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MANAGEMENT PLANNING PROGRAM IN INFORMATION SYSTEMS

RESIDUAL VALUE FORECASTS FOR IBM 3420 SERIES MAGNETIC TAPE SYSTEMS

APRIL 1981

MANAGEMENT PLANNING PROGRAM IN INFORMATION SYSTEMS

OBJECTIVE: To provide managers of large computer and communications systems with timely and accurate information on developments which affect today's decisions and plans for the future

DESCRIPTION: Cli ices each year:

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- "Vendor Watc f major computer/communicatic a communications software, mc arketing strategy areas.
- Management than technology or vendor relat nal, budget, and personnel iss
- EDP And Co ses and composite forecasts of r/communications managers by rating ratio data. Published dur
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- Inquiry Servi ch staff on an as-needed basis
- Presentation entations to client management

RESEARCH METHO mputers, communications, and assoc

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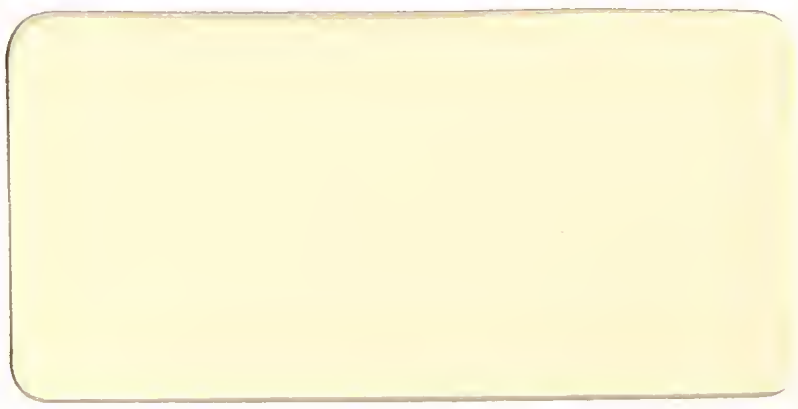
- Conclusions derived from the research are based on the judgement of INPUT's staff.
- Professional staff supporting this program average nearly 20 years of experience in data processing and communications, including senior management positions with major vendors and users.



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RESIDUAL VALUE FORECASTS
FOR IBM 3420 SERIES
MAGNETIC TAPE SYSTEMS

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ABSTRACT

This report reviews the technology, performance and history of IBM 3420 tape drive models. (Alternative designs such as the IBM 8809 "streaming" tape drive, and technologies such as Calcomp's "Automatic Tape Library" and IBM's 3850 mass storage system are mentioned briefly.) The impact of new technologies on conventional tape storage systems is assessed, and their future use is evaluated and projected. The price history of IBM 3420 tape drive series is reviewed, and residual values of all models are projected.

U-R10-413
April 1981

INPUT

RESIDUAL VALUE FORECASTS FOR IBM 3420 SERIES MAGNETIC TAPE SYSTEMS

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RESIDUAL VALUE FORECASTS FOR IBM 3420 SERIES MAGNETIC TAPE DRIVES

LIST OF EXHIBITS

I INTRODUCTION

- This report on IBM 3420 series magnetic tape drives is issued as part of the residual value forecasting service in INPUT's planning service for information systems managers. This report is intended to complement the basic program which produces residual value forecasts of large IBM and software compatible mainframes at six-month intervals.

- These periodic supplements are not meant to provide in-depth technical analysis of the selected peripheral area. They are rather designed to provide financial managers an overview useful in evaluating device acquisition decisions.

- Tape drive technology has undergone less frequent change than disk drive technology (INPUT's September 1980 Residual Value Forecasts for IBM Multiplatter Moving Head, Disk Storage Systems reported on IBM disk products). The disk market has seen very high growth rates. A 30% to 40% per year growth in on-line disk storage has caused manufacturers to push technological limits more aggressively, is resulting in a higher rate of new model introductions.

- The first models of the 3420 tape drive series (003, 005, and 007) were introduced in 1969. Since that time, growth in the installed base has grown at a modest rate (estimated at about 10% per year) and the quoted lead time from IBM for delivery of 3420 disk drives has averaged four to six months.

The delivery lead time for disk technology products has been considerably less stable.

- This report is provided in two sections.

  - Section II presents a review of magnetic tape storage technology.

  - Section III provides forecasts of residual values for IBM 3420 series products.

II A REVIEW OF MAGNETIC TAPE STORAGE TECHNOLOGY

- Magnetic tape storage technology is composed of three basic parts. These are the media, the tape drive, and the controller unit. This residual value report focuses only on IBM 3420 tape drives.

- The media is magnetic tape. For the 3420 tape drive, the tape is one-half inch wide and available in various lengths from a few hundred to a few thousand feet. The tape is spooled on a 10½ inch reel. The most common length is 2,400 feet, costing about $10 to $20 per reel depending upon the quality sought and quantity of reels purchased.

- Information is recorded on the tape as magnetized (or not) "spots" - thus a given "spot" represents one binary digit (or bit). The tape has nine parallel tracks each containing the bits of information. The tape read/write head thus sees sequential rows of nine bits each (where eight bits represent characters and the ninth bit is used for error checking).

- The tape drive is the device that moves the magnetic tape past the read/write heads. The principal difference between the six models in the 3420 tape drive series is the velocity with which the tape is moved past the read/write heads (designated in inches per second) and the tape recording density (in bytes per linear inch of tape) that the heads can read or write. Exhibit II-1 presents the principal characteristics of the IBM 3420 tape drive models.

EXHIBIT II-1

PRINCIPAL CHARACTERISTICS OF THE IBM 3420 TAPE DRIVE MODELS

IBM TAPE STORAGE DEVICE	YEAR ANNOUNCED	TAPE SPEED (INCHES/ SECOND)	TAPE RECORDING DENSITY (BYTES/INCH)	MAXIMUM DATA RATE (BYTES/ SECOND)	PURCHASE PRICE* (AS OF 3/81)
3420-003	1969	75	1,600	120,000	$17,790
3420-005	1969	125	1,600	200,000	22,680
3420-007	1969	200	1,600	320,000	24,990
3420-004	1973	75	6,250	470,000	20,845
3420-006	1973	125	6,250	780,000	23,945
3420-008	1973	200	6,250	1,250,000	26,295

*PURCHASE PRICE INCLUDES FEATURE 6631 (1600 BPI DENSITY) FOR MODELS 003, 005 AND 007 (COST = $3,450) AND FEATURE 6420 (6250 BPI DENSITY) FOR MODELS 004, 006 AND 008 (COST = $2,405).

- Much of the component cost of the 3420 tape unit is represented in the tape movement mechanisms that permit rapid starts and stops. This jerky movement as data on the tape is found and then transferred to the processor has been historically required by the host computer. A significant cost savings is feasible if such starts and stops are eliminated. Such units are beginning to be built (e.g., the IBM 8809 tape drive announced for 4331 and 8100 processors) and are called "streaming" tape drives.

- The 3420 model "family" is fully upward compatible, i.e., the least expensive model 003 can be upgraded in steps (or directly to) the most expensive model 008. The cost from IBM to convert from one model to another is shown in Exhibit II-2.

- Exhibit II-3 compares the dollar cost for model conversion to the incremental increase in the data transfer rate (in bytes/second) - both in actual units and as percentages. The relative "bargain," i.e., the percentage gain in data transfer rate compared to the percentage increase in the dollar investment varies significantly.

- The final component of the tape storage system is the controller unit. It is the "traffic cop" that regulates the flow of data between the tape drive and the processor. Typically a single controller can accommodate several tape drives (e.g., the 3803 control unit used with 3420 tape drives can attach up to eight tape units).

- Magnetic tape systems reside at the bottom of the memory hierarchy, as shown in Exhibit II-4. Computer systems employ a range of storage devices when processing information - where the trade-off between levels is the cost of storage versus the speed by which the stored data can be transferred to the processing unit.

- The strength of magnetic tape systems is their capability of storing very large amounts of data relatively cheaply. A weakness is the manual labor involved in locating the appropriate tape reel and mounting the reel on the tape drive.

EXHIBIT II-2

IBM 3420 TAPE DRIVE MODEL CONVERSION PRICES
(FIELD UPGRADABLE)

FROM \ TO	005	007	004	006	008
003	$4,890	$9,010	$10,010	$13,890	$16,820
005		9,010	10,010	10,660	16,820
007			10,010	10,660	11,290
004				3,880	13,420
006					13,420

NOTE: PRICES IN EFFECT AT MARCH 1981.

EXHIBIT II-3

COMPARISON OF MODEL CONVERSION DOLLAR COST TO INCREMENTAL INCREASE IN DATA TRANSFER RATE

IBM 3420 UPGRADE
CONVERSION RATIOS
(DOLLARS/DATA RATE)

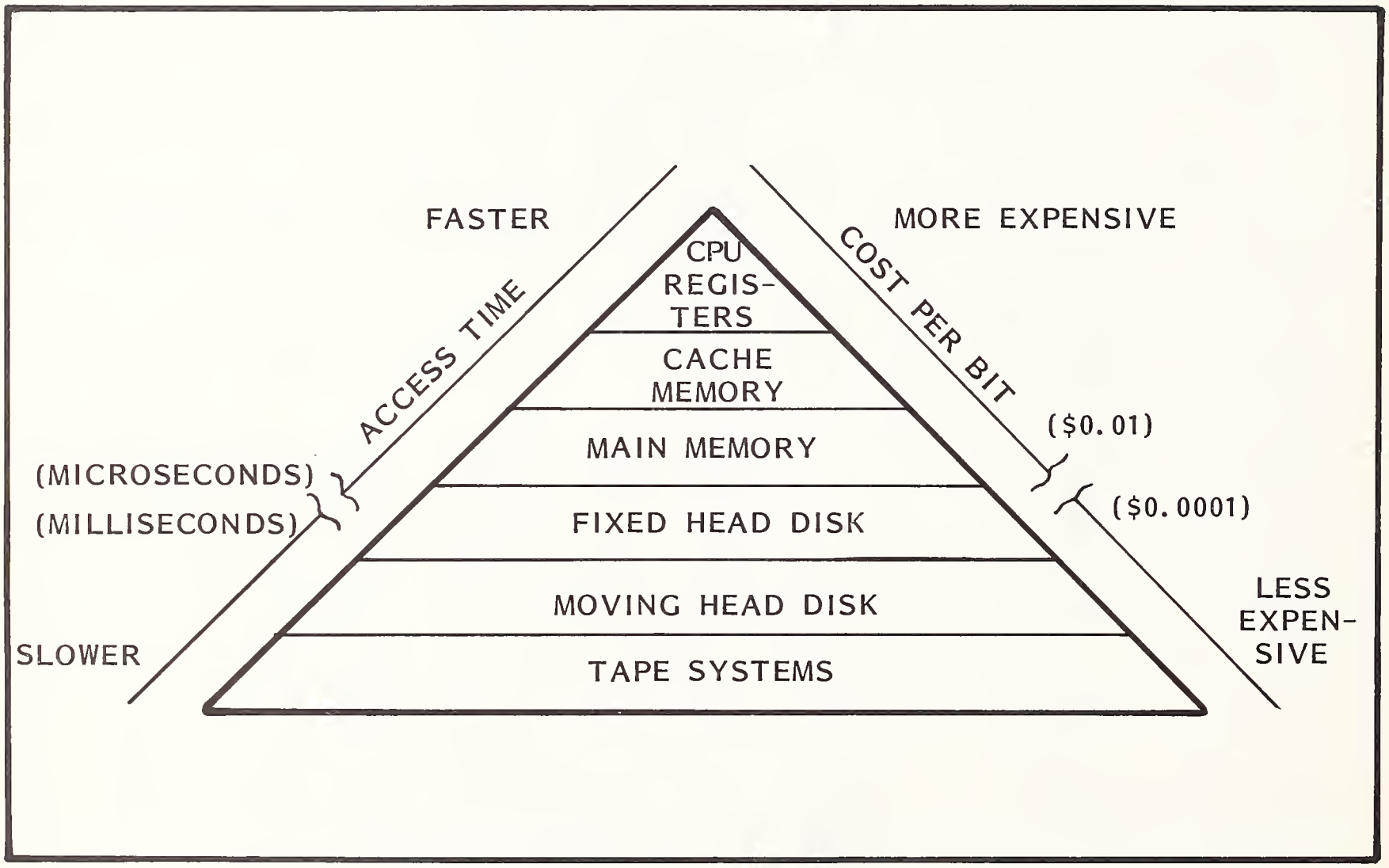
FROM \ TO	005	007	004	006	008
003	$4,890 80K	$9,010 200K	$10,010 350K	$13,890 660K	$16,820 1,130K
005		$9,010 120K	$10,010 270K	$10,660 580K	$16,820 1,050K
007			$10,010 150K	$10,660 460K	$11,290 930K
004				$3,880 310K	$13,420 780K
006					$13,420 470K

