK Analog-Digital, Digital-Analog Converter.

PERSONNEL REQUIREMENTS

WSMR IRM

	Two 8-Hour Shifts	
	Used	Recommended
Supervisors	5	5
Analysts	5	8
Programmers	8	12
Clerks	1	1
Operators	9	9
Engineers	6	6
Technicians	1	2
In-Output Oper	4	4

Operation tends toward closed shop.

Operators after a 90 day indoctrination assignment elsewhere within the division are assigned to the computer with a combination of on-the-job and a six week course taught periodically by our own personnel. Programmers are normally hired as professional mathematicians with strong physics background and are assigned initially in other sections of the organization to familiarize themselves with the mathematical and physical problems which they are concerned with. At the conclusion of approximately 1 year assignment in this area programmer trainees are selected and after attending a six week training course either taught in house or at the manufacturer's plant are given on-the-job assignments. Six months to a year are required to provde proficient programmers for our operation after selection and assignment to the computing laboratory. Training of technicians and engineers is a responsibility of the manufacturer and are provided by him.

Programmer training in this activity is more concerned with teaching new employees the techniques and approaches used in solution of range instrumentation problems. This is more difficult than teaching the art of programming of computers. The period prior to assignment to computers is used to screen out prospective programmers who do not have what our management considers to be desirable qualities and traits for this particular type of operation.

Eglin AFB

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Operators	2	2
In-Output Oper	1	1

Operation tends toward closed shop.

Methods of training used includes on-the-job training, organized programming classes, and contractor courses.

Holloman AFB

	One 8-Hour Shift	
	Used	Recommended
Supervisors	4	4
Analysts	4	6
Programmers	12	20
Coders	0	2
Clerks	1	2
Librarians	2	3
Operators	3	5
Engineers	2	2
Technicians	5	5
In-Output Oper	1	2

Operation tends toward closed shop.

Methods of training used are for programmers: Remington Rand programming course plus on-the-job training; and others: on-the-job training.

W-P AFB

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	5	5
Analysts	5	9
Programmers & Coders	25	30
Clerks	2	3
Librarians	0	1
Operators	8	8
In-Output Oper	4	6

Methods of training used includes formal classes by company representatives and by operating installation and extensive "on-the-job" training.

Open shop operation attempted with limited success, probably due to training in machine coding. Plan to use FORTRAN extensively on open-shop basis with the IBM 7090.

NASA Lewis

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	2	3
Analysts	2	4
Programmers	18	30
Coders	12	20
Clerks	0	1/2
Librarians	0	1/2
Operators	7	9
Engineers	2	4
Technicians	8	8

Operation tends toward closed shop.

Supervisors, analysts, programmers, engineers should have professional degrees, then on-the-job training. All others can be subprofessional or wage board, with on-the-job training.

Lockheed

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	1	1
Analysts	2	2
Programmers	15	15
Clerks	1	1
Librarians	1	1
Operators	11	11
Engineers	6	7
Technicians	3	4
In-Output Oper	4	5

These systems are currently operating on production jobs, with little check out on new programming. Above figures are for two computers.

Operation tends toward closed shop.

Operator training is primarily done on-the-job.

Johns Hopkins APL

	One 8-Hour Shift	Two 8-Hour Shifts	Three 8-Hour Shifts
Supervisors	3	4	5
Analysts	1	2	3
Programmers	15	20	25
Clerks	2	3	4
Librarians	1	1	2
Operators	4	6	9
In-Output Oper	3	4	6
Tape Handlers	1	1	1

Operation tends toward closed shop.

Methods of training used includes formal instruction, provided by computer manufacturer, formal instruction provided by our training officer, and on-the-job training at own installation.

Johns Hopkins ORO

	One 8-Hour Shift		Two 8-Hour Shifts		Three 8-Hour Shifts	
	U	R	U	R	U	R
Supervisors	1					
Analysts	6	10				
Programmers	20	30				
Engineers	3	3	2	2	2	2

The personnel listed above reflect only the Computing Laboratory staff. Throughout the organization there are approximately 60 persons classified as analysts or research assistants who are highly competent programmers. Personnel in the machine operating group perform 1103A operations, IBM machine wiring and operations and key punching as required.

Operation tends toward open shop.

All personnel hired by ORO are given a two-month training assignment in the Computing Laboratory prior to an assignment to a research task. The two-month training is divided as follows: one month devoted to 1103A characteristics and general programming techniques, one month development of a practical problem. Operators, engineers and technicians are supplied as required by Remington Rand.

Southern Methodist

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	2
Analysts	6	10
Clerks	3	4
Engineers	1	

Operation tends toward open shop.

Methods of training used includes credit courses in the university and on-the-job training.

U of Minn

Staff consists of:

One department head
One research fellow
One junior engineer (maintenance)
One secretary
Seven research assistants (part time)
Three maintenance technicians (part time)

With this staff 12 to 14 hours of computing time is available daily, when needed.

Clients are urged to do as much programming, coding, and operating as possible with all non-routine problems. Any routine or standardized problem, such as matrix inversion, is done by the staff (if a program is available for the problem).

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

WSMR IRM

Average error-free running period 4 Hours
Good time 60 Hours/Week (Average)
Attempted to run time 70 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.85
Above figures based on period 1 Jan 59 to 31 Mar 60
Passed Customer Acceptance Test 17 Feb 58
Time is not available for rent to outside organizations.

Most difficulties account for the difference between good time and attempted to run time were caused by mechanical malfunction of Uniservos. Until very recently it was necessary to write programs utilizing all available Uniservos and a malfunction of any one would result in an attempt to run resulting in failure. Recently the number of Uniservos have been increased to 10 which will tend to eliminate this source of difficulty.

Holloman AFB

Good time 57.34 Hours/Week (Average)
Attempted to run time 60 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.95
Above figures based on period 1 Jan 60 to 30 Apr 60
Passed Customer Acceptance Test (1) Mar 57 (2)Nov 57
Time is available for rent to qualified outside organizations.

W-P AFB

Good time 101.58 Hours/Week (Average)
Attempted to run time 103.66 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.979
Above figures based on period 1 Apr 60 to 1 Oct 60
Passed Customer Acceptance Test Jun 58
Time is available for rent to qualified outside organizations.

NASA Lewis

Good time 77.5 Hours/Week (Average)
Attempted to run time 93.0 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.834
Above figures based on period 1 Jan 59 to 1 Jan 60
Passed Customer Acceptance Test Sep 55
Time is not available for rent to outside organizations.

Lockheed

Average error-free running period 30 Hours
Good time 272.4 Hours/Week (Average)
Attempted to run time 280.2 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.966
Above figures based on period 1 Feb 60 to 27 Mar 60
Passed Customer Acceptance Test (1) Apr 58 (2) Jul 58
Time is available for rent to outside organizations.

The above figures are based on a two computer system.

Johns Hopkins APL

Average error-free running period 19.6 Hours
Operating ratio 0.98
Above figures based on period 20 May 57 to present
Passed Customer Acceptance Test 20 May 57
Time is available for rent to qualified outside organizations.

Johns Hopkins ORO

Good time 113.7 Hours/Week (Average)
Attempted to run time 115.7 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.982
Above figures based on period 1 Apr 60 to Jul 60
Passed Customer Acceptance Test Sep 57
Time is available for rent to qualified outside organizations.

Southern Methodist

Good time 45 Hours/Week (Average)
Attempted to run time 45.5 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.99
Above figures based on period 1 Jul 59 to 1 Jul 60
Time is available for rent to qualified outside organizations.

U of Minn

Average error-free running period 18.67 Hours
Good time 51.10 Hours/Week (Average)
Attempted to run time 55.30 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.924
Above figures based on period 1 Jul 59 to 30 Jun 60
Passed Customer Acceptance Test Jun 58
Time is available for rent to outside organizations.

ADDITIONAL FEATURES AND REMARKS

WSMR IRM

The water cooled design of this equipment virtually eliminates difficulties associated with refrigeration and air conditioning. As a matter of actual fact the computer room is cooler than is maintained in most offices.

Magnetic tapes are stored in wall cabinets within the computer room. The number required is small as compared with most installations of this type. Normal building conditioning provides adequate protection from humidity temperature, etc. Security against loss of operating ability due to fire is accomplished by providing duplicate tapes to other installations under this command such that in case 1 tape is damaged it could be replaced within a matter of an hour or two and by duplicate programming of problems on other machines in the neighborhood, such as the IBM 704 located at DRD-N and the IBM 704 Computer operated by the Flight Simulation Laboratory at WSMR. For the particular applications involved at WSMR loss of data tapes is not as critical as the loss of programming tapes. No special care is taken to insure against loss of data tapes.

Integrated Range Mission of White Sands Missile Range operates two computing facilities. The 1103A reported in this questionnaire and an IBM 704 Computer physically located at Holloman Air Force Base are reported on separately. Both computers are used for the same type of activity, namely the conversion of raw range flight test measurements to engineering forms of data. It is anticipated that about January 1962 it will become necessary to replace the existing 1103A Computer with a solid state computer having much greater internal speed and greater capacity. Machines of the CDC 1604, IBM 7090, Philco 2000, etc. type are being considered. A feasibility study is under way to ascertain whether at that time it will be feasible to replace the 704 Computer at Holloman with a high speed data link and utilize the one high speed computing facility in place of the two now in operation.

It is planned to replace the card-to-tape converter, the tape-to-card converter, and the high speed printer with a USS 80 Computer. In so doing the overall operation will be speeded up, economy in floor space will be achieved, and an increase computing capacity will be provided while at the same time the cost of operation will be reduced.

Eglin AFB

Additional equipment can be connected by controlled bits on a selector board (colloquially designated OR board).

NASA Lewis

Simultaneous input, output, and computing on problems. Concurrent operation on two separate problems, each with its own input, output, and computer.

The machine, its peripheral equipment and its programming aids are tailored to do data reduction in the most efficient manner, with the lowest level programmers possible.

Lockheed

A library system for reserved tapes is maintained. No particular protection for tapes due to durability of metal tapes. Fireproof storage media is currently undergoing evaluation.

The 1103AF system is composed of the following components: 2 Univac Scientific 1103AF Computers each with floating point, variable block, 8,192 words of core storage and 16,384 words of drum storage. There are two Remington Rand 600 lines/min printers, and one Remington Rand Card-to-Tape Converter.

Johns Hopkins ORO

Outstanding features are considerable memory capacity, high internal operating speed, and great versatility in transferring information to and from external equipment.

U of Minn

Electronic Associates DATALINK provides 6 channels of conversion from analog to digital (13 bits/word) and 4 channels of conversion from digital to analog. The DATALINK connects the 1103 with a REAC (Reeves Electronic Analog Computer) containing two computer cabinets (20 amplifiers in each) and a cabinet of four servos.

The 1103 has been modified to include two special instructions for work with polynomials, an instruction for transmission of a word from the left half of the accumulator, and an interrupt feature to increase system efficiency when external equipment is used.

FUTURE PLANS

Holloman AFB

An output platform is being designed which allows an automatic recording, i.e. without computer control, of all real-time computer outputs and a digital and analog display of real-time computer outputs.

W-P AFB

The 1103A will be phased out by June 1961 due to the installation of the IBM 7090 in November 1960.

NASA Lewis

Additional tape handlers, floating-point arithmetic hardware, high-speed line printer, compiler, and high-speed plotting are planned.

Lockheed

LMSD is in the process of converting all 1103AF work to IBM 7090 and CDC 1604 Systems. Both 1103AF's will be released.

Johns Hopkins APL

IBM 7090 Computer System with 1401 C3 planned for installation.

Southern Methodist

On line printer for 1103.

Addition of Solid State 90 with six tapes, computer and full complement of Remington Rand tabulation equipment.

INSTALLATIONS

White Sands Missile Range
Integrated Range Mission-DRD
White Sands Missile Range, New Mexico

3208th Test Group (TF)
Computer Operations
AFGC (PGVMC)
Eglin Air Force Base, Florida

Air Force Missile Development Center
Analysis and Computation Division (MDWC)
Holloman Air Force Base, New Mexico

Wright Air Development Division
Digital Computation Branch (WWDCD)
Wright-Patterson Air Force Base, Ohio

National Aeronautics & Space Administration
Lewis Research Center
21000 Brookpark Road
Cleveland 35, Ohio

Lockheed Missile and Space Division
Digital Computer Operations
Sunnyvale, California

Johns Hopkins University
Applied Physics Laboratory
8621 Georgia Avenue
Silver Spring, Maryland

Johns Hopkins University
Operations Research Office
6935 Arlington Road
Bethesda 14, Maryland

Southern Methodist
Computing Laboratory
Dallas 22, Texas

University of Minnesota
Numerical Analysis Center
Minneapolis 14, Minnesota

PRODUCTION RECORD

Number of Univac 1100 Series Systems (all models) delivered is 45.

UNIVAC 1105

Univac 1105 Computing System

MANUFACTURER

Remington Rand Univac Division
Sperry Rand Corporation

APPLICATIONS

Manufacturer

System is used for both scientific and commercial applications, for example, satellite tracking and trajectory calculations, linear programming, logictics, scheduling, inventory control, and census.

The Univac 1105 Computing System is a synchronous, large scale, high speed, general purpose, automatic data processing computing system. Programs of internally stored instructions, capable of self-modification, determine the sequence of operations. Internal storage is afforded by directly addressable magnetic cores and drums. The system is designed to use magnetic tape, punched cards, punched paper tape, electric typewriter, analog-to-digital and digital-to-analog converters, visual displays, plotters and real time instrumentation as input-output.

U. S. Air Force, Dayton AF Depot

Located at Dayton Air Force Depot, Wilmington Pike, Dayton, Ohio, the system is used for the following fields of application:

Photo by Remington Rand Univac

Stock Control and Distribution - Inventory Management

Method of controlling and distributing material by Air Material Command Supply Depots and AMA's to Air Force activities, maintenance contractors and other military services world-wide. The system provides a data processing technique which enables AMC to administer a timely, accurate and effective supply logistics system. It provides item accounting, including inventory position and various products for effective management of serviceable, reparable and excess material. By-products which are the basis for dollar accounting and Air Force assets management, inputs for requirements computation and other stock control purposes are provided.

Management and Control of Due-In-Assets

Recording of assets due in from contractual procurement, Department of Defense excesses or other Air Force activities. The depot having responsibility for a commodity class or specified weapons system utilizes this data system to administer a more timely and effective logictical support system. Item account-

Photo by Remington Rand Univac

ing providing due-in status data for utilization in material distribution, requirements computation and buying programs, are included in this system.

Requirements Computation - Replacement Type Items

The purpose of this application is to design, develop, and implement a data flow and data processing system by which various types of replacement item data products, required at appropriate AMA/AFD, Hq AMC, and higher headquarters management levels may be periodically computed on an AF world-wide basis. The system as designed is to be capable of promptly reacting to changes in the many elements which affect AF requirements for items (e.g., program changes, authorization changes, support policy changes, funding limitations, etc.) is also to be compatible with the latest data handling and processing technological improvements. The system as presently implemented is designed to provide the following major types of replacement item requirements and related management data summarized by weapons/support system, funds program/project; program group, mission code, property class, AMA/AFD, or total AMC, as appropriate for the products involved. Data now output from the system are: time-phased projections of "gross" and "net" item requirements; procurement program and budget estimates item and/or dollar summaries of the above; contract termination and retention/disposal level data; consolidated asset and item information data summary products; item-dollar inventory segmentation and requirements support effectiveness data; and weapon and support systems.

Product Performance Analysis Airborne Armament and Electronic Items

A data processing system that will measure the weapon and/or commodity performance and meet the needs of the reliability and the product improvement and USAF Acturial programs; provide serviceability and reliability indicators, acturial life expectancies and failure pattern; and correlate configuration data, reliability, usage, failure and consumption data, and other historical data into a data system for the air vehicle.

Covers the system that will measure the weapon's performance and provide an early warning and ready reference master record of failure trends by system and component within the weapon system; provide maximum automatic analysis; provide for the weapon managers, serviceability and reliability indicators such as acturial usage data, service life factors, failure rate grpahs, economic life factors, and condemnation rates that are essential to product improvement, provisioning, and the computation of requirements, and evaluation of periodic inspection intervals.

Technology Center

Photo by Remington Rand Univac

The following applications are scheduled to be production runs in the near future.

IM/FSC Cataloging, Standardization and File Maintenance

This project is to develop a system which will establish, maintain and distribute Federal Catalog and related data applicable to all inventory manager items, including, but not limited to, the following: Federal, Catalog, EAM Detail and Trailor Cards, Stock Control Data Cards, Packaging and Transportation Data Cards, Interchangeability Record Cards, and Family Group Publication EAM Cards. The system will provide for the: initiation and distribution of stock list change, initiate suspense and follow-up on request for Federal stock number, notification of stock number assignment to Air Force contractors; publication of stock control data sections; cross-reference sections; transportation and packaging data sections; interchangeability and substitution data sections and possibly the identification section of AF stock list. Initially, the ADP systems utilizing outputs from this project for the updating of catalog data are restricted to: Inventory Manager Stock Control and Distribution Management and control of Due-in Assets, maintenance operating stock support; requirements computation for consumption-type items. Weapons systems control and distribution; and base support class stock control and distribution.

Master Material Support Record

This project will develop procedures to establish and maintain a master material Support Record that will provide a complete source-coded range of parts and materials with replacement rates required for all levels of repair support. This record will be developed from initial provisioning source-coded documents and up-dated based upon engineering changes, source code changes, stock list changes, changes to replacement factors derived from improved methods of computation, and changes to specialized repair activity material standards and contractual material requirement lists. The record will serve as a basis for initial SRA material standards and contractual MRL's and provide a means whereby the Inventory Manager can analyze these documents and establish an acceptable relationship between SRA and contractor material projections and the Master Material Support Record. This project will furnish source data for computation of the Buyers Guide for operations and maintenance parts and material.

Manpower Management (Personnel and Labor Accounting)

This project involves a recording of employee skills, abilities, education, training, experience and test scores as a basis for selecting out of five (5) best qualified personnel for a given position vacancy.

Photo by McClellan Air Force Base

Normally, this process will occur within a single depot, but for certain categories the entire command will serve as the selection base. Related products, required periodically, would be Reduction in Force Registers, data on skills losses (turn-over), skills-usage trends, and on inventory of skills levels as a basis for determining proper station assignment of new missions or functions.

Automation of Item Schedules for Procurement Documents

This project visualizes optional automation of the PR coordination cycle as a continuous flow from generation of a requirements to the subsequent automatic preparation of IFB/RFP schedules. Areas to be incorporated within the project include: the automatic grouping of items for procurement purposes, automatic initiation of funds, standardization of procurement data, precoordination of PR's, and automatic preparation of item schedules.

Civilian Personnel and Labor Accounting

The objective of this project is to permit machine preparation of the following in lieu of the present manual systems:

SF 50's Personnel Action; periodic pay increases; notification of automatic actions, i.e., age, retirement, service awards, detail expirations, annual performance evaluations; Unit Manning Document; all statistical reports; automatic print-out to indicate any condition reflected by statistics, requiring administrative action, i.e., sick leave, turnover, tardiness, unused annual leave, grade levels, job-shortage categories, etc.; classification survey schedules; rosters of all persons who have received training by specific courses and rosters of all training received (all courses) by specific individuals; skills rosters, for purposes of Merit Promotion Program, detailing employees, reassignment, training, recruitment, etc.; profiles for merit promotion program in rank order; print-out of entire service history of any employee for any reason needed; payrolls; and leave, bond, retirement records currently maintained manually.

USAF ROAMA Griffiss AFB, N. Y.
Located in Building No. 311, system is used for stock control and distribution, requirements computation, and Ground C&E Management.

USAF Sacramento Air Materiel Comd, McClellan AFB
Located at McClellan AFB, California, the system is used for weapons system inventory control and distribution and requirements computation.

Bureau of the Census
Located in Washington D.C., the system is used for statistical data processing for current statistical

surveys of population, trade, and industry, decennial censuses of population and housing, and other major periodic censuses involving editing and rearranging of input, sorting and merging of records, tallying, tabulating, and summarizing data, computing percentages, medians, means, weights, variances, etc. for data, and arranging and preparing tables, listings, labels, etc. for high speed printer.

Bureau of the Census - Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.
Same as for Bureau of Census in Washington, D. C.

Bureau of Census - University of North Carolina, Chapel Hill, North Carolina
Same as Bureau of Census in Washington, D. C.

University of North Carolina
Located in Phillips Hall, University of North Carolina, Chapel Hill, North Carolina, the system is used for data processing for the Bureau of the Census, Washington, D. C., scientific research, statistical applications, automatic programming research, and teaching.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	36
Binary digits/instruction	36
Instructions per word	1
Instructions decoded	41 fixed point and 9 floating point
Arithmetic system	Fixed and floating point

1 bit sign, 35 bit number
1 bit sign, 8 bit characteristic, 27 bit mantissa

Instruction type	Two address

6 bit operation code and two 15-bit operand addresses

Photo by University of North Carolina

Number range Fixed point $2^{35} - 1 \geq X \geq 0$
Floating point $2^{127} > X \geq 2^{-129}$ and 0

Instruction word format

Operation Code		1st Address		2nd Address	
35	30	29	15	14	0

Automatic built-in subroutines include automatic interrupt feature, external function instructions, repeat instruction, floating point polynomial multiply and inner product instructions.

Automatic coding includes UNICODE algebraic compiler, USE compiler, IT algebraic compiler, GAT compiler, AIMACO business compiler, and 650 Simulator.

Registers include a 72 bit directly addressable accumulator, a 36 bit directly addressable multiplier-quotient register, a 36 bit input-output register, and an 8 bit input/output register.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	32-60	12-28
Mult	116-410	92-386
Div	482-490	466-474

Arithmetic mode	Parallel
Timing	Synchronous
Operation	Sequential

STORAGE

Manufacturer

Media	No. of Words	No. of Binary/Digits	Access Microsec
Magnetic Core	4,096	147,456	8
	8,192	294,912	
	12,288	442,368	
Magnetic Drum	16,384	589,824	17,000
	32,768	1,179,648	

Magnetic Tape

No. of units that can be connected	24 Units
No. of char/linear inch of tape	250 Char/inch
Channels or tracks on the tape	8 Tracks/tape
Blank tape separating each record	1.2 or 2.4 Inches
Tape speed	100 Inches/sec
Transfer rate	25,000 Char/sec
Start time	3.5 Millisec
Stop time	3.5 Millisec
Average time for experienced operator to change reel of tape	10-15 Seconds
Physical properties of tape	
Width	0.5 Inches
Length of reel	2,400 Feet
Composition	Mylar or metallic

USAF DAFD

Media	No. of Words	No. of Digits/Word	Access Microsec
Magnetic Core	12,288	12 Octal	8
Magnetic Drum	32,768	12 Octal	17,000
Magnetic Tapes	Up to 720,000	12 Octal	50,000 (120 words)

(95% free for computation)

USAF ROAMA

Media	No. of Words	No. of Binary/Dig	Access Microsec
Magnetic Core 0	4,096	36	8
Magnetic Core 1	4,096	36	8
Magnetic Core 2	4,096	36	8
Magnetic Drum	32,768	36	17,000
Magnetic Tape	Unlimited		

USAF SAMC

Media	No. of Words	No. of Digits	Access Microsec
Magnetic Core	12,288	73,748	12
Magnetic Drum	32,768	196,608	17,000
Magnetic Tape			
Census Washington; Census-Armour; Census U of NC			
Magnetic Core	8,192	49,152	6
Magnetic Drum	16,384	98,304	2-34,000

U of NC

Media	No. of Words	Access Microsec
Magnetic Cores (2)	8,192	8
Magnetic Drum (Double)	32,768	0-34,000

17 buffered tape units in the system

INPUT

Manufacturer

Media	Speed
Cards	120 cards/min
Magnetic Tape	25,000 char/sec
Paper Tape	200 char/sec

Magnetic tape block length is variable. Tape may be read backward. Six bit characters are used on both paper and magnetic tape. Paper tape is seven channel tape. 80 column cards are used.

USAF DAFD

Media	Speed
Punch Cards	120 cards/min
Punch Paper Tapes	17 words/sec
Magnetic Tape	3,300 words/sec

ROAMA

Photoelectric Reader	12,000 char/min
Magnetic Tape	100 inches/sec

Magnetic tape reading any density.

USAF SAMC

Magnetic Tape	300 microsec/word
Paper Tape	200 frames/sec

There are 20 magnetic tape unit.

Census Washington, Census-Armour, Census-U of NC

Magnetic Tape (2 independent channels)	20,000 char/sec
Paper Tape (Ferranti)	200 char/sec
Keyboard Insert	Manual

Two independent channels of magnetic tape. Magnetic tape is utilized in the buffered free-run mode.

Census-U of NC has 120 cards/min reader.

U of NC

Cards	120 cards/min
Paper Tape	230 frames/sec
Magnetic Tape	100 in/sec

128 lines per inch - low density

200 lines per inch - high density

OUTPUT

Manufacturer

Media	Speed
Cards	120 cards/min
Paper Tape	60 bit char/sec
Typewriter (Flexowriter)	10 char/sec
High Speed Printer	600 lines/min
	120 char/line

Cathode ray tube (visual display) read-out may be added. 80 column cards are used. Six bit characters, seven channel paper tape. The high speed printer is operated off-line. It can be adapted for plotting.

USAF DAFD

Punch Cards	120 cards/min
Paper Tape	5 words/sec
Magnetic Tape	3,300 words/sec
Typewriter	10 char/sec

ROAMA

Magnetic Tape	100 in/sec
High Speed Paper Tape Punch	3,600 char/min

Magnetic tape writing at a density of 128 or 200 lines/inch.

USAF SAMC

Magnetic Tape	300 microsec/word
Paper Tape	60 frames/sec
Typewriter	100 words/min

Census Washington, Census-Armour, Census-U of NC

Magnetic Tape	20,000 char/sec
Paper Tape (Teletype)	60 char/sec
Monitoring Typewriter (Flexowriter)	10 char/sec

U of NC

Cards	120 cards/min
Paper Tape	60 frames/sec
Magnetic Tape	100 in/sec
Typewriter	10 char/sec

Cards are not in use.

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Manufacturer

Type	Quantity
Tubes	
7AK7	3,261
5963	3,066
6AN5	947
5725	252
All others	767
Diodes	
HD2261	12,789
1N143	2,112
1N117	1,208
All others	306
Transistors	
2N414	724
T1677	288
2N315	136
Magnetic Cores	
S-4	294,912
All others	9,138

A total of 21 tube types are used.
Eleven types of diodes are used.
Ten types of transistors are used.
Three types of cores are used.

Components for Uniservo II (Model 102), a 3rd Core Bank, and floating point circuiting are not included in the above figures, but are listed below-

3rd Core Bank

Vacuum Tubes	Diodes	Cores	Transistors
8 types- total 471	3 types- total 2,267	147,456 Type S-4	None

Floating Point

3 types- total 244	5 types- total 678	None	None

Uniservo II

7 types- total 43	4 types- total 9	None	None

CHECKING FEATURES

Manufacturer

Checking features include overflow, timing, in-output, illegal operation codes and addresses, and safety interlocks.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer

Power, entire computer system	160 Kw, 175 KVA, 0.9 pf
Room size	49 ft x 64 ft x 10 ft
Floor loading	47 lbs/sq ft
Weight, computer	35 Tons

Air conditioning unit for cooling input water should be at least 35 tons capacity.

USAF DAFD

Floor loading	size of plenum 22 ft x 50 ft x 13 ft
Weight, computer	63,753 lbs

Computer is installed in a warehouse type building with plywood temporary constructed walls. The lighting, floor and power supply is that of a typical office.

The Univac 1105 Computer System is operated from a 208V, 3 phase, 4 wire, 60 cps. supply. Isolation from line transients is achieved by use of a motor-alternator set and 70 KVA stabeline supplied with the equipment. The motor-alternator, together with its controls, is located in a separate room. The connection to the computer is below the floor. The maintenance area is supplied with 115V, 15 amp. single place outlets at each bench and three phase, 208V, 15 amp, four wire, 60 cps. service for the chassis test unit. The line-to-line voltage is 208V ± 10% during normal operation. All three line-to-line voltages are balanced to within 2% during normal operations. The basic equipment load consists of a 100 hp motor, 3 hp blower motors, a 3/4 hp drum motor, and 70 KVA stabeline. The 100 hp motor, which drives a 75 KVA alternator, is started with no load and has a reduced voltage starter control.

The floor space for the 1105 computer is approximately 3,752 sq ft. The power, refrigeration and equipment room uses approximately 2,450 sq ft.

The cooling system requires 50°F cooling water and a room temperature of approximately 80°F maximum at 60% relative humidity or lower. This system consists of three fans cabinets which cool the room air and a plenum which distributes the cooled air to the electronic computer. In addition to the computer, each uniservo requires 3.5 gallons of water per minute. Requirements and data for the air cooling system are as follows:

Cooling water temperature (Input) 50°F max.
Cooling water pressure (Input) 60 lbs/sq in, gage
Water flow through entire system 168 gal/min, max
Exhaust air temperature from computer 74°F-80°F.
Maximum allowable relative humidity 60°.
Blower capacity 12,750 cu ft/min

ROAMA

Power, computer	170 Kw	170 KVA
Power, air condi	40.4 Kw	40.7 KVA
Volume, computer		41,000 cu ft
Volume, air conditioner		42.0 cu ft
Area, computer		4,100 sq ft
Area, air conditioner		84 sq ft
Floor loading		200 lbs/sq ft
		4,800 lbs concen max
Capacity, air conditioner		75 Tons
Weight, computer		63,253 lbs
Weight, air conditioner		8,000 lbs

208, 3 phase, 4 wires, 60 cps for computer. 220V, 3 phase, 4 wire for air conditioner. Constructed new permanent building designed specifically for the computer.