IBM 3420 UPGRADE
CONVERSION RATIOS
(PERCENT)

FROM \ TO	005	007	004	006	008
003	34% 67	63% 167	70% 292	97% 550	117% 942
005		47 60	52 135	55 290	87 525
007			46 47	50 144	52 291
004				18 66	62 166
006					54 60

EXHIBIT II-4

THE MEMORY HIERARCHY



This weakness led Calcomp Corp. to develop the "Automatic Tape Library" - a large mechanical system that uses robotics to pluck standard tape reels from containers and automatically mount them on standard tape drives. IBM's not very successful mass storage system product line (the 3850) was also designed to reduce the need for manual intervention in locating and "staging for processing" very large or infrequently accessed data files.

- The continuing rapid decline in the cost of disk storage - and the appearance of commercial bubble memory and optical disk products - has caused some to question the future viability of magnetic tape storage technology. Although these trends and emerging technologies will slow the growth pattern for magnetic tape systems, INPUT predicts magnetic tape will remain a major data storage medium at least through this decade.

- Tape storage systems currently support three major functions - and the displacement caused by emerging technologies may be very different across these three functions. The functions are:

  - Serial transaction processing - the retention of files suitable for serial processing; e.g., a payroll file where information records are processed (computation of salary payment) and updated (cumulative totals of taxes withheld, etc.) for employees of a company.

  - Archival storage - the retention of large files in computer readable form to satisfy auditability requirements or to permit retrieval of currently inactive information at a future date.

  - Disk storage back-up - the transfer of information from on-line disk storage devices to magnetic tape for "safe" storage. The tape reels are typically stored off-site to insure against catastrophic circumstances; e.g., fire or flooding.

- Although other technologies (e.g., mass storage systems using very high density tape or laser-based optical disks) will begin to absorb some of the data

storage now relegated to magnetic tape, retroactive conversion of tape libraries is not likely and an important role will remain for 3420 type tape systems for a number of years.

III RESIDUAL VALUE FORECASTS FOR THE IBM 3420 TAPE DRIVE SERIES

- The three principal forces influencing the residual values of IBM tape drives will be:
  - New product announcements.
  - Price changes on announced products.
  - Availability, either new from IBM or in the used market.
- The 1600 bpi model series (003, 005, 007) was announced in 1969. The upward compatible 6250 bpi model series (004, 006, 008) was announced in 1973.
- There was a strong rumor that IBM would announce new tape drive technology with the H-series computer family. This did not happen. The expected new product line was reported to have three models (data transfer rates of 1.5, 2.5, and 3.2 megabytes/second) using half-inch tape media in cartridges. The media would employ 18-track format at 20,000 linear bits per inch.
- At least one PCM competitor (STC) is known to have a comparable product ready to go into production.
- The group assigned within IBM to bring the product into the marketplace has reportedly been disbanded and it now appears that an announcement in the near term is unlikely.

- Two possible reasons given for the product introduction delay are:

  - Insufficient market demand (and thus inadequate projected return on investment) to warrant going forward in the near future.

  - Utilization of thin film heads would compete with the priority need for head production capacity by the 3370, 3375 and 3380 disk drive program.

- INPUT does project that a new tape drive product will be introduced, but not until the installed base of 3081 processors and high capacity 3380 disk drives is such that market demand will support a new product line. There will be need for a product to back up 3380 disks which make use of the higher channel data transfer rates available on the 3081 CPU. The impact of such a product on 3420 residual values is not expected until the 1983 timeframe.

- Exhibit III-1 provides a price change history for the 3420 tape drive series. Since 1974, there have been three pricing changes and only the December 1979 pricing change (a 5% increase) applied to all models in the series. The June 1977 pricing change (a 10% increase) applied only to models 3 and 5, while the September 1980 action (a 20% decrease) only affected models 4, 6 and 8.

- The September 1980 price reductions on the 4, 6 and 8 models made this group much more attractive relative to the 3, 5 and 7 group, and also were designed to stimulate conversions from lease to purchase to help IBM's 1980 fiscal results.

- Future pricing actions are expected to be applied uniformly to all models and will be primarily adjustments to preserve profit margins against inflation (i.e., price increases approximating the rate of inflation at roughly yearly intervals). Such pricing actions will have little direct impact on residual values.

- Availability of product to meet demand is expected to remain in reasonable balance. There are no discernible trends or forecasted events that would

EXHIBIT III-1

PRICE HISTORY OF

IBM 3420 MODEL 003, 005, 007, 004, 006, AND 008 TAPE DRIVES

1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
003 (10/69) $13,580	(11/70) $15,980	(5/71) $13,580		(11/73) $13,800	(9/74) $12,420			(6/77) $13,660		(12/79) $14,340		
005 (10/69) $18,170	(11/70) $21,380	(5/71) $18,170		(11/73) $18,500	(9/74) $16,650			(6/77) $18,320		(12/79) $19,230		
007 (10/69) $22,380	(11/70) $26,330	(5/71) $22,380		(11/73) $22,800	(9/74) $20,520					(12/79) $21,540		
			004 (3/73) $24,000	(11/73) $24,400	(9/74) $21,960					(12/79) $23,050	(9/80) $18,440	
			006 (3/73) $28,000	(11/73) $28,500	(9/74) $25,650					(12/79) $26,930	(9/80) $21,540	
			008 (3/73) $31,000	(11/73) $31,600	(9/74) $28,440					(12/79) $29,860	(9/80) $23,890	

cause a major shift in the supply or demand categories. It is possible that product shortage may develop when IBM begins the conversion process to new technology (expected in late 1982) and that this could lead to a situation similar to what happened with the 3350 disk product (i.e., a major shortfall in supply leading to a rapid increase in used market values - apparently caused by reductions in 3350 production as the manufacturing capacity was shifted toward the 3380 product line). INPUT assumes IBM will anticipate and better manage this process in the future.

- Exhibit III-2 provides projected used market values for the IBM 3420 tape drive series at the beginning of years 1982 to 1986. Exhibits III-3 through III-8 display both historical used market values and residual value forecasts (i.e., graphs of the projections contained in Exhibit III-1).

- The odd numbered models (3, 5 and 7) are projected to perform a bit differently in the used market than the somewhat newer and generally more attractive even numbered models (4, 6 and 8).

- One aspect which tends to regulate the used market price differential between models is the ability to upgrade any model; i.e., a model 3 can be upgraded in place to a model 4, 5, 6, 7 or 8. Exhibit II-2 shows the cost to upgrade, while Exhibit II-3 expresses the relationships between the cost to upgrade and the incremental data transfer rate thereby obtained. It should be noted that cable length restrictions can become a consideration as one moves upward in data transfer rates (i.e. the higher the data rate, the closer the drives must be to the host computer).

- As will be noted on Exhibits III-2 through III-8, the used market values of all 3420 models have been increasing in recent months. This is attributed to increased demand stemming from 43XX installations.

- INPUT projects the odd numbered models will continue to rise slightly in value, peaking sometime this summer. Values are then expected to decline

EXHIBIT III-2

PROJECTED USED MARKET RETAIL PRICES FOR
IBM 3420 TAPE DRIVE SERIES

PROJECTED USED MARKET RETAIL PRICE AT JANUARY 1 OF:					
MODEL	1982	1983	1984	1985	1986
3420-003	$ 6,000	$ 4,000	$ 1,500	$ 1,000	$ 500
3420-005	9,500	7,000	3,500	2,500	2,000
3420-007	12,000	11,000	7,000	4,500	3,500
3420-004	15,000	13,500	7,500	5,000	4,000
3420-006	18,000	17,000	11,500	9,000	8,000
3420-008	20,000	19,000	13,500	11,000	10,000

The values shown are retail prices projected in a future used market. At any given point in time, three price levels exist:

Retail Price - The amount an end user would pay for the equipment.

Dealer Price - The amount a dealer or broker would pay another dealer to acquire equipment to complete a contracted sales obligation. (A dealer will buy for inventory, a broker acts solely as a middleperson between buyer and seller.)

Wholesale Price - The amount a dealer/broker would pay an end user to acquire the equipment.

The dollar spread between these price levels depends upon the value of the transaction. For the range of values shown above, the wholesale price will typically be 70% to 80% of the retail price, but with a minimum transaction value (i.e., spread between wholesale and retail prices) of $2,000 to $3,000.

EXHIBIT III-3

RESIDUAL VALUE FORECAST FOR IBM 3420-003 TAPE DRIVE

(PRODUCT ANNOUNCED OCTOBER 1, 1969, WITH A PURCHASE PRICE OF $13,580)