USAF SAMC

Power, computer	146 Kw	170 KVA	0.86 pf
Power, air condi	160 Kw	200 KVA	0.86 pf
Volume, computer		3,246 cu ft	
Volume, air conditioner		846 cu ft	
Area, computer		3,600 sq ft	
Area, air conditioner		1,881 sq ft	
Room size, computer		60 ft x 60 ft	
Room size. air conditioner		42 ft x 65 ft	
Floor loading		150 lbs/sq ft	
		700 lbs concen max	
Weight, computer		57,089 lbs	
Weight, air conditioner		75,000 lbs	

Floor is cement and was trenched for cables and chilled water pipes. Acoustical tile was applied to a false ceiling and walls of the room. It was necessary to increase the power to meet the demands of the UFC and 1105. Site preparation for both systems was done simultaneously. Air conditioning was increased and necessary duct work installed.

Census Washington

Power, computer	150 Kw	170 KVA	0.9 pf
Volume, computer		30,000 cu ft	
Area, computer		3,000 sq ft	
Room size		100 ft x 30 ft x 10 ft	
Floor loading		50 lbs/sq ft	
Weight, computer		60,450 lbs, each	

Alteration of area from previously subdivided sections into the large enclosed area 100x60. Provision of chilled water lines, power conduits and space, air conditioning equipment and air ducts. Alteration of lighting fixtures. Area enclosed in fire wall construction. Air conditioner part of integrated system.

Census - Armour

Power, air cond	25 Kw	29 KVA
Room size, computer		50 ft x 60 ft x 10 ft

Site specifications included on plans for newly constructed building.

Census - U of NC

Power, air condition		29 KVA 25 Kw
Room size, computer		40 ft x 75 ft x 10 ft

Site specifications included in plans for newly constructed building.

U of NC

Power, computer 110 Kw	170 KVA	0.9 pf inductive
Power, air cond	100 KVA	
Volume, computer	17,000 cu ft	
Area, computer	2,816 sq ft	
Area, air conditioner	600 sq ft	
Floor loading	70 lbs/sq ft	
Capacity, air conditioner	75 Tons	
Weight, computer	35 Tons	

Computer was installed in the basement of a new building and the space was specifically constructed for this purpose, i.e. with a recessed floor and plenum type of installation.

PRODUCTION RECORD

Manufacturer

Number produced to date 45 incl. all 1100 models

COST, PRICE AND RENTAL RATES

Manufacturer

	Cost	Monthly Rental
Basic system, consisting of 8,192 words Magnetic Core, 16,384 words Magnetic Drum, Central Processor, Peripheral Control, and 16 UNISERVO II	$1,932,000	$33,060
Additional Equipment		
4,096 Magnetic Core	$195,000	$4,500
16,384 Magnetic Drum	60,000	1,500
Floating Point	65,000	1,545
Uniservo II	20,000	450
Card In-Output	55,000	1,310
High Speed Printer	185,000	3,300

Printer is off-line, 80 column card unit.

Training courses and manuals are provided for all computers whether purchased or rented.

USAF DAFD

Model 1105 Univac Computer (Basic) includes:	$1,612,000	$33,060
Magnetic Core Storage (8,192 words)		
Magnetic Drum Storage (16,384 words)		
Two Section Tape Input/Output Buffer; 120 words/Section		
Variable Block Length Feature		
Magnetic Tape Control (Accommodates up to 24 magnetic tape units)		
Power Supply		
Desk Console with Monitorial Oscilloscope		
Arithmetic Section		
Main Control Section		
Air Conditioning Section (Requires Customer-Furnished 50° Water)		
The following Directly Connected Input/Output Units:		
1-Photo-electric Punched Paper Tape Reader		
1-High Speed Paper Tape Punch		
1-Monitoring Electric Typewriter		
Additional Equipment:		
1 - Additional Bank of 4,096 Word Core Storage	$ 195,000	$ 4,500
1 - Additional Magnetic Drum Storage 16,384 Words	60,000	1,500
20 - Uniservo II Magnetic Tape Units	400,000	9,000
5 - Unityper II	22,500	450
1 - Univac Verifier (Non-printing Type)	15,000	250
1 - Card to Metallic Tape Converter, 80 column	143,300	2,540
1 - High Speed Printer - Off-Line (Water Cooled) (600 lines per minute)	185,000	3,300
1 - Metallic Tape to Card Converter - 80 column	Quoted on request	2,385
	$1,020,000	$23,925
Total approx. Selling Price (Basic and Additional Equipment)	$2,632,800	
Total monthly rental	$ 56,985	

Maintenance/Service Contracting:

Remington Rand will keep the equipment in good operating condition, all costs of maintenance will be borne by the contractor unless the required maintenance is due to the fault or negligence of the installation.

Remington Rand shall have its personnel in attendance during all periods of operation unless other mutually agreeable arrangements have been made. The maintenance personnel during a principal period of maintenance which is any eight consecutive hours per day plus an official meal period not to exceed one hour per day, Monday thru Friday, excluding holidays. By giving seven days notice to the contractor, additional maintenance service periods of time other than the designated Principal Period of maintenance can be arranged.

All preventive (scheduled) maintenance will be performed at a time other than during working hours, unless otherwise arranged.

The installation will be charged for maintenance whenever (1) maintenance personnel are required outside the principal period of maintenance, and the total operational use time on the main frame (or central computer) during the Principal Period of maintenance, is less than 176 hours during a calendar month. However, there will be no extra maintenance charge for periods of preventive or remedial maintenance. Extra maintenance will be at the rate of twelve dollars per man hour computed to the nearest one-half hour.

ROAMA

Central Computer	$33,060
Addition Bank Word Core Storage	4,500
Additional Magnetic Drum Storage	1,500
Twenty Uniservos	9,000
Bi-Directional Converter	4,275
High Speed Printer	3,300

USAF SAMC

1105 Basic, Magnetic Core Storage, Magnetic Drum Storage, Uniservo II, $48,060 per month.
Flexowriter $110 per month.
Maintenance is included in rental price.

Census Washington

2 Univac 1105 Computers, 18 tape units each, site preparation and installation, spare chassis, initial parts inventory, test equipment $3,080,000 total.

1 Unityper Mod II, 3 Flexowriters, 1 high speed printer buffered with extra print head $258,000.

Card-to-tape converter $2,600 per month.

Own maintenance is performed.

Census - Armour

Equipment owned by University but shared with Bureau of the Census on pro rata cost basis. Equipment includes 1 Univac 1105 Computer with 17 tape units, 1 high-speed printer, 1 unityper, 2 Flexowriters. Census share of total installation current cost and equipment amortization (for 90 to 100 hours per week of computer time) equals $320,000 yr.

Census - U of NC

Equipment owned by University but shared with Bureau of the Census on pro rata cost basis. Equipment includes 1 Univac 1105 Computer with 17 tape units, 1 high-speed printer, 1 unityper, 2 Flexowriters. Census share of total installation current cost and equipment amortization (for 90 to 100 hours per week of computer time) equals $320,000 yr.

U of NC

The system was purchased for $2,450,000.

The Univac 1105 Data Automation System at the University of North Carolina is made up of the following:

1 Univac Scientific Computer Model 1103A consisting of 4,096 words of core storage, 16,384 words of drum storage, photo-electric paper tape reader, high speed paper tape punch, on line Flexowriter, supervisory control console, motor alternator set, plenum type construction, air conditioning fan bay.
2 120 word core buffer units
1 Additional bank of 4,096 word core memory
1 Variable block feature for magnetic tape recording
17 Uniservo II, high density tape units
1 Off Line High Speed Printer
1 Unityper II
1 Additional Drum, 16,384 word capacity
1 1105 operational test unit
1 Complement of 1105 replacement chassis
1 Floating Point Feature
4 Off Line Flexowriters
1 Spare Photo Electric Paper Tape Reader
1 Spare High Speed Paper Tape Punch

PERSONNEL REQUIREMENTS

Manufacturer

	One 8-Hour Shift	Two 8-Hour Shifts	Three 8-Hour Shifts
Supervisors	4	5	6
Analysts	7	7	7
Program & Coders	15	16	17
Clerks	2	2 1/2	3
Librarians	1/2	1/2	1/2
Operators	3	4	5
Engineers	3	4	5
Technicians	3	5	7
In-Output Oper	1 1/2	2	2 1/2

Free courses are provided to the customer to instruct its personnel in programming for and maintenance of the computer.

USAF DAFD

	One 8-Hour Shift	
	Used	Recommended
Supervisors	4	5
Analysts	17	20
Programmers	31	44
Clerks	4	2
Librarians	2	2
Operators		4

4 Engineers and 3 Technicians used on three 8-hour shifts.

The Dayton AF Depot currently has two large scale electronic computers in operation viz., Univac I and Model 1105. Univac I is scheduled to be discontinued in the near future. At the present time there are twenty-one (21) civilians and five (5) airmen assigned to the operation of these computers.

3 Supervisors
1 Unit Chief
1 Supervisory Tape Librarian
1 Peripheral Equipment Supervisor
10 Civilian computer operators
6 Operate both Univac I and 1105
4 Operate only Univac I
5 Airmen computer operators
1 Operates both Univac I and 1105
3 Operate only Univac I
1 Operates only peripheral equipment
2 Civilian tape librarians
2 Civilian clerks
4 Civilian peripheral equipment operators

A one eight-hour shift is scheduled with available time on two other shifts depending upon the nature of the work and its priority.

Methods of training used includes training by the equipment manufacturer, Remington Rand Corp, and on-the-job training.

ROAMA

	One 8-Hour Shift	
	Used	Recommended
Supervisors	1	1
Librarians	1	1
Operators	3	3
In-Output Oper	3	3

Methods of training used includes manufacturer's courses.

USAF SAMC

	One 8-Hour Shift		Three 8-Hour Shifts	
	Used	Recom	Used	Recomm
Supervisors			4	4
Analysts	52	52		
Programmers	63	63		
Librarians			3	4
Operators			12	12

Personnel support the 650, UFC and 1105 systems.

Operation tends toward closed shop.

Manufacturer training and on-the-job training is utilized.

Census Washington

	Three 8-Hour Shifts
Supervisors	3
Analysts, Programmers & Coders	40
Clerks	8
Librarians	5
Operators	12
Engineers	2
Technicians	15
In-Output Oper	8
Tape Handlers	20
Other	4

Most programmers shown are customer employees; tape handlers are customer employees.

Operation tends toward open shop.

Training Branch conducts formal classroom sessions for programmers, operators (followed by on-the-job training) executive orientation, brush-up seminars. Classroom and on-the-job training also conducted for engineers and technicians.

Census - Armour

	Three 8-Hour Shifts
Supervisors	3
Analysts, Programmers & Coders	20
Clerks	2
Operators	6
Engineers	1
Technicians	10
In-Output Oper	2
Tape Handlers	5

Programmers shown are customer employees, tape handlers are customer employees; all others are University employees.

Operation tends toward open shop.

Training Branch conducts formal classroom sessions for programmers, operators (followed by on-the-job training) executive orientation, brush-up seminars. Classroom and on-the-job training also conducted for engineers and technicians.

Census - U of NC

	Three 8-Hour Shifts
Supervisors	3
Analysts, Programmers & Coders	20
Clerks	2
Operators	6
Engineers	1
Technicians	10
In-Output Oper	2
Tape Handlers	5

Programmers shown are customer employees, tape handlers are customer employees; all others are University employees.

Operation tends toward open shop.

Training Branch conducts formal classroom sessions for programmers, operators (followed by on-the-job training) executive orientation, brush-up seminars. Classroom and on-the-job training also conducted for engineers and technicians.

U of NC

	One 8-Hour Shift	Three 8-Hour Shifts
Supervisors	1	
Analysts	2	
Programmers	6	
Clerks	1	
Librarians	1	
Operators		4
Engineers		5
Technicians		8
In-Output Oper		3
Tape Handlers		4

The 8 hour shift figures represent University requirements only. The three 8 hour shifts requirements represent University and Bureau of the Census personnel needs since the University supplies all personnel in these particular categories.

Operation tends toward open shop.

Methods of training used includes training course conducted by the Bureau of the Census for Computer Operators, vourses conducted by the Computation Center for training maintenance personnel (This is not an accredited University course.), on-the-job training, accredited University courses and Graduate Seminars on Computer Usage and Programming. (These courses at present are oriented towards scientific applications.), and special short courses on programming (Not accredited University courses.).

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

Regularly scheduled preventive maintenance procedures designed to detect failing components before errors occur.

USAF DAFD

Good time 60 Hours/Week (Average)
Attempted to run time 71 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.8 to 1.0
Above figures based on period from May 60 to Jul 60
Passed Customer Acceptance Test 30 Apr 60
Time is not available for rent to outside organizations.

USAF SAMC

Good time 98 Hours/Week (Average)
Attempted to run time 100 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.98
Above figures based on Mar and Apr 60
Passed Customer Acceptance Test 30 Apr 60
Time is not available for rent to outside organizations.

Good time includes Set-up time. The 2 hours lost time is unscheduled maintenance.

Census Washington

Good time (each machine) 126 Hours/Week (Average)
includes lost time from non-machine causes)
Attempted to run time 136 Hours/Week (Average)
(each machine; excludes scheduled maintenance)
Operating ratio (Good/Attempted to run time) 0.927
Above figures based on period 3 Apr 60 to 23 Apr 60
Passed Customer Acceptance Test Feb 59 and Jun 59
Time is not available for rent to outside organizations.

Census - Armour

Good time 85 Hours/Week (Average)
Attempted to run time 101 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.85
Above figures based on period 28 Feb 60 to 1 May 60
Passed Customer Acceptance Test Jul 59
Time is not available for rent to outside organizations.

Good time includes lost time from non-machine causes. Attempted to run time excludes scheduled maintenance.

Census - U of NC

Good time 85 Hours/Week (Average)
Attempted to run time 101 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.85
Above figures based on period 28 Feb 60 to 1 May 60
Passed Customer Acceptance Test Jul 59
Time is not available for rent to outside organizations.

Good time includes lost time from non-machine causes. Attempted to run time excludes scheduled maintenance.

U of NC

Good time 107.4 Hours/Week (Average)
Attempted to run time 122 Hours/Week (Average)
Operating Ratio (Good/Attempted to run time) 0.88
Above figures based on period 1 Jul 60 to 1 Oct 60
Passed Customer Acceptance Test 22 Aug 59
Time is available for rent to qualified outside organizations. Approximately 15 hours per week is available for outside organizations.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Outstanding features are interrupt feature, simultaneous read-write-compute, two address logic, 2 input-output registers for a large variety of on-line equipment, and repeat command. A unique system advantage is continuous input format capability on magnetic tape.

Special recommended procedures for magnetic tape labelling, storing, shipping, and protection from humidity, temperature, electrical, fire, or other damage are described in the Users Guide for Care and Preservation of Metallic Tape.

USAF DAFD

The 1105 Univac Computer is specifically designed for applications requiring great programming versatility, high operating speed, and large storage capacity. Maximum use of the high speed inherent in this computer is permitted by the unusual logical design and its unique Program Interrupt feature. In addition to performing large scale calculations, the system is adaptable to a wide variety of applications including simulation and control in real time.

Programs of internally stored instructions, capable of self-modification, determine the sequence of operations. Thus, the computing system is fully automatic. Its high speed results from parallel mode operation whereby all digits of a number are operated upon simultaneously.

Magnetic tapes are stored in a specially constructed concrete block vault and lined with copper screened wire to avoid any magnetic disturbance. Atmospheric conditions are 70°F and 50% R.H. Approximately 7,336 tapes are stored in cabinets elevated from the floor. Tape management is under the supervision of the tape librarian.

Peripheral Equipment - Space required is approximately 1,525 sq ft for the following equipment:

Card-to-Tape Converter
Tape-to-Card Converter
High Speed Printer

The above components have an independent chilled water system and require 220 volts, single phase 60 cycle current.

USAF SAMC

The 1105's two bi-directional tape buffers, twenty Uniservo tape units and "interrupt" feature facilitate efficient simultaneous input, output and computation functions. The automatic programming in use on the 1105 provides for optimum use of its data processing capabilities.

Census Washington, Census-Armour, Census U of NC

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage include fire wall construction; metallic containers for magnetic tape, fire fighting organization and training, control system for defective and damaged tapes, and standardization of tape reel lengths and markings.

FUTURE PLANS

USAF SAMC

SMAMA will acquire another 1105 in FY61 to support an advanced weapon system.

U of NC

Proposed new components include a locally designed and constructed 400 card/min reader and a programmer controlled clock and stop watch.

INSTALLATIONS

U. S. Air Force Dayton AF Depot
Wilmington Pike
Dayton, Ohio

U. S. Air Force ROAMA
Griffiss Air Force Base, New York

U. S. A. F. Sacramento Air Materiel Command
Data Systems Division, Comptroller
McClellan Air Force Base, California

Bureau of the Census
Washington 25, D. C.

Armour Research Foundation of Illinois Institute of Technology
Chicago, Illinois

Bureau of the Census
University of North Carolina
Chapel Hill, North Carolina

University of North Carolina
Computation Center
P. O. Box 929
Chapel Hill, North Carolina

The Prudential Insurance Company of America
Post Office Drawer 594
Newark 1, New Jersey

UNIVAC 1107

UNIVAC Thin Film Memory Computer 1107

MANUFACTURER

Sperry Rand Corporation
Remington Rand Univac Division

APPLICATIONS

Manufacturer

Basically, the UNIVAC 1107 is an advanced solid state data processing system designed and developed to provide reliable solutions to complex problems. This computer system is well suited to off-line, on-line and real-time problems in commercial, scientific, and military applications. With a versatile input-output section and a larger internal memory backed by a powerful instruction repertoire, the UNIVAC 1107 has capabilities not found in former systems.

The 1107 can efficiently and economically handle a wide range of applications, such as tactical data systems, command and control systems, digital communication and switching systems, data reduction and analysis, logistics, scientific computation, traffic control, reservation systems, computational analysis, inventory and scheduling systems, intelligence systems, systems simulation, missile and satellite dynamics, and process control.

Photo by Remington Rand Univac Division, Sperry Rand Corporation

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary
Binary digits/word	36
Binary digits/instruction	36
Instructions/word	1
Instructions decoded	114
Arithmetic system	Fixed and floating point

Partial and multiple arithmetic may be performed. In partial arithmetic any 1/2, 1/3, or 1/6 of a word may be added in an entire (A) Register, giving one sum. Fields or Partial Words may be used in all the arithmetic operations. In multiple arithmetic, the two halves or three thirds of a word may be added in an (A) Register, giving two or three sums respectfully. Subtraction may also be performed in a similar manner.

Instruction type	One address (Modified)
Number range	From $-(2^{35}-1)$ to $+(2^{35}-1)$

Instruction word format

36 31	30 27	26 23	22 19	18	17	16 1
f	j	a	b	h	i	u

Legend
u - Base Operand Address Designator (16 Bits)
i - Indirect Address Designator (1 Bit)
h - Increment Designator (1 Bit)
b - (B) Register Designator (4 Bits)
a - (A) Register Designator (4 Bits)
j - Partial Word or Minor Function Code (4 Bits)
f - Function Code (6 Bits)

Automatic coding includes ALGOL, with Fortran Translator and COBOL. Basic Utility Library includes an executive routine and an Advanced Computer-Oriented Mnemonic Code Assembly System; also sort-merge and debugging programs.

Registers and B-boxes include 16 (A) Registers (accumulators), 15 Index Registers and 36 Special Control Registers.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	4.0	0.8
Mult	12.7	7.4
Div	31	24
Arithmetic mode	Parallel	
Timing	Synchronous	
Operation	Concurrent	

STORAGE

Media	No. of Words	Total No. of Bin Coded Dec Digits	Access Microsec
Magnetic Core	65,536 max	589,824	1.8
Thin Film	128	1,152	0.3
Drum, FH 500 ea	262,144	2,359,296	8,500 avg
Drum, FH 800 ea	786,432	7,077,888	17,000 avg

	Models IIA	III
No. of units that can be connected	Up to 12 tape units may be connected to one channel. One magnetic tape control unit required per channel.	
No. of char/linear inch	250	1,000 Pulses/in
Channels or tracks (includes parity and timing track)	8	- Tracks/tape
Blank tape between records	1.0	0.75 Inches
Tape speed	100	100 Inches/sec
Transfer rate	25,000	120,000 Char/sec
Start time	12	6.3 Millisec
Stop time	9	6.3 Millisec
Average time for experienced operator to change reel of tape	30	30 Seconds
Physical properties of tape		
Width	0.500	0.500 Inches
Length of reel	2,400	2,400 Feet
Composition	Metallic and Mylar	Metallic and Mylar

INPUT OUTPUT

Media	Speed
Magnetic Tape (Model IIA)	25,000 kilocycles/sec
Magnetic Tape (Model III)	120,000 kilocycles/sec
Paper Tape Reader	400 frames/sec
Card Reader	600 or 700 cards/min
Paper Tape Punch	110 frames/sec
Card Punch	150 or 300 cards/min
Printer	600 or 700 lines/min

The complete line of Univac peripheral devices as well as specialized devices may be used if so desired. The input-output section of the computer has been designed to be adaptable to future peripheral equipments.

Sixteen bi-directional channels are provided.

Up to 12 tape units may be connected to one channel.

One magnetic tape control unit is required per channel.

CHECKING FEATURES

Logical checks include parity bits checking on magnetic tape. Transfer checks are made on all other peripheral devices. Special instructions facilitate program parity checks.

PRODUCTION RECORD

Time required for delivery 18 months

PERSONNEL REQUIREMENTS

Appropriate training courses will be made available to all users.

ADDITIONAL FEATURES AND REMARKS

Outstanding features and unique system advantages include:

A thin-film control memory is used for arithmetic and index registers, for input-output access control and for special controls and for auxiliary storage.

The thin-film storage has a 300 nanosecond (millimicrosecond) access time with a complete cycle time of 600 nanoseconds (millimicroseconds).

A ferrite core memory for instructions and operands available in capacities of 16,384 words in one bank; or of 16,384, 32,768, 49,152,or 65,536 words in two separately accessed banks.

Two microsecond effective cycle time for core storage (overlapping of two banks).

There are 36-bit words in both the magnetic film and core memories.

Computer system has an extremely powerful instruction repertoire, including fixed and floating point, integer and fractional arithmetic.

Design includes 16 bi-directional channels, capable of concurrent input-output transmissions up to 250,000 words per second, without direct supervision of the main program.

ALGOL and COBOL compiling programs and a FORTRAN translating program will be provided. (The 1107 will accommodate all routines previously coded in FORTRAN.)

Also provided is an executive routine capable of integrating routines of multiple programs.

The 1107 instruction word format provides for indexing, automatic index-register incrementation, partial word transfers and indirect addressing, along with a current operand reference and specification of an arithmetic register.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

	KVA	Weight Lbs.	(I N C H E S) Width	Depth	Height	BTU per Hr.
Central Computer	7.5	1,850	74	34.5	82	19.9
Power Control Center	---	800	48	34.5	82	*
Operator Console	---	550	54	35	50	*
Core Memory (65,000 words)	5	2,000	36	34.5	82	14
Magnetic Tape Control	1.9	125	20	34.5	82	5.1
Uniservo IIA Power Supply	12 Units Max. 40.6	3,000	57	32.75	82	10 (for 12 units)
Uniservo IIA	3.1	800	31	34	82	8.5
Magnetic Drum Control	1.5	125	20	34.5	82	4.1
FH 880 Drum Cabinet	1.9	800	50	32.5	49.75	5.1
FH 500 Drum Cabinet	1.6	600	38.25	29.5	46.75	4.5
Model 46 Line Printer Control	1.5	125	20	34.5	82	4.1
Model 46 Line Printer	4.4	1,613	72.25	32	52.5	12
Card Control Cabinet	1.5	125	20	34.5	82	4.1
P19 Card Punch - 80 Column	1.5	1,100	27	49	54.5	4.1
P19 Card Punch - 90 Column	1.5	1,100	27	49	54.5	4.1
M45 Card Reader - 80 Column	1.3	400	27	51	49.25	3.5
M45 Card Reader - 90 Column	1.3	400	27	51	49.25	3.5
Paper Tape Control Cabinet	1.2	800	24	34.5	82	2.6

Note: Tape Reader and Punch included in the Paper Tape Control Unit.
* Included in Central Computer.

Voltages	Frequency
208 ± %	384-440 cps
(208-220) ± 10%	57-63 cps
(208-120)	59.5-60.5 cps

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

	No. of Transistors	No. of Diodes
Central Processor	12,000	60,000
Core Memory (65,000 words)	6,676	10,608
Magnetic Tape Control	1,014	2,894
Uniservo IIA Power Supply	0	0
Uniservo IIA	0	15
Magnetic Drum Control	1,100	3,500
FH 880 Drum Control	1,100	700
FH 500 Drum Cabinet	600	700
Model 46 Line Printer Control	1,250	4,500
Model 46 Line Printer	12	500
Card Control Cabinet	1,000	3,000
Card Punch - 80 Column	75	1,000
Card Punch - 90 Column	75	600
Card Reader - 80 Column	75	500
Card Reader - 90 Column	75	400
Paper Tape Control Cabinet	500	1,500

UNIVAC FILE 0

Univac File Computer Model 0

MANUFACTURER

Remington Rand Division
Sperry Rand Corporation

Photo by Michigan Bell Telephone Company

APPLICATIONS

Manufacturer

The Univac File Computer is a general purpose, medium-priced electronic data processing system with a magnetic drum memory. Automatic tape collating and sorting may be performed without requiring computer time, which, during the process, may be spent on other operations. Random access is provided to 180,000 alphanumeric characters on one drum and to the magnetic core memory. A maximum of eight drums may be added to one system. The system is controlled by external panel wiring. Input/output devices consist of an electric typewriter, a punched card unit and a perforated tape unit, a magnetic tape unit and a high-speed printer.

Frankford Arsenal, Comptroller's Office
Located in Building 51, 2nd Floor, the system is used for cost accounting and payroll, including payroll for personal services and printing of payroll checks.

ROAMA, Griffiss AFB, New York
Located in Depot Supply Bldg. No. 1, East Wing, the system is used for requirements computation, appropriation accounting, and CESAC.

Chesapeake and Potomac Telephone Co. of Maryland
Located at 5711 York Road, Baltimore 12, Maryland, the system is used for the rating of long distance messages. Terminating point information is stored on the drums. Calculation of rate is based on location of originating and terminating points, duration and class of call. Rate and miscellaneous billing and statictical data are punched into the message card.

Douglas Aircraft Company, Dept. G-318, Santa Monica
Located at C-107, Long Beach, the system is used for general accounting, labor distribution, cost and expense ledgers, material, and payroll.

Douglas Aircraft Company, Inc., Tulsa Division
Located at 2000 North Memorial Drive, Tulsa, Oklahoma, the system is used for work determination (search stored master files for technical orders and planned jobs applicable to aircraft coming in for modification), payroll (create payroll working cards and compute earnings and taxes. Update earnings, total-to-date records, and vacation/sick leave records. Create quarterly and year-end tax report cards), cost labor and estimating (summarize hours worked, allocating indirect time to applicable direct charge and create cards for accounting cost labor reports and manufacturing control performance reports and work history), and cost ledger (perform allocations and create cards showing cost of work charged to other divisions of the company.

Michigan Bell Telephone Company
Located at 105 E. Bethune, Detroit, Michigan and 3530 Eastern S. E., Grand Rapids, Michigan, the computers are used to rate "long distance" toll messages.

Photo by Michigan Bell Telephone Company

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Bin coded dec (excess 3)
Digits per word	12 digits including sign
Digits/instruction	12 characters/instruction
Instructions per word	1 plus sub command

All instructions are programmed by external plugboard.

Arithmetic system	Fixed point
Instruction type	Three address
Number range	99,999,999,999- to 99,999,999,999+

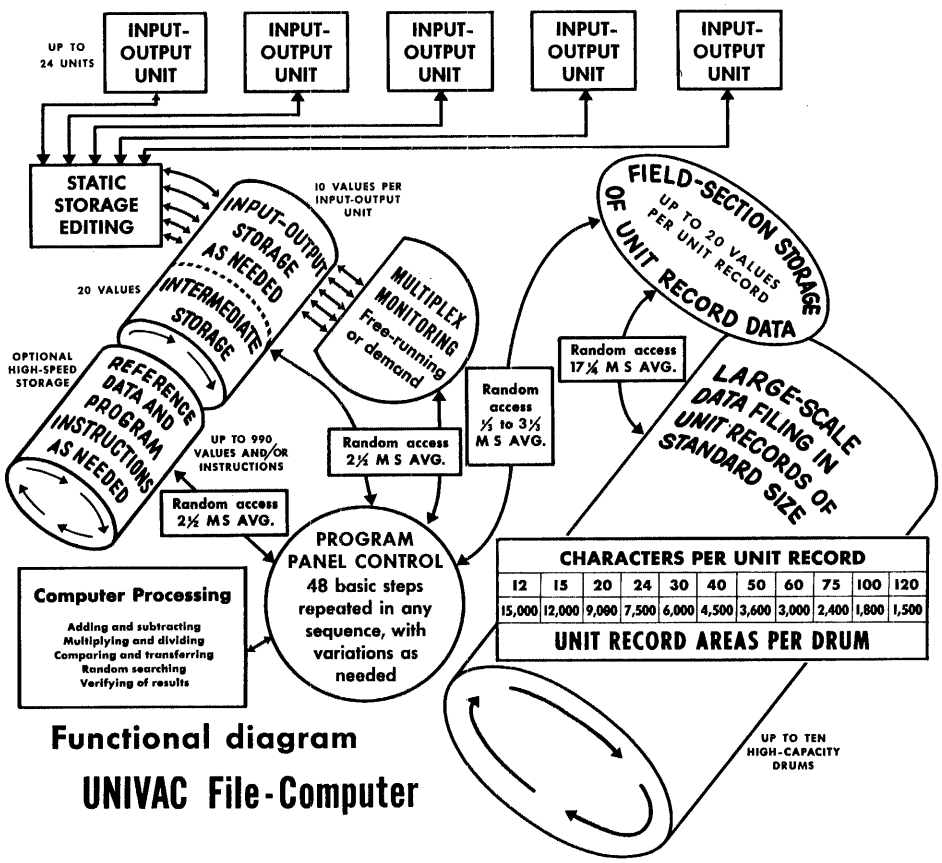
Instruction word format

V_1 Address of first operand	V_2 Address of 2nd operand	R Address for Result Storage	Process	Special Char. Sub-Command
3 digits	3 digits	3 digits	2 digits	

Automatic built-in subroutines includes tape search.
Each register is a 12 character shift register with lower position reserved for algebraic sign.

Register A
Receives first operand

Register B
Receives second operand



Functional diagram

UNIVAC File-Computer

Register C

Accumulates the result in add and subtract operation, in division it receives the remainder, in multiplication it receives most significant product digits.

Register D

Accumulates the result in add and subtract operations, in division it stores the quotient, in multiplication it stores the least significant product digits.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	8,610	1,200
Mult	23,800	16,300 Multiplier = 55555
Div	27,500	approx 20,000 6 digit dividend & 6 digit divisor

The storage access for add, multiply & divide operations includes accessing of the two operands and the result.

Arithmetic mode	Serial
Timing	Synchronous
Operation (System)	Concurrent

STORAGE

Manufacturer

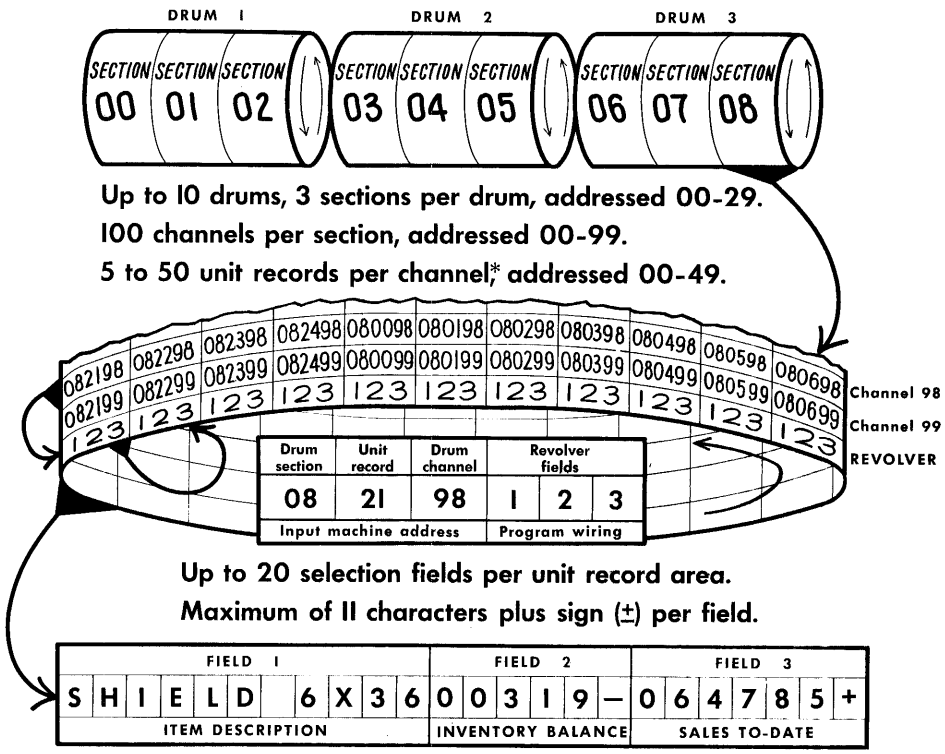
Media	No. of Words	No. of Alphanum Char	Access Microsec
Drum (High Speed)	1,070	12,840	2,500 avg
Drum (Mass Memory)(optional)	15,000/unit	180,000/unit	17,000

Max. 8 units

Magnetic Tape

No. of units that can be connected	10 Units
No. of char/linear inch of tape	139 Char/inch
Channels or tracks on the tape	7 Track/tape
Blank tape separating each record	0.5 Inches
Tape speed	75 Inches/sec
Transfer rate	10,425 Char/sec
Start time	7 Millisec
Stop time	10 Millisec
Average time for experienced operator to change reel of tape	30 Seconds
Physical properties of tape	
Width	0.5 Inches
Length of reel	2,400 Feet
Composition	Mylar or metal

900 microseconds, above, inlcudes time to transfer one word to an arithmetic register.



HIGH–CAPACITY GENERAL STORAGE

The following installation utilizes 1 General Storage Drum of 15,000 words, 12 characters/word, each:
Frankford

The following installation utilizes 4 General Storage Drums of 15,000 words, 12 characters/word, each:
Michigan Bell Telephone - Grand Rapids

The following installation utilizes 5 General Storage Drums of 15,000 12 characters/word, each:
Michigan Bell Telephone - Detroit

The following installations utilize 6 General Storage Drums of 15,000 words, 12 characters/word, each:
Douglas Santa Monica
Douglas Tulsa

Six large-capacity drums are used. Each drum has 300 "tracks" of 600 digits. "Unit Record" lengths of 12, 15, 20, 24, 30, 40, 50, 60, 75, 100, or 120 digits are available. "Field", or word, lengths within a unit record may vary from 1 to 20 digits, entirely at the discretion of the programmer. Alphabetic characters require only one digit of storage.

The following installations utilize 8 General Storage Drums of 15,000 words, 12 characters/word, each:
ROAMA
C and P Telephone

Each drum has a capacity of 180,000 digits. This is divided into 4500 - 40 digit words. Therefore, the total storage available on the 8 drums is 1,440,000 digits.

INPUT

Media	Manufacturer Speed
Magnetic Tape	10,425 char/sec
Paper Tape	200 char/sec
Card Read/Punch Unit	150 cards/sec

All input devices are on line. 80 or 90 column cards may be used.

The following organizations utilize the input devices indicated:

Frankford
Cards and magnetic tape

ROAMA
Cards, magnetic tape and inquiry typewriter

C and P Telephone
Cards

Douglas Santa Monica
Cards

Douglas Tulsa
Cards. An input speed of 600 cards/min. is possible, using all units.

Michigan Bell Telephone - Detroit
Cards

Michigan Bell Telephone - Grand Rapids
Cards

OUTPUT

Manufacturer

Media	Speed
Magnetic Tape	10,425 char/sec
Paper Tape	60 char/sec
Card Punch 80 or 90	150 cards/min
High Speed Printer	600 lines/min
Inquiry Typewriter	10 char/sec

Compatibility of tapes is possible with other Univac tape systems. Printer may be operated on or off line.

The following organizations utilize the output devices indicated:

Frankford

Cards, magnetic tape and high speed printer.

ROAMA

Cards, magnetic tape and inquiry typewriter.

C and P Telephone

Cards. Speed on two I.O. units - approx. 160 cards/min. Speed on three I.O. units - approx. 180 cards/min. Application calls for read and punch in same card. Maximum speeds per I.O. are read and/or punch 150 cards/min.

Douglas Santa Monica

Cards

Douglas Tulsa

Cards. An output speed of 600 cards/min. is possible, using all units.

Michigan Bell Telephone - Detroit

Cards

Michigan Bell Telephone - Grand Rapids

Cards

CHECKING FEATURES

Manufacturer

Checking features include odd parity, execution of arithmetic and some transfer instruction with built in checks, complete tape read checks, and logical checks.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer

Power, computer	74.4 KVA		0.95 pf
Power, air conditioner	14.9 Kw		
Room size	1,400 sq ft		
Capacity, air conditioner	19.8 Tons		
Weight, computer	8,000-10,000 lbs		

No special facilities are required. Standard 3 phase 220 volt power is used.

Frankford

Power, computer	100 Kw	112 KVA	0.90 pf
Power, air cond	98.8 Kw	70 KVA	0.85 pf
Volume, computer		26,640 cu ft	
Volume, air condition		1,530 cu ft	
Area, computer		1,800 sq ft	
Area, air conditioner		255 sq ft	
Floor loading		100 lbs/sq ft	
		100 lbs concen max	
Capacity, air conditioner		60 Tons	
Weight, computer		19,430 lbs	
Weight, air conditioner		16,900 lbs, incl cooling tower	

Plenums - length 48 ft, width 37, height 15 (48' x 37 x 15 = 26,640 cu ft.). Building type - manufacturing type of pre-World War II Type. Building modifications - installation of air conditioner and electrical receptacles. 480V, 60 cycle, 3 phase, stepped down to 230V.

Above power includes peripheral equipment.

ROAMA

Power, computer	94 Kw	3 phase, 4 wire	
Power, air condi	27.5 Kw	27.5 KVA	220V, 3 phase, 4 wire
Volume, computer		21,600 cu ft	
Volume, air conditioner		1,180 cu ft	
Area, computer		2,400 sq ft	
Area, air conditioner		150 sq ft	
Floor loading		150 lbs/sq ft	
		2,200 lbs concen max	
Capacity, air conditioner		48 Tons	
Weight, computer		38,210 lbs	
Weight, air conditioner		7,500 lbs	

Modified portion of existing permanent type warehouse including installation of raised wood floor with asphalt tile, new partitions to segregate area, air conditioning, lighting and electrical power and distribution.

C and P Telephone

Power, computer	27.0 Kw	29.7 KVA	0.90 pf
Volume, computer		678 cu ft	
Volume, air conditioner		96 cu ft	
Area, computer		129.1 sq ft	
Area, air conditioner		9.7 sq ft	
Room size, computer		20 ft x 38 ft	
Room size, air conditioner		Located in same room	
Floor loading		133.1 lbs/sq ft	
		150 lbs concen max	
Capacity, air conditioner		10 Tons	
Weight, computer		17,177 lbs	

3 phase, 208 volt, 4 wire circuit required for computer voltage regulator. Required - (Line voltage variations exceeded ± 5%) 40 K.V.A. 3-phase 113 Amp-Stabiline rectifier purchased through Remington Rand. Partitioning and ventilating hoods erected.

Douglas Santa Monica

Power, computer	29.5 KVA	
Area, computer	180 sq ft	
Room size	60 ft x 20 ft	
Floor loading	150 lbs/sq ft	
	2,050 lbs concen max	
Capacity, air conditioner	15 Tons	
Weight, computer	20,050 lbs	
Weight, air conditioner	1,500 lbs	

Six inch raised false floor installed over power cables. Exhaust diffusers installed in ceiling for heat dissipation/air conditioning.

Douglas Tulsa

Power, computer	29.5 KVA	0.85 pf	3 phase, 208/230V reg.
Power, air cond	11.2 Kw	15 KVA	0.70 pf
Volume, computer		900 cu ft	
Volume, air conditioner		112 cu ft	
Area, computer		180 sq ft	
Area, air conditioner		16 sq ft	
Room size, computer		60 ft x 20 ft	
Room size, air conditioner		8 ft x 8 ft	
Floor loading		150 lbs/sq ft	
		2,050 lbs concen max	
Capacity, air conditioner		15 Tons	
Weight, computer		20,050 lbs	
Weight, air conditioner		1,500 lbs	

Floor-to-ceiling partitions installed around computer area. Six-inch raised false floor installed over power cables. Three sixty-inch combination exhaust-diffusers installed in ceiling for heat dissipation/air conditioning.

Michigan Bell Telephone - Detroit

Michigan Bell Telephone - Grand Rapids

Power, computer	13.2 Kw	23.3 KVA	0.75 pf
Power, air cond	11.1 Kw	14 KVA	0.75 pf
Volume, computer		12,000 cu ft	
Volume, air conditioner		72 cu ft	

Area, computer	750 sq ft
Area, air conditioner	36 sq ft
Room size, computer	24 ft x 20 ft
Room size, air conditioner	Ceiling unit
Room size, maintenance	8 ft x 10 ft
Floor loading	164 lbs/sq ft
	650 lbs concen max
Capacity, air conditioner	7 Tons
Weight, computer	15,570 lbs
Weight, air conditioner	900 lbs

The installation of a seven ton air conditioning unit and an extension of our power distribution circuits were the only site preparations required. (We did partition the computer room at Detroit. However, at Grand Rapids, the Univac was installed in an unpartitioned room with other punched card equipment.)

PRODUCTION RECORD

Manufacturer

See Production Record of Univac File Model 1.

The Univac File Model 1 is the current Univac File model being delivered.

COST, PRICE AND RENTAL RATES

Frankford

Basic System

Program Control Unit, Arithmetic Unit = $2,450 + $15= $2,465.

Additional equipment

Sort 1 Collate System	$750
High Speed Printer	2,725
Magnetic Tape Units (6)	4,500
90 Col Card Unit	1,300
General Storage	850

Maintenance included for prime shift.

Extra shift rental/maintenance at $12 per hour per engineer.

ROAMA

Basic system

Main frame	$4,190
Supv. Console	150
Inquiry Typewriter	350
Card Unit	1,300
Unityper	90
Seven Magnetic Tape Units	5,250
Eight General Storage Drums	4,600

Additional equipment

High Speed Printer	$3,300
Sort Collate/four mag. tape units	3,750

Figures shown are monthly prime shift rental rates.

C and P Telephone

Basic system

1 - Arithmetic & Control, 1 - General Storage, and 1 80 Col. I.O. = $4,600.

Additional equipment

1 - 80 col. I.O., and 7 additional drums = $3,750.

3rd I.O. on standby basis at present.

Douglas Tulsa

Basic system

Program Control Unit, Arith,etic Control Unit, General Storage Unit, Four Input-Output Units and Adaptors, Six Large-Capacity Magnetic Drums = $8,790.

Michigan Bell Telephone - Detroit

Michigan Bell Telephone - Grand Rapids

	Price
Central Computer, Input/Output Unit and General Storage	$219,000
One Input/Output Unit	$55,000 ea.
Four General Storage Drums	21,000 ea.
	Rental
Central Computer, 80 Column Input/ Output Unit and General Storage	4,350
One 80 Column Input/Output Unit	$1,050
Four General Storage Drums	350 ea.

PERSONNEL REQUIREMENTS

Manufacturer

	One 8-Hour Shift
Supervisors	1
Analysts	1
Programmers	3
Coders	2
Clerks	1
Librarians	1
Operators	2
Engineers	1
Technicians	3

Training made available by the manufacturer to the user includes programming schools and sales support personnel.

Frankford

	Two 8-Hour Shifts	
	Used	Recommended
Supervisors	1	3
Analysts	2	2
Programmers	7	7
Librarians	1	2
Operators	3	7

Operation tends toward closed shop.

Methods of training used includes 120 hours classroom training by Rem-Rand personnel for programmers, 80 hours classroom training by Rem-Rand personnel and on-the-job training by experienced Arsenal programmers for operators.

ROAMA

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	1	3
Operators	1	3
Engineers	6	9
In-Output Oper	2	6

Operation tends toward closed shop.

C and P Telephone

	One 8-Hour Shift
Supervisors	1
Programmers	2
Operators	2

Programmers and supervisors are part time.

Operators were trained by programmers on-the-job.

Operating instructions are being prepared.

Douglas Santa Monica

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

Operation tends toward closed shop.

Methods of training used include two weeks course followed by on-the-job training.

Douglas Tulsa

	One 8-Hour Shift
Supervisors	1
Analysts	3
Operators	2
Engineers	1
Technicians	1

Analysts perform their own programming. No coding

required. Two additional systems analysts available, if needed, from outside the department.

Operation tends toward open shop.

Methods of training used include two-week familiarization course followed by on-the-job training.

Michigan Bell Telephone - Detroit
Michigan Bell Telephone - Grand Rapids

	One 8-Hour Shift	Two 8-Hour Shifts
Supervisors	1	1
Programmers	1	1
Operators	1	2
Engineers	2	3

Operation tends toward open shop.

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

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

Numerous built-in checking features.

Frankford

Average error-free running period 30.3 Hours
Good time 67 Hours/Week (Average)
Attempted to run time 76 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.88
Above figures based on period from Jan 60 to Mar 60
Passed Customer Acceptance Test 15 Jul 59
Time is available for rent to qualified outside organizations. Presently, there is time available on the computer system pending the implementation of further applications. This time would be available in the meantime to an organization or agency with a compatible system.

ROAMA

Good time 119 Hours/Week (Average)
Attempted to run time) 128 Hours/Week (Average)
Operating ratio 0.93
Above figures based on period 1 Feb 60 to 31 Mar 60
Time is not available for rent to outside organizations.

C and P Telephone

Average error-free running period 6.4 Days
Good time 42.33 Hours/Week (Average)
Attempted to run time 42.5 Hours/Week (Average)
Operating ratio 0.996
Above figures based on period 1 Jul 60 to 31 Jul 60
Passed Customer Acceptance Test 1 Feb 60
Time is not available for rent to outside organizations.

New program cutover on 25 Jul 60 - initial program used from Feb 60 until Jul 60. Analysis on new program is not complete.

Douglas Santa Monica

Average error-free running period 40 Hours
Good time 40 Hours/Week (Average)
Attempted to run time 41 Hours/Week (Average)
Operating ratio 0.975
Above figures based on period from Jul 59 to Jul 60
Passed Customer Acceptance Test Jul 58
Time is available for rent to outside organizations.

Douglas Tulsa

Average error-free running period Two Weeks
Good time 44.6 Hours/Week (Average)
Attempted to run time 46 Hours/Week (Average)
Operating ratio 0.97
Above figures based on period 1 Jan 60 to 30 Apr 60
Passed Customer Acceptance Test 1 Sep 57
Time is available for rent to outside organizations.

Michigan Bell Telephone - Detroit
Michigan Bell Telephone - Grand Rapids

Good time 70 Hours/Week (Average)
Attempted to run time 78 Hours/Week (Average)
Operating ratio 0.93
Above figures based on period 1 Apr 60 to 1 May 60
Passed Customer Acceptance Test 1 Sep 59
Time is not available for rent to outside organizations.

We have encountered considerable 80 column punch trouble with the Detroit Univac. The Grand Rapids installation has been, in comparison, trouble free.

ADDITIONAL FEATURES AND REMARKS

Frankford

A unique system advantage is that sort/collate system may be off line or the tape units may be used on-line as demand stations.

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature, and physical, electrical, fire and other damage include labelling (tape number, program number, period ending date, description and blockette count), storage (2 fireproof closed cabinets - 1 open cabinet), protection against atmospheric conditions (air conditioning), and a disaster plan (source tapes stored in separate location) is in effect.

Our Model 0, UFC is composed of a Main Control Unit, an Arithmetic and Control Unit, a General Storage Drum, a 90 column I/O Unit, a 90 column Adaptor, six Tape Units, a Sort/Collate System (Main Control plus four of above tape units), and a High Speed Printer (Printing Unit, Type Reader, Memory Unit, Control Unit).

ROAMA

Tapes are stored in the computer room which is air conditioned and humidity controlled. The room is equipped with a sprinkler system in case of fire however, the tapes are stored in plastic containers and metal filed which are not fireproof. Labels are AMC Form 55 dated Oct. 58.

Douglas Tulsa

An outstanding feature is the magnetic drum storage, which is expandable to 1,800,000 digits on request, and expandable to 5,940,000 digits with circuitry modification.

The unique system advantages include true random access storage and self-checking arithmetic processes.

Michigan Bell Telephone - Detroit
Michigan Bell Telephone - Grand Rapids

Outstanding feature is the random access memory. Unique system advantage is that system rates toll messages in random terminating point order and accumulates statistics and study data.

FUTURE PLANS

Manufacturer

Univac File Model 1 is the current Univac File model.

Frankford

It is planned that additional payroll, budget and program cost applications will be added to the existing equipment as soon as possible. A proposed integrated Financial Management System for the entire Arsenal when implemented would require a computer with a greater potnetial than the one currently in use. It is believed that a computer of the second generation type (transistorized) would prove of greater

benefit to the Arsenal and would eliminate the obsolescence of such equipment for greater period of time.

C and P Telephone

Modifications of 80 column read punch (P-19) presently used on Univac Solid State Computer may permit it to be used on Model 0. This will increase time available for computing from 85 milliseconds to 400 milliseconds. It is anticipated that 2 P-19's would furnish at least the same output volumes as the 3 I.O.'s used presently.

Douglas Santa Monica

System is to be retired within the next few months.

Douglas Tulsa

Two Univac Electronic Tabulators are on order and will provide high-speed printing capability. Each machine consists of a 450-card per-minute reader, a 150 card-per-minute punch, a 600 line-per-minute printer and a processor which includes a 2,400-word (10 digit) drum.

Michigan Bell Telephone - Detroit

Michigan Bell Telephone - Grand Rapids

Several new applications for the Univac are in the planning stage. For the most part, they involve statistical analysis of toll message volume data.

INSTALLATIONS

Frankford Arsenal
Bridge and Tacony Streets
Philadelphia, Pennsylvania

ROAMA
Griffiss Air Force Base, New York

Chesapeake and Potomac Telephone Company of Maryland
5711 York Road
Baltimore 12, Maryland

Douglas Aircraft Company, Dept. C-107
Long Beach, California

Douglas Aircraft Company, Inc.
2000 North Memorial Drive
Tulsa, Oklahoma

Michigan Bell Telephone Company
105 E. Bethune
Detroit, Michigan

Michigan Bell Telephone Company
3530 Eastern S. E.
Grand Rapids, Michigan

UNIVAC FILE 1

Univac File Computer Model 1

MANUFACTURER

Remington Rand Division
Sperry Rand Corporation

Photo by Remington Rand Univac

APPLICATIONS

Manufacturer

The Univac File-Computer is a general purpose, medium-priced electronic data processing system with a magnetic drum memory. Automatic tape collating and sorting may be performed without requiring computer time, which, during the process, may be spent on other operations. Random access is provided to 180,000 alpha-numeric characters on one drum and to the magnetic core memory. A maximum of ten drums may be added to one system. The system is controlled by external panel wiring and by internally stored programs. Input/output devices consist of an electric typewriter, a punched card unit and a perforated tape unit, a magnetic tape unit and a high-speed printer.

U. S. Army Chemical Center

Supply Management National Inventory Control Point, Army Industrial Fund Inventory, and Army Industrial Fund Cost Accounting.

New applications will include:
Corps wide Appropriation Financial Accounting, surveillance statistics for Chemical Corps materiel, civilian payroll, inventory and supply management of Chemical Corps, inspection aids and equipment, military personnel statistics, and Chemical Corps Tables of Distribution.

U. S. Army Military Traffic Management Agency

Located in Washington, D. C., the system is used by a single manager charged with the responsibility for compiling of statistical data for the Department of Defense on all forms of transportation used by all military departments.

U. S. Marine Corps Supply Center, Albany, Ga.

Located at the Marine Corps Supply Center, Albany, Ga., applications include computer processing under the current Marine Corps concept of supply management, which involves the use of the File Computer as the primary processing tool of the Marine Corps supply

Photo by Remington Rand Univac

centers, and inventory control point. Each of our two supply centers manage a supply complex. For example, this activity is responsible for the area extending east of a north-south line passing through El Paso, Texas including the Near East and Mediterranean areas. All inventory and financial management of stocks at the supply center and the stock account at MCS, Quantico, Va., Camp Lejeune, N.C., and MCRD, Parris Island, S.C., is accomplished by this supply center. The inventory records for each of the above activities are maintained on magnetic tape and updated periodically on our computer. The financial accounting is accomplished to support each inventory updating process.

U. S. Marine Corps Supply Center, Barstow, Calif. Located in the Administrative Division, at Barstow, California, the system is used for supply inventory control and accounting and for stores accounting (monetary value of stores).

USAF Headquarters Command, Bolling AFB

Base inventory control and monetary accounting-Inventory records are maintained on magnetic tape and each day supply transactions (issues, turn-ins, receipts, etc.) update the inventory on hand balances, resulting in requisition, back orders, etc. Entire application consists of approximately 35 programs.

Military personnel accounting - This application provides for the maintenance of personnel strength files on magnetic tape and for periodic summarization of data for submission to Hq USAF. There are approximately 20 programs utilized in support of this application.

Civilian payroll accounting - This application provides for the bi-weekly computation of pay data for 5,000 civilian employees serviced by Bolling AFB.

USAF Sacramento Air Materiel Area, McClellan AFB System is used for maintenance engineering management and aircraft configuration control for the F-104.

USAF Special Communications Center, Kelly AFB System is located at San Antonio, Texas.

USAF Warner Robins Air Materiel Area

The computer is used for the property accounting system which encompasses the processing of all documents i.e., requisitions, receipts, IAVs, stock list changes, etc., that effect inventory management stock control and distribution of Air Force controlled inventory. It also originates feeder data for many other systems dealing with material such as IAM, GSSF, maintenance production system, maintenance, supply, civil engineers, administrative services, and tenant organizations, cost system inventory, and stock balance and consumption reporting.

The computer is used for Maintenance Engineering Management - material control and production item reporting. This project provides for control and accounting of material used in the Directorate of Maintenance Engineering repair activities. It includes provisions for maintenance of material standards; computation of material requirements on the 90/180 day programmed workload and other non-programmed work as it generates; preparation of necessary documentation to effect physical movement of stock to the maintenance support stock in conjunction with AMCL 25-156 and to accomplish the determination of support-ability for production; analysis of material usage related to production items; accumulation of cost for actual material consumed; computation of maintenance stock support utilization and effectiveness; accumulation of production data and reporting for the material repair system and other production reporting.

Computer will shortly be used for base support class stock control and distribution. This is a method for controlling and distributing material to support AMC internal depot functions including MOS operation and tenant organizations. The basic function of this system is to provide data required to enable the supply components to administer timely, accurate, and effective material support. The system provides current inventory positions and various products for management of serviceable, reparable, and excess material. The system also provides such by-products of data as can be used in dollar management of AF assets processed by the computer to effect obligation on distribution of material; appropriate reserve level notices; back-order action as appropriate; and preparation of outputs for further use in supply and dollar accounting reports.

Douglas Aircraft Company, Department G-318 No. 1 Located in A7-123 Santa Monica, the system is used for parts sales, provisioning, and inventory.

Douglas Aircraft Company, Department G-318 No. 2 Located in A-312, Santa Monica, California, the system is used for production scheduling, tooling, and material release.

Douglas Aircraft Company, Department G-318, No. 3
Located in B-107, El Segundo, the system is used for general accounting, labor distribution, cost & expense ledgers, material, and payroll.

Douglas Aircraft Company, Department G-318, No. 4
Located in C-107, Long Beach, the system is used for general accounting, labor distribution, cost & expense ledgers, material, and payroll.

Douglas Aircraft Company, Department G-318, No. 5
Located at C-107, Long Beach, the system is used for production scheduling, tooling, material release, and order location.

Douglas Aircraft Company, Department G-318, No. 6
Located at A-107, Santa Monica, the system is used for general accounting, labor distribution, cost & expense ledgers, material, and payroll.

First National City Bank of New York
Located at 399 Park Avenue, N.Y.C., the system is used Personnel (daily and monthly absentee report, job classification study, personnel statistic report, and profit sharing studies), by Comptrollers (allocation of departmental budget expense), by the Paymaster (payroll and related reports), by others for salary, employment, vacation studies, and reconcilement of travelers checks. Planned applications include accounting (head office and branch general ledger accounting) and inventory (stationery).

Photo by U. S. Army Chemical Center

Western Electric Company, Incorporated
Located at 2500 Broening Highway, Baltimore 24, Maryland, the system is used for preparation of hourly payrolls and related report data, employee wage incentive credits and monthly balance earnings, monthly accounting details and report data, merchandise warehouse stock maintenance, and merchandise warehouse inventory control.

PROGRAMMING AND NUMERICAL SYSTEM

Manufacturer	
Internal number system	Binary coded dec (excess 3)
Alphanum char/word	12 char, incl sign
Characters per instruction	12 alphanum
Instructions per word	1 plus sub command
Instructions decoded	Internal 27 plus 11 sub-instructions External 19 plus 17 sub-instructions
Arithmetic system	Fixed point
Instruction type	Three address
Number range	99,999,999,999- to 99,999,999,999+

Instruction word format

V_1 Address of first operand	V_2 Address of 2nd operand	R Address for Result Storage	Process	Special Char. Sub-Command
3 digits	3 digits	3 digits	2 digits	1 digit

Automatic built-in subroutines includes tape search.

Each register is a 12 character shift register with lower position reserved for algebraic sign.

Register A

Receives first operand

Register B

Receives second operand

Register C

Accumulates the result in add and subtract operation, in division it receives the remainder, in multiplication it receives most significant product digits.

Register D

Accumulates the result in add and subtract operations, in division it stores the quotient, in multiplication it stores the least significant product digits.

Photo by U. S. Army Chemical Center

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	8,610	1,200
Mult	23,800	16,300 Multiplier = 55555
Div	27,500	approx 20,000 6 digit dividend & 6 digit divisor

The storage access for add, multiply & divide operations includes accessing of the two operands and the result.

Arithmetic mode	Serial
Timing	Synchronous
Operation (System)	Concurrent

STORAGE

Media	Manufacturer No. of Words	No. of Alphnum Char	Access Microsec
Magnetic Core	20	240	900
Drum (High Speed	1,070	12,840	2,500 avg
Drum (Mass Memory)(optional) Max. 10 units	15,000/unit	180,000/unit	17,000

Photo by U. S. Marine Corps Supply Center Barstow

Magnetic Tape

No. of units that can be connected	10	Units
No. of char/linear inch of tape	139	Char/inch
Channels or tracks on the tape	7	Tracks/tape
Blank tape separating each record	0.5	Inches
Tape speed	75	Inches/sec
Transfer rate	10,425	Char/sec
Start time	7	Millisec
Stop time	10	Millisec
Average time for experienced operator to change reel of tape	30	Seconds
Physical properties of tape		
Width	0.5	Inches
Length of reel	2,400	Feet
Composition	Mylar or metal	

900 microseconds, above, includes time to transfer one word to an arithmetic register.

USMC SC Albany

Storage capacity of the high speed drum consists of the following categories of tracks.

Tracks 0-9 = Input/output tracks. Each basic track is dual in nature for track switching consequently doubling the storage capacity.

Tracks 11-12 = Factor Storage

Tracks 13-97 = Program Storage

Track 99w = Stores field selection pattern

Western Electric

Media	No. of Words	No. of Digits	Access Microsec	
High Speed Drum	1,050	11 + sign/word	Min.	0588
			Avg.	3,087
			Max.	5,586
Large Capacity Storage Drums	Variable Unit Records	180,000/drum	Avg.	17,000
			Max.	34,000
Buffers (Magnetic Core)	20	240	Min.	630
			Avg.	861
			Max.	1,092

Unit records can run in multiples of 12 up to 120.