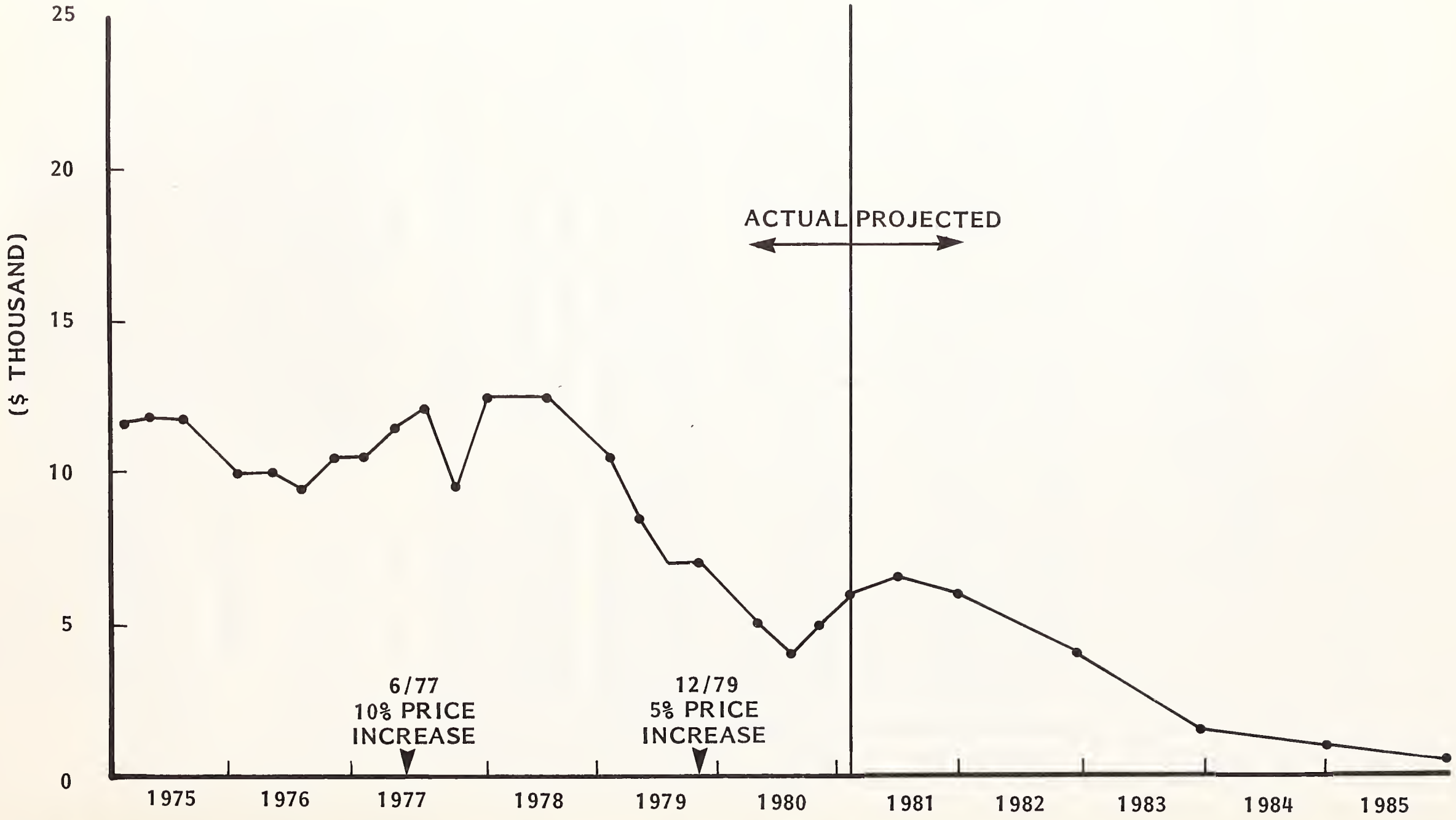


EXHIBIT III-4

RESIDUAL VALUE FORECAST FOR IBM 3420-005 TAPE DRIVE
(PRODUCT ANNOUNCED OCTOBER 1, 1969, WITH A
PURCHASE PRICE OF $18,170)

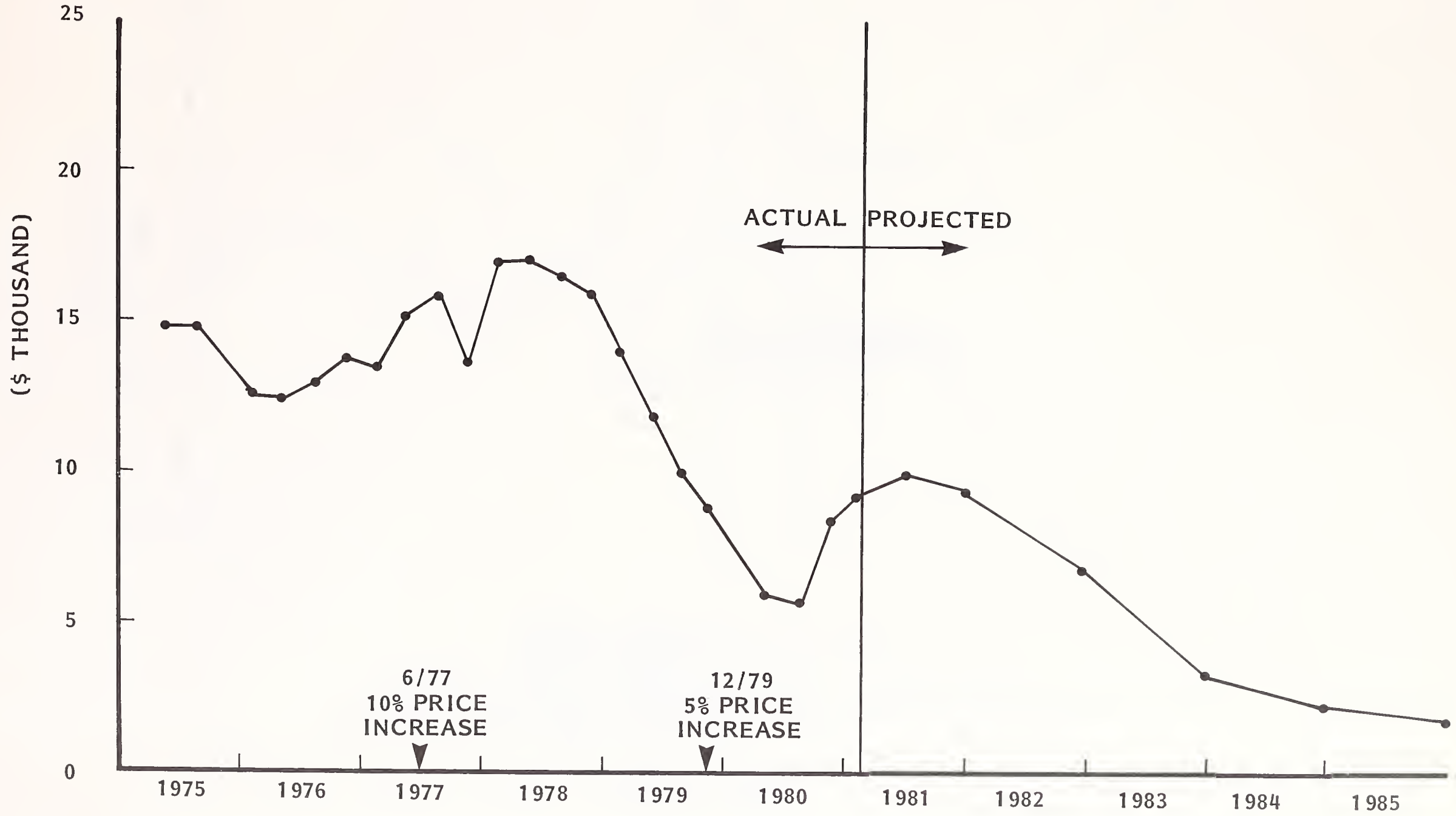


EXHIBIT III-5

RESIDUAL VALUE FORECAST FOR IBM 3420-007 TAPE DRIVE
(PRODUCT ANNOUNCED OCTOBER 1, 1969, WITH A
PURCHASE PRICE OF $22,380)

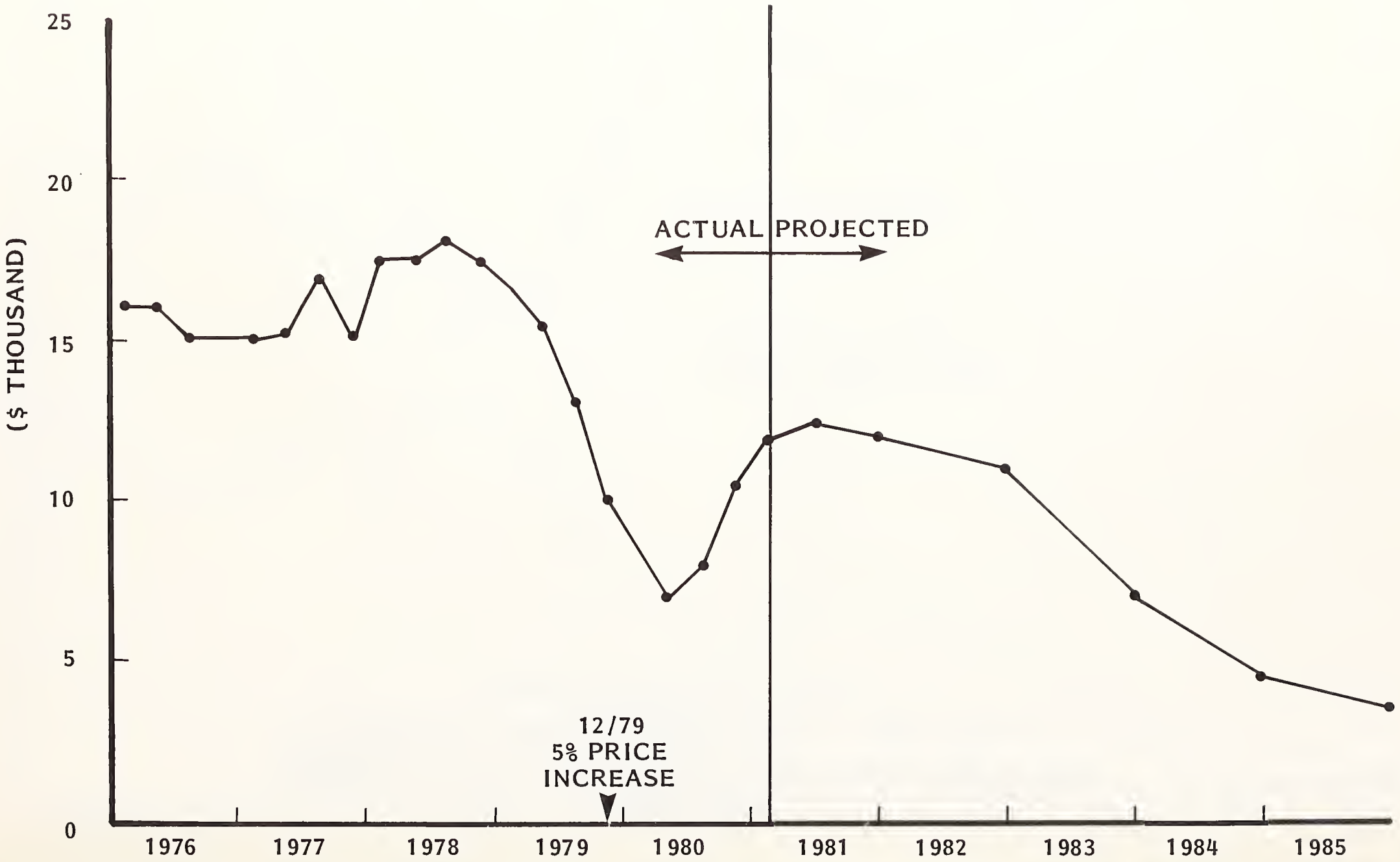


EXHIBIT III-6

RESIDUAL VALUE FORECAST FOR IBM 3420-004 TAPE DRIVE

(PRODUCT ANNOUNCED MARCH 7, 1973, WITH A PURCHASE PRICE OF $24,000)