Memory Locations				
Register "A"	1	11 + sign		
Register "B"	1	11 + sign		
Register "C"	1	11 + sign	Min.	588
Register "D"	1	11 + sign	Avg	819
Instruction Revolver	1	11 + sign	Max.	1,050
General Storage Address Register		7		
Program Address Counters	-	3		
Code Distributor Register	-	1		

The following installations utilize 1 General Storage Drum of 15,000 words, 12 characters/word, each:

USA CC	Douglas 1
USA MTMA	Douglas 2
USAF SCC	

The following installation utilizes 2 General Storage Drums of 15,000 words, 12 characters/word:
USMC SC Barstow

The following installations utilize 3 General Storage Drums of 15,000 words, 12 characters/word, each:

USAF Bolling	USAF McClellan

The following installation utilizes 4 General Storage Drums of 15,000 words, 12 characters/word:
1st National City Bank

The following installations utilize 6 General Storage Drums of 15,000 words, 12 characters/word, each:

Douglas 4	Douglas 6

The following installation utilizes 7 General Storage Drums of 15,000 words, 12 characters/word:
Douglas 3

The following installations utilize 8 General Storage Drums of 15,000 words, 12 characters/word, each:

USAF WRAMA	Douglas 5

Photo by U. S. Marine Corps Supply Center Barstow

INPUT OUTPUT

Manufacturer Media	Speed
Magnetic Tape	10,425 char/sec
Paper Tape	200 char/sec
Card Read/Punch Unit	150 cards/sec

All input devices are on line. 80 or 90 column cards may be used.

Media	Speed
Magnetic Tape	10,425 char/sec
Paper Tape	60 char/sec
Card Punch 80 or 90	150 cards/min
High Speed Printer	600 lines/min
Inquiry Typewriter	10 char/sec

Compatibility of tapes is possible with other Univac Tape Systems. Printer may be operated on or off line.

The following organizations utilize the Input/Output devices indicated:

USA CC

Cards, mag tape, typewriter, and high speed printer.

USA MTMA

Cards, mag tape, typewriter, and high speed printer.

USMC SC Albany

Media	Speed
80 Column Card Unit	300 cards/min

This loading speed is attained bu utilizing both the read and punch channel for reading (punching only rate = 150 cpm)

Magnetic Tape Units	11.5 Millisec

This time represents the speed with which one blockeet (120 characters) of info passes by read write head

Inquiry Typewriter	Manual

Operator must key in desired info for transfer and loading

Media	Speed
80 Column Card Unit	150 cards/min

This component possesses a punching capability in one channel only.

Magnetic Tape Units	Same as input
Inquiry Typewriter	8.5 Char/sec

USMC SC Barstow
Cards, magnetic tape, typewriter and high speed printer.
USAF Bolling
Cards, magnetic tape and typewriter.
USAF McClellan
Cards, magnetic tape and typewriter.

Photo by U. S. Marine Corps Supply Center Barstow

USAF SCC
Magnetic tape and typewriter.
USAF WRAMA
Cards, magnetic tape and typewriter
Douglas 1
Cards and magnetic tape.
Douglas 2
Cards and magnetic tape.
Douglas 3
Cards
Douglas 4
Cards and magnetic tape
Douglas 5
Cards and magnetic tape
Douglas 6
Cards
1st National City Bank
Cards and magnetic tape. 4 tape units with Sort Collate Control Unit allows off line sort-merge routines.
Western Electric
Cards and magnetic tape.

CHECKING FEATURES

Manufacturer

Checking features include odd parity, execution of arithmetic and some transfer instruction with built in checks, complete tape read checks, and logical checks.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer

Power, computer		74.4 KVA	0.95 pf
Power, air conditioner		14.9 Kw	
Room size, computer		1,400 sq ft	
Capacity, air conditioner		19.8 Tons	
Weight, computer		8,000-10,000 lbs	

No special facilities are required. Standard 3 phase 220 volt power is used.

USA CC

Power, computer	28 Kw	30 KVA	0.95 pf
Power, air condi		107 Kw	0.83 pf
Volume, computer		343 cu ft	
Area, computer		752 sq ft	
Floor loading		120 lbs/sq ft	
		140 lbs concen max	
Capacity, air conditioner		80 Tons	
Weight, computer		7,060 lbs	

Photo by U. S. Marine Corps Supply Center Albany

Converted warehouse type building - approximately 11,000 square feet. False acoustic tile ceiling, tile floor. EAM equipment partitioned separately from computer room. Separate offices for programmers and administrative personnel. Completely rewired and florescent lighting installed.

USA MTMA

Power, computer	88.2 KVA
Volume, computer	16,000 cu ft
Volume, air conditioner	3,600 cu ft
Area, computer	2,000 sq ft
Area, air conditioner	400 sq ft
Weight, air conditioner	2,400 lbs

False ceilings and floors, sound proofing of walls and ceilings, picture windows, wide doors, electrical floor channels, air conditioning ducts, fuse panels and storm windows.

USMC SC Albany

Power, computer	191 Kw	225 KVA	0.85 pf
Power, air condi	170 Kw	200 KVA	0.85 pf
Volume, computer		17,550 cu ft	
Volume, air conditioner		3,861 cu ft	
Area, computer		1,950 sq ft	
Area, air conditioner		429 sq ft	
Room size, computer		L-75, W-26, H-9	
Room size, air condi		L-16.5, W-26, H-9	
Floor loading		17.16 lbs/sq ft	
		55.3 lbs concen max	

Photo by Bolling Air Force Base

Capacity, air conditioner	60 Tons
Weight, computer	31,472 lbs
Weight, air conditioner	5,360 lbs

Computer utilizes separate power source. Air conditioner shares power source. Approximately 200 KVA available. False floor ratings are uniform load = 150 lbs/sq ft and concen load = 500 lbs/sq ft.

Our computer site was constructed within one wing of an already existing brick and concrete structure. The required floor space was determined utilizing two existing walls of the wing and the rectangular structure was completed by the construction of two concrete block walls. Power requirement were met by installation of a separate transformer bank, voltage regulator and switching gear. Power lines were run through pre-existing control room located in the same wing and then into computer site. Acoustical tile ceiling of permanent structure was retained.

USMC SC Barstow

Power, computer	52.5 Kw	69.6 KVA	0.75 pf
Power, air condi	45.1 Kw	57.4 KVA	0.78 pf
Volume, computer		798	cu ft
Volume, air conditioner		1,105	cu ft
Area, computer		166.6	sq ft
Area, air conditioner		121	sq ft
Room size, computer		42	ft x 70 ft
Room size, air conditioner		12	ft x 17.5 ft
Floor loading		118	lbs/sq ft
		700	lbs concen max
Capacity, air conditioner		50	Tons
Weight, computer		27,930	lbs
Weight, air conditioner		4,000	lbs

New wing constructed, size 42 ft x 70 ft, stucco wall, false floor, false ceiling. Hot and cold air plenums, source and exhaust duct work for airflow. Power distribution system including 3 ea 50 KVA and 2 ea KVA transformers, 1 ea 27.5 KVA and 1 ea 90 KVA voltage regulators installed.

USAF Bolling

Power, computer	100.5 KVA
Power, air conditioner	48.672 Kw
Volume, computer	1,229.5 cu ft
Volume, air conditioner	5,600 cu ft
Area, computer	291.0 sq ft
Area, air conditioner	560 sq ft
Room size, computer	40 ft x 60 ft
Room size, air cond (40 Tons)	13 ft x 14 ft
Room size, air cond (15 Tons)	7 ft x 14 ft
Floor loading	140.0 lbs concen max
Capacity, air conditioner	55 Tons
Weight, computer	155,000 lbs
Weight, air conditioner	5,500 lbs

A supply warehouse (Butler Building) was modified. False ceiling, tile floor, air conditioning, wall partitions and the required power supply were added to the building housing the computer and punch card machine areas.

USAF McClellan

Power, computer	56.1 Kw	65.3 KVA	0.86 pf
Power, air condi	160 Kw	200 KVA	0.86 pf
Volume, computer		1,283	cu ft
Volume, air conditioner		846	cu ft
Area, computer		2,356	sq ft
Area, air conditioner		1,881	sq ft
Room size, computer		38	ft x 62 ft
Room size, air conditioner		42	ft x 65 ft
Floor loading		150	lbs/sq ft
		700	lbs concen max
Capacity, air conditioner		155	Tons
Weight, computer		22,520	lbs
Weight, air conditioner		75,000	lbs

Air conditioner serves both 1105 and UFC.

A plenum was constructed for the control cabinets, and storage cabinets. Acoustical tile was applied to a false ceiling and to the walls of the room. It was necessary to increase the power to meet the demands of the UFC and 1105. Site preparation for both systems was done simultaneously. Air conditioning was increased and necessary duct work was installed.

USAF SCC

Power, computer	111.2 Kw	136.5 KVA
Power, air conditioner		2 Kw ea
Volume, computer		1,624.8 cu ft
Volume, air conditioner		216 cu ft ea
Area, computer		645 sq ft
Area, air conditioner		36 sq ft ea
Room size		50 ft x 40 ft
Capacity, air conditioner		2 - 10 Ton Units
Weight, computer		30,192 lbs

Installation of false floor of 1 1/8 inch plywood covered with vinyl.

USAF WRAMA

Power, computer	94.15 Kw	129.65 KVA
Power, air con	74.6 Kw	100.0 KVA
Volume, computer		8,184 cu ft
Volume, compressor		588 cu ft
Volume, air handling unit		756 cu ft
Area, computer		1,364 sq ft
Area, compressor		84 sq ft
Area, air handling unit		84 sq ft
Room size, computer		2,110 sq ft
Room size, compressor		247 sq ft
Room size, air handling unit		210 sq ft
Floor loading		190 lbs/sq ft
Capacity, air conditioner		29 Tons

Photo by Sacramento Air Materiel Area McClellan AFB

Weight, computer	36,278 lbs
Weight, compressor	5,110 lbs
Weight, air handling unit	3,560 lbs
Weight, air condi total	8,670 lbs

Site preparation required the modification and installation of temperature and humidity control for an existing building. The relocation of electrical accounting machine equipment, key punch equipment and supporting personnel was required to provide 2,423 square feet of floor space area for the Univac File Computer System and an equipment maintenance area.

Approximately 29 tons of air conditioning were installed for the File Computer Area. The high speed printer which is cooled by a closed-loop chilled water system required 28 gallons of water per minute at 50°F.

The only false flooring required for the installation of the File Computer System was approximately 360 square feet in the high speed printer area.

The power factor for the computer is between unity and 0.95 inductive. The power factor for the air conditioner, including air handling unit and compressor, are 0.85 to 0.90 fully loaded.

Douglas 1

Power, computer	71 Kw	88.5 KVA
Area, computer		1,400 sq ft
Room size, computer		30 ft x 35 ft
Floor loading		150 lbs/sq ft
		2,200 lbs concen max
Capacity, air conditioner		20 Tons
Weight, computer		22,920 lbs

Six inch raised false floor to provide for power cables. Exhaust diffusers installed in ceiling for heat dissipation/air conditioning.

Douglas 2

Power, computer	57 Kw	75.5 KVA
Area, computer		1,400 sq ft
Area, air conditioner		100 sq ft
Room size, computer		30 ft x 35 ft
Floor loading		150 lbs/sq ft
		2,200 lbs concen max
Capacity, air conditioner		20 Tons
Weight, computer		18,740 lbs

Six inch raised floor to provide for power cables. Exhaust diffusers installed in ceiling for heat dissipation/air conditioning.

Douglas 3

Power, computer	53 Kw	69.5 KVA
Area, computer		1,000 sq ft
Room size, computer		30 ft x 34 ft
Floor loading		150 lbs/sq ft
		2,200 lbs concen max
Capacity, air conditioner		50 Tons
Weight, computer		23,920 lbs

Six inch raised false floor to provide for power cables. Exhaust diffusers installed in ceiling for heat dissipation/air conditioning.

Douglas 4

Power, computer	72.5 Kw	89 KVA
Area, computer		1,400 sq ft
Area, air conditioner		100 sq ft
Room size, computer		30 ft x 35 ft
Floor loading		150 lbs/sq ft
		2,200 lbs concen max
Capacity, air conditioner		20 Tons
Weight, computer		28,920 lbs

Six inch raised floor to provide for power cables. Exhaust diffusers installed in ceiling for heat dissipation/air conditioning.

Douglas 5

Power, computer	75.5 Kw	92 KVA
Area, computer		1,400 sq ft
Area, air conditioner		100 sq ft
Room size, computer		30 ft x 35 ft
Floor loading		150 lbs/sq ft
		2,200 lbs concen max
Capacity, air conditioner		20 Tons
Weight, computer		31,480 lbs

Six inch raised false floor to provide for power cables. Exhaust diffusers installed in ceiling for heat dissipation/air conditioning.

Douglas 6

Power, computer	51.5 Kw	68 KVA
Area, computer		1,000 sq ft
Area, air conditioner		100 sq ft
Room size, computer		30 ft x 33 ft
Floor loading		150 lbs/sq ft
		2,200 lbs concen max
Capacity, air conditioner		20 Tons
Weight, computer		22,400 lbs

Six inch raised false floor to provide for power cables. Exhaust diffusers installed in ceiling for heat dissipation/air conditioning.

1st National City Bank

Power, computer		88 KVA
Volume, computer		14,400 cu ft
Volume, air conditioner		6,400 cu ft
Area, computer		1,800 sq ft
Area, air conditioner		800 sq ft
Room size, computer		30 ft x 60 ft
Room size, air condi	2 rooms	20 ft x 20 ft
Floor loading		70 lbs/sq ft
Capacity, air conditioner		60 Tons
Weight, computer		30,400 lbs (including peripheral equipment)
Weight, air conditioner		6,000 lbs

Install - roof water tower for air conditioner, air condition room with plenum and ducts to computer room, computer room prepared with wall for prevention of humidity seepage, raceways and floor ducts prepare for electric lines, direct electric line from street, and voltage regulators.

Western Electric

Power, computer	64.8 Kw	76.25 KVA 0.85 overall
Power, air condi	18.0 Kw	22.5 KVA 0.80
Volume, computer		29,400 cu ft
Volume, equip room		7,500 cu ft
Area, computer		2,450 sq ft
Area, equip room		625 sq ft
Room size, computer		60 ft x 41 ft x 12 ft
Room size, equip room		25 ft x 25 ft x 12 ft
Floor loading		10 lbs/sq ft
		150 lbs concen max
Capacity, air conditioner		15 Tons (Room only)
Weight, computer		27,000 lbs
Weight, air conditioner		10,000 lbs

Computer installation made in existing building on second floor. Each computer cabinet is air conditioned from a duct beneath the floor. Cabinets are not hooded. Cabinets exhaust into computer room. Return air for under floor system is picked up in room through grilles in ceiling and over cabinets. Separate air conditioning system maintains room air conditions.

PRODUCTION RECORD

Manufacturer

Number produced to date	164
Number in current operation	110
Number in current production	27
Number on order	14
Time required for delivery	6 months

COST, PRICE AND RENTAL RATES

Manufacturer

Quan	Unit	Cost	Monthly Rental
1	Model 1 Computer	$176,000	$4,190

Includes:
- Arithmetic Unit
- Program Control Unit No. 1
- Program Control Unit No. 2
- Multiplex Control for 10 input/output Devices
- High Speed Core Buffer-120 characters
- Plugboard Control-48 Program Steps
- High Speed Storage Drum
  - Dual input/output tracks for each input/output unit
  - 87 Additional High Speed Tracks
  - Field select in tracks for 20 sub track addresses

1	General Storage Unit Includes 1 Drum and Control Circuitry High Speed Core Buffer-120 characters	$59,000	1,400
1	High Speed Printer On line and air cooled	152,600	2,725
4	Magnetic Tape Units, 34,000 each	136,000	3,000 750 ea
1	Inquiry Typewriter	15,000	350
1	Console Control Panel	6,300	150
1	Sort Collate Device Not including Tape Handling Units	34,000	750
	Additional Equipment		
	Additional General Storage Unit w/1 drum	$21,000	$500
	Additional General Storage Unit w/2 drums	38,000	900
	90 Column Card Sensing Punching Unit	55,000	1,300
	80 Column Card Sensing Punching Unit	55,000	1,300
	Paper Tape Reading or Punching Unit	61,000	1,450
	High Speed Printer On Line or Off Line-Air Cooled	218,400	3,900

Service contract available.

USA CC

Main frame, 6 tape units, 80 column read, punch unit, hi-speed printer-gen storage dr., console, and inquiry typewriter rents for $15,190 per month.

USA MTMA

		Yearly Rental
1	Main Frame consisting of 2 program control units & arithmetic unit at $4,190.	$50,280
1	General Storage Unit at $1,400	16,800
1	Card sensing & punching unit at $1,300	15,600
7	Magnetic tape units at $750	63,000
1	Typewriter inquiry at $350	4,200
1	Console at $150	1,000
1	Sort collate unit at $750	9,000
1	High speed printer & control unit at $3,300	39,600
	Headquarters Computer Total	$200,280

USMC SC Albany

Program control unit no. 1, program control unit no. 2, and arithmetic unit - total approximate cost = $176,000.

General storage control w/2 drums, 80 col. card unit w/adapter, sort/collate control, console and inquiry typewriter, twelve magnetic tape units, and high speed printer - total approx. cost = $783,300.

Program control unit no. 1, program control unit no. 2, and arithmetic unit - rental rate = $4,190 per month (176 prime hours)

General storage control w/2 drums, 80 col. card unit w/adapter, sort/collate control, console & inquiry typewriter, twelve magnetic tape units, and high speed printer - rental rate = $16,750 per month (176 prime hours)

All EDP equipment shown above is rented. Maintenance/service cost included in rental.

USMC SC Barstow

Type 1 Univac File Computer System

Contract No. GS-00S-23295

Period July 1, 1959 thru June 30, 1960

Description	Mach. No.	Monthly Rate
Prog. Control Unit No. 1	901	$4,190
Arithmetic Unit		
Prog. Control Unit No. 2		
General Storage Unit	950	1,400
EXT. Storage Unit 1 Drum	960	500
Console Control Panel	901	150
Sense & Punch Unit	910	1,300
Sense & Punch Control Unit		
Magnetic Tape Unit No. 85	931	750
Magnetic Tape Unit No. 57	932	750
Magnetic Tape Unit No. 98	933	750
Magnetic Tape Unit No. 53	934	750
Magnetic Tape Unit No. 91	935	750
Magnetic Tape Unit No. 58	936	750
Magnetic Tape Unit No. 54	937	750
Magnetic Tape Unit No. 59	938	750
Typewriter Unit	901	350
Typewriter Inquiry Desk	901	350
Sort Collate Unit	970	750
H.S. Printer Head	920	3,300
H.S. Memory Unit		
H.S. Power Supply		
H.S. Mod. UN. Servo		
Total		$17,940

Maintenance included in rental contract.

USAF Bolling

	Cost	Monthly Rental
Central Processor	$176,000	$4,190
General Stor Control	59,000	1,400
General Stor Drum (3)	59,000	1,400
Read Punch Unit	55,000	1,300
Tape Units (9)	306,000	6,750
Sort-Collate	34,000	750
Inquiry Typewriter	15,000	350
Console	6,300	150
Printer	185,000	3,300

Maintenance/service contract - extra shift - $12 per hour per man.

USAF McClellan

6 Tape units, 1-inquiry typewriter, 1-console, 2-control cabinets, 1-arithmetic unit, 3-magnetic drums, 2-bull units, 2-80 col. card adapters, and 1-general storage rents for $14,090 per month.

2-high speed printers, 1-card-to tape converter, 1-tape to-card converter rents for $11,620 per month.

USAF SCC

Basic System		Monthly Rental
UFC-1		$4,190
2-S/C Units		1,500
12 MTU	($750 ea)	9,000
High speed printer		3,300
Additional Equipment		
General Storage Control		900
High Speed Drum		500
Console		150
Typewriter		350

USAF WRAMA

Rental contracting and rates for basic system
Univac File Computer Model 1
Includes:

Arithmetic Unit	$4,190
Program Control Unit No. 1	
Program Control Unit No. 2	
General Storage Control Unit with one drum	1,400
General Storage Extension Cabinet with one drum	500
(3) General Storage Extension Cabinets with six drums	2,700
80 Column Card Input-Output with Control Unit	1,300
(8) Magnetic Tape Units	6,000
Inquiry Typewriter	350
Console Control Panel	150
Total	$16,590

Rental rates for additional equipment

Sort-Collate Unit	$750
(4) Magnetic Tape Units	3,000
High Speed Printer	3,300
Total	$7,050
	$16,590
	7,050
	$23,640

Douglas 1

Main frame, 4-read-punches, typewriter console, sort collate and five magnetic tape units $10,000/month.
Maintenance/service contracting included in rental

Douglas 2

Main frame, 2 read-punches, 1 large capacity drum, 1 sort-collate, and 5 magnetic tape units $11,000 per month.
Maintenance/service contract included in rental.

Douglas 3

Main frame, 4 read-punches, typewriter console, and 7 extension drums $9,200/month.

Douglas 4

Main frame, 2 read-punches, typewriter console, sort-collate, 5 magnetic tape units, and 6 large capacity drums $12,000/month.
Maintenance/service contract included in rental.

Douglas 5

Main frame, 2 read-punches, typewriter console, sort-collate, 6 magnetic tape units, and 8 large capacity drums $13,000/month.
Maintenance/service contract included in rental.

Douglas 6

Main frame, 4 read-punches, typewriter console, 6 extension drums $9,300/month.
Maintenance/service included in rental.

1st National City Bank

Program Control Unit No. 1 and No. 2 plus arithmetic unit $4,190 per monnel.

General storage control plus 4 drums	$2,300
7 tape units	4,350
2 80 column read/punch units	2,350
1 Sort collate control	600
Printer	2,000
Typewriter console	250

Maintenance/service contract included in rental fee.

Western Electric

	Monthly Rental
1 Model I Basic Computer, includes: Arithmetic Unit, Type 6901; Program Control Unit No. 1, Type 6900; Program Control Unit No. 2, Type 6903; Multiplex Control for 10 input/output stations; Code Distributor; Channel Search, equal or unequal commands; High speed core buffer, 120 characters; Track accessibility, track & buffer on track, word and field addressible.; Internally stored programming; Plugboard control, 48 program steps; High speed storage drum; Dual input/output tracks for each input/output unit; 87 additional high speed storage tracks; Field selection tracks for 20 sub track addresses	$4,190

Additional equipment

1 Model I General Storage Unit - Type 6902, includes: One drum and control circuitry; Storage capacity 300 tracks, 600 characters each variable unit record length permits each track to be sub-divided into unit records of 12 characters each. Each unit record is divisible into 120 fields.; High speed core buffer, 120 characters	$1,400
3 Additional Model I Storage Drums, includes: Extension cabinet with 1 drum, Type 6912 ($500); Extension cabinet with 2 drums, Type 6922 ($900)	1,400
1 90 Column Sensing Punching Unit, full post read, Type 4931	1,300
6 Magnetic Tape Units, Type 4950 w/control unit, Type 4850 at $750 each.	4,500
1 Sort Collate Unit, Type 4955	750
1 Inquiry Typewriter, Type 4962	350
1 Console Control Panel, Type 4963	150
1 Univac High Speed Printer, Off-line only, includes: Printer Unit, Type 4996; Control Unit, Type 4896; Magnetic Tape Unit, Type 4951; Manual Paper Tape Loop Punch No. 800376	3,300
Total	$13,150

PERSONNEL REQUIREMENTS

Manufacturer

	One 8-Hour Shift
Supervisors	1
Analysts	1
Programmers	3
Coders	2
Clerks	1
Librarians	1
Operators	2
Engineers	1
Technicians	3

Training made available by the manufacturer to the user includes programming schools and sales support personnel.

USA CC

	One 8-Hour Shift	
	Used	Recommended
Supervisors	5	6
Analysts, Programmers & Coders	15	
Clerks	2	
Operators	2	
In-Output Oper	1	

Number of analysts, programmers and coders is sufficient for the three applications being developed.

Methods of training used includes Remington Rand instructors, ORD Management Engineering Training Agency, and on-the-job.

USA MTMA

	One 8-Hour Shift		Two 8-Hour Shifts		Three 8-Hour Shifts	
	U	R	U	R	U	R
Supervisors	2	2	1	2	1	2
Analysts	2	4				
Programmers	4	4				
Coders		4				
Clerks		1				
Librarians	1	1		1		1
Operators	2	2	2	2	2	2
Engineers		2				
Technicians		2				
In-Output Oper		2				
Tape Handlers		2				

Operation tends toward open shop.

Methods of training used include manufacturer's programming training courses and on-the-job training for operators.

USMC SC Albany

Supervisors	1	1	1	2	1	3
Analysts	1	2	1	2	1	2
Programmers	6	6	6	6	6	6
Librarians	1	1	1	2	1	3
Operators	4	4	8	8	8	12
Engineers	2	2	4	4	6	6

In order to properly evaluate the personnel requirements reflected above, certain operating characteristics of this EDP installation must be considered.

Our computer programs are relatively stable. We process utilizing two major computer programs and our working shifts are varied. In most cases to satisfy the fluctuation in processing volume.

The majority of our present day programming effort concerns the implementation of changes and refinement of the two major programs. Acceptance and programming of new computer applications are limited because of lack of available machine time.

No civilian personnel are presently employed in our EDP operation. Military tables of organization do not facilitiate inclusion of multiple billets for additional operating shifts even though required and/or desired.

Utilize equipment manufacturer's schools and extensive period of on-the-site training under direct supervision of skilled personnel.

USMC SC Barstow

Supervisors	1	1	2	2	3	3
A, P and C	9 (For all three jobs on all shifts)					
Librarians	1	1				
Operators	2	2	4	4	6	6
Eng & Tech	2	2	4	4	6	6
In-Out & Tape	3	3	6	6	9	9

3 - 8 hour shifts not used every day, dependent upon workload. Military training duties require alternates.

Methods of training used includes contractor conducted classes and on-the-job training.

USAF Bolling

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	9	9
Analysts	1	3
Programmers	27	25
Clerks	30	30
Librarians	1	3
Operators	7	9
In-Output Oper	45	57

Operation tends toward open shop.

Methods of training used includes Manufacturer's Programming Courses and on-the-job training.

USAF McClellan

	Three 8-Hour Shifts	
	Used	Recommended
Supervisors	4	4
Librarians	3	4
Operators	18	18

Same supervisors in charge of both UFC and 1105.

Same librarians support both UFC and 1105.

Analysts and programmers support the 650, 1105 and UFC systems.

Manufacturer training and on-the-job training is utilized.

USAF SCC

	One 8-Hour Shift	Two 8-Hour Shifts
Supervisors	8	9
Analysts	4	4
Programmers-Coders	18	18
Clerks	1	1
Operators-Librarians	5	5
Engineers-Technicians	2	2
Input Oper	1	

Third shift is used for maintenance. Programmers are also required to do EAM project planning, and all coding. Analysts also do programming if required.

Operation tends toward closed shop.

Methods of training used includes Sperry-Rand instructors for operators and programmers and on-the-job training by experienced operators.

USAF WRAMA

Formal classroom training is conducted by the manufacturer for both operating and programming personnel. On-the-job training is conducted by senior operators, programmers, and supervisory personnel.

Douglas 1

	One 8-Hour Shift
Supervisors	2
Analysts	1
Programmers	3
Operators	3

Operation tends toward closed shop.

Methods of training used includes two weeks course followed by on-the-job training.

Douglas 2

Supervisors	3
Analysts	2
Programmers	5
Operators	4

Operation tends toward closed shop.

Methods of training used includes two week course followed by on-the-job training.

Douglas 3

Supervisors	2
Analysts	2
Programmers	1
Operators	3

Operation tends toward closed shop.

Methods of training used includes two weeks course followed by on-the-job training.

Douglas 4

Supervisors	2
Analysts	1
Programmers	2
Operators	3

Operation tends toward closed shop.

Methods of training used includes two weeks course followed by on-the-job training.

Douglas 5

	One 8-Hour Shift
Supervisors	2
Analysts	1
Programmers	2
Operators	3

Operation tends toward closed shop.

Methods of training used includes two weeks course followed by on-the-job training.

Douglas 6

Supervisors	1
Analysts	3
Programmers	2
Operators	3

Operation tends toward closed shop.

Methods of training used includes two week course followed by on-the-job training.

1st National City Bank

Supervisors	1
Analysts	5
Programmers	2
Clerks	2
Operators	6
Technicians	3

Analysts are Research & Development staff who program additional applications and assist in revision of present programs.

Operators handle all phases of operation including tape handling, etc.

Operation tends toward open shop.

Methods of training used includes Remington Rand Programming School, and on-the-job training.

Western Electric

Supervisors	5
Analysts	6
Programmers	4
Librarians	1
Operators	2
Technicians	1

Operation tends toward open shop.

Methods of training used includes instruction classes conducted by computer manufacturer, reviewing existing operations, and assisting with simple development studies.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

Numerous built-in checking features.

USA CC

Good time 494.7 Hours/Week (Average)
Attempted to run time 511.1 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.967
Above figures based on period 2 May 60 to 15 Jun 60
Passed Customer Acceptance Test 21 Apr
Time is not available for rent to outside organizations.

USA MTMA

Average error-free running period 4 Hours
Good time 50 Hours/Week (Average)
Attempted to run time 60 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.83
Above figures based on period 1 Mar 59 to 31 May 60
Passed Customer Acceptance Test 1 Mar 59
Time is not available for rent to outside organizations.

USMC SC Albany

Average error-free running period 87.4 Hours Week
Good time 90 Hours/Week (Average)
Attempted to run time 96 Hours/Week (Average)
Operating ratio (Good/Attempted to run time 0.938
Above figures based on period from Oct 59 to Apr 60
Passed Customer Acceptance Test Oct 58
Time is not available for rent to outside organizations.

Above computations are based on an average processing week consisting of 14 hour shifts on 4 days and 20 hour shifts on 2 days for a total of 96 processing hours per week. The "average error-free running time" represents the "good time" less the time lost as a result of program and/or operator error only while the "good time" is the "attempted to run time" less that time lost as a result of equipment failure only.

USMC SC Barstow

Average error-free running period 16.7 Hrs/day
Good time 90.6 Hours/Week (Average)
Attempted to run time 92.3 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.98
Above figures based on period 28 Mar 60 to 5 Jun 60
Passed Customer Acceptance Test Dec 58
Time is not available for rent to outside organizations.

5.3 hrs lost time due to power failure, and 0.9 hrs lost time due to air conditioner failure out of 16.7 hrs lost.

USAF Bolling

Average error-free running period 3 Hours
Good time 94 Hours/Week (Average)
Attempted to run time 100 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.94
Above figures based on period from Feb 60 to Apr 60
Passed Customer Acceptance Test 6 Mar 59
Time is not available for rent to outside organizations.

USAF McClellan

Good time 116 Hours/Week (Average)
Attempted to run time 121 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.958
Above figures based on March and April 1960
Passed Customer Acceptance Test 19 May 59
Time is not available for rent to outside organizations.

Good time includes set up. Five hours is unscheduled maintenance.

USAF SCC

Good time 35/97/73 Hours/Week (Average)
Attempted to run time 40/112/83 Hours/Week (Average)
Operating ratio 0.875/0.865/0.88
Above figures based on period from Sep 59 to May 60
Time is not available for rent to outside organizations.

The main frame is operated only on an 8 hr. prime shift, 5 days a week. The Sort/Collate Units are operated on two 8 hr. shifts, 7 days a week, and the printer is operated about 1 1/2 8 hr. shifts (variable) 7 days a week; therefore, figures above are broken out in three groups: 1st group, Main frame; 2nd group, S/C Units; 3rd group, Printer.

USAF WRAMA

Average error-free running period 3.4 Hours
Good time 111.8 Hours/Week (Average)
Attempted to run time 115.0 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.97
Above figures based on period 1 Apr 60 to 30 Apr 60
Passed Customer Acceptance Test 18 Sep 59
Time is not available for rent to outside organizations.

Douglas 1
Average error-free running period 44 Hours
Good time 60 Hours/Week (Average)
Attempted to run time 60+ Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.967
Above figures based on period from Mar 59 to Jul 60
Passed Customer Acceptance Test Mar 59
Time is available for rent to outside organizations.

Douglas 2
Average error-free running period 40 Hours
Good time 60 Hours/Week (Average)
Attempted to run time 64 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.94
Above figures based on period from Oct 58 to Jul 60
Passed Customer Acceptance Test Oct 58
Time is available for rent to outside organizations.

Douglas 3
Average error-free running period 48 Hours
Good time 40 Hours/Week (Average)
Attempted to run time 41 Hours/Week (Average)
Operating ratio 0.97
Above figures based on period from Jul 59 to Jul 60
Passed Customer Acceptance Test Jul 59
Time is available for rent to outside organizations.

Douglas 4
Average error-free running period 35 Hours
Good time 80 Hours/Week (Average)
Attempted to run time 81 Hours/Week (Average)
Operating ratio 0.968
Above figures based on period from Apr 59 to Jul 60
Passed Customer Acceptance Test Apr 59
Time is available for rent to outside organizations.

Douglas 5
Average error-free running period 38 Hours
Good time 60 Hours/Week (Average)
Attempted to run time 62 Hours/Week (Average)
Operating ratio 0.973
Above figures based on period from Mar 60 to Jul 60
Passed Customer Acceptance Test Mar 60
Time is available for rent to outside organizations.

Douglas 6
Average error-free running period 48 Hours
Good time 60 Hours/Week (Average)
Attempted to run time 62 Hours/Week (Average)
Operating ratio 0.97
Above figures based on period from Jun 59 to Jul 60
Passed Customer Acceptance Test Aug 58
Time is available for rent to outside organizations.

1st National City Bank
Good time 39 Hours/Week (Average)
Attempted to run time 40 Hours/Week (Average)
Operating ratio 0.97
Above figures based on period from Jan 60 to Apr 60
Passed Customer Acceptance Test Feb 59
Time is not available for rent to outside organizations.

Western Electric
Average error-free running period 15 Hours
Good time 61 Hours/Week (Average)
Attempted to run time 62 3/4 Hours/Week (Average)
Operating ratio 0.97
Above figures based on period 28 Mar 60 to 26 Jun 60
Passed Customer Acceptance Test 1 Jul 59
Time is not available for rent to outside organizations.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Outstanding features are flexibility (random access storage) and various input-output devices are shared time operation.

Fireproof vault for storing tapes. Tape sorting and collating device available.

Randex mass memory available 6,000,000 char/drum unit.

USA CC

Buffering in all input/output units as well as main frame - time sharing capabilities of I/O equipment, i.e., drum or tape search; the main frame can be computing while these operations are being carried on.

USA MTMA

Sort/Collate System allows sorting, merging, sequence checking, duplicating and extracting off line, and the tape units used with this system may be used on line as needed.

USMC SC Albany

Outstanding features include flexibility of input/output equipment, time sharing features, internal and external programming, self checking features, automatic data translation, and three-address logic in single instruction.

Tape handling:

Color coded labels containing the process number, brief nomenclature, process date, reel numer of reel file, and internal label information consisting of day, month, year and reel number of reel file. Tape storage consists of a primary location adjacent to computer with same temperature and humidity control as computer room and an alternate storage location containing necessary duplicate record tapes. All tape reels are kept in individual plastic containers and stored in partitioned metal cabinets. Tapes are shipped in telescoping solid fiber containers.

USMC SC Barstow

Outstanding feature is flexibility of magnetic tape units and off-line sort collate capabilities.

Magnetic tape handling:

Tapes are labelled with color coded labels denoting specific program and day of processing.

Rotation system of grandfather, parent, offspring tape generation used for all files except program tapes. Tape storage divided into two separate buildings to prevent entire file destruction.

Tape storage and operating areas humidity and temperature controlled.

Tapes stored in tape racks enclosed in steel cabinets.

Tape shipments are made in special pressboard containers; all tapes have identifying numbers and receipt system is employed.

Computer and storage areas protected by high pressure automatic sprinkler system. CO_2 bottles located in computer room for small fires.

USAF Bolling

Outstanding features include large drum storage capacity for storing the more comprehensive programs and read-write-compute overlap.

Tapes are numbered and assigned to specific application in blocks of numbers i.e., Supply Master Record-Tape No. 30 - 44 provides 3 tapes per day for 5 days. Periodically backup tapes are removed to another physical location in anticipation of disaster. Tapes require periodic airing (pass thru a tape unit) to insure maximum performance.

USAF McClellan

The sort collate unit relieves the main frame for computing operations while sorting and merging operations are being performed.

Individual tape units can be off lined at will and used to perform sequence checking and searching operations without utilizing the main frame of the computer.

Tape is stored in concrete fire proof vault and a fire resistant room. Tape storage area has humidity and temperature control. The tape is identified in the first block of the tape, also a label is attached to the outside of the container and on the reel itself.

USAF SCC

Individual sort/collate system. Printer control panel. Flexibility to call up information on individual components.

Magnetic tape labelling:

Labelled by numbered tag attached to reel, protected from ablve by metal cabinets (not fire proof).

USAF WRAMA

Tape labelling:

Magnetic tape labelling is accomplished by writing a label on the tape consisting of a description of the file, the reel number, and the date. A label may vary from one word (maximum of 12 digits) to two words in length. In addition to the above each reel of tape is tagged with an AMC Form 55, EDPE Tape Identification, which consist of a six digit job number and a job description.

Tape storage:

Tape reels are placed in individual plastic containers and stored in a fire-proof tape vault which is humidity controlled. Tape movement into and out of the tape vault is controlled by a tape librarian.

Douglas 3

Outstanding feature is random access storage.

1st National City Bank

Outstanding features are the random access drums and the off line sort collate feature.

Computer labels tape, tape reel is numbered, use is recorded, stored in vault (RIR Tape Bins) and vault is fire protected and air and humidity conditioned.

Western Electric

Outstanding features are large capacity storage drums and sort collate system-sort, merge, collate, etc., magnetic tapes.

Tapes are controlled by tape librarian. Use 1" x 3" gummed labels for tape labelling and stored in plastic containers in tape cabinets in air conditioned room which is humidity controlled.

Tape room protected from fire by sprinkler system.

FUTURE PLANS

USMC SC Albany

To date a study has been conducted on the possible employment of a solid state computer, the Remington Rand USS 80 in conjunction with our present system. This new equipment would replace certain components of our Univac File Computer thereby facilitating an increase in our processing capabilities while maintaining relatively the same monthly rental expenditure. The proposal is under study at Headquarters Marine Corps.

A major re-programming effort will commence in the near future for the purpose of including new concepts developed by observation and study of our present programs, new and varied requirements of the computer serviced functions and incorporation of new programming techniques derived during the past 2 1/2 years of operation.

USMC SC Barstow

Proposal for installation of additional equipment to modify present system under study at Headquarters, U. S. Marine Corps.

USAF Bolling

Plan to augment the Univac File Computer with a Univac Solid State 80. This would provide increased processing capability to convert the following applications:

Unit Manning Document Application - A system to account for manpower space allocations for all organizations of Headquarters Command.

Unit Allowance List Applications - A system for maintaining in use and authorized unit supply records for all equipment issued to support base organizations' missions.

Comprehensive Civilian Pay and Leave Accounting Application - This is a comprehensive system which produces payroll register, checks, bonds, expense distribution reports, payroll reconciliations, W-2 statements and appropriation data.

USAF McClellan

It is planned (machine time permitting) to put a Base Support Control Distribution application on the Univac File Computer.

USAF SCC

Plan to release the UFC-1 and install an IBM 705 and two 1401 systems. Also plan to release an IBM 101 and replace it with a 108.

1st National City Bank

Planned applications include accounting (Head Office and Branch General Ledger Accounting) and inventory (stationery).

Western Electric

Currently making feasibility studies of Remington Rand Univac III and similar equipment manufactured by IBM, RCA and Minneapolis-Honeywell.

Future applications include production control in several operating shops, cost bulletin revision in one selected shop, monthly payroll, machine capacity hours, and ordering, scheduling and manufacture of toll cable.

INSTALLATIONS

U. S. Army Chemical Center
Army Chemical Center, Maryland

U. S. Army Military Traffic Management Agency
Washington 25, D. C.

U. S. Marine Corps Supply Center
Albany, Georgia

U. S. Marine Corps Supply Center
Barstow, California

U. S. A. F. Headquarters Command
Director of Statistical Services, DCS/Comptroller
Bolling Air Force Base, Washington 25, D. C.

Sacramento Air Materiel Area
Data Systems Division, Comptroller
McClellan Air Force Base, California

U. S. Air Force Special Communications Center
Kelly Air Force Base
San Antonio, Texas

Warner Robins Air Materiel Area
Data Systems Division, Comptroller
Robins Air Force Base, Georgia

Douglas Aircraft Company, Department G-318 (3)
3000 Ocean Park Blvd.
Santa Monica, California

Douglas Aircraft Company, Department B-107 (1)
El Segundo, California

Douglas Aircraft Company, Department C-107 (2)
Long Beach, California

First National City Bank of New York
55 Wall Street
New York 15, N. Y.

Western Electric Company, Incorporated
Business Methods Development Department, 33
2500 Broening Highway
Baltimore 24, Maryland

UNIVAC LARC

Universal Automatic Computer Model LARC

MANUFACTURER

Sperry Rand Corporation
Remington Rand Univac Division

Photo by Remington Rand Univac Division of Sperry Rand Corporation

APPLICATIONS

Manufacturer

Univac LARC is designed for large-scale business data processing as well as scientific computing. This includes any problems requiring large amounts of input/output and extremely fast computing, such as data retrieval, linear programming, language translation, atomic codes, equipment design, large-scale customer accounting and billing, etc.

University of California
Lawrence Radiation Laboratory

Located at Livermore, California, system is used for the solution of differential equations.

PROGRAMMING AND NUMERICAL SYSTEM

Manufacturer

Internal number system	Binary coded decimal
Decimal digits/word	12
Decimal digits/instruction	12
Instructions/word	1
Instructions decoded	1
Arithmetic system	Fixed and floating point

Built-in double precision arithmetic both modes.

Instruction type	One address
Number range	$10^{-50} < N < 10^{50}$ 20 significant digits

Instruction word format

Computer	Processor
T,OP,AA,BB,MMMMM	OP,NNNNN,MMMMM

OP = Op Code
T = Tracing Digit
AA = Fast Register
BB = B-Box
M = Operand Address
N = Operand Address

SAL Assembly System is available, an algebraic compiler, all I/O Routines, and a sort-merge generator.

The LARC can have up to 99 fast accumulating registers which are also used as "B"-Boxes. In addition, the Univac LARC has a built-in multi-level indirect addressing system.

ARITHMETIC UNIT

Manufacturer

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	4	4
Mult	8	8
Div	28	28

Effective access time is zero, therefore, excluding and including access times are equal.

Arithmetic mode	Parallel
Timing	Synchronous
Operation	Sequential and concurrent

STORAGE

Manufacturer

Media	No. of Words	No. of Digits	Access Microsec
Ferrite Core	97,500	1,170,000	4
Magnetic Drums (24)	6,000,000	72,000,000	68,000
Ferrite Cores	100	1,200	1

Magnetic Tape

No. of units that can be connected	40 Units
No. of chars/linear inch of tape	250 Chars/inch
Channels or tracks on the tape	8 Tracks/tape
Blank tape separating each record	1.2 or 2.4 Inches
Tape speed	100 Inches/sec
Transfer rate	25,000 Chars/sec
Start time	3.5 Millisec
Stop time	3.5 Millisec
Average time for experienced operator to change reel of tape	10-15 Seconds
Physical properties of tape Width	0.5 Inches

Photo by Lawrence Radiation Laboratory, University of California

Length of reel	2,400 Feet
Composition	Mylar or metallic

UCRL

Media	Words	No. of Dec/Digits	Access Microsec
Core	30,000	12	4
Drum	3,000,000	12	30/word
Magnetic Tape		12	20 KC

Core memory expandable to 97,500 words
Drum memory expandable to 6×10^6 words

INPUT

Manufacturer

Media	Speed
Uniservo II	100 in/sec
Uniservo III	100 in/sec

Adequate circuits are available to handle any other desired input/output devices.

UCRL

Magnetic Tape	20 Kc/sec
6 Tape Units expansible to 40	
3 Tape units expansible to 4	
Punch Paper Tape	10 char/sec
Numeric input only	

OUTPUT

Manufacturer

Media	Speed
Uniservo II	100 in/sec
Uniservo III	100 in/sec
High Speed Printer	600 lines/min
Charactron Film Recorder	15,000 char/sec

Adequate circuits are available to handle any other desired input/output devices.

UCRL

Magnetic Tape (Uniservo II)	20 Kc
Charactron 35 mm Film	15 Kc
15 Kc alphanumeric output	
2 Kc plotting mode	
On Line Printer	600 lines/min
120 character output	
Console Printer	10 char/sec
Alphanumeric output	

CHECKING FEATURES

Manufacturer

Automatic checking of all data transfers and all arithmetic operations.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer

Power, computer	350	KVA
Volume, computer	500	cu ft
Approximate - for computer unit only		
Area, computer	65	sq ft
For compiler unit only		
Room size	3,000	sq ft for system
Capacity, air conditioner	70	Tons
False flooring required for cold water piping.		

UCRL

Power, computer 167 Kw	334	KVA 0.5 pf
Power, air conditioner	60	HP Compressor motor
	15	HP Pump motor
Volume, computer	33,480	cu ft
Volume, motor generators	3,884	cu ft
Volume, air conditioner	2,700	cu ft
Area, computer	3,720	sq ft
Area, motor generators	324	sq ft
Area, air conditioner	225	sq ft
Room size, computer	32	ft x 85 ft
Room size, drum room	24	ft x 42 ft
Room size, air conditioner	15	ft x 15 ft
Floor loading	400	lbs/sq ft
Capacity, air conditioner	60	tons, each
	120	tons, total
Weight, computer	115,000	lbs
Weight, motor generators	18,000	lbs, total
Two MG sets. One is a spare.		
Weight, air conditioner	2,000	lbs, total
Two 60 ton units. One is a spare.		

Plenum ceiling for room air conditioning ducting. Concrete block building construction. The building has its own 12 KV to 440/208/120 volt substation. Substation has a transfer switch to pick up a spare transmission line. Also it has an oil disconnect switch, 750 KVA step down transformer - and a set of distribution breakers.

PRODUCTION RECORD

Manufacturer

Number produced to date	1
Number in current operation	1
Number in current production	1

COST, PRICE AND RENTAL RATES

Manufacturer

A typical basic system cost $6,000,000 or rents at $135,000/month. A basic system consists of:

1	Operator Control Console
2	Alphanumeric Console Printers
1	Engineer Control Console
2	Drum-Read Synchronizers
2	Tape Read-Write Synchronizers
1	Drum-Write Synchronizer
1	High-Speed Printer Synchronizer
1	Console Printer Synchronizer
1	Tape Position Checker Synchronizer
2	Numeric Keyboards
1	Computer
1	Processor
26	Multipurpose Fast Registers
8	Magnetic Core Storage Units (2,500 words each)
12	Magnetic Drum Storage units (250,000 words each)
4	Uniservo II Magnetic Tape Units
1	High-Speed Printer (on-line)

Maintenance cost is included in monthly rental.

PERSONNEL REQUIREMENTS

UCRL

	Three 8-Hour Shifts
Supervisors	2
Programmers	25
Engineers	18
In-Output Oper	4

Operation tends toward open shop.

Programmers are trained by being given a short general programming course on the job training with experienced senior programmer. Maintenance engineers are given six months to one year training at Remington Rand, in Philadelphia, with LARC System during construction. A minimum of 18 Maintenance Engineers is necessary for 24 hour operation (7 day). This total includes engineers to maintain associated electronic equipment being used or designed.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

UCRL

Initial Test April 1960

Time is available for rent to qualified outside organizations.

Machine presently being installed at LRL, Livermore, California.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Outstanding features are ultra high computing speeds and the input-output control completely independent of computing. Due to the Univac LARC's unusual design features, it is possible to adapt any source of input/output to the Univac LARC. It combines the advantages of Solid State components, modular construction, overlapping operations, automatic error correction and a very fast and a very large memory system.

UCRL

Outstanding features include a two computer system (arithmetic, input-output processor); decimal fixed or floating point with provisions for double precision for double precision arithmetic; single bit error detection of information in transmission and arithmetic operation; and balanced ratio of high speed auxiliary storage with core storage.

Unique system advantages include a two computer system, which allows versatility and flexibility for handling input-output equipment, and program interrupt on programmer contingency and machine error, which allows greater ease in programming.

Tape will be housed in metal cabinets in an air conditioned room with proper humidity control.

Magnetic Core Storage

The core storage is divided into modular units each of which has a capacity of 2,500 words of 12 decimal digits. Four storage units are contained in a cabinet. The storage units may be added to a system in units of four up to a maximum of 39 units (10 cabinets); the equivalent of 97,500 words. Each cabinet has its own power supply, clock-pulse generator, and heat exchangers. Because of a logical limitation on the number of storage addresses available for assignment, one cabinet in a completely expanded storage system of ten cabinets would contain only three 2,500-word units.

Each storage unit contains the switching, timing, and amplifying circuits that are required for independent operation. The division of the storage into independent units permits simultaneous reference to storage: by the Computer, for obtaining instructions and for transferring operands; and by the Processor, for transfers involved in carrying out its program and for transferring data to or from the auxiliary storage or input-output. It also permits off-line maintenance to be performed on a single unit while the others are operating.

INSTALLATIONS

University of California
Lawrence Radiation Laboratory
Box 808
Livermore, California

UNIVAC SOLID STATE 80/90

MANUFACTURER

Univac Solid State 80/90

Remington Rand Univac
Division of Sperry Rand Corporation

APPLICATIONS

Manufacturer

System is designed as a general purpose data processing system for use in general accounting, inventory, billing, budget control, sales analysis, statistics, railroad accounting, and revenue accounting, as well as scientific computing. The Univac Solid-State Computer is a medium-priced data processing system for business use. The term "Solid-State" refers to the use of Ferractor amplifiers and transistors. The Solid-State consists of a central processor, a read-punch unit, a high-speed card reader and a high-speed printer. Automatic coding techniques simplify programming. The Solid-State system may be ordered with magnetic tape units for either the 90-column system or the 80-column system.

U. S. A. Chemical Corps Biological Laboratories

Located at Fort Detrick, Maryland, USS 90 system is used for mathematical and statistical applications in matrix solution, linear regression, probit regression, analysis of variance, differential equations, numerical integration, function evaluation, etc. It is also used for comptroller functions, e.g. civilian payroll and leave, labor and material distribution, expenditure order statements, and overhead distribution.

Armed Services Technical Information Agency

Located at Arlington Hall Station, Arlington 12, Virginia, the USS 90 System is used in conjunction with the control of research and development documentation. Applications involved pertain to, request validation; inventory control and statistics; production control; document accountability; cumulative indexing of the ASTIA Technical Abstract Bulletin; and preparation of miscellaneous publications.

Photo by Remington Rand Univac

Champlin Oil and Refining Company

Located at Enid, Oklahoma, USS 80 System is used for accounting and data processing, e.g. detail ledger, payroll, gas measurement, sales analysis, and statistical reports. It is also used in technical applications, e.g. refinery materials balances, inventories, cost allocations, mass spectrometer analysis, etc.

Cook Technological Center, Division of Cook Electric Company

Located at 6401 W. Oakton St., Morton Grove, Illinois, the USS 90 is used for inventory control, job costing, payroll, trajectory studies, statistical analyses, operational systems studies, optical ray traces, radiation analysis, and probability theoretical analysis.

Douglas Aircraft Company

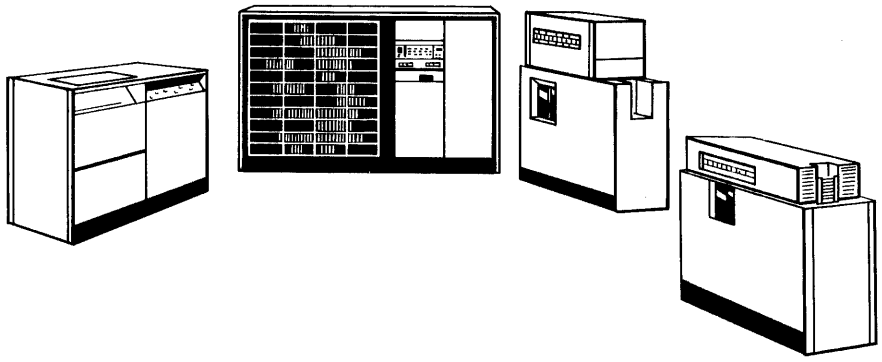
Located at Charlotte, North Carolina, the system is used for general accounting, labor distribution, cost and expense ledgers, material, and payroll.

Mason & Hanger-Silas Mason Co., Inc.

Located at Burlington, Iowa, USS 90 is used for payroll and all related reports, labor cost distribution, material cost distribution, inventory control and purchase requisitions, production reporting for A.E.C. activities, personnel reporting, document control, and production inventories.

Shell Development Company

Located at 3747 Bellaire Blvd., Houston, Texas, USS 80 is used for scientific calculations in reservoir engineering and mechanical engineering.



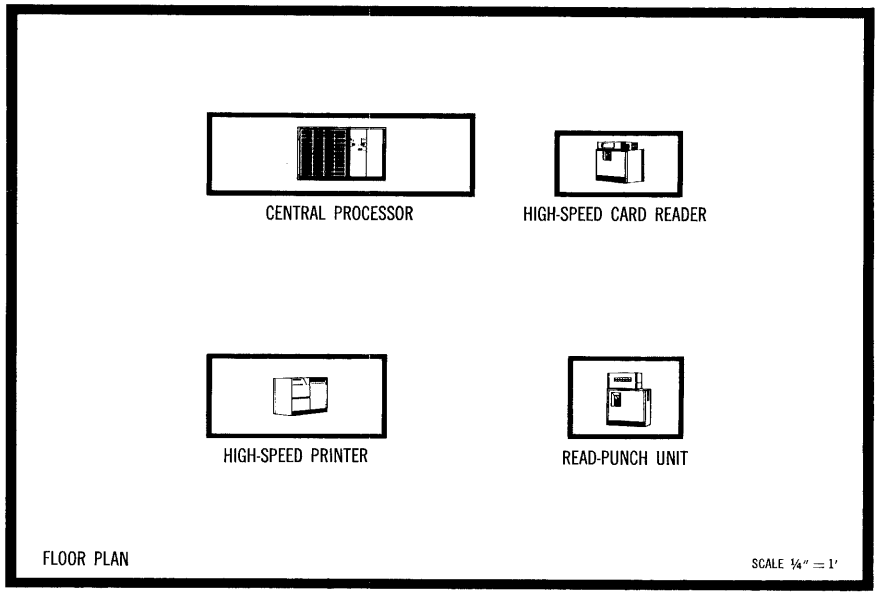


Photo by Remington Rand Univac

PROGRAMMING AND NUMERICAL SYSTEM

Manufacturer

Internal number system	Biquinary coded decimal
Decimal digits/word	10 plus sign
Decimal digits/instruction	10 (sign not used)
Instructions/word	1
Instructions decoded	53
Arithmetic system	Fixed point
Instruction type	One and a half address

One address is the operand - the half address refers to the address of next instruction to be executed. Next instruction is the (c) portion of the instruction.

Number range -9999999999 to +9999999999

Instruction word format

Instruction Code	(m) Address	(c) Address

(m) Address is address of operand
(c) Address is the address of the next instruction to be executed

A sizable number of precoded routines are supplied to Solid Stated Computer users. Approximate 58 routines available for 80 column tape system, and 62 available for 90 column tape system.

Automatic coding includes an X-6 assembly available for card and tape system.

Registers and B-boxes

3 - 10 digit arithmetic registers are included in the design.

3 - index registers (4 digits each) are optionally available.

ARITHMETIC UNIT

Manufacturer

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	1,360	85
Mult	1,275	
Div	1,275	

Multiply time calculation - 5 word time plus no. of multiplier digits plus sum of these digits (min. 119 microseconds, max. 1,785 microseconds).

Central Processor and High-Speed Reader

Photo by Mason & Hanger-Silas Mason & Co., Inc.

Divide time - 5 word time plus 2 times number of digits in quotient plus the sum of the odd digit positions in the quotient plus the sum of the tens complement of the even digit-positions in the quotient. 425 microseconds min., 1955 microsec. max.

Average access time is used in above table. Operands and results are assumed stored in high speed access portion of the drum. Word time is 17 microseconds.

Construction (Arithmetic unit only)		
Vacuum tubes		20
Transistors		700
Condenser-Diodes		23,000
Magnetic Amplifiers (Ferractors)		3,000
Arithmetic mode	Serial by digit	
	Parallel by bit	
Timing	Synchronous	
Operation	Concurrent	

The "Including Storage Access" add, multiply, and divide times include the time necessary for accessing the two operands and the result address.

STORAGE

Media	Manufacturer No. of Words	No. of Digits	Access Microsec
Drum	4,000	40,000	1,700 (avg)
Drum	1,000	10,000	425 (avg)
Drum Mass Memory (per unit)	2,304,000 plus signs	over 24,000,000 incl signs	385

Up to 10 drum units are possible.

Magnetic Tape		
No. of units that can be connected	10	Units
No. of chars/linear inch of tape	250	Char/inch
Channels or tracks (8 incl sprocket)	7	Tracks/tape
Blank tape separating each record	1.05	Inches
Tape speed	100	Inches/sec
Transfer rate	25,000	Char/sec
Start time	12	Millisec
Stop time	9	Millisec
Average time for experienced operator to change reel of tape	30	Seconds

Physical properties of tape

Width	0.5015+0.0000-0.0030 Inches
Length of reel	2,500 Feet
(Recording surface)	
Composition	Mylar

All users have the 5,000 word drum. Standardized system comparison for formula [(A+B)·C]/D → Memory requires 1.19 milliseconds.

INPUT

Manufacturer Media	Speed
High Speed Card Reader	450 cards/min
Read-Punch Card Unit	150 cards/min
Magnetic Tape	100 inches/sec

No plugboard is used. 80 or 90 column card units are available. Tape densities and formats are compatible with other Univac tape systems.

USA CCBL	
Read Punch Unit	150 cards/min
High Speed Reader	450 cards/min
ASTIA	
Punched Cards (90 col.)	450 cards/min
Punched Cards	150 cards/min

Punch unit also has capability to read as well as punch.

Photo by Armed Services Technical Information Agency

Champlin Media	Speed
Punched Cards (80 col.)	450 cards/min
Cook	
High Speed Reader	450 cards/min (90 col/card)
Read-Punch Unit	150 cards/min (90 col/card)
Douglas	
Read-Punch	150 cards/min
Mason	
Read-Punch Unit	150 cards/min
High Speed Reader	450 cards/min

Above units are buffered to the system and can be utilized singularly or together.

Shell	
Cards (80 column)	450 cards/min

OUTPUT

Manufacturer Media	Speed
Read-Punch Card Unit	150 cards/min
Magnetic Tape	100 inches/sec
High Speed Printer	600 lines/min
Card Punching Printer	150 cards/min

Printer prints 130 char/line. Card Punching Printer prints on both sides of Tab Card - a maximum of 13 lines on a side. Instantaneous printing rate is 900

High Speed Printer

lines/minute.

USA CCBL

Media	Speed
Read Punch Unit	150 cards/min
High Speed Printer	600 lines/min

ASTIA

Punched Cards (90 col.)	150 cards/min
Printer	600 lines/min

Punch unit also has capability to read as well as punch.

Champlin

Printer	600 lines/min
Punched Cards (80 col.)	150 lines/min

Cook

Read-Punch Unit	150 cards/min (90 col/card)
High Speed Printer	600 lines/min (130 dig/line)

Douglas

Printer	600 lines/min

Mason

High Speed Printer	600 lines/min
Read-Punch Unit	150 cards/min

Above units can be used singularly or together. Utilization of punch with printer will slow speed considerable, dependent on punching requirements. 130 sectors of printing.

Photo by Mason & Hangar - Silas Mason Co., Inc.

Shell

Media	Speed
Cards	150 cards/min
Line Printer	600 lines/min

80 column cards are used.