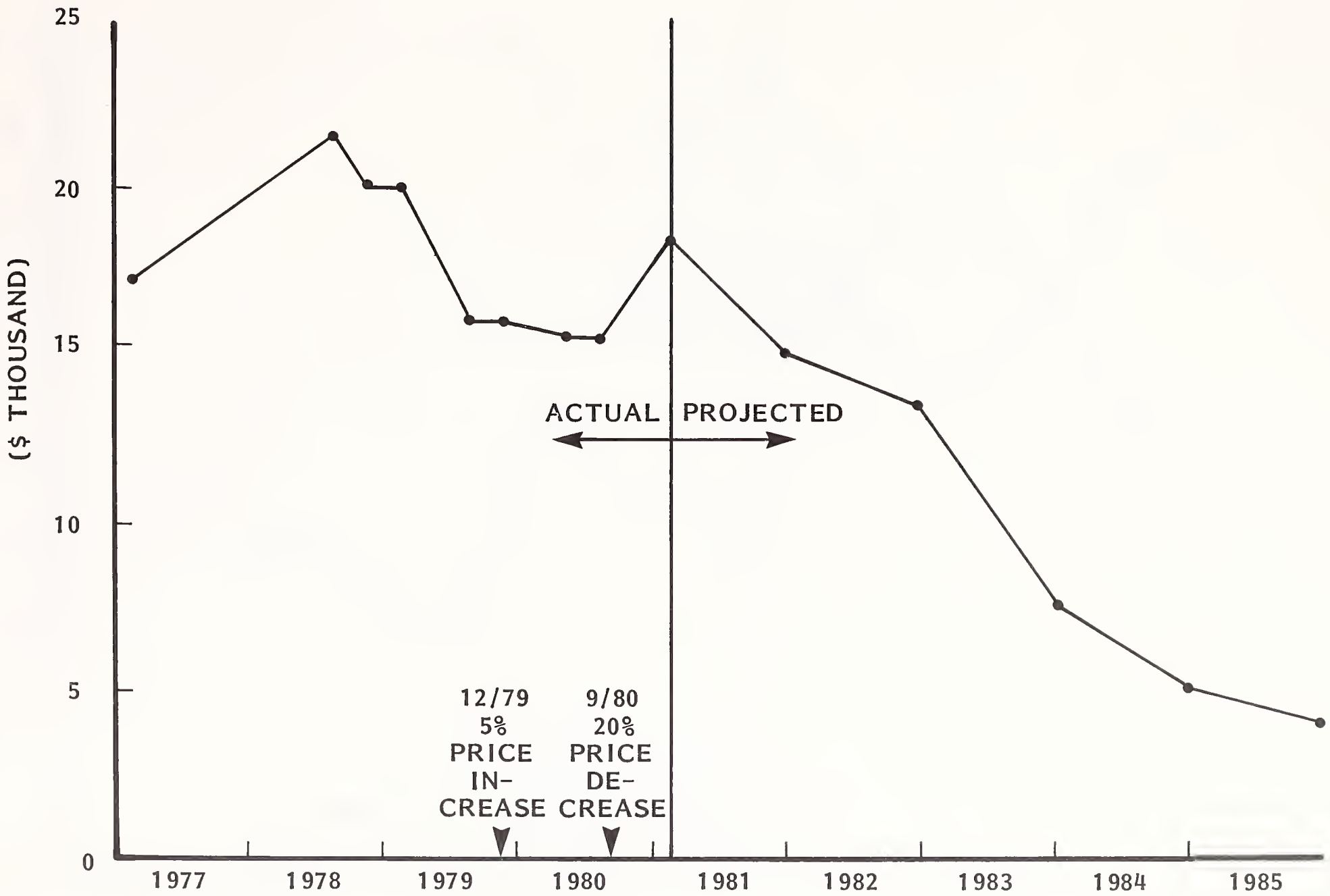


EXHIBIT III-7

RESIDUAL VALUE FORECAST FOR IBM 3420-006 TAPE DRIVE
(PRODUCT ANNOUNCED MARCH 7, 1973, WITH A
PURCHASE PRICE OF $28,000)

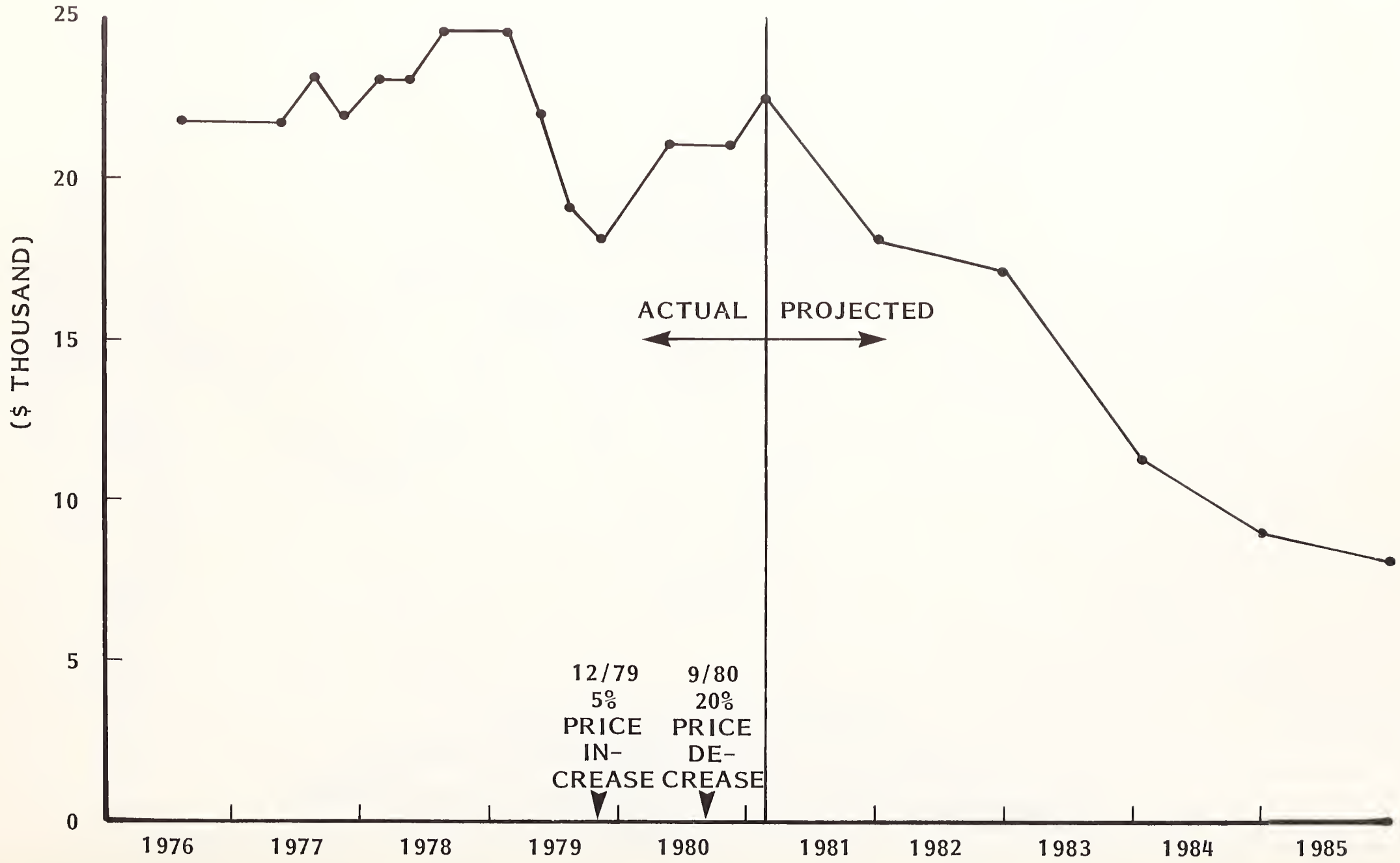
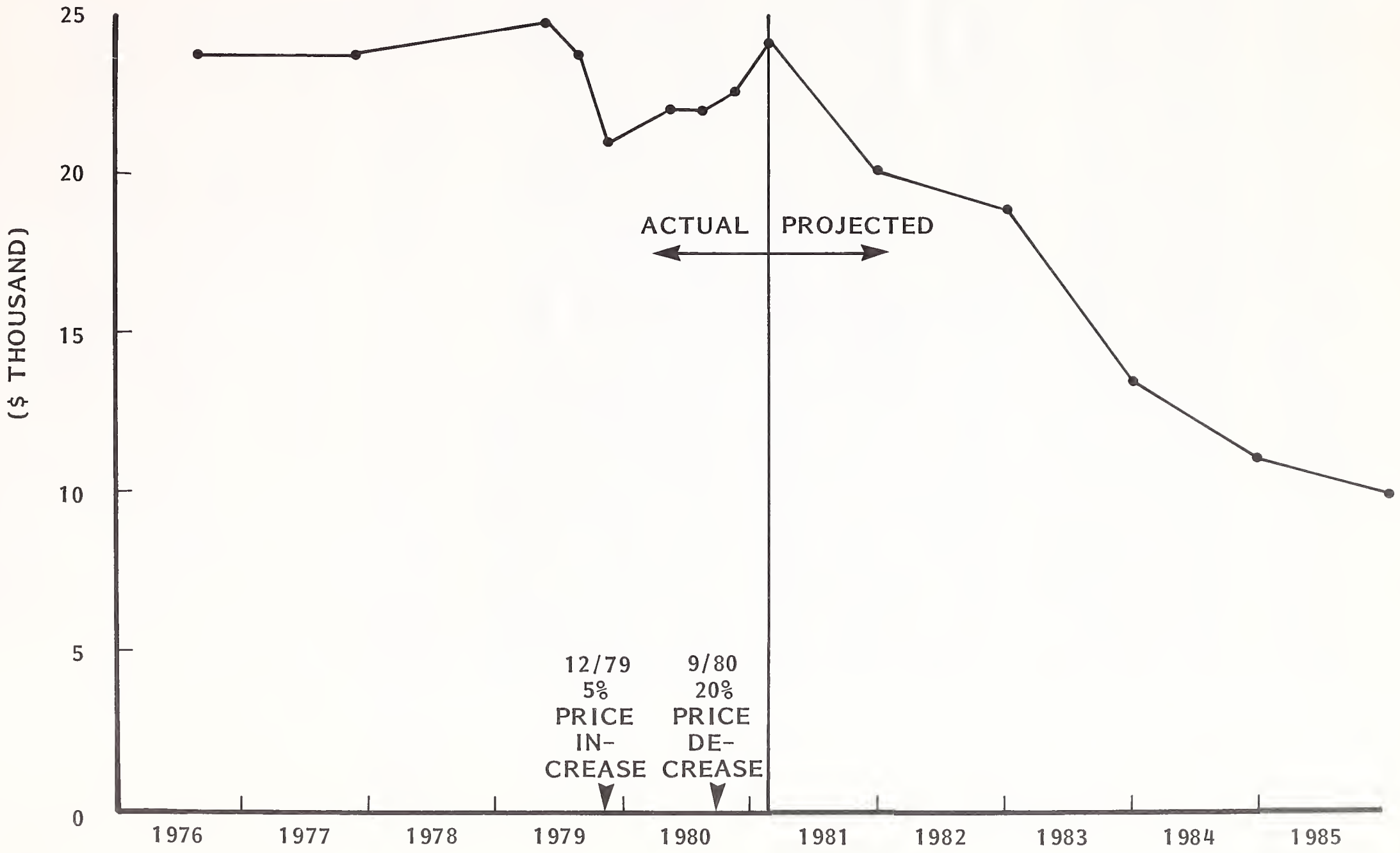


EXHIBIT III-8

RESIDUAL VALUE FORECAST FOR IBM 3420-008 TAPE DRIVE
(PRODUCT ANNOUNCED MARCH 7, 1973, WITH A
PURCHASE PRICE OF $31,000)



slowly until the beginning of 1983, at which point the impact of a new product introduction by IBM will cause values to decline much more rapidly.

- A similar long-term scenario is projected for the even numbered models. It should be noted that the list prices between comparative models (e.g., model 5 versus model 6) are relatively close ($22,680 versus $23,945) and thus the higher absolute values for the even numbered models represent a much higher percentage of list price.

- The sharp decline shown for the even numbered models in 1981 reflects an expected adjustment in the used market for the September 1980 20% price decrease. Unless the availability of new products from IBM considerably worsens (which is not expected), the used market values for the models 4, 6 and 8 should settle to about 75% of list price by the end of 1981, then drift slowly downward in 1982 until experiencing a sharp drop in 1983.

- Residual values for tape drives from plug compatible manufacturers (e.g., STC, Memorex, CDC, etc.) are too volatile to predict with acceptable confidence levels. Trading is much less frequent and the marketplace for PCM equipment is more limited. In general, used PCM disk drives will trade at 60% to 80% of comparable IBM products, although exceptions (both higher and lower) have been noted.

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MANAGEMENT PLANNING PROGRAM IN INFORMATION SYSTEMS

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

JUNE 1981

MANAGEMENT PLANNING PROGRAM IN INFORMATION SYSTEMS

OBJECTIVE: To provide managers of large computer and communications systems with timely and accurate information on developments which affect today's decisions and plans for the future.

DESCRIPTION: Client of this program receive the following services each year:

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- [illegible]ng Report - Analyses and composite [illegible] plans of computer/communications [illegible]on. Includes operating ratio data. [illegible]ar.
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- [illegible] with senior research staff on an as-[illegible]nd visits.
- [illegible]l or specific presentations to client

R[illegible]nsive research in computers, commu-n[illegible]

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- [illegible]sional interviews with users, vendors, [illegible]er analysts.
- [illegible]e based on the judgement of INPUT's
- [illegible]gram average nearly 20 years of experience in data processing and communications, including senior management positions with major vendors and users.

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AUTHOR

Residual Value Forecasts for Large IBM and Software-Compatible Mainframe

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INFORMATION SYSTEMS PROGRAM

RESIDUAL VALUE FORECASTS
FOR LARGE IBM AND
SOFTWARE-COMPATIBLE MAINFRAMES

JUNE 1981

INPUT

2471 EAST BAYSHORE ROAD, SUITE 600, PALO ALTO, CA 94303 (415) 493-1600

July 22, 1981

Dear Client:

On June 26, 1981, after this report was prepared, IBM announced price changes for many of its hardware and software products. Announced price decreases took effect July 1, 1981, while price increases will become effective on or after October 1, 1981. Analysis of the various price changes has led us to the following conclusions:

- IBM is increasing the attractiveness of converting any remaining rented or leased System 370 Models 158 and 168 to purchase, as monthly lease and rental charges for these machines are being raised up to 7%, while purchase prices are unchanged, and monthly maintenance charges have been reduced 4-5%.

- A comparable but relatively less attractive conversion inducement is suggested by price changes on the 303X processors, with rental and lease prices rising 4-7% while purchase and maintenance prices are unchanged.

- Price increases of up to 15% on software products, as well as hardware price increases of 5-7% on the 4300 series of processors, suggest that strong demand for such products more than offsets any price sensitivity over the intermediate term.

In INPUT's opinion, these changes have no material impact on the residual value forecasts presented in the enclosed report.

The third quarter report will provide an update on the nonmainframe equipment for which INPUT has previously provided residual value forecasts: printers, disks, and magnetic tape drives.

Very truly yours,

George Heidenrich

George Heidenrich
Director, Management Planning Program
in Information Systems

GH:ml

Enclosure

RESIDUAL VALUE FORECASTS
FOR LARGE IBM AND
SOFTWARE-COMPATIBLE MAINFRAMES

ABSTRACT

This report presents the periodic update of the Residual Value Forecast for large IBM and plug-compatible mainframes. Emphasis is placed on the increasing role of "environmental" factors such as electrical power, air conditioning, and floor space requirements in determining computer upgrade decisions.

U-R11-413
June 1981

INPUT

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

CONTENTS

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

EXHIBITS

I INTRODUCTION

- This Residual Value Forecast is produced as part of the Management Planning Program in Information Systems. Data contained in this series of reports are updated periodically. Key issues, such as the future of IBM hardware and software and major product announcements, are the subjects of various other INPUT reports including the Technology and Management Issues Briefs, another part of the Information Systems Program.

- In December 1980, INPUT published the sixth report in its continuing series on residual values of large IBM and software-compatible mainframes. This report reviews significant events since December and updates the earlier residual value forecasts based on an analysis of recent developments.

- Forecasted residual values are provided for IBM, Amdahl and National Advanced Systems (NAS) processors. This report focuses on large-scale mainframes but includes residual value forecasts for the 43XX CPU product series.

- Chapter II reviews recent used-market activity in the IBM, Amdahl and NAS processors reported upon in this report. The used computer industry does not publish records of transactions. Information in this chapter was obtained by interviewing people active in market trading.

- Chapter III reviews vendor activity since INPUT's December 1980 report. Significant announcements are summarized, with INPUT commentary where

appropriate. Neither IBM nor Amdahl has unveiled any major new products since the IBM 3081 announcement and Amdahl's responding 5860 and 5880 announcement in November of 1980. NAS has been the most active of the three vendors in the period covered by this report - as it moved toward presenting a more competitive product line in the large processor market.

- Residual value projections for the various processors covered by this report are given in Chapter IV. The used computer industry, by convention, always lists used equipment as a percentage of the manufacturer's current list price. The projections in Chapter IV follow this convention. Readers are cautioned to consider past price changes when analyzing their own unique situations.

II REVIEW OF RECENT USED-MARKET ACTIVITY

- Overall the used market for IBM mid- to large-scale processors has been relatively stable in recent months. The announcement by IBM of the first "H" series processor, the 3081, followed quickly by Amdahl's response with the 5860 and 5880 CPUs, both in November of 1980, removed much of the uncertainty that had been troubling the market.

- Values for IBM 370/158 and 370/168 processors continued to drift downward. Recent trades have been at 6% to 9% of list price. Very attractive lease arrangements are available - as many owners choose not to sell to protect themselves against investment tax credit (ITC) rebates (i.e., a machine must be held for seven years or longer to qualify for the maximum 10% ITC).

- The IBM 3031 dropped substantially in price - much more rapidly than INPUT had predicted in the December 1980 residual value forecasts. Expected demand from overseas markets did not materialize for this air-cooled machine. The much lower power and space requirements (and significantly lower maintenance costs) of the 4341 models 1 and 2 took their toll. The 3031s are currently selling at 36% to 42% of list price.

- IBM 3032 values have remained relatively unchanged in recent months. If anything, there has been some strengthening in prices as few machines have entered the market. Trading activity has been in the 45% to 50% range. However, volume deliveries of the 3033 model S and/or the announcement of a 4351 class mainframe will cause 3032 values to slip rapidly.

- Demand for IBM 3033 processors continues to be strong, with poor product availability in the used market. The 3033 is selling at 83% to 85% of list (equivalent to full list pricing when the ITC and warranty are considered). Delivery positions for the 3033 model S and N are selling for about $40,000. (Reportedly a fourth quarter delivery position for a 3081 is worth $750,000!)

- A number of IBM 4331 processors have traded in recent months. The prices have been suprisingly low for such a recently announced product. Retail prices are at about 75%, with wholesale at about 60%. The large spread is due to the low unit cost of the 4331 (10% to 15% is required to produce a reasonable return to the middleman on a given transaction). IBM's aggressive lease pricing for the 43XX machines requires a 60% wholesale price in order for dealers and brokers to compete effectively. The 4331 is an entry level system that some users quickly outgrew - a contributary cause to its early appearance in the used market.

- The IBM 4341 is in stong demand - commanding a slight premium over IBM list prices. The first machines (Model 1s) have only recently been listed on the used market - at 90% to 92% of IBM's current price.

- Amdahl V/5 and V/6 systems are reported as trading in the 50% to 60% range. This is very close to INPUT predictions and reflects Amdahl's efforts to maintain a strong secondary market for its products. Favorable attitudes by Amdahl customers on product reliability and software support continue to broaden the acceptability of Amdahl at traditional IBM sites. This expands the available territory where remarketing of a used Amdahl machine can occur.

- NAS processors continue to largely elude the existing broker/dealer community. NAS has chosen itself to resell the machines received as trade-ins on more powerful systems. Customer loyalty to NAS appears quite strong - attesting to a high level of user satisfaction. NAS advertises that its product family "boasts higher residual values over time than even IBM," a claim INPUT has not yet been able to verify due to the lack of trading information.

III REVIEW OF VENDOR ANNOUNCEMENTS (DECEMBER 1980-MAY 1981)

- A trend in recent years is for IBM to make significant product announcements in the second half of the calendar year. This was especially noticeable during this report period, perhaps because IBM wants nothing to detract from the impact of the 3081 introduction.

- Although no major news about mainframes has emerged from IBM (or Amdahl) since November, there have been recent actions by IBM that may have significant future impact. These include the "Statement of Direction" (a promise that IBM products from various divisions will be able to communicate with one another), the introduction of a relational data base product, and a strong indication that IBM will support the X.25 link level protocol.

- What news there was, sorted by vendor, follows:

A. IBM ANNOUNCEMENTS

- December 1980:

  - IBM continued a trend started in June 1979 of increasing prices every six months - in June and December. This price increase amounted to 7-8% for lease and rental prices, and up to 15% for software and maintenance. Purchase prices for processors remained unchanged -

further encouraging outright purchase. The 3081 and 3033 S processors (announced the prior month) were not included in the general price increase.

- The production status of the 3031 and 3032 processors was changed from "new" to "limited new" indicating IBM would no longer be actively marketing these products. The 4341 Model Group 2 replaces the 3031, and the 3033 S displaces the 3032 in IBM's marketing hierarchy.

- March 1981:

  - The 3033 S processor maximum channel capacity was increased from six to twelve. This was done in reaction to customer complaints about the inability to adequately accommodate needed peripherals with only six channels.

B. AMDAHL ANNOUNCEMENTS

- Amdahl reported substantially improved profitability and cash flow for the first two quarters of 1981 over 1980 results. Also, in May it announced a new release, its VM/Performance Enhancement - with reduced system overhead providing improved throughput. There were no new CPU product announcements or significant changes in its processor family.

C. NATIONAL ADVANCED SYSTEMS (NAS) ANNOUNCEMENTS

- January 1981:

  - NAS announced a dual processor version of the AS/9000 mainframe with first deliveries scheduled for the fourth quarter of 1981. An AS/9000

can be upgraded in place to the dual processor configuration - a tightly coupled system based upon the Hitachi built M200H CPUs. The system can support up to 32 megabytes of memory and 32 channels, with a price spread of $5.6 million to $6.5 million. Performance in millions of instructions executed per second (MIPS) is estimated at 14 to 16, compared to an estimated 10 for IBM's 3081 and 12 for Amdahl's 5860.

- February 1981:

  - Enhancements to both the AS/7000 series and AS/9000 processors were announced. The AS/7000 changes include new microcode to improve performance and the ability to add additional channel capacity. AS/9000 changes include expansion of main memory capacity from 16 to 32 megabytes and an increase in channel capacity from 16 to 24. Additional data-streaming capacity was also added, as was an MVS/SP assist feature.

  - A version of the AS/9000 was introduced, offering about 80% of the standard AS/9000 performance at about two-thirds the price. The new version is called the AS/9000 N and is field upgradable to the AS/9000.

D. OTHER ANNOUNCEMENTS

- January 1981:

  - Both Acsys Corp., the IBM-compatible mainframe start-up firm (founded by Gene Amdahl) and Storage Technology Corporation announced plans to raise $100 million and $50 million, respectively, to develop large-scale mainframes for 1984 delivery. Both expected to use R&D limited partnerships as the fund-raising vehicle to avoid loss of equity and thus operating control over the organizations developing the product.

- April 1981:

  - Storage Technology announced it had successfully raised $50 million for STC Computer Research by selling $50,000 units to individual investors. The limited partnership is funding development to the engineering prototype stage whereupon STC will have the opportunity to buy all or part of the technology.