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type	Manufacturer Quantity	
Tubes	20	Processor
	-	Read-Punch
	-	Reader
	144	Printer
	22	Synchronizer
	29	Servo
	215	
Diodes	23,000	Processor
	550	Read-Punch
	545	Reader
	500	Printer
	11,900	Synchronizer
	10	Servo
	36,505	

Read-Punch Unit

Type	Quantity	
Transistors	700	Processor
	12	Read-Punch
	37	Reader
	2	Printer
	168	Synchronizer
	-	Servo
	919	

CHECKING FEATURES

Manufacturer

Odd parity, overflow, complete tape read checks. Two read stations in card equipment. Logical checks in central processor and printer.

Photo by Mason & Hangar - Silas Mason Co., Inc.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

	Manufacturer	
Power, computer	48.2 KVA	0.8 pf
Area, computer	925 sq ft	
Capacity, air condition	11.8 Tons	
Weight, computer system	12,027 lbs, total, incl 2 magnetic tape units	

Cable duct work is supplied with computer, if desired. No special flooring is required. Power includes printer, punch, reader and 10 servos.

USA CCBL

Power, computer	13.52 Kw	16.9 KVA	0.8 pf
Power, air condition	33 Kw	33 KVA	1 pf
Volume, computer		297 cu ft	
Volume, air conditioner		80 cu ft	
Area, computer		576 sq ft	
Area, air conditioner		18 sq ft	
Room size		28 ft x 17 ft	
Capacity, air conditioner		5 Tons	
Weight, computer		7,237 lbs	
Weight, air conditioner		1,000 lbs	

Installation of 5 ton air conditioner. Power line from transformer in basement to computer room. Air conditioner is in addition to building air conditioner.

ASTIA

Power, computer	16 Kw	14.4 KVA
Volume, computer		3,180 cu ft
Area, computer		530 sq ft
Room size		1,060 sq ft
Floor loading		118.4 lbs/sq ft
		473.6 lbs concen max
Weight, computer		7,237 lbs

Building - Temporary government structure.

Floor - Raised in area where data processing equipment is located.

Walls - Partitioned with glass panels for equipment viewing.

Champlin

Power, computer	15 KVA
Volume, computer	8,400 cu ft
Volume, air conditioner	60 cu ft
Area, computer	840 sq ft
Area, air conditioner	20 sq ft
Room size	30 ft x 28 ft
Capacity, air conditioner	5 Ton
Weight, computer	8,000 lbs
Weight, air conditioner	500 lbs

30 x 28 ft room prepared by combining three separate rooms. Space provided also includes space required for four tape units and tape synchronizer to be installed later.

Cook

Power, computer	12 Kw	15 KVA	0.8 pf
Volume, computer		340 cu ft	
Area, computer		275 sq ft	
Room size		575 sq ft	
Floor loading		24 lbs/sq ft	
		3,064 lbs concen max	
Weight, computer		6,500 lbs	

No special site preparation requirements.

Douglas

Power, computer	15 KVA
Power, air conditioner	7.5 KVA
Volume, computer	600 cu ft
Volume, air conditioner	60 cu ft
Area, computer	120 sq ft
Area, air conditioner	10 sq ft
Room size, computer	30 ft x 20 ft
Room size, air conditioner	6 ft x 6 ft
Floor loading	150 lbs/sq ft
	3,500 lbs concen max
Capacity, air conditioner	5 Tons
Weight, computer	6,200 lbs
Weight, air conditioner	900 lbs

Six inch raised false floor to provide for power cables. Exhaust-diffusers installed in ceiling for heat dissipation/air conditioning. Power is single phase, 3-wire, 240 volt system.

Mason

Power, computer	16.32 Kw	14.4 KVA	0.85 pf
Power, air condition	11 Kw		0.85 pf
Volume, computer		296.9 cu ft	
Volume, air conditioner		120 cu ft	
Area, computer		58.1 sq ft	
Area, air conditioner		15 sq ft	
Room size, computer		530 sq ft	
Room size, air conditioner		20 sq ft	
Floor loading		124.5 lbs/sq ft	
		147.1 lbs concen max	
Capacity, air conditioner		10 Tons	
Weight, computer		7,237 lbs	
Weight, air conditioner		1,985 lbs	

No site preparations required except to electrical distribution. Building is brick construction with concrete and asphalt flooring. Two single phase 210 volt regulators were installed for power requirement control.

Shell

Power, computer	14.5 KVA
Volume, computer	318 cu ft
Area, computer	62 sq ft
Room size	20 ft x 25 ft
Weight, computer	6,425 lbs

Single phase, 220 volt, 70 ampere, 60 cycle, AC power.

PRODUCTION RECORD

Manufacturer

Number in current operation	190
Number on order	300
Time required for delivery	12 months

COST, PRICE AND RENTAL RATES

Manufacturer

	Cost	Monthly Rental
Card System 80 or 90 Column		
1 Central Processor	$234,215	$4,685
1 Read-Punch Unit	48,650	975
1 Card Reader	15,290	305
1 Printer on-line	49,345	985
Basic Type -Card System (80 or 90 Col.)		
1 Central Processor (w/3 Index Reg)	$241,715	$4,835
1 Magnetic Tape Synchronizer	50,000	1,000
2 Magnetic Tape Unit (ea 20,000/450)	40,000	900
1 Read-Punch Unit	48,650	975
1 Card-Reader	15,290	305
1 Printer on-line	49,345	985
Additional Equipment		
Card System		
3 Index Registers	$ 7,500	$ 150
1 Printer Off-Line	195,000	3,500
Tape-Card System		
1 Card Punching Printer	125,000	2,700
1 Printer Off-Line	195,000	3,500

Up to max. 10 tape units at 20,000/450 each.

A service cintract is available.

USA CCBL

Central processor cost $234,587.87.

Read Punch Unit, High Speed Reader, High Speed Printer rents for $2,265/monthly.

Maintenance service contracting is $13,000/year.

ASTIA

Rental rates for basic system

	Monthly Rental
Type 7909	$4,835
Type 7904	305
Type 7910	975
Type 7901	985

Rental rates for additional equipment

Tape Synchronizer	$1,000
Randex Drum Unit	1,500
Randex Control Unit	2,000
Tape Uniservo	450 each
Unityper	30 each

Champlin

Central processor, reader, read-punch, and printer make up basic system. Sales price $347,000.

Tape Synchronizer - 4 tape units - price not available (not now installed)

The above system rents for $7,100 per month.

Tape equipment rents for $2,900 per month.

Service on all equipment is included in above rental rates.

Cook

The 7900 Series Central Processor, High-Speed Reader, High-Speed Printer, and Read-Punch Unit cost $450,000 and rents at $6,900/month.

The Sorter, Verifier, Collator, Interpreter, and Key punch cost $15,000 and rents at $400/month.

Douglas

Rental rate for processor, card read-punch, and printer is $8,000/month.

Maintenance service contracting is included in rental.

Mason

Rental rates for additional equipment

2 Electronic Collators	$ 125
1 Reproducing Collator	170
2 Alpha-punches	55
1 Verifier	60
1 Interpreter	105
1 420 Electronic Sorter	85
1 421 Electronic Sorter	100

Shell

Central processor, high speed printer, high speed reader, and read punch unit rents for $7,100/month.

PERSONNEL REQUIREMENTS

Manufacturer

	One 8-Hour Shift	Two 8-Hour Shifts	Three 8-Hour Shifts
Supervisors	2	2	3
Analysts	A supervisory function		
Program-Coders	5	5	5
Clerks	3	3	3
Librarians	1	1	1
Operators	2	4	6
Engineers	1	1	1
Technicians	1	2	3

Programming course supplied on regional basis.

USA CCBL

	One 8-Hour Shift	
	Used	Recommended
Supervisors	4	
Programmers	5	8
Operators	3	3
Technicians	1	1

Methods of training used includes formal courses in machine operation and programming and on-the-job training.

ASTIA

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

Operation tends toward closed shop.

Programming course conducted by contractor followed up with on-the-job training.

Champlin

	One 8-Hour Shift		Two 8-Hour Shifts	
	Used	Recomm	Used	Recomm
Supervisors	1	1	2	2
Analysts	2	2	4	4
Programmers	4	4	8	8
Operators	1	1	2	2
In-Output Oper	1	1	2	2

Operation tends toward open shop.

All personnel directly and indirectly connected with programming and operation attended four week machine logic training course conducted by Remington Rand Training Department.

Cook

	One 8-Hour Shift	
	Used	Recommended
Supervisors	2	2
Programmers	5	5
Operators	2	2
Engineers	2	2

Operation tends toward open shop.

Schooling provided by Remington Rand both in Chicago and at Purdue University, Lafayette, Indiana.

Douglas

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

Operation tends toward open shop.

Two week course followed by on-the-job training.

Mason

	One 8-Hour Shift
Supervisors	1
Programmers	1
Coders	1
Clerks	3
Operators	3
In-Output Oper	3

Operation tends toward open shop.

Methods of training used are customer training and seminar schools and on-the-job training.

Shell

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

Operation tends toward open shop.

Methods of training used includes formal lectures and on-the-job training.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

A preventive maintenance check is made by service engineer at start of each working day.

USA CCBL

Time is available for rent to qualified outside organizations.

System is presently being used one full shift plus four hours overtime per day.

ASTIA

Good time 30 Hours/Week (Average)

Above figure based on period 15 Feb 60 to 31 May 60

Passed Customer Acceptance Test 13 Feb 60

Time is not available for rent to outside organizations.

Champlin

Time is not available for rent to outside organizations.

Computer installed 11 March 1960.

Cook

Good time 35 Hours/Week (Average)

Attempted to run time 40 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.875

Above figures based on period 1 Jun 60 to 31 Jul 60

Passed Customer Acceptance Test 31 Dec 59

Time is available for rent to qualified outside organizations.

Douglas

Average error-free running period 1 Week

Good time 40 Hours/Week (Average)

Attempted to run time 40 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.97

Above figures based on period from Jun 60 to Sep 60

Passed Customer Acceptance Test Jun 60

Time is available for rent to outside organizations.

Mason

Time is not available for rent to outside organizations.

Computer was accepted three months ago. Reliability in past two months has been better than 90%.

Shell

Time is not available for rent to outside organizations.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Outstanding features are simultaneous operations, namely, card reading, card punching, printing, tape read or write, compute. All input-output units are buffered. Card punching printer provides the ability to punch a card and print on both sides of the same card. Punching is verified.

ASTIA

Outstanding features include an extremely low heat output and operates at maximum 100°F and a minimum of 60°F.

Unique system advantages are extreme versatility - basic punched card input-output is small scale system, yet addition of drives and random access storage will place it in medium scale category, and bit-by-bit logic permitted simple solution to problem of representing some 240 need-to-know categories plus user code, security clearance, VIA code and user category in one punch card for each user-contract combination.

Mason

Outstanding features include flexibility over conventional printers, reliability and no plug boards: programs are loaded directly on the drum.

Unique system advantages include reduction operator processing, enabling printing of reports and punching of summary cards simultaneously, and tightening of control in hands of supervision.

Card storage racks are in a large walk-in vault, the bell system replaced the sprinkler system, and temperature and humidity are controlled by air-conditioning.

Subject installation was added to replace a UNIVAC 120 System which required a number of additional tabulating equipment for support. The new system enabled a considerable reduction in supporting equipment and personnel while allowing greater control and flexibility of operations. Process of changing existing procedures over to new system is about completed.

FUTURE PLANS

USA CCBL

Purchase or rental of Index Registers and Magnetic Tape Units is planned.

ASTIA

The addition of tape equipment and randex units are planned. The addition of these units will provide the capability to add the following applications:

Information search and retrieval
Document Identification
Document Destruction Control
Bibliography Compilation and Print Out.

Mason

Maintenance scheduling and control procedures are being discussed and formulated for application on the new system.

Engineering problems are in the programming stage to enable the production of punched tape to be used in conjunction with numerical control tape operated production machines.

Shell

Anticipate addition of magnetic tapes, i.e. a tape synchronizer and 2 to 5 tape units.

Kaiser Steel Corporation anticipates installation of UNIVAC Solid State 80 System.

INSTALLATIONS

U. S. Army Chemical Corps Biological Laboratories
Fort Detrick, Maryland

Armed Services Technical Information Agency
Arlington Hall Station
Arlington 12, Virginia

Champlin Oil and Refining Company
P. O. Box 552
Enid, Oklahoma

Cook Technological Center
Division of Cook Electric Company
6401 West Oakton Street
Morton Grove, Illinois

Douglas Aircraft Company
3000 Ocean Park Blvd.
Santa Monica, California

Mason and Hanger-Silas Mason Co., Inc.
Box 561, Iowa Ordnance Plant
Burlington, Iowa

Chase Manhattan Bank (SS 80)
57 William Street, Room 200
New York, N. Y.

Purdue University (SS 80)
Computing Laboratory ENAD
W. Lafayette, Indiana

Shell Development Company
E and P Research, Computing Section
3747 Bellaire Blvd.
Houston, Texas

North Carolina State College
Raleigh, North Carolina (SS 80 Proposed)

Southern Methodist University (SS 90)
Dallas 22, Texas

ADDITIONAL REMARKS

	Weights (Shipping) Lbs	Heat Dissipation	Air Conditioning (Approx. Tons)
Card Reader	815	3,396 BTU/hr	.27
Card Punch 80 Col.	1,120	3,396 BTU/hr	.27
Card Punch 90 Col.	1,420	3,780 BTU/hr	.32
Printer	1,720	11,910 BTU/hr	1.0
Processor	3,760	27,660 BTU/hr	2.3
Tape Synchronizer	2,980	13,020 BTU/hr	1.1
Tape Unit (each)	758	8,160 BTU/hr	.68

Random Drum Units and Card Punching Printer are also available.

UNIVAC STEP

Univac Solid State STEP Card and STEP Tape Systems

MANUFACTURER

Remington Rand Univac Division
Sperry Rand Corporation

Photo by Sperry Rand Corporation

APPLICATIONS

General purpose data processing system designed for general accounting, inventory, billing, budget control, sales analysis, and statistics, as well as scientific applications.

The Univac Solid State STEP System (Simple Transition Electronic Processing) is a modular version of the Solid State 80 and 90 System. STEP offers speed, accuracy, and economy of the Univac Solid State Computer to the user not requiring the full capabilities of the larger system. STEP is available to either the 80 or 90 column card user. Magnetic tapes, Randex Drum Unit and card punching printer are also available.

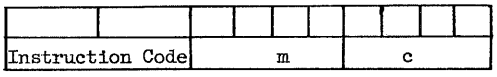
PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits/word	10 plus sign
Decimal digits/instruction	10 (sign pos. not used)
Instructions/word	1
Instructions decoded	53
Arithmetic system	Fixed point
Add, subtract, multiply,	and divide
Instruction type	One and one-half address

One address refers to the operand or (m) portion of the instruction word. The half address refers to the address of the next instruction to be executed. Next instruction address is given in the (c) portion of the instruction word.

Number range -9999999999 to +9999999999

Instruction word format



(m) address is address of operand
(c) address is address of the next instruction to be executed

A basic package of input-output and test routines are supplied to all STEP users. None are built in.

Automatic coding

X-6 Assembly System

Registers and B-boxes

Three 10 digit arithmetic registers are included in all models. Three index registers (4 digits each) are available on all STEP Tape Systems and are optional on the STEP Card Systems.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	1,360	85
Mult	1,275 plus	

Average access time was used, also assumed operands and results were stored in high speed access portion of drum.

Div 1,275 plus

Access time includes accessing 2 operands and result address.

Calculation of multiply time in word times is the sum of 3 factors. Five word times, plus the number of multiplier digits, plus the sum of the multiplier digits - Min. time 119 microseconds. Maximum time 1,785 microseconds.

Divide time expressed in word times is calculated as follows: five word times, plus twice the number of digits in the quotient, plus the sum of the odd digit positions in the quotient, plus the sum of the tens complement of the even digit - positions in the quotient. Minimum time 425 microseconds. Maximum time 1,955 microseconds.

Construction (Arithmetic unit only)

Vacuum-tubes	20
Transistors	700
Condenser-diodes	23,000
Ferractors (Magnetic Amplifiers)	3,000

Arithmetic mode Serial by digit, parallel by bit

Word time is 17 microseconds.

Timing Synchronous

Operation Concurrent

STORAGE

Media	No. of Words	No. of Digits	Access Microsec
Drum (Fast Memory)	2,400 Basic	24,000	1,700

Additional fast memory can be specified in increments of 4,000 digits up to a maximum of 16,000 digits. Maximum fast memory available on one processor is 40,000 digits.

Drum (High Speed Memory) 425

First 2,000 digits (200 words) of high speed memory is a prerequisite to additional high speed memory and/or additional fast memory. Additional high speed memory can be specified in increments of 2,000 digits up to a maximum of 8,000 digits. Maximum high speed memory of any one processor is 10,000 digits.

Drum Mass Memory (Randex Drum) optional	2,304,000(min) 23,040,000(max)	24,000,000 incl. signs 240,000,000 incl. signs	385,000 (Avg)

Magnetic Tape

No. of units that can be connected	10 Units
No. of char/linear inch of tape	250 Char/inch
Channels or tracks on the tape	7 Tracks/tape
Blank tape separating each record	1.05 Inches
Tape speed	100 Inches/sec
Transfer rate	25,000 Char/sec
Start time	12 Millisec
Stop time	9 Millisec
Average time for experienced operator to change reel of tape	30 Seconds
Physical properties of tape	
Width (+.000 -.003)	0.5015 Inches
Length of reel	2,500 Feet
Composition	Mylar

INPUT

Media	Speed
High Speed Card Reader	450 cards/min
Read-Punch Card Unit	150 cards/min
Magnetic Tape	100 in/sec
	25,000 pulses/sec

Tape densities and formats are compatible with other Univac tape systems. 80 or 90 column cards may be used (no plug-bcards).

OUTPUT

Media	Speed
Read-Punch Card Unit	150 cards/min
Magnetic Tape	100 in/sec
	25,000 pulses/sec
High Speed Printer	600 lines/min
	130 char/line possible
Card Punching Printer	150 cards/min

Card Punching Printer prints on both sides of tab card. A maximum of 13 lines on a side. Instantaneous printing rate is 400 lines/min. (Optionally available on either the 80 col. card or 80 col. tape systems. Not available on 90 col. systems).

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Type		Quantity	Use
Tubes			
		20	Processor
		--	Read-Punch Unit
		--	Card Reader
		144	H. S. Printer
		22	Synchronizer
		29	Servo Unit
	Total	215	
Diodes			
		23,000	Processor
		550	Read-Punch Unit
		545	Card Reader
		500	H. S. Printer
		11,900	Synchronizer
		10	Servo Unit
	Total	36,505	
Transistors			
		700	Processor
		12	Read-Punch Unit
		37	Card Reader
		2	H. S. Printer
		168	Synchronizer
		--	Servo Unit
	Total	919	

CHECKING FEATURES

Odd parity, arithmetic overflow, complete magnetic tape. Checks - card equipment has 2 read stations; punch unit has a post read station for checking card punching. Central processor and printer design include logical checks.

COST, PRICE AND RENTAL RATES

	Cost	Monthly Rental
Sale Price of basic STEP Card System (80 or 90 col.)	$175,000	$3,500
Price includes -		
Central Processor (24,000 digits of fast memory)		
High Speed Card Reader 450 cards/min.		
Read-Punch Unit 150 cards/min.		
High Speed Printer 600 lines/min. w/a 100 printing positions		
Registers A, X.L.		
Sale Price of basic STEP Tape System (80 or 90 col.)		
Basic units listed above plus the following -	$175,000	$3,500
Tape Synchronizer 8	50,000	1,000
Uniservo II Tape Units (maximum 10)	each 20,000	450
Index Registers (3)	7,500	150
Sale Price of Additional Equipment		
Multiply and Divide Feature	20,000	400
Pre and Post Reading Station on Punch Unit and Stacker Select on Card Reader and Punch	15,000	300
Additional Print Positions for High Speed Printer		
30 Additional Print Positions	2,500	50
Available in increments of 20 positions	1,500	30
Available in increments of 10 positions	1,000	20
600 cards/min. speed for Card Reader	10,000	200
Index Registers (3) Card System option	7,500	150
Additional Memory		
First 2,000 digits of High Speed Memory	22,500	450
Each additional increment of High Speed Memory (2,000 digits) (maximum 10,000 digits per system)	15,625	312.50
Each additional increment of Fast Memory (4,000 digits) (maximum 40,000 digits per system)	12,000	250
First 2,000 digits of High Speed Memory is a prerequisite to additional High Speed Memory and/or additional Fast Memory.		
Randex		
Includes: Randex Drum Unit (24 million digits) Power Control Unit	$166,850	$3,550
Additional Randex Drum Units (24 million digits) This price is for each additional drum unit up to a total of 4 (96 million digits). Prices on units in excess of 4 up to a total of 9 will be quoted on request.	each 89,300	1,900
Synchronizer	50,000	1,000
Randex requires a synchronizer. When specified with a tape system, Randex will be under the control of the tape synchronizer. No additional synchronizer is required.		
When Randex is specified for use with a card system, a synchronizer must be included.		
Card-Punching Printer	125,000	2,700
An on-line card punching printer is available for 80 column systems.		

Maintenance included in rental contract. Service contract available to STEP System purchasers.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Power, computer (card system) 16.9 KVA 0.8 pf
(Reader, punch, printer and processor)
Power, computer (tape system)
Add 7.0 KVA for synchronizer and first tape unit
Add 2.5 KVA for each additional tape unit

Volume, processor	144 cu ft
Volume, reader	24 cu ft
Volume, punch	36 cu ft
Volume, printer	64 cu ft
Area, processor	24 sq ft
Area, reader	6 sq ft
Area, punch	6 sq ft
Area, printer	16 sq ft
Floor loading, processor	146.8 lbs/sq ft
reader	91.8 lbs/sq ft
punch	134.0 lbs/sq ft
printer	96.5 lbs/sq ft

Common base available for processor.
Capacity, air conditioner 5 Tons
Tonnage required to compensate for machine heat only.
Weight, computer 7,162 lbs
Cable duct work is supplied with computer, if desired. No special flooring required.

PRODUCTION RECORD

Number produced to date	200
Number in current operation	175
Time required for delivery	9 months

PERSONNEL REQUIREMENTS

Personnel requirements depend upon the operation and application involved - whether it is one large volume application or several small ones, etc.

Programming course supplied on a regional basis.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

A preventive maintenance check is made by a service engineer at the start of each working day.

ADDITIONAL FEATURES AND REMARKS

Outstanding features are modular design. All input-output units are buffered, including Randex availability of card punching printer.

Instruction List and Programming Aids

Instruction Format

The Univac Solid-State Computer employs a one and one-half address instruction code system, with one instruction per processor word. Each instruction word is written in ten decimal digits and consists of an operation code, the address of the operand, and the address of the next instruction. The leftmost digit position is considered the most significant digit (MSD) and the rightmost digit position is considered the least significant digit (LSD).

The leftmost two digits are the operation code (OC), which tells the processor the arithmetic or logical operation to execute. The next four digits, the m portion, supply the address of the operand, which is usually the address of a word in storage. The remaining four digits, termed the c address, are the location of the next instruction. The m and c addresses may have different significance for some special instructions, as noted in the instruction definitions.

Instruction Cycle

The instruction cycle - the steps the processor takes in executing a command - usually occurs in four phases. (In a few instructions, there is no search for the operand.) The duration of a phase is measured in units called word times. A word time is that interval in which the drum revolves one word under the read-write heads - in the Univac Solid-State Computer, 0.017 milliseconds. The four phases are:

(1) Staticize the Instruction:
The instruction located by the previous search (4) is transferred from the drum location to the static register (operation code only) and register C (the entire word). This step requires one word time.

(2) Search for the Operand:
If the m address part of the instruction does not refer to a drum storage location or a register, this step is ignored and no time is required. If it does refer to a drum location, the address of the next available storage location on the drum is compared with the first address part of the contents of register C every word time until a match is obtained. Register C contains the entire instruction. This step requires a minimum of one word time and a maximum of 200 word times.

(3) Execute the Instruction:
The operation indicated in the instruction is performed. The time required for this phase depends upon the type of operation to be performed.

(4) Search for the Next Instruction:
The address of the next available storage location on the drum is compared with the second address part of the contents of register C until a match is obtained. This step requires a minimum of one word time and a possible maximum of 200 word times.

UNIVAC I

Universal Automatic Computer Model I

MANUFACTURER

Remington Rand Univac
Division of Sperry Rand Corporation

Photo by Franklin Life Insurance Company

APPLICATIONS

Manufacturer
General purpose large scale digital computing.

Army Map Service
Located in Erskine Hall, Army Map Service, the system is used for Geodesy photogrammetry, and mapping computations, including, e.g. special map projections and coordinate systems, least square adjustments of triangulation, traverse computation and adjustment, transformation of rectangular and geographic coordinates, analytic adjustment of aerial photographic strips and blocks, satellite orbit computations, geodetic and mathematical tables, and star occultation computations.

U. S. Navy David Taylor Model Basin
Located at the David Taylor Model Basin, Carderock, Md., the system is used for the solution of naval engineering problems, solution of naval logistics problems, and for financial management analysis.

Air University, Maxwell AFB, Alabama
Located at Montgomery, Alabama, the system is used for data processing of all educational record keeping involved in administering 336,000 correspondence students enrolled under the auspices of the Air University Extension Course Institute and for statistical reports and analysis of 113,000 Air Force officer jobs and records to aid the Air Force Educational Requirement Board determine qualitative, college level, educational needs for Air Force officers.

Bureau of the Census, Washington 25, D.C.
Located in Washington, D.C., the system is used for statistical data processing for current surveys of foreign trade and other programs of the Bureau of the Census and for service work for other Federal agencies, involving editing and rearranging of input, sorting and merging of records, tallying, tabulating, and summarizing data, computing percentages, medians, means, weights, variances, etc. for data, and arrang-

Photo by Franklin Life Insurance Company

ing and preparing tables, listings, labels, etc. for high speed printer.

Internal Revenue Service Statistics Division
Located in Suitland, Maryland (U. S. Dept. of Commerce, Bureau of the Census), the system is used for data edit, sort, merge, and compilation of statistical data for statistics of income publications on economic aspects of business and individual income tax returns.

The Chesapeake & Ohio Railway Company
One computer located at 400 Terminal Tower, Cleveland 1, Ohio and another at Case Institute of Technology, Cleveland, Ohio, they are used for payroll, freight revenue accounting, private line car accounting, and stockholder records.

The Franklin Institute Computing Center
Located at separate facilities in building housing Science Museum and Laboratories for Research & Development, the system is used as a service bureau. Being a service bureau, the nature of the workload is constantly changing. During the three and one-half years of operation we have handled almost every conceivable type of mathematical and data processing application. As a general rule, individual research, engineering and mathematical projects have numerically exceeded straight data processing jobs while the greater overall volume of machine time is devoted to the latter. In order to keep programming costs at a minimum, extensive use is made of the Library of Univac I Routines whenever possible. Time is also made available on an open shop basis and users and area businessmen are encouraged to familiarize themselves with the various mathematical compilers and automatic programming routines by attending one or more of a series of classes periodically conducted at the Center. Business applications such as payroll reporting, cost account reporting, sales statistical summarizations and various statistical analyses have been done for a number of firms. Scientific applications include the engineering problem solutions from areas such as helicopter design, nuclear reactor design, bearing design, geodetic surveys and many others.

The Franklin Life Insurance Company
Located at 800 South Sixth Street, Springfield, Ill., the two systems are operated back-to-back applied to insurance activities.

Great Northern Railway Company
Located at 175 East Fourth, St. Paul, Minnesota, system is used for material, payroll, car records, freight revenue statistics, capital expenditures, sales statistics, and passenger statistics applications.

University of Pennsylvania Computing Center
The Univac I System is being used by the University for a variety of research problems and for commercial applications.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits/word	12 (11 plus sign)
Decimal digits/instruction	6
Instructions/word	2
Instructions decoded	63
Instructions used	45
Arithmetic system	Fixed point
Instruction type	One address
Number range	Between -1 and +1

Floating point is performed by sub-routines supplied with the computer. The decimal point occurs at the right of the sign digit.

Photo by Pacific Mutual Life Insurance Company

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	525	282.6
Mult	2,150	1,907.6
Div	3,950	3,707.6

Construction	5,000 vacuum tubes
Rapid access word registers	4
Basic pulse repetition rate	2.25 Mc/sec
Arithmetic mode	Serial
Timing	Synchronous
Operation	Sequential

The minimum storage access time is 40.4 microseconds.
The maximum storage access time 404 microseconds.

STORAGE

Manufacturer

Medium	No. of Words	No. of Digits	Access Microsec
Acoustic Delay Line	1,000	12,000	40.4 to 404

The acoustic medium is mercury. If average access time is 5 word times, the average access time would be 202 microseconds.

All users have 1,000 words of mecury delay line memory.

Franklin Life

10 words of information are stored serially in a memory channel which is 400 microseconds long. Access time may be materially reduced from 200 microseconds average if minimum latency programming is employed.

Great Northern

Media	No. of Words	No. of Digits	Access Microsec
Mercury Delay Memory	1,000	12,000	40 min
4 One Word Mercury Delay Registers	4	48	40
1 Two Word Register	2	24	80
1 Ten Word Register	10	120	400

Input-output storage areas give an additional 60 words or 720 digits each of storage.

INPUT

Manufacturer Media	Speed	
Magnetic Tape (UNISERVO I)	12,800 char/sec	
Keyboard	Manual	
Unityper II	Keypunching	50 char/in density
Verifier	Keypunching	Verifies Unityper II recording

Photo by David Taylor Model Basin

80 Column Card-to-Tape Converter	240 char/min	120 char/in density
90 Column Card-to-Tape Converter	240 char/min	120 char/in density
Paper Tape to Magnetic Tape Converter	200 char/sec	5, 6 or 7 channel code
Magnetic Tape to Magnetic Tape Transrecorder	90 char/sec	Speed dependent upon communication facilities

Army Map Service

Media	Speed	
Magnetic Tape (on-line)	12,800 char/sec	
Uniservo I - metallic tape only used		
Keyboard (on-line)	Manual typing	
Unityper II (off-line)	Manual typing	
80 Col. Card-Tape Converter (off-line)	240 cards/min	
One 80 col. card converted to 10 word item on tape		

David Taylor

Magnetic Tape	100 in/sec	10 Uniservos

Air University

Cards-to-Magnetic Tape	100 cards/min	
Through card to tape converter		
Typing-to-Magnetic Tape	40 words/min	
Through Unityper		

Media	Speed	
C and O		
Metallic Tape	100 in/sec	
Franklin Institute		
Magnetic Tape	12,800 char/sec	
Plastic Tape	12,800 char/sec	

System modified to read 16,000 char/sec on continuous read.