IV PROJECTED RESIDUAL VALUES FOR LARGE IBM AND SOFTWARE-COMPATIBLE PROCESSORS

- INPUT projects residual values based on:
  - Anticipated actions by IBM.
  - Responding strategies by the software-compatible mainframe manufacturers.
  - Analysis of technology development and how it affects the changing role of the large CPU in evolving communications/data base networks.
  - Analysis of other variables affecting residual values, as described in the appendices of previous reports (see Residual Value reports dated April 1978, October 1978, April 1979 and October 1979). For example, the cost of energy to operate large computer systems is becoming a more significant issue, as shown in Exhibits IV-1 and IV-2.
- The format followed in presenting residual value projections is consistent with that adopted in the prior mainframe report (December 1980). Projected future values are presented in table form, as shown in Exhibit IV-3, supplemented by graphical presentations for the IBM 3033 and 3081, Amdahl 5860, and NAS AS/9000, as shown in Exhibits IV-4 through IV-7.

EXHIBIT IV-1

FORECASTED GROWTH IN ELECTRICAL POWER COSTS
(PER KILOWATT HOUR IN NORTHERN CALIFORNIA AREA)

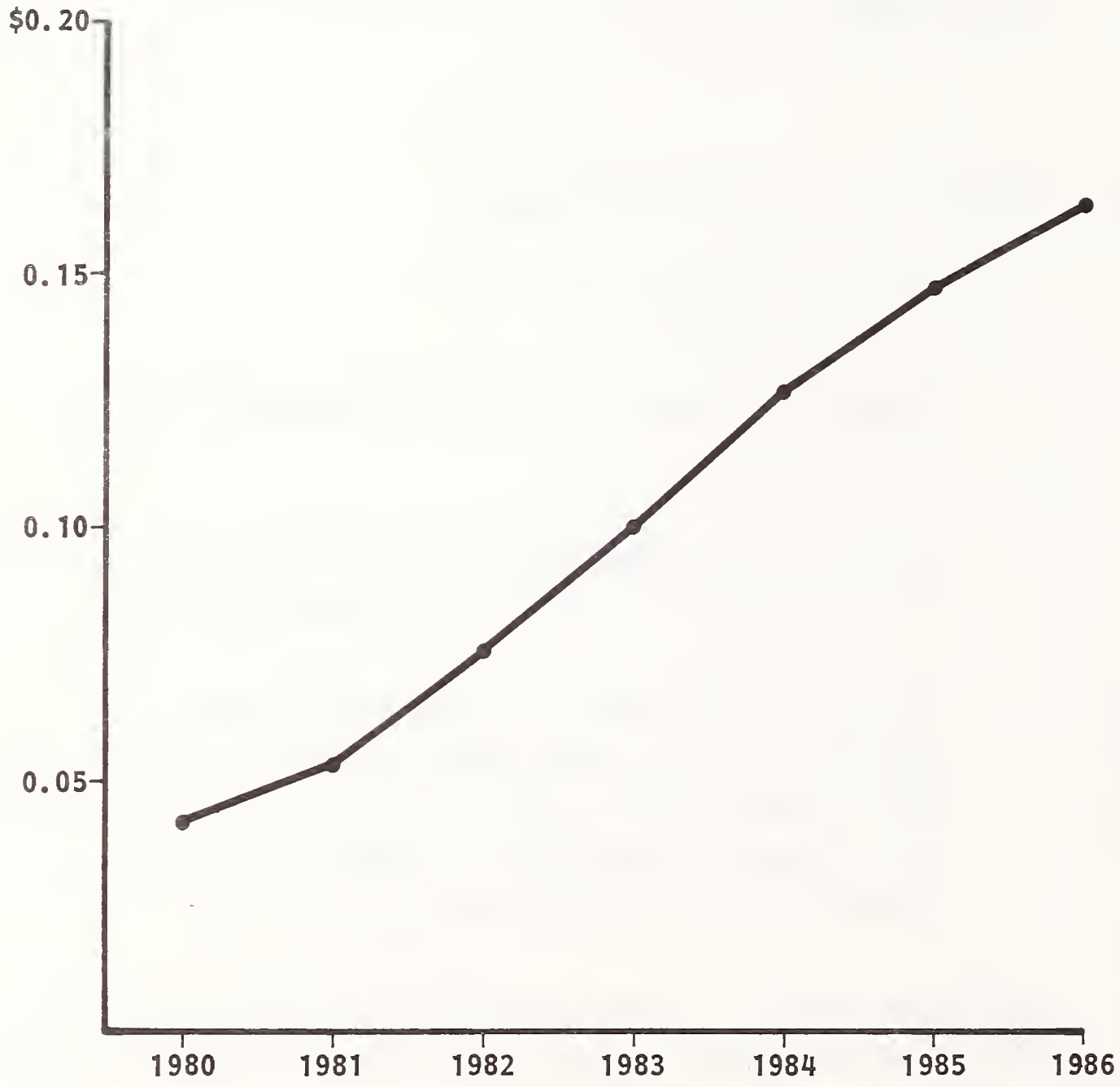


EXHIBIT IV-2

ELECTRICAL POWER, AIR CONDITIONING, AND FLOOR SPACE REQUIREMENTS
FOR CERTAIN IBM, NAS, AND AMDAHL PROCESSORS

	IBM			NAS			AMDAHL		
	168 (2.5 MIPS)	3033 (4.8 MIPS)	3081 (10 MIPS)	AS7000 (5.4 MIPS)	AS9000N (7.5 MIPS)	AS9000 OPC (15 MIPS)	470 V/6 (3.5 MIPS)	470 V/8 (7 MIPS)	5860 (13 MIPS)
ELECTRICAL POWER (KVA)	150.3	83.3	37.1	36.7	46.5	80.5	74.5	57.0	37.5
HEAT OUTPUT (BTU)	333,435	218,150	80,300	102,950	144,250	248,650	174,100	145,940	112,950
FLOOR SPACE (SQUARE FEET)	229.8	138.7	96.7	91.2	118.5	202.5	124.1	88.2	78.7

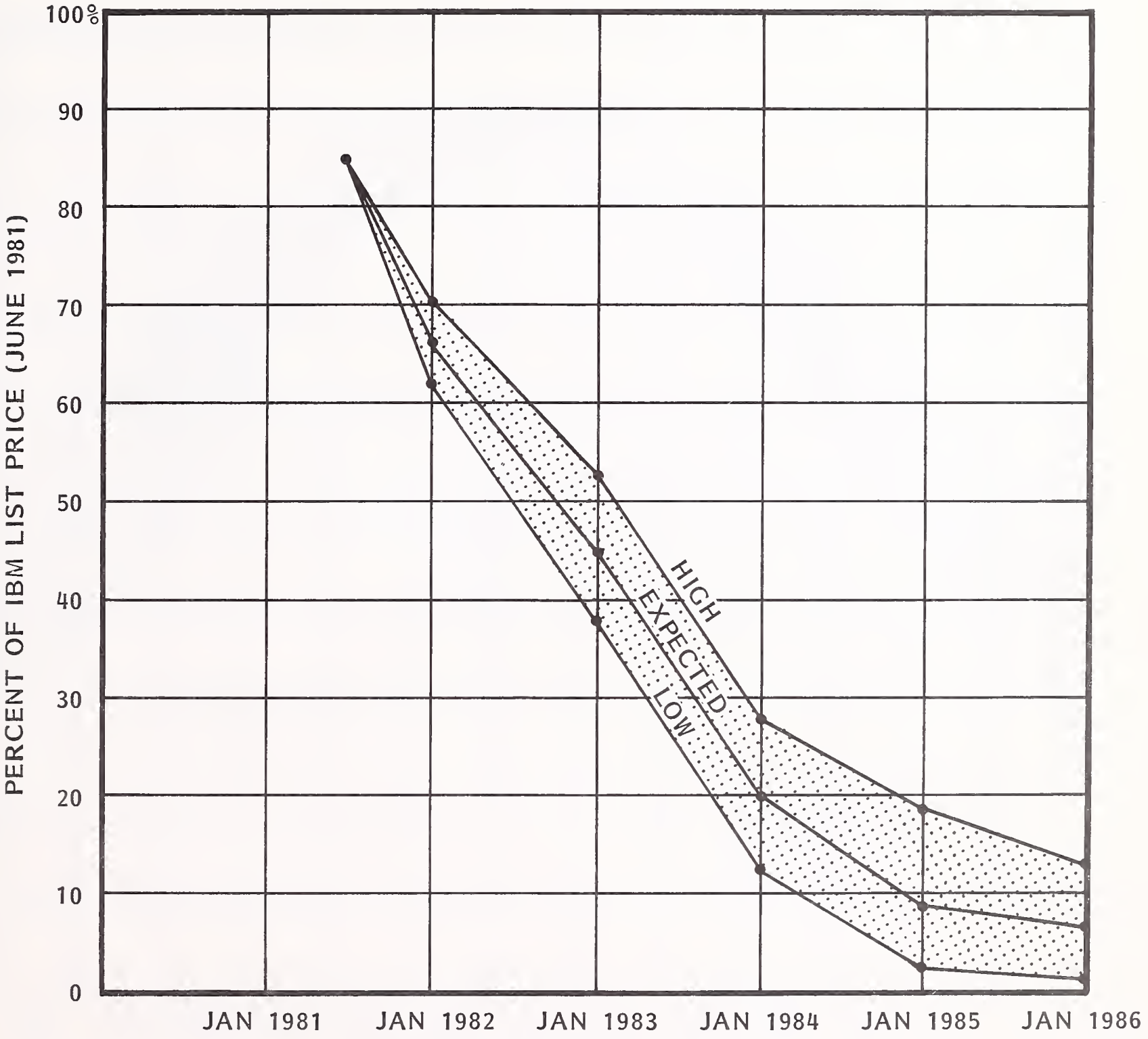
EXHIBIT IV-3

PROJECTED RESIDUAL VALUES FOR
IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

VENDOR	PROCESSOR MODEL	PROJECTED RESIDUAL VALUE AS PERCENT OF VENDOR LIST PRICE (JUNE 1981)				
		JAN. 1982	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986
IBM	370/158-3	7%	6%	3%	2%	1%
	370/168-3	6	5	3	2	1
IBM	3031	36	21	11	7	4
	3032	34	20	10	6	3
	3933-S	77	54	27	14	7
	3033-N	74	51	23	12	6
	3033	67	45	20	9	5
IBM	4331-1	60	50	45	40	19
	4331-2	75	63	60	44	21
	4341-1	80	73	51	46	23
	4341-2	85	78	59	50	27
IBM	3081	90	88	80	57	40
AMDAHL	470 V/5	45	29	17	9	2
	470 V/6-11	40	26	15	8	1
AMDAHL	470 V/7 SERIES	76	54	28	15	4
	470 V/8	79	56	30	17	6
AMDAHL	5860	-	85	78	56	40
	5880	-	-	85	63	44
NAS	AS/5000	43	27	17	8	3
	AS/5000 N,E	67	46	27	14	6
	AS/7000	39	23	13	6	2
NAS	AS/9000 SERIES	80	72	63	40	28

EXHIBIT IV-4

PROJECTED RESIDUAL VALUES FOR THE IBM 3033 PROCESSOR

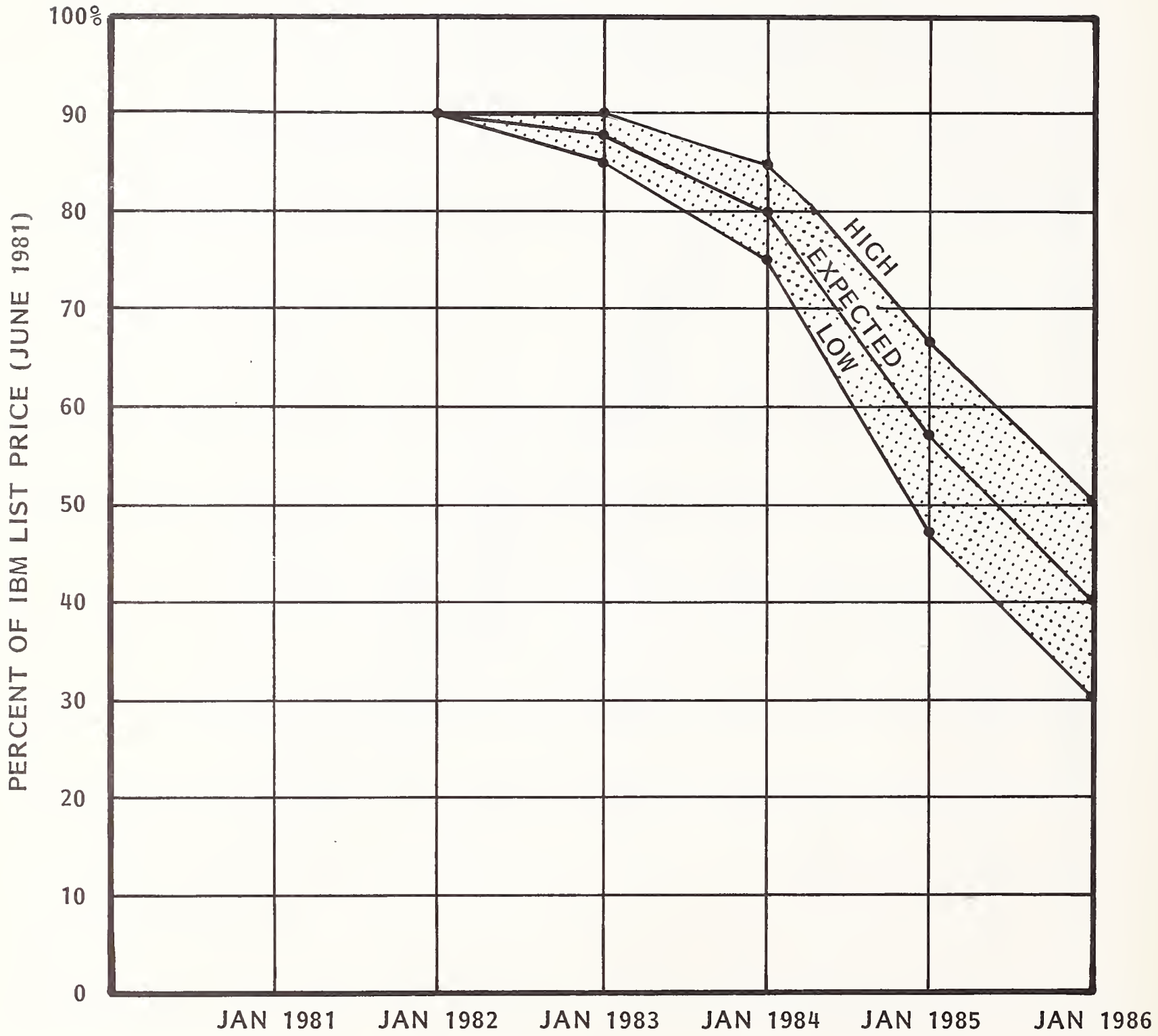


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN 1982	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	70%	52%	28%	18%	13%
EXPECTED	67	45	20	9	5
LOW	63	38	12	2	1

EXHIBIT IV-5

PROJECTED RESIDUAL VALUES FOR THE IBM 3081 PROCESSOR

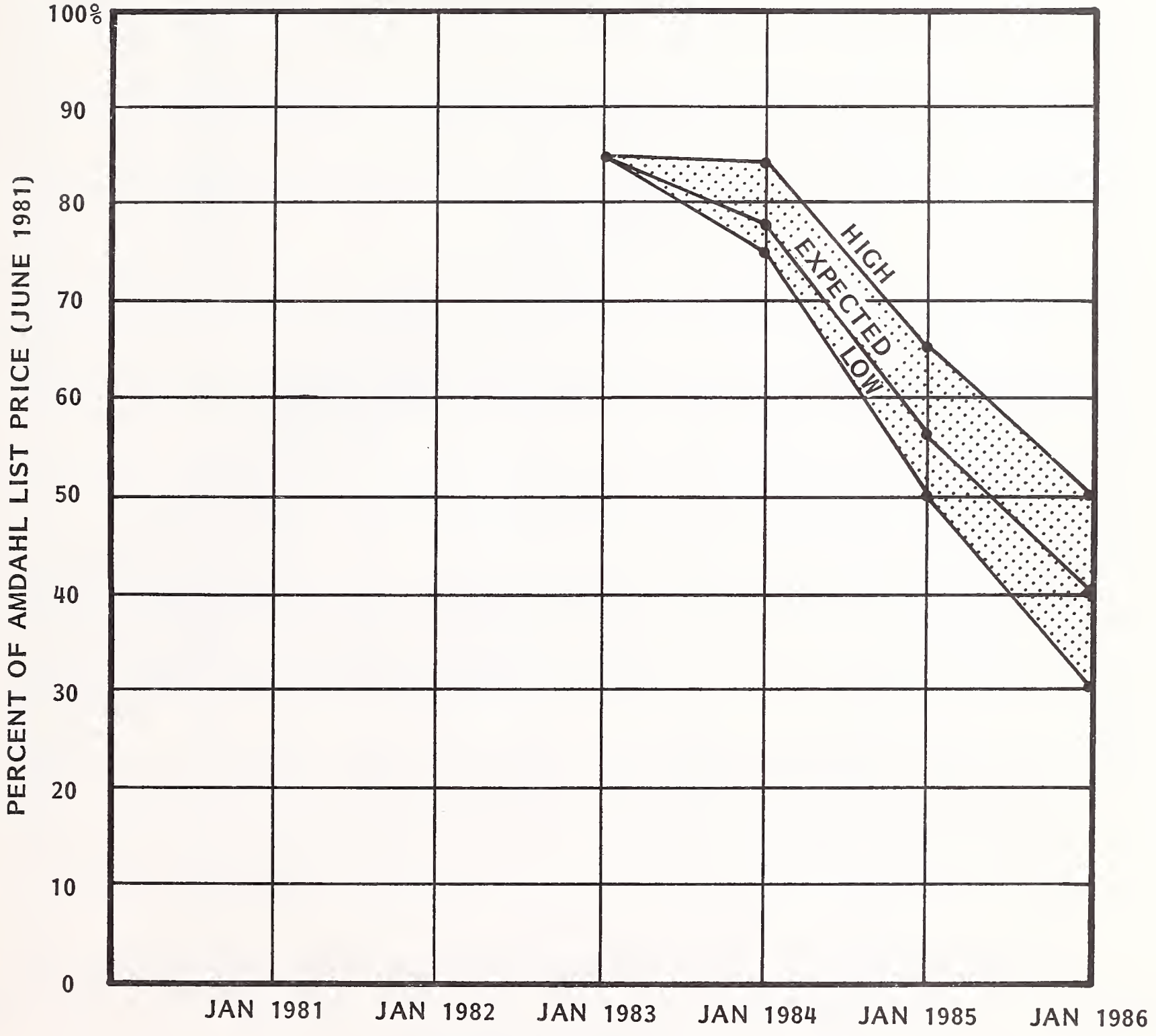


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN 1982	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	-	90%	85%	66%	50%
EXPECTED	90%	88	80	57	40
LOW	-	85	75	47	30

EXHIBIT IV-6

PROJECTED RESIDUAL VALUES FOR THE AMDAHL 5860 PROCESSOR

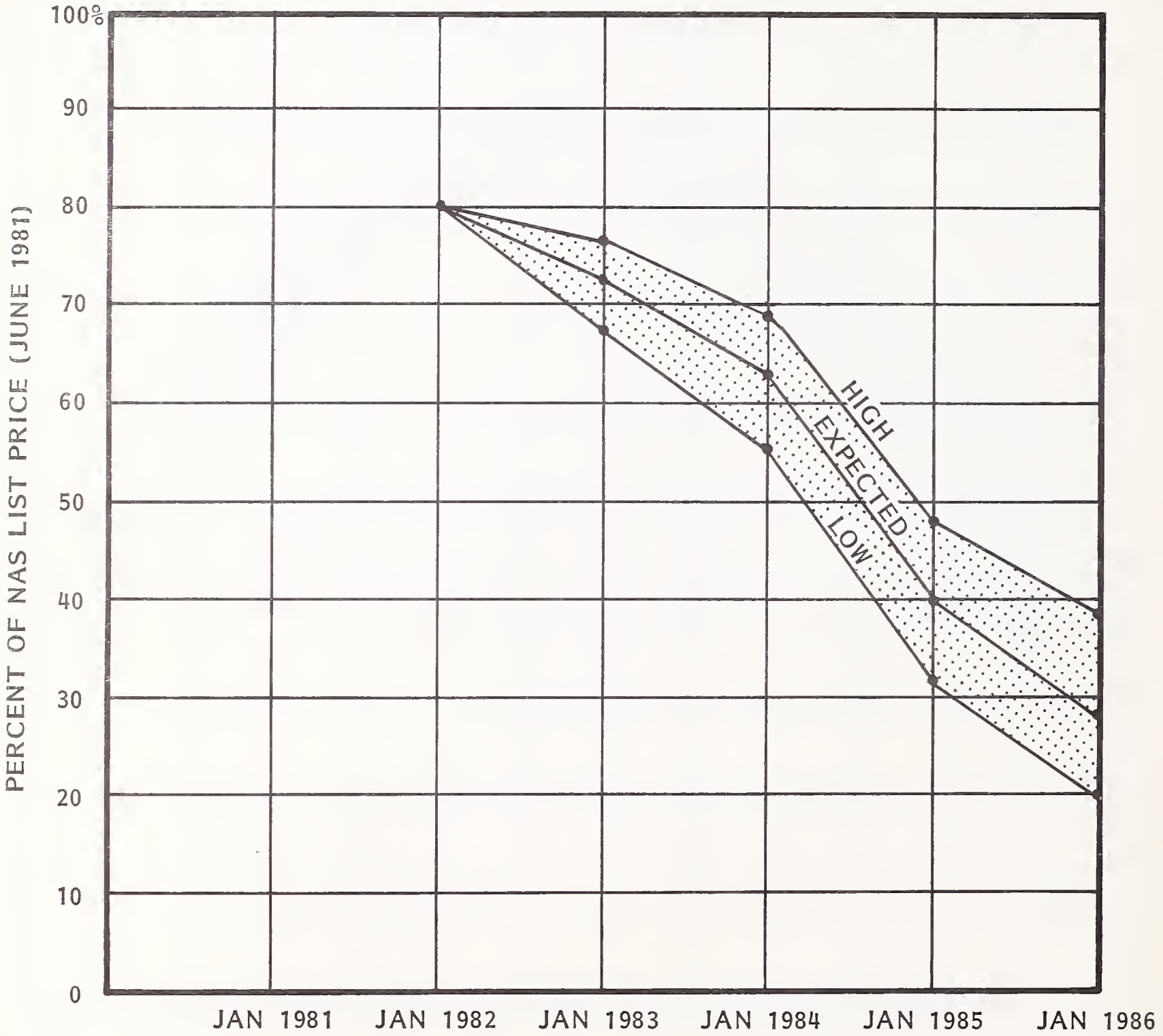


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	–	84%	65%	50%
EXPECTED	85%	78	56	40
LOW	–	75	50	30

EXHIBIT IV-7

PROJECTED RESIDUAL VALUES FOR THE NAS AS/9000 PROCESSOR



PROJECTED VALUES

PROJECTED VALUES RANGE	JAN 1982	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	-	76%	69%	48%	38%
EXPECTED	80%	72	63	40	28
LOW	-	67	55	31	20

- The values shown represent wholesale prices; i.e., the amount a used computer industry dealer will pay for the equipment for subsequent resale to an end user at a higher price.