Franklin Life		
Magnetic Tape (metal)	7,200 char/sec	
(Both systems)	Assumes tape limited program	

OUTPUT

Manufacturer Media	Speed	
Uniservo I	12,800 char/sec	
Printing Unit	10 char/sec	
Uniprinter	10 char/sec	20 char/in density
High Speed Printer	600 lines/min	130 char/line (max)
Tape-to-Card Converter	120 cards/min	80 column cards
Magnetic Tape to Paper Tape Converter	50 char/sec	5, 6 or 7 channel code
Magnetic Tape to Magnetic Tape Transrecorder	90 char/sec	Speed dependent upon communication facilities

Photo by Wright-Patterson Air Force Base

Media	Speed
Army Map Service	
Magnetic Tape (on-line)	12,800 char/sec

Uniservo I - metallic tape only used

Typewriter (on-line)	10 char/sec
High Speed Printer (off-line)	600 lines/min

120 char/line - 51 printable characters

Point Plotter (off-line)	Up to 50 pts/min

40"x40" plot table - magnetic tape input

Some non-standard symbols on High Speed Printer, such as Greek letters, degree symbol.

David Taylor	
Magnetic Tape	100 in/sec
Rem Rand High Speed Printer (off-line)	600 lines/min 120 char/line
Uniprinter (on-line)	10 char/sec
Air University	
Tape-to-Card	100 cards/min
Tape-to-Printer	600 lines/min
C and O	
Metallic Tape	100 in/sec
Franklin Institute	
Magnetic Tape	12,800 char/sec
Plastic Tape	12,800 char/sec

System modified to write 16,000 char/min on continuous write.

Media	Speed
Franklin Life	
Magnetic Tape (metal) (Both systems)	7,200 char/sec Assumes tape limited program

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	5,200
Tube types	15
Crystal diodes	18,000

Army Map Service

The tube types used throughout the entire system include the 25L6, 6AN5, 7AK7, 6AU6, 6BE6, 6SN7, 6X5, 6AK7, 28D7, 807, 829B, 2050, 5545, 5651, 5687, 6AL5, 6AK5, 6AH6, 5V4, 5R4, 4D32, 3C23, 8008. The system includes the computer, power supply, supervisory control, printer and 8 Uniservos.

Franklin Life

Approximately 50% of the tube complement are 25L6's. Each of ten Uniservos (tape handlers) are separate and interchangeable.

Photo by Wright Patterson Air Force Base

CHECKING FEATURES

Manufacturer

Duplicate circuitry for checking results of computation and comparison.

Odd-even pulse

Read-in and read-out pulse check on the 720-digit auxiliary storage.

Three minute interval pulse check.

Automatic re-read provides for reading a block from the tape again when the first reading indicates an error. Marginal checking causes weak tubes to fail during scheduled maintenance instead of during production time.

Army Map Service

Trouble shooting and indicating checks on this system include:

DC fault test and locator
Primary alarm circuits
Audio check
Mercury tank heater monitor
Storage checker
Checking circuits
Marginal check
Function table checker and neon bank
Duplicate arithmetic circuits

Test bench and various test equipments
2 modifications for checking purposes
ACC voltage monitor either by meter or scope

Every character has an odd number of pulses. Odd-even checkers on input and output buffers and in other circuits within the machine. Other automatic internal checking features also included.

David Taylor

Checking summarized as parity, comparison and counting.

Franklin Institute & Univ. of California
Radiation Laboratory

Parity check throughout system, character count on each block of input and output, and parallel computing .

Franklin Life

No programmed checks are used in normal operation, except during maintenance time, because of the comprehensive hardware checking circuits mentioned above.

Odd-even check of each decimal digit transferred within main computer and of digits coming from or going to magnetic tape.

Duplicated circuits of all arithmetic operations and most control functions.

Photo by Wright-Patterson Air Force Base

POWER, SPACE, WEIGHT, AND SITE PREPARATION

	Manufacturer		
Power, computer	81 Kw	90 KVA	0.98 pf
124.5 KVA w/10 Uniservos and power supply			
Volume, computer	943 cu ft		
Area, computer	16 ft x 22 ft		
Height, computer	8 ft 6 9/16 in		
Width, computer	14 ft 3 3/8 in		
Depth, computer	7 ft 10 in		
Weight, computer	16,686 lbs		
Capacity, air conditioner	35 Tons		

The choice of air conditioner is optional with customer. A closed chilled-air system cools the Central Computer Group and heavy auxiliaries. Chilled water must be supplied at a temperature from 45° to 50° with controls to the Power Supply and the Central Computer. The Central Computer and the Power Supply Unit require 35 Tons of refrigeration.

Franklin Institute

Center on first floor of Museum building; air conditioning, power supply, etc. routed from basement to direct overhead. Vinyl tile floor, acoustical ceiling. Adjacent theater, viewing platform and progress of mathematics exhibit included in air conditioning requirements.

Army Map Service

Power, computer	125 KVA
Room size, computer	1,400 sq ft

(Not including peripheral equipment or personnel)

Capacity, air conditioner	50 Tons
Weight, computer	19,000 lbs

False ceiling installed - return-air ducts above false ceiling. No false floor - cabling between equipment, and input air ducts, suspended from ceiling of floor below. Control system cooled by air system rather than chilled water - automatic controls to switch between direct outdoor air and internal re-circulating conditioned air depending on outside temperatures. Computer designed for 2-phase power-80 KVA Scott transformer used to convert from 3-phase.

David Taylor

Power, computer	129.5 KVA
Volume, computer	11,000 cu ft
Volume, air conditioner	4,200 cu ft
Area, computer	1,000 sq ft
Area, air conditioner	600 sq ft
Room size, computer	20 ft x 50 ft
Room size, air conditioner	40 ft x 15 ft
Floor loading	100 lbs/sq ft
Capacity, air conditioner	35 Tons
Weight, computer	29,853

Photo by Wright-Patterson Air Force Base

Air University

Power, computer	170 KVA
Area, computer	50 ft x 70 ft
Area, air conditioner	12 ft x 30 ft
Capacity, air conditioner	35 Tons
Weight, computer	40,500 lbs

False floor, air conditioning, and power cubicle.

Bureau of the Census

Power, computer	124 Kw	125 KVA	0.9 pf
Volume, computer		10,660 cu ft	
Area, computer		1,066 sq ft	
Room size, computer		50 ft x 34 ft x 10 ft	
Floor loading		167-295 lbs/sq ft	
Weight, computer		29,863 lbs each	

Air conditioning is part of integrated system. Separate figures not available.

Univac I, Serial 1 - Partitioning area from larger open space. Construction of fire walls and provision of fire doors. Drilling holes in 10 inch concrete floor for air passages; one 2 ft x 7 ft and three 2 ft x 2 ft. Installation of intake grills and exhaust plenum. Construction of fan room on floor below computer. Run of power wiring conduits from basement to third floor.

Univac I, Serial 13 - Area provided for in preparation for Serial 1. Required only the addition of necessary power conduits and chilled water lines from

basement to third floor.

C and O

Power, computer	150 KVA	0.9 pf
Power, air conditioner	35 Amps at 440V	
Volume, computer	2,322 cu ft	
Volume, air conditioner	600 cu ft	
Area, computer	391 sq ft	
Area, air conditioner	100 sq ft	
Room size, computer	1,200 sq ft	
Room size, air conditioner	170 sq ft	
Floor loading	175 lbs/sq ft	
	250 lbs concen max	
Capacity, air conditioner	50 Tons	
Weight, computer	28,040 lbs	

Building of concrete and steel construction; power fed through 3-inch conduit from power distribution equipment located on floor below computer; lucite false ceiling; room air conditioning through vents in ceiling; cable channels recessed into concrete floor.

Franklin Life

Power, computer 125 Kw	130 KVA	0.96 pf
Power, air conditioner	115 KVA	
Volume, computer	955 cu ft	
Volume, Servo System	150 cu ft	
Area, computer	113 sq ft	
Area, Servo System	30 sq ft	

Photo by Franklin Life Insurance Company

Floor loading	150 lbs/sq ft	
Capacity, air conditioner	60 Tons	
Weight, computer	16,800 lbs	

Cut 7 holes through adjoining walls of two buildings to allow usage of attic room of one building as switchgear room. Removed part of false ceiling to run power and water lines to the computer. Built cement block room on the roof of adjacent building to house air conditioning equipment.

Franklin Life

Same requirement as above.

Removed 4 feet of wall between two windows to allow sections of the central computer to be craned in. Enclosed 390 sq ft of floor area for switchgear room. Removed part of false ceiling to allow room for computer. Removed portion of false ceiling temporarily to run power from switchgear room to computer and to run chilled water lines. Installed air conditioning equipment in basement.

Great Northern

Power, computer	130 KVA	0.92 pf
Power, air conditioner	40 KVA	0.92 pf
Volume, computer	955 cu ft	
Area, computer	1,650 sq ft	
Room size	1,962 sq ft	
Floor loading	80-125 lbs/sq ft	
	167 lbs concen max	
Weight, computer	16,686 lbs	

Air conditioning system is chilled water for cooling computer, power supply and auxiliary equipment. 3 inch pipe columns installed from ceiling to floor on floor below computer.

PRODUCTION RECORD

Number produced to date	48
Delivery Time	Availability basis

COST, PRICE AND RENTAL RATES

Manufacturer

Description	Base Monthly Rental 1 Shift-5 day week	Outright Sale Price F. O. B. Factory
UNIVAC I Central Computer w/ Power Supply & Supervisory Control Desk	$13,390	$750,000
UNISERVO I	320	18,000
UNIPRINTER	390	22,000
UNITYPER II	90	4,500
High Speed Printer	3,300	185,000
Card-to-Tape Unit (47 Character Code)	2,520	142,100
Card-to-Tape Unit (38 Character Code)	2,500	---
Tape-to-Card Unit	2,300	130,000
Perforated Tape-to-Magnetic Tape (PTM) Converter	1,800	108,000
Magnetic Tape-to-Perforated Tape (MTP) Converter	1,500	90,000

Prices quoted above subject to change without notice. Rental charges include maintenance service, spare parts and test equipment. Separate maintenance contract and maintenance advisory service contract available to purchasers of UNIVAC Systems.

Army Map Service

Basic System

Central computer, 8 Uniservos, high speed printer, and 3 Unityper II's cost approx. $600,000 (1952 price) (also 2 Unityper I's, 4 Uniprinters - no longer used).

Rental Rates for Additional Equipment

80 Col. Card-Tape Converter $2,520/month. IBM Card Equipment - six 024 Keypunches, one 083 Sorter, one 089 Collator, one 407 Tabulator, one 514 Reproducer, and one 557 Interpreter rents for $1,900/month.

Maintenance service is approx. $9,700/month for seventeen 8-hour operational shifts per week.

David Taylor

Cost of Basic System

Central Processing Unit, 10 Uniservos, Uniprinter, and 2 Unityper I were purchased at a total cost of $1,000,000.

Cost for Additional Equipment

Card to Tape Converter 185,000

Rental Rates for Additional Equipment

1 Unityper II 90/month

Rem Rand High Speed Printer 3,300/month

Service contract with Rem Rand, approx. $8,000/mo.

Air University

Cost of Basic System

UNIVAC Main Computer and 11 Servos - $500,000 (purchased in 1952).

Cost of Additional Equipment

Card to Tape Converter, High Speed Printer, Unityper-Verifier, and 3 Unitypers - $353,000.

Rental Rates for Additional Equipment

Tape to Card Converter 2,385/month

Maintenance cost $75,000 per year (3 shifts).

Bureau of the Census

Basic System

2 Univac I, 10 tape units each, non-expendable parts, test equipment, site preparation and installation, initial parts inventory $1,857,000 total

Additional Equipment

No longer in use: 2 low speed printers, 1 card-to-tape converter, 1 Unityper, Mod. 1.

Remaining in use: 1 high speed printer, 1 Unityper, 1 extra print head, 1 printer buffer $271,000.

3-shift maintenance contracts for each of 2 Univac I Computers at standard Remington Rand rates.

C and O

Terminal Tower, Cleveland

Own Central Computer & Servos	- cost	$873,000
Own 1 High Speed Printer	- cost	130,000
Lease 1 High Speed Printer	-	4,700/month
Lease 1 Card-to-Tape Converter	-	2,605/month
Lease 1 Tape-to-Card Converter	-	2,300/month
Lease 1 Unityper	-	90/month

Maintenance contract on computer and servos - $8,000/month.

Maintenance contract on 1 high speed printer - $500/month.

Case Institute of Technology, Cleveland

Central Computer and Servos (2 - 8 hour shifts) $26,950/month.

Frankling Life

Basic System

1 Univac I Computer (10 Servos), 2 high speed printers, and 20 Unitypers (exclud. installation) cost $1,200,000.

All maintenance is performed by Frankling Life personnel.

Franklin Life

1 Univac I System (10 Servos) excluding installation cost $300,000.

All maintenance is performed by Franklin Life personnel.

Great Northern

Univac Computer, 10 Servos, and console cost $1,000,000.

High speed printer - 600 lines per minute, card-to-tape converter cost $500,000.

Service contract - Computer 2 shifts $5,310; printer 2 shifts $1,522.50; Card to tape 1 shift $740.

PERSONNEL REQUIREMENTS

Manufacturer

The number of engineers, technicians, and operators required depends upon the equipment complement of the Univac System and the shift operation.

Army Map Service

	Three 8-Hour Shifts
Supervisors	8
Analysts	8
Programmers	15
Clerks	3
Operators	6
Engineers	1
In-Output Oper	11

Operation tends toward closed shop.

Methods of training used include basic training by equipment manufacturers (e.g. Rem Rand programming, IBM card equip operation), on-the-job training by experienced personnel and supervisors, advanced training - university courses in mathematics, etc., and Peraonnel Division training facilities for supervisory training.

Central Computer operating 3 shifts 6 days/week.

Peripheral (in-output) equip operating 1 shift 6/ days.

Programming - 1 shift 5 days.

Present Organization Structure
Present Authorized Strength - 52

Programming Br.-18 Applications
Chief, Asst Chief, Research Br.
Clerk-Typist 1
15 Programmers

Computing Br - 29
Chf, Asst Chf, Adm
Clerk-Tape Librarian

Operations Unit
1 Supervisor

7 Project Mathematicians

6 Systems Operators
In-Out Oper
1 Asst Supvr

6 Input Equip Oper
5 Output Equip Oper

David Taylor

	One 8-Hour Shift Used	Recommended
Analysts	8	8
Programmers	12	12
Coders	0	0
Clerks	0	0
Librarians	0	1
In-Output Oper	1	3

Operation tends toward closed shop.

Methods of training used include on-the-job and by the manufacturer.

Air University

	Three 8-Hour Shifts
Supervisors	1
Programmers	4
Clerks	1
Operators	7
Technicians	5

Operation tends toward closed shop.

Methods of training used includes on-the-job training. Programmers attended manufacturer's programming school.

Bureau of the Census

	Three 8-Hour Shifts
Supervisors	3
Analysts, programmers & coders	20
Clerks	5
Librarians	2
Operators	9
Engineers	1
Technicians	10
In-Output Oper	6
Tape Handlers	10
Other	1

Programmers shown are customer employees; technicians are contract maintenance employees; tape handlers are customer employees.

Operation tends toward open shop.

Training Branch conducts formal classroom sessions for programmers, operators (followed by on-the-job training) executive orientation, brush-up seminars. Classroom and on-the-job training are also conducted for engineers and technicians.

Internal Revenue

	One 8-Hour Shift Used	Recommended
Supervisors	1	
Analysts	4	6
Programmers	15	20
Clerks	3	4
Librarians	2	2
In-Output Oper	3	3
Tape Handlers	1	2 to 4

Programming courses provided by manufacturer when available.

Programming course presented by an experienced Division programmer.

Programming course presented by other owners such as Bureau of the Census.

C and O

	Five 8-Hour Shifts
Supervisors	7
Analysts	6
Programmers	11
Clerks	8
Operators	8
Engineers	7
Technicians	4
In-Output Oper	6

Personnel are for two systems.

Operation tends toward closed shop.

Computer operators trained by manufacturer, auxiliary equipment operators trained on-the-job.

Franklin Institute

	One 8-Hour Shift		Two 8-Hour Shifts		Three 8-Hour Shifts	
	U	Rec	U	Rec	U	Rec
Clerks	1	1	1	2	1	2
Librarians	0	1	0	1	0	1
Operators	2	2	4	4	5	6
Engineers	1	1	1	1	1	1
Technicians	3	3	5	5	6	6
Tape Hand	0	0	0	0	0	0

Operation tends toward closed shop.

Methods of training used includes: programmers - formal classes plus study; maintenance and operations-informal classes, study and on-job training.

Franklin Life

	One 8-Hour Shift	Two 8-Hour Shifts	Three 8-Hour Shifts
Supervisors	1	1	1
Analysts	1		
Programmers	8		
Coders	6		
Clerks	50		
Librarians	1		
Operators	2	2	2
Engineers	2	1	1
Technicians	2	2	2
In-Output Oper	20	10 (4 hrs)	

The same staff of employees is used to maintain programs and operate both computers.

Operation tends toward open shop.

Methods of training includes on-the-job training with an experienced employee.

Great Northern

	Two 8-Hour Shifts Used	Recommended
Programmers	1	
Operators	2	
Engineers	4	5
Technicians	1	2
In-Output Oper	3	
Tape Handlers	1	

Operators and tape handler schooled by equipment manufacturer. The machine is serviced by the manufacturer.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

Reliability and operating experience are based on several years records. Using the formula "Available Operating Time" minus "Lost Time" divided by "Scheduled Operating Time", cumulative performance of the UNIVAC I Central Computers averages 93.0%.

Army Map Service

Good time	125 Hours/Week (Average)
Attempted to run time	136 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.92
Above figures based on period from 1957 to present
Passed Customer Acceptance Test Apr 52
Time is not available for rent to outside organizations.

Small increments of time occasionally made available for other Dept. of Defense offices (usually Corps of Engrs agencies), only when specifically so directed by higher authority (Office of Chief of Engrs, U. S. Army).

David Taylor

Good time	114 Hours/Week (Average)
Attempted to run time	120 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.95-0.97
Above figures based on period 1 Jul 59 to 31 May 60
Passed Customer Acceptance Test Apr 53
Time is available for rent to qualified outside organizations.

Air University

Good time	80 Hours/Week (Average)
Attempted to run time	100 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.80
Above figures based on period from Jan 60 to Jul 60
Time is available for rent to qualified outside organizations.

System was first installed in Pentagon in 1952. It was moved to Maxwell AFB in 1958.

Bureau of the Census

Good time (each machine)	137 Hours/Week (Average)
Attempted to run time	148 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.926
Above figures based on period 3 Apr 60 to 23 Apr 60
Passed Cusotmer Acceptance Test: Serial 1 (51);13 (55)
Time is not available for rent to outside organizations.

Good time includes lost time from non-machine causes. Attempted to run time excludes scheduled maintenance. Figures are for each machine.

C and O

Average error-free running period	24 Hours
Good time	186 Hours/Week (Average)
Attempted to run time	192 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.97
Above figures based on period from Mar 57 to Jun 60
Passed Customer Acceptance Test Feb 56
Time is available for rent to qualified outside organizations.

E. I. du Pont de Nemours and Company

Average error-free running period	168.6 Minutes
Good time	3,707 Hours
(Scheduled minus Down Time minus All Lost Time)	
Attempted to run time	3,895 Hours

Operating ratio (Good/Attempted to run time) 0.95
Above figures based on period 23 Dec 55 to 20 Dec 56.
Passed Customer Acceptance Test 10 Apr 55

Franklin Institute

Good time	57 Hours/Week (Average)
Attempted to run time	60 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.95 to 1.0
Above figures based on period from Jan 57 to Jan 60
Passed Customer Acceptance Test Jan 57
Time is available for rent to outside organizations.

The machine is available on an hourly rental basis and only good time is charageable; no minimum time requirement exists.

Hourly Rates for Use of Computer and Peripheral Equipment

Computer (UNIVAC I)

Hours/Fiscal Month	Dollars/Hour
less than 22	120
22 and between 22 and 44	115
44 and between 44 and 88	110
88 and between 88 and 176	105
176 and up	100
Unityper or Keypunch	3
High Speed Printer	15
Card-to-Tape Converter	10
Uniprinter	5

The above rates include good machine time and an operator and use of a large library of routines. Reasonable quantities of accompanying deleaving and bursting of multiple-part forms are performed without charge.

Customer is billed for time used to the nearest minute. No minimum charge.

Discount

A ten (10) percent discount will be allowed on Univac I Computer billing for those contracting for 22 or more hours in any fiscal month, subject to the following provision. A contract, purchase order, or the equivalent must be in effect prior to the beginning of the month of machine use for a specified amount of time that will be paid for by the customer whether used or not. The discount will be allowed on the specified amount of Univac I Computer time only, regardless of the acutal amount of time used. Time used in excess of that contracted for in this way will not be subject to the discount. The discount does not apply for peripheral equipment usage.

Services of Additional Personnel

The services of additional personnel are available for analysis, programming, coding and instruction or training of others on scientific or industrial applications at the following direct labor hourly rates which are subject to our standard overhead rate:

Senior Methods Analyst	$5
Mathods Analyst	4
Programmer	3

Supplies

The hourly rates listed above include the normal use of magnetic tape and continuous forms. Tabulating cards, special forms and other supplies are not included and all such materials, including tapes to be retained by the customer, will be billed at prices currently in effect and will represent an additional charge.

Estimates

Estimates or proposals are furnished upon request at no cost or obligation. Proposals can be based on a cost plus overhead, time and services, or fixed-price basis.

Agreements

We will start on receipt of your contract, purchase order, or written go-ahead. Operation is on a 4, 4, 5 week quarter. Fiscal January 1960 ends January 29. Billing is monthly unless specified otherwise.

Inquiries

Inquiries should be addressed as above or call LOcust 4-3600, Ext. 246 (Philadelphia 3, Pa.).

Effective Date

This rate schedule is effective 1 January 1960, and is subject to change.

Franklin Life

Good time	127 Hours/Week (Average)
Attempted to run time	148 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.867
Above figures based on period 1 Jan 60 to 1 Apr 60
Time is available for rent to outside organizations.

Franklin Life

Good time	138 Hours/Week (Average)
Attempted to run time	148 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.94
Above figures based on period 1 Jan 59 to 31 Dec 59
Passed Customer Acceptance Test 15 Mar 55
Time is available for rent to outside organizations.

General Electric Company

Good time	82.9 Hours/Week (Average)
Attempted to run time	93.9 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.872
Above figures based on period 2 Sep 56 to 23 Dec 56.
The "Good" time/week indicated above does not include re-run time. Good time is defined as the time that the Univac was producing good, usable output that did not have to be redone for any of a number of reasons associated with tape or machine malfunctions.

Great Northern

Good time	76 Hours/Week (Average)
Attempted to run time	80 Hours/Week (Average)

Operating ratio (Good/Attempted to run time) 0.95
Above figures based on period from Oct 58 to present
Passed Customer Acceptance Test Mar 56
Time is not available for rent to outside organizations.
System is operated 2 shifts per week.

New York University, AEC Facility

Good time	3,740 Hours
Attempted to run time	4,084 Hours

Operating ratio (Good/Attempted to run time) 0.91
Above figures based on period from Jan 56 to Jul 56
Passed Customer Acceptance Test Nov 52
These figures were essentially constant for two and one-half years.

Pacific Mutual Life Insurance Company
Operating ratio (Good/Attempted to run) Exceeds 0.90
Above figure based on period from Oct 55 to Dec 56

University of California Radiation Laboratory

Average error-free running period	5.5 Hours
Good time	1,816 Hours
Attempted to run time	2,000 Hours

Operating ratio (Good/Attempted to run time) 0.91
Above figures based on period 1 Jul 56 to 30 Sep 56
Passed Customer Acceptance Test 19 Nov 52

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Library and compiler routines for mathematical and commercial use and service routines for maintenance use are available to customers.

In addition to the checking circuits in the Central Computer, the Card-to-Tape Converter, the Tape-to-Card Converter and the High Speed Printer contain built-in checking features.

Design features which facilitate maintenance include accessibility of chassis through doors in the casework and accessibility of interwiring between chassis from inside.

Simultaneous reading, writing and computation are possible due to built-in buffer units.

Univac can read from one Uniservo; write on a second and rewind a third. Unless there is another read, write or rewind instruction immediately following, Univac may continue to compute while the reading, writing, and rewinding operations are being performed.

Army Map Service

Only metallic tape is used - on site storage in metal cabinets (standard supply cabinets w/vertical dividers on each shelf) and tape carts. Duplicates of program tapes in fireproof cabinets and duplicates of important permanent file data at Army Map Service Depository.

Machine was operated by Army Map Service at factory (Philadelphia) from date of acceptance, April 1952, until September 1952. After Serial No. 2 machine was installed and checked out in Washington (Air Force-Pentagon), and Serial No. 4 was completed and operating at factory, this machine was moved to its present site at Army Map Service. Full operation by Army Map Service started 4 January 1953, and machine has been operating 3 shifts/day 6 or 7 days/week ever since.

Bureau of the Census

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage, includes fire wall construction; metallic containers for magnetic tape, fire fighting organization and training, control system for defective and damaged tapes, standardization of tape reel lengths and markings.

C and O

Outstanding features include accuracy, reliability and duplicated circuitry.

Tape labelling by Labelon Marking Tape; permanent wall cabinets provided for tape storage to protect against dirt and physical damage.

Leased time from Case Institute includes only the Central Computer and not the auxiliary equipment.

Franklin Institute

System is maintained by Franklin Institute personnel. Changes and modifications provide 15% to 25% increase in speed without affecting Univac I compatability.

Labelon and self sticking adhesive used to identify tapes. Metal wall cabinets provide storage for 3,600 tapes. Area completely air conditioned and humidity and temperature has never been problem. Area in use or patrolled at all times and equipment available to minimize fire hazard.

Open or closed shop operation on 3 shift basis. Government, industrial and scientific work.

Univac System Changes

Continuous Write

A continuous write feature has been installed in the F.I.C.C. Univac I. Start-stop time is eliminated when writing sequential "strings" of data. System evaluation is not possible as the change has been in use only a short time. A complete tape may be generated in a continuous mode, in approximately three minutes (rewind time). A maximum gain of 25% may be expected in tape limited applications.

A continuous read modification is presently being installed.

The continuous write consists of 14 tubes and associated hardware. Installation time is not known since the modification was undertaken on a development basis.

Clear 0 Tanks on Read-In Switch

A switch has been added to select read-in or read-out clear. It has prevented re-runs on many occasions by allowing re-write on output errors.

File Computer Operation

The Remington Rand File Computer is capable of producing tape output that is acceptable to the Univac I Computer. Standard Univac I output cannot, however, be read by file equipment.

F.I.C.C. recently tackled the problem of reverse compatibility. Certain problems center about the difference between the two computers. Other headaches are primarily a result of the use of plastic tapes.

A practical working solution has been found to the Univac I File problem. The necessary modifications have been installed at F.I.C.C. The Univac I can be switched to file mode in approximately one minute.

A list of the changes necessary to generate file output is available upon request.

Empty 1 Tank Inhibit

Circuitry has been installed in the central computer to prevent dumping an empty 1 tank. The circuits actually combine the 1 overlay and empty 1 tank into one modification.

The change involves 2 tubes and associated components. The rewind overload neon on supervisory control was removed and a blinking neon substituted as an indicator.

Q and T Order Modification

It has been demonstrated that a faulty contact can cause loss of screen voltage on one or more tubes resulting in introduction of errors which might remain undected until output is examined and inconsistencies noted.

Through the installation of duplicate backboard terminals, this has been corrected. Univac II installations desiring more technical information on this change are encouraged to request same.

High Speed Printer

The rectifier bottles in the H.S.P. power supply have been eliminated in part. Silicone (Texas Instruments) diodes have been installed. The initial cost of the silicones is less than the price of the "bottles" and a much longer and trouble free life can be expected. Generated heat in the unit has been reduced by two kilowatts.

The silicone diodes have been operational for eight months and have been completely trouble free.

Intermittent operation of the switches on the printer console has been traced to dirt filtering into the switch contacts. A vinyl bag was constructed and the entire area sealed. There have been few troubles since this addition.

Card to Tape

The card to tape card feed unit has been souped up to 320 cards per minute. No circuit changes were found necessary. The unit was retimed for this speed and has performed admirably.

Tektronix Scope

An "A plus B" sweep has been wired into one 535 scope. It allows two signals to be displayed simultaneously on a single sweep. It is particularly useful in observation of signal timing in "difficult to live with" input-output areas.

This change, consisting of one capacitor and one resistor, is being checked out with the Tektronix organization.

Literature

Literature is available on request to Franklin Institute Director, Computer Center, 20th and Parkway, Philadelphia 3, Pa.

Franklin Life

Outstanding feature is dual circuitry.

Great Northern

Adopted procedures for magnetic tape labelling, storage, shipping, and protection from humidity, temperature and physical, electrical, fire, or other damage include external and internal label, distribution of copies of different tapes in other offices in same building. Plan to purchase fireproof case.

FUTURE PLANS

Army Map Service

Minneapolis-Honeywell H800 Computer currently on order to replace present Univac I. Delivery scheduled for early 1961. Univac I will be retained for at least 6 months to 1 year after H800 delivery, so that conversion process to new equipment can be made in an orderly and gradual manner.

H800 equipment to include the following major features:

16,000 word memory
Floating point operation
2 tape control units
12 magnetic tape units
High speed printer (on or off line)
Card Reader

New applications include:

Processing digitalized map (topographic) data including digital mal library

Preparing tape for controlling router to carve terrain models

Intercontinental geodetric datum adjustments
Special satellite and space programs
Other classified projects

Internal Revenue

An IBM system has been designated for Service wide use. Details of the system as to components, application, etc. are not available for public release at this time. Initial installation of equipment is scheduled for October 1961.

It is planned to compile as much statistics of income data as possible as a by-product of data recording for operational purposes in the described ADP Master File system.

INSTALLATIONS

Bureau of Census
Department of Commerce
Washington 25, D. C.

Office of the Air Controller
Headquarters U. S. Air Force
Washington 25, D. C.

Army Map Service
6500 Brooks Lane
Washington 25, D. C.

Bureau of Ships
Department of the Navy
Washington 25, D. C.

David Taylor Model Basin
Applied Mathematics Laboratory
Washington 7, D. C.

Air University
Maxwell Air Force Base, Alabama

Wright Patterson Air Force Base (AMC)
Air Materiel Command, Dayton, Ohio

Bureau of the Census
Washington 25, D. C.

Bureau of the Census
Federal Office Building No. 3
Suitland, Maryland

Air Materiel Command, Sacramento, California

Air Materiel Command, Gentilly

Internal Revenue Service
12th and Constitution Ave., N. W.
Washington 25, D. C.

New York University (AEC)
45 Fourth Avenue
New York, New York

University of California (AEC)
Radiation Laboratory, P. O. Box 808
Livermore, California

Electronic Computing Center
Remington Rand
315 Fourth Avenue
New York, New York

General Electric Company
310 West Liberty Street
Louisville, Kentucky

Metropolitan Life Insurance Company
One Madison Avenue
New York 10, New York

United States Steel
National Tube Division
525 William Penn Place
Pittsburgh, Pennsylvania

E. I. du Pont de Nemours and Company
Louviers Building
Wilmington, Delaware

United States Steel
Gary Steel Works
Chicago, Illinois

Franklin Life Insurance Company
800 South Sixth Street
Springfield, Illinois

E. R. A.
1900 W. Minnehaha Avenue
St. Paul 4, Minnesota

Pacific Mutual Life Insurance Company
Box 6050, Metropolitan Station
Los Angeles 55, California

Westinghouse Electric Company
P. O. Box 2278 3 Gateway
Pittsburgh 30, Pennsylvania

Electronic Computing Center
Remington Rand
2601 Wilshire Blvd.
Los Angeles, California

Chesapeake and Ohio Railroad
400 Terminal Tower Building
Cleveland 1, Ohio

John Hancock Mutual Life Insurance Company
200 Berkeley Street
Boston, Massachusetts

Consolidated Edison Company of New York

Metropolitan Life Insurance Company
One Madison Avenue
New York 10, New York

Life and Casualty Insurance Company of Tennessee

Frankfurt, Germany, Service Bureau

Sylvania Electric Products, Incorporated
Camillus, New York

Great Northern Railroad
175 E. Fourth Street
St. Paul 1, Minnesota

The Franklin Institute
20th and Parkway
Philadelphia 3, Pennsylvania

University of Pennsylvania
The Computer Center
Philadelphia 4, Pennsylvania

Boston, Massachusetts, Service Bureau

Consolidated Edison
4 Irving Place
New York 3, New York

The Carborundum Company
Buffalo, New York

Sperry Gyroscope

Harvard University
Cambridge, Massachusetts

UNIVAC II

Universal Automatic Computer Model II

MANUFACTURER

Remington Rand Univac Division
Sperry Rand Corporation

APPLICATIONS

Manufacturer
General purpose digital computer.

U. S. Navy Electronics Supply Office
Located at the Southwest corner of 1st deck, ESO Building, Great Lakes, Illinois, the system is used for inventory control (180,000 items, 21 stock points $200 million value. Weekly stock review, redistribution, procurement, and allocation), for electronic repair parts allowance lists (active plus reserve ships, shore installations, etc. Weekly process), for stock number identification (Technical document for use by electronic technicians), for Tables and Allowance Guides (To maintain and support a specific model of electronic equipment or system. Tri-weekly process), for consolidated load lists (Computed and tailored requirements lists for maintaining proper range and depth of stock aboard tenders and supply support ships. Semi-annual process), for stratification of assets and requirements (A stratified item-by-item comparison of system inventory vs future needs to identify material which will be purchased or declared excess during the apportionment and budget fiscal years. Annual processing), for contractor performance and analysis (Control of material ordered from suppliers to determine; contractor performance, cost, procurement lead time and its variation, overdue contracts, contractor follow-up, etc. Weekly process) and for management statistics (Various statistical controls to measure activity and system effectiveness, stock turn-over, volume of issues, sales, etc. Weekly and quarterly process).

Photo by U. S. Navy Electronics Supply Office

U. S. Department of Agriculture
Commodity Stabilization Service
Located at the CSS Commodity Office, Kansas City, Missouri, the system is used in the Grain Price Support Program. This involves processing price support loan and purchase agreement transactions for the 31 states served by this office as a data processing center for this program. This application includes computation of loan and purchase transactions, prep-

aration of settlement statements with farmers and producers, and recordation of accountability for these transactions - approximately 1 million transactions are processed annually.

Metropolitan Life Insurance Company
Located at 1 Madison Avenue, NYC (3 Univac II's) and 315 Park Avenue So., NYC (across the street - 1 Univac II), the four systems are used for actuarial (classification, valuation, mortality studies and special studies), for debit accounting (preparation of life and lapse registers), for payroll, for city mortgage accounting, and for ordinary policy service (billing, dividend calculation, premium, dividend and commission accounting).

Pacific Mutual Life Insurance Company
Located in the Home Office Building in Los Angeles, California, the computer is used as the integral part of an integrated data processing system used to do our normal billing, collections, valuation, lapses, agents records, commissions, loans, claims and just about every other facet of the ordinary life insurance work. In addition we do some actuarial studies, agency department contest records and several miscellaneous jobs.

United States Steel Corporation
Located at 1509 Muriel Street, Pittsburgh 3, the system is used for accounting, statistical, analytical,

Photo by U. S. Navy Electronics Supply Office

and engineering (multiple correlations and regression analyses) problems.

PROGRAMMING AND NUMERICAL SYSTEM

Internal number system	Binary coded decimal
Decimal digits/word	12
Decimal digits/instruction	6
Instructions per word	2
Instructions decoded	54
Instructions used	54
Arithmetic system	Fixed point
Instruction type	One address
Number range	Between -1 and +1

Decimal point occurs at the right of the sign digit.

ARITHMETIC UNIT

	Incl Stor Access Microsec	Exclud Stor Access Microsec
Add	160	120
Mult	1,720	1,680
Div	3,030	2,990
Construction	Vacuum tubes	
Arithmetic mode	Serial	
Timing	Synchronous	
Operation	Sequential	

Addition, subtraction, and multiplication times given below include reading and executing the instruction. The time includes formation of the result in the accumulator. All instructions, however are performed at minimum latency rates.

Average Operating Speeds in Microseconds	
Addition or Subtraction	200 (11-digit numbers)
Multiplication	1,900 (11-digit numbers)
Division	3,700 (11-digit numbers)
Comparison	200 (12-digit numbers)
Transfer (Memory to Register or vice versa)	40/word + 80/instruction

STORAGE

Manufacturer	
Medium	Magnetic Core
Capacity	10,000 words 120,000 characters
Memory Locations	0000 - 1999
Access time	Zero (Memory references begin during "Time Out")
Basic Cycle	20 microseconds
Construction	42 separate magnetic core planes, each one a rectangle 50 cores wide and 80 cores long.

Each of the planes is divided into two sections of 50 by 40 cores, making 2,000 cores in each section. Each section contains one core - for one binary position (bit) - of every one of the 2,000 words. The same relative binary position of the other half-word is held in a core in the same physical location in the other section of the plane. Thus each plane contains two binary positions in each of 2,000 words; the first and 43rd, for example, or the 9th and 52nd. Physically the memory is a rectangular prism 7 1/4 inches x 10 inches x 12 3/4 inches.

Photo by Great Northern Railway Company

A memory location thus always implies two cores in all 42 planes. The two cores are determined by the intersection of one column of fifty possible columns with two rows of the 80 possible rows. One row is in each section of the plane. All 42 planes are used twice for each word.

Associated with the memory is a half-word insertion register of 42-bit capacity. Each bit is temporarily stored in a magnetic core of this register during a memory reference. Each of these register cores is associated with one of the 42 memory planes. To write into the memory, the first half of the word is placed in the insertion register and the address selector alerts the appropriate column and the proper row of the top section in each of the 42 planes. At the appropriate instant the information is transferred from each core of the insertion register to the selected core in the corresponding plane of the memory. 42 pulse times later, the second half word has been placed in the insertion register and the process is repeated in the lower section of the memory. Read-outs are accomplished in a reverse manner. The speed of the memory has been adjusted to the speed of the arithmetic portion of the Univac which permits the transfer into or out of the memory of 12 characters in 40 microseconds. Word pulses flow from or to the high speed bus and the insertion register via a mechanism which converts from serial to parallel and vice versa, in 42 bit modules.

All users utilize a 2,000 word 24,000 digit, magnetic core storage unit.

Commodity Stabilization Service
16 - Uniservo II's

Photo by Great Northern Railway Company

INPUT

Manufacturer Media	
Magnetic Tape (Uniservo II)	20,12.4, or 5 Kc digit rate; 100 in/sec
Keyboard	Manual
Unityper II	Manual (50 char/in density)
Card to Tape Converter	240 cards/min (80 or 90 col cards)
Paper Tape to Magnetic Tape Converter	200 char/sec (5, 6 or 7 channel)
Verifier	Keypunching (Verification of Unityper II Tapes)

The UNISERVO II

Purpose

The Uniservo II transports tape over a standard magnetic head (for reading and recording) under the control of Univac II.

Physical Specifications

The Uniservo is housed in a cabinet, the upper section of which contains the reel mounts and is covered by a removable glass door. The front panel doors are interlocked such that the center drive is stopped whenever the doors are opened. The entire front cover is easily removed, giving access to the loops.

Height	62 inches
Width	30 inches
Depth	30 inches
Working Space	6 ft 5 in x 5 ft 9 3/4 in.
Weight	650 lbs.

Operation

Input Function. A Uniservo may be used to read the coded, magnetic dots on the tape moving forward or backward and transfer the data in the form of electronic pulses to Univac.

Output Function. A Uniservo may be used to record the results of Univac processing in the form of coded, magnetic dots on a metallic tape or a mylar tape moving forward.

Reel Mounts. The reel mounts hold the standard 6 inch and 8 inch reels for magnetic tape and an 11 inch reel for mylar tape.

Tape Handling System. There are two independent servo systems - the two reel motor servos. The center drive is a magnetic clutch and the control signal to the clutch is supplied by Univac. The tape around the center drive hub is isolated from the tape reels by two loops of tape. The reel servos are controlled by loop size detectors.

The mylar spacer used on Uniservo I, has been eliminated on Uniservo II to accommodate the higher pulse writing density. A new hard surface to minimize head wear is being provided on Uniservo II.

Standard Magnetic Head. The standard magnetic head reads from or records in 8 channels. Seven of the channels are used for the 7-pulse code of the Univac System and the 8th channel is a sprocket channel.

Tape speed. 100 inches per second (nominal). Tape packing density 120 characters/inch.

Magnetic Clutch. Uniservo II is equipped with a magnetic clutch which provides the following:

Start-Stop time of 5 milliseconds maximum.
Reading or writing speed of 51 milliseconds for 720 characters (51 ms maximum to start, read 1 block, and stop).

Rewind of any number of Uniservos, up to and including 16, simultaneously.

Safety Switches. The Uniservo is fully equipped with safety switches which apply brakes to the reels if either of the 2 loops exceeds the prescribed length.

Control. The control of a Uniservo is maintained by Univac and exercised during a program by the following types of instructions:

Read Forward
Read Backward
Record at high pulse density
Record at low pulse density
Rewind without interlock
Rewind with interlock

Connection to Univac. As many as 16 Uniservos may be connected to Univac II at any one time. The connection is made by means of a sectional trough on the top of the line of Uniservos and continuing from the first Uniservo of the line to one corner of Univac. Uniservos may be electrically interchanged without effecting the program.

Power Requirements

The main power for the Uniservos is supplied by Univac.

USN ESO

Media	Speed
Unityper	Keyboard
(Off-line: source document/Univac tape)	
Card-to-Tape	240 cards/min (Off-line)
Uniservo (Tape Station) (On-line, read operation)	25 Kilocycle/sec

Commodity Stabilization Service

Off-line Equipment

1 Card-to-Tape Converter (80 column card)
2 Tape-to-High Speed Printers (600 lpm printers)
1 Bi-directional Paper Tape to Magnetic Tape (B-PTM-7)
1 Tape Cleaner
2 Unitypers

Metropolitan Life

Medium	Speed
Univac Card-to-Tape Converter	240 cards/min

Pacific Mutual

Uniservo II	100 inches/sec
	250 char/inch

Very reliable with metallic tape. Input buffering of 60 words of magnetic core.

USS

Magnetic Tape	250 char/in
	100 inches/sec

80-column card to magnetic tape converter. 300 cards per minute.

OUTPUT

Manufacturer Media	
Magnetic Tape (Uniservo II)	20, 12.4, Or 5 Kc digit rate
Uniprinter	10 char/sec (20 char/in density)
High Speed Printer	600 lines/min (130 char/line, maximum)
Tape to Card Converter	120 cards/min (80 col cards)
Magnetic Tape to Paper Tape Conversion	60 char/sec (5, 6, or 7 channel)
Magnetic Tape to Magnetic Tape Transrecorder	90 char/sec (Speed dependent upon communication facilities)

USN ESO

Media	Speed
Tape-to-Card	120 cards/min (Off-line)
High Speed Printer	600 lines/min (Off-line)
Uniservo (Tape Station) (On-line, write operation)	25 Kilocycle/sec

Metropolitan Life

Univac Hi Speed Printer	600 lines/min
Univac Tape to Card Converter	120 cards/min

Pacific Mutual

Uniservo II	100 inch/sec
	250 char/in

Very reliable with metallic tape.

Output buffering of 60 words of core. Can simultaneously read on 1 tape handler, write on a second and be rewinding a third.

USS

Magnetic Tape	250 char/in
	100 in/sec
High Speed Printer	600 lines/min (Off-line)

Magnetic tape to 80-column card converter - 120 cards per minute.

CIRCUIT ELEMENTS OF ENTIRE SYSTEM

Tubes	5,200
Tube types	20
Crystal diodes	18,000
Magnetic cores	184,000
Transistors	1,200
Separate cabinets	4

Above figures are approximate and do not include input-output devices.

CHECKING FEATURES

Checking Circuits

Whenever feasible, registers and other circuits appear in duplicate. Their contents are continuously compared so that inconsistencies between the data in the identical units give an indication of faulty operation, and stall the computer. At this point, the instruction may be repeated.

The pulse code used in the Univac System is so designed that all characters contain an odd number of pulses. At several strategic points within Univac, every character is checked for an odd number of pulses. An indication is given whenever an even number of pulses is detected, and the computer stalls. Other types of checking circuits cause Univac to stall when other types of errors occur.

An error occurs if reference to a non-existent memory address is attempted.

An odd-even error in the transfer rI to rM will result in a transfer stop and the location of the error (rI address) will be indicated.

The 720 character count will be displayed on a modulus 100 counter.

"All ones" checker. In addition to the parity bits check on the high speed bus, a second checker establishes that the invalid "all ones" character is not inadvertently created by a system fault.

Input and output checkers also detect the invalid "all ones" character.

Built-in checking features are contained in the Card-to-Tape Converter, the Tape-to-Card Converter and the High Speed Printer.

Fusing

Univac is completely fused in order that faults may be isolated. Each bay has its own set of fuses in addition to main fuses on all DC and AC potentials.

If a fuse blows, power is shut off and an indicator circuit shows in which bay the blown fuse is located, and a "flag" indicates the specific fuse.

Voltage Monitoring

An automatic voltage monitoring system continuously monitors all critical DC potentials giving an alarm if any moves outside the prescribed limits.

POWER, SPACE, WEIGHT, AND SITE PREPARATION

Manufacturer

Univac has a separate power supply unit. The Univac II is designed to operate from a power service of 480 volts, 208 volts or 240 volts, three phase, 60 cycle. The system voltage must be specified in advance in order that the switch gear and 75 KVA transformer listed below may be properly supplied.

Power Requirement:

	Kw	KVA	PF
Motor Generator	47.3	59.2	0.8
Heaters	45.0	45.0	
Blower Motor	6.1	7.65	0.8
Standby, etc.	2.0	2.0	
Uniservo 16 x 1.5 Kw	24.0	30.0	0.8
	124.4	143.85	

Univac II Power System

The electrical power system for Univac II Central Computer and Uniservos consists of a packaged switchgear unit, a 75 KVA transformer, a 400 cycle motor generator set and a power supply unit. The power and control installation for the chilled water system and the peripheral equipment are discussed below. Wiring between units of the system is to be done by the user.

Switchgear. The switchgear unit controls the incoming power, the motor generator set supply and 400 cycle output circuit, the filament power and Uniservo power, and it is the center of all power control circuits. The main line circuit breaker will be supplied according to the system voltage. The motor starter will always be supplied for 480 volts. Dimensions: 8 ft 4 in wide; 30 in deep; 6 ft high.

75 KVA Transformer. A 75 KVA transformer, air cooled type, is supplied for mounting by the customer. If the system voltage is 480 volts the transformer will be 480/208 and connected between the main line circuit breaker and the filament power circuit breaker. If the system voltage is 208 volts the transformer will be 208/480 and connected between the main line circuit breaker and the motor circuit breaker. If the system voltage is 240 volts the transformer will be β40/480 and connected between the main line circuit breaker and the motor circuit breaker.

Motor Generator Set. The motor generator set consists of a 75 HP motor and two 25 KVA, 0.9 power factor 400 cycle generators. The motor is served by 480 volts, 3 phase from the switchgear. The 400 cycle output is controlled by electrically operated circuit breakers in the switchgear. Control of 400 cycle voltage and excitation for the generators is by the exciter regulator units in the switchgear.

Base 93 in long x 24 in
Overall 104 1/8 in long x 29 in
Area - 15.8 sq ft
Floor loading - 284 lbs/sq ft

Space Requirements

	Approximate Dimensions
Height	102 9/16 in.
Width	171 3/8 in.
Depth	94 3/4 in.
Working Space	16 ft x 22 in.
Weight	16,000 lbs

Univac contains thirteen bays of chassis. These bays are arranged in a structure resembling a letter "C". There are two bays at each end, five bays along one side and four bays and a door allowing access to the interior of Univac along the other side.

Each bay contains three-tiered sections. Each section contains twelve removable or plug-in type chassis. The chassis in each bay are accessible through doors which make up the casework. The core storage sections, however, contain 36 printed circuit chassis.

The inter-wiring between chassis is one the back boards of the sections and bays and is accessible from inside Univac.

Cooling System Requirements. The heat generated by the 5,200 vacuum tubes and the electronic components requires a cooling system. The Central Computer, Uniservos and power supply are cooled by a circulating chilled water system. 130 gallons per minute of 50° water are required. A three way mixing valve with controls and a circulating pump are required for the Central Computer and Uniservos. The power supply unit contains its own control. Water connections for the power supply may enter the cabinet either at the top or bottom. Water connections for the Central Computer and the Uniservos are at the sides near the floor and the piping may be run either on the ceiling or below the floor.

Refrigeration System Requirements. The Central Computer, Uniservos, and power supply units require 35 Tons of refrigeration.

USN ESO

Power, computer	190 Kw	190.5 KVA	0.95 pf
Power, air condit	75 Kw	75 KVA	0.9 pf
Volume, computer		1,200 cu ft	
Volume, peripheral equip		10,560 cu ft	
Volume, air cond & cooling tanks		1,200 cu ft	
Area, computer		1,636 sq ft	
Area, peripheral equip		1,056 sq ft	
Area, air conditioning		450 sq ft	
Room size, computer		49.5 ft x 33 ft	
Room size, peripheral equip		32 ft x 33 ft	
Room size, air conditioning		400 sq ft	
Floor loading		20 lbs/sq ft	
		250 lbs concen max	
Capacity, air conditioner		75 Tons	
Weight, computer		36,000 lbs	
Weight, peripheral equip		14,000 lbs	
Weight, air conditioner		3,000 lbs	
Total weight		53,000 lbs	

Building modifications consisted of trenching in floors to accommodate chilled water cooling system and power cables. Water supply and return with 100 ton cooling tower and basin installed on roof of building. 75 ton compressor to produce cold water for ADP equipment and room air conditioning. Duct work for room air conditioning is installed in regular ceiling. Existing power facilities were adequate to assume the load from ADP without modification.

Metropolitan Life

Power, computer	124 Kw	144 KVA	0.86 pf
Power, water cooler		25 Kw	
Volume, computer, 16 servos, power units		1,200 cu ft	
Area, computer, 16 servos, power units		250 sq ft	
Area, water cooler		900 sq ft	
Room size		2,000 sq ft	
Floor loading		10 lbs/sq ft	
		284 lbs concen max	
Capacity, water cooler		50 Tons per comp.	
Weight, computer		16,000 lbs	
Weight, water cooler		13,000 lbs	

Above figures are for each computer.

Walled room for motor-generator sets and voltage regulators and switch gear, fenced areas for tape storage, installed separate refrigeration equipment on 15th floor and water lines to computers on 20th floor, installed power lines from 15th floor transformers to 20th floor, dug channels in concrete floor for lines between electronic units.

Pacific Mutual

Power, computer	150 KVA 1.0 pf 3 phase
Room size, computer	1,500 sq ft
Floor loading	150 lbs/sq ft
Weight, computer	35,000 lbs

Installed special power lines to fourth floor site from special switchboard directly from street transformer. False ceiling primarily for esthetic purposes. Ducts installed for room air conditioning.

USS

Power, computer	221 Kw	246 KVA	0.90 pf
Power, air cond	90 Kw	106 KVA	0.85 pf
Volume, computer		70,630 cu ft	
Volume, air conditioner		28,996 cu ft	
Area, computer		7,063 sq ft	
Area, air conditioner		2,636 sq ft	
Floor loading		250 lbs/sq ft	
		250 lbs concen max	
Capacity, air conditioner		148 Tons	
		25,000 cu ft/min	

Converted warehouse to office-type space. Plenum chambers provided. Complete air filtering and air-conditioning. Installed ceiling lights, wall panels and tiled floor. 440 volt supply to switch gear. Equipment fed by conduit and cable racks.

COST, PRICE AND RENTAL RATES

Manufacturer (Original Prices)

Description	Base Monthly Rental 1 Shift 5 Day Week	Outright Sale Price F.O.B. Factory
Univac II Central Computer w/power supply & supervisory ctl desk	$18,540.00	$970,000
Uniservo II	450.00	20,000
Uniprinter	390.00	22,000
Extra Dolly Assembly for Uniprinter	122.50	7,000
Unityper II	90.00	4,500
Verifier	Not currently available	
High Speed Printer	3,300.00	185,000
Card-to-Tape Unit w/47 character code	2,520.00	142,100
Card-to-Tape Unit w/38 character code	2,500.00	---
Tape-to-Card Unit	2,300.00	130,000
Perforated Tape to Magnetic Tape (PTM) Converter	1,800.00	108,000
Magnetic Tape to Perforated Tape (MTP) Converter	1,500.00	90,000

The high speed printer and the card-to-tape unit with the 47 character code requires a customer furnished voltage regulator. Prices are subject to change without notice.

Rental charges include maintenance service, spare parts and test equipment. Separate maintenance contract and maintenance advisory service contract available to purchasers of Univac Systems.

USN ESO

	Prime Monthly Usage Rates
Central Computer w/12 Uniservos	$23,940
High Speed Printer	4,250
Card-to-Tape	2,540
Tape-to-Card	2,385
Unityper	90
Verifier	250

Metropolitan Life

4 Univac II's, ea, with 16 Uniservos, total $4,035,000.

3 Card-to-Tape Converters, 2 Tape-to-Card Converters, 3 High Speed Printers cost $1,345,000.

1 High Speed Printer rents at $5,000/month.

Maintenance service for 4 Univacs and auxiliaries cost $52,000/month.

Pacific Mutual

Unitypers, computer, servos and printer cost approximately $1.5 million.

Maintenance service is performed by own maintenance staff.

USS

Basic system includes two (2) Univac II Computers, twenty-eight (28) Uniservos, one (1) Unityper, and one (1) Unityper-verifier.

Additional equipment includes one (1) Card-to-Tape Converter, one (1) Tape-to-Card Converter, and two (2) High Speed Printers, with core buffers.

Equipment is rented. Maintenance is performed by the lessor.

PERSONNEL REQUIREMENTS

Manufacturer

The number of engineers, technicians and operators required depends upon the equipment complement of the Univac System and the shift operation.

USN ESO

	One 8-Hour Shift		Two 8-Hour Shifts		Three 8-Hour Shifts	
	U	R	U	R	U	R
Supervisors	5	5				
Analysts	7	8				
Programmers	16	20				
Clerks	5	5				
Librarians	1	1				
Operators	2	2	4	4	5	6
Engineers	4	4	6	6	8	9
In-Out Oper	2	2	4	4	6	6
Tape Handlers	1	1	2	2	3	3

The operators include the shift supervisor for each of the 1st and 2nd shifts.

Engineers are Remington Rand personnel included as part of the rental contract.

Operation tends toward closed shop.

Methods of training used include 8 weeks of classroom instruction plus 18 weeks of on-the-job training. Formal training agreements between ESO and Civil Service Commission.

Government wages in this line of work are not competitive with those being offered by ADPS users in industry and/or ADPS manufacturers. Skilled employees after 18-24 months training and experience in this field of work are showing a growing tendency to accept non-government employment.

Metropolitan Life

	One 8-Hour Shift		Two 10-Hour Shifts 4 Days/Week	
	Used	Recomm	Used	Recommended
Supervisors	4	4	6	8
Programmers	6	6		
Clerks	12	13		
Librarians	3	3		
Operators				14
In-Output Opera				24
Tape Handlers				4

Methods of training used includes suppliers classes for programmers and operators, occasional special classes run by programming coordinator, and on-the-job training for clerks, librarians, tape handlers, and in-output operators.

Machines work 20 hours per day, 6 days per week. Operators work 10 hours per day, 4 days per week.

Pacific Mutual

	Three 8-Hour Shifts	
	Used	Recommended
Programmers	26	
Librarians	0	1
Operators	5	6
Engineers	9	9
In-Output Opera	4	5

Operation tends toward open shop.

Method of training used is basically on-the-job training with some formalized classroom work.

"Typical" personnel is difficult to recommend or give with great detail due to emphases and approaches to the problem. Each group must study their own problem and then work out the personnel set up.

USS

	Two 8-Hour Shifts
Supervisors	7
Analysts	33
Coders	2
Clerks	4
Operators	5
In-Output Opera	3
Tape Handlers	4

Methods of training used includes equipment manufacturer schools, internal schools, and on-the-job training.

RELIABILITY, OPERATING EXPERIENCE, AND TIME AVAILABILITY

Manufacturer

Reliability and operating experience based on the formula: (Available Operating Time minus Lost Time) divided by (Scheduled Operating Time). The cumulative performance reports for Univac I Central Computers have averaged 93.0%.

USN ESO

Average error-free running period 16 Hours
Good time 123 Hours/Week (Average)
Attempted to run time 136 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.90
Above figures based on period 1 Jul 59 to 30 Apr 60
Passed Customer Acceptance Test 1 Jul 58
Time is not available for rent to outside organizations.

Computer is normally run for 40 straight hours and then there is an 8 hour preventative maintenance shift before the next 40 hours.

The 10 per cent lost time includes losses as a result of tape; computer, operator, program and data error conditions.

Metropolitan Life

Good time 102.2 Hours/Week (Average) includ good rerun time
Attempted to run time 112.7 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.91
Above figures based on period from Jan 59 to Jan 60
Passed Customer Acceptance Test May 58
Time is not available for rent to outside organizations.

These Univacs were acquired under an option to convert Univac I's to Univac II's. The first Univac I was accepted in late 1954.

Pacific Mutual

Good time approx 100 Hours/Week (Average)
Attempted to run time 120 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) About 0.80 and improving.
Above figures based on period 1 Jan 60 to present
Passed Customer Acceptance Test 1959
Time is not available for rent to outside organizations.

USS

Good time 120 Hours/Week (Average)
Attempted to run time 137 Hours/Week (Average)
Operating ratio (Good/Attempted to run time) 0.87
Above figures based on period 14 Mar 60 to 9 Apr 60
Passed Customer Acceptance Test May 59
Time is not available for rent to outside organizations.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

Buffer Units

Input buffer (rI) 60 words of core storage. Input character rate up to 40,000 per second - dependent upon speed of Uniservos.

Output buffer (r0) 60 words of core storage. Output character rates of 20,000; 12,400; and 5,000 per second.

Transfer buffer (rW) 9 words of core storage. Cooperates with main memory during V and W instructions to transfer up to 9 words at 25,000 words per second. Transfer buffer (rZ) 60 words of core storage.

Control of Operation

Univac is controlled by instructions which are recorded on tape and read into the memory. The instructions are stored in successive memory locations beginning at 0000. Two instructions may be stored in each memory location.

Simultaneous reading, writing and computation are possible due to built-in buffer units. Univac can read from one Uniservo, write on a second and rewind all other Uniservos simultaneously. Unless there is another read, write or rewind instruction immediately following, Univac may continue to compute while reading, writing and rewinding operations are being performed.

Univac starts operating in accordance with the instructions stored in memory location 0000 and refers automatically to suceeding memory locations. Certain of the instructions read from the tapes the source data upon which the instructions operate and store the source data in the memory. Other instructions cause Univac to record the results of the operations on tape.

The operation of Univac is controlled by automatic sequencing. It may be interrupted by instructions that transfer the control of Univac from one memory location to another memory location not in sequence. This mode of operation conserves space in the memory