- Some of the values shown in Exhibit IV-3 have been revised downward from the December 1980 projections. These revisions (for the IBM 370/158, 370/168, 303X series, and NAS AS/9000 series processors) resulted from a more detailed analysis of relative financing and operating costs vis-a-vis newer technologies. Clearly some factors have assumed a much more important role in residual values:

  - The cost of capital to acquire computing equipment.

  - "Environmentals" such as electrical power, air conditioning and floor space requirements.

  - The cost of hardware and software maintenance.

- These areas were identified by INPUT some time ago (early 1977) as contributing factors in residual value forecasting - but their relative importance has grown substantially since then.

- For example, Exhibit IV-1 presents forecasted growth in electrical power costs in the northern California area. Other areas of the country are expected to follow similar patterns. Exhibit IV-2 presents electrical power, air conditioning and floor space requirements for certain IBM, NAS and Amdahl processors. Assuming a need for 10 MIPS in processing power, the difference in environmentals between four 370/168 machines and a 3081 is quite impressive, as shown below:

	(4) 370/168s	3081
Electrical power (KVA)	601.2	37.1
Air conditioning (BTUs/hr)	1,333,820	80,300
Floor space (sq. ft.)	919.2	96.7

- Both energy costs and building costs are expected to increase at double digit inflationary rates for the next several years, suggesting a close look that such costs be taken as part of alternative replacement processor life cycle costing.

- Exhibit IV-2 also shows the NAS AS/9000 series compares favorably on environmentals when matched against 303X products - but not well with the recently announced IBM 3081 or Amdahl 5860. This suggests NAS will announce a repackaged product with considerably improved environmentals in the not too distant future (with an adverse impact on the residual values for the current AS/9000 product series).

- An important component of the used computer market is leasing transactions - either subleasing when equipment already on lease is displaced or purchasing equipment to fulfill a prearranged leasing opportunity. Such leases compete with IBM's own leasing programs. The combination of high-interest rates and greater conservatism in future residuals has been a strong force in declining 370 and 303X values, since the purchase price needed to package a profitable leasing deal has shrunk substantially.

- Comparative maintenance costs were identified as an important factor in residual value forecasts in INPUT's initial report (1977) and reiterated in the March 1979 report that analyzed the 4331 product introduction. The differential maintenance costs between the 4341-2 and the 3031 (9/5 coverage for four-megabyte, six-channel configurations) amounts to $2,200/month, or $132,000 over a five-year time span. The differential between a 3081 and 3033 MP (9/5 coverage for 24-megabyte, 24-channel configurations) is $9,150/month, or $549,000 over a five-year time span.

- The 4331-1 has excellent price/performance, low maintenance costs and very good environmentals. Why then does this relatively recently announced IBM processor command only 60% of the wholesale market? Some reasons are:

  - Absolute price. At an entry price of about $70,000, the dollar spread between retail and wholesale prices to create a profitable transaction

for a dealer represents a sizable chunk. Further, the 4331 is a feature-sensitive machine and thus typically will require reconfiguring for the new owner (the cost of which is borne by the dealer, increasing the spread needed to have a reasonable profit).

- Leasing rather than purchase demand. The 4331 is the entry point in the 43XX series. Demand for outright purchase is not strong; i.e., most users prefer to lease. High interest rates for dealers require a 60% purchase price in order to structure a leasing price sufficiently lower than IBM's to be competitive and still return a reasonable profit to the dealer.

- Another reason why INPUT has lowered 43XX projected values over December 1980 forecasts is the volume discounting IBM is allegedly offering to large accounts. Discounts of 15% to 20% have reportedly been offered to customers capable of buying 50 to 100 machines.

- In December 1980, INPUT published the Vendor Watch Report, Large-Scale IBM and Plug Compatible Strategies, which reviewed expected actions of IBM and software-compatible mainframe suppliers through the mid-1980s. The projections contained in that report are still considered valid and, in part, are the basis for the forecasts on residual values shown in Exhibit IV-3.

- INPUT expects both Amdahl and NAS to remain viable alternatives in the large mainframe market. Reportedly, order positions have been received for the initial 18 months' production capacity for Amdahl's 5860 CPU. Hitachi has announced three and four processor configurations for the M200H. IBM is following true to form in letting someone else develop the concept while the market is tiny. IBM will have four processor complexes in the H series - but only when the market is attuned to buy in volume.

- The projections contained in this report assume IBM's near-term strategy is to actively market the 3033 and its spin-offs (models N and S) through 1981 and into early 1982. The 3033 product group will be phased out when appropriate

(about mid-1982) by new product offerings, 31-bit addressing (allowing large memory configurations), and software/firmware products not available to 303X series systems. Revenue enhancement in the software services, local processing (office automation) and telecommunications areas will permit substantive price reductions on large mainframes in the 1984 timeframe (note correspondence with proposed introduction of Acsys and STC large-scale processors) without sacrificing long-term financial objectives. These projected price reductions are the primary cause of the sharp decline in values shown in Exhibits IV-5 through IV-7.

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Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

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RESIDUAL VALUE FORECASTS
FOR IBM DISK, TAPE, AND
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OCTOBER 1981

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PRINTER SYSTEMS

OCTOBER 1981

RESIDUAL VALUE FORECASTS FOR IBM DISK, TAPE, AND PRINTER SYSTEMS

ABSTRACT

This report is the first semi-annual update of the Residual Value Forecast for IBM peripherals. Extensive revisions have been made to the forecasts for disk values, based upon recent delivery slippages. Minor adjustments have been made to tape and printer forecasts, but both have been converted to a "percent of list price" format to conform to other forecasts in the Residual Value series.

U-R12-413
October 1981

RESIDUAL VALUE FORECASTS FOR IBM DISK, TAPE, AND PRINTER SYSTEMS

CONTENTS

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EXHIBITS

I INTRODUCTION

- This report on selected IBM disk, tape, and printer products is issued as part of the Residual Value Forecasting series in INPUT's Management Planning Program In Information Systems. Information contained in these reports is updated on a periodic basis. These reports are not meant to provide detailed technical analyses of the selected computer peripheral areas, but rather to provide an overview useful in equipment acquisition decision-making.

- IBM products covered in this report are the model series 3350 and 3380 disk drives, model series 3420 tape drives, and printer models 1403N1, 3211, and 3800. This report updates earlier residual forecasts for these products. The earlier reports in this series - containing technology overviews for the respective peripheral category - are:

  - Residual Value Forecasts for IBM Multiplatter, Moving-Head Disk Storage Systems (June 1979, September 1980).

  - Residual Value Forecasts for Printers (March 1980).

  - Residual Value Forecasts for IBM 3420 Series Magnetic Tape Systems (April 1981).

- No significant hardware announcements by IBM have occurred in these selected peripheral areas since the issuance of the above listed INPUT reports. The last major new product announcements in the respective peripheral areas were:

  - 3380 Disk Drive Products - June 1980.

  - 6670 Printing System - February 1979.

  - 3420 Models 4, 6, and 8 - March 1973.

- Chapter II of this report provides a review of recent developments within the disk, tape, and printer areas relevant to residual value forecasts contained herein.

- Chapter III provides residual value forecasts for selected IBM peripheral products.

II A REVIEW OF RECENT DEVELOPMENTS IN DISK, TAPE, AND PRINTER TECHNOLOGY

A. DISKS

- IBM followed what is now a consistent pattern of price changes (announcements in June and December with rental, leasing, and maintenance increases effective in October and April, respectively) with its June 1981 price change announcement.

  - Lease and rental prices went up 7% while purchase prices increased 5%.

  - Excluded from price increases were the new 3380 disk drives and the not so new 3420 series tape drives.

  - Monthly maintenance fees increased 15% while hourly charges rose by 10%.

- Memorex and Storage Technology Corporation (STC) followed shortly thereafter with similar price increases for their products. STC matched IBM price increases in the lease, purchase, and maintenance areas. Memorex increases varied by model but overall averaged close to the IBM "guidelines."

- The major event in the disk area was IBM's slippage in 3380 delivery schedules. The first slippage (six-month delay announced in March 1981) caused absolute chaos in the 3350 market. Used market prices leapt to 150% to 170% of IBM

list price as some buyers who had been stretching capacity until arrival of 3380s were caught in a serious bind and bid up prices for scarcely used 3350s.

- The second slippage (average 14-month delay announced on September 30, 1981) was not expected. It will again put pressure on 3350 used market pricing, but the impact should be much less dramatic. The reason it was not expected is because IBM has been delivering 3380 drives to selected test sites for some time - and they have been working well. One customer site has had prototype drives since May (replaced with production models in August) - with virtually no problems from either the prototype or production versions.

- The second delay seems not to be caused by the production problems - apparently with the media and media lubricant - encountered in late 1980. Rather it is a combination of a steep increase in the use of Department of Defense (DOD) ratings to acquire better delivery positions.

  - The 1959 Defense Production Act allows companies with defense contracts to obtain - if granted by DOD - a priority position in equipment delivery schedules.

- IBM also has a requirement to honor a large 3350 order backlog (thus preventing a capacity shift to 3380 production). Booked orders for 3350s exceed production capacity in the first half of 1982, causing IBM to offer customers improvement in 3380 deliveries if they cancel or delay 3350 orders.

- In conjunction with its October 21, 1981, announcement of the 3081 Model Group K, IBM introduced two new models of the 3880 storage control unit. Like previously announced models of the 3880, the new Models 11 and 13 contain two microprocessor-based storage directors that provide separate data paths into larger IBM processors.

- The 3880 Model 11, with a purchase price of $251,520, will be available in the 1982 second quarter. It is attachable to System/370 models 158 and 168, 4341, 3000-series, and 3081 processors via 1.5-, 2-, or 3-megabyte channels.

- One of the two storage directors manages up to four 3350 units and an 8-megabyte cache memory which can retain and transfer active program channels at a rate of up to one 4-K page in less than three milliseconds. Supported by MVS/SP and VM/SP, it is designed to improve system paging performance from 3350 disk drives.

- The 3880 Model 13 is priced at $260,880 and is scheduled to be shipped beginning in the third quarter of 1982. It can be attached to IBM 4341, 3000-series, and 3081 processors, via 3-megabyte data streaming channels. The two storage directors manage up to eight 3380 disk units and either four or eight megabytes of cache memory to transfer application and system data.

- The 3880 Model 11 appears to be a paging subsystem aimed at performance and response time improvement. Its support of the 3350 only for program paging seems likely to extend the life of the 3350, but increasingly as a program residence device rather than a data storage system.

  - This assessment is reinforced by the announced VM/SP support, as VM's stated purpose is to ease program development problems.

- INPUT believes that IBM achieves gross margins of 90% or more on its disk drives when the devices are in full production. The 3350s are at this stage in the product cycle, but the unprecedented demand for 3350s is impacting IBM's opportunity to achieve gross margin improvement on 3380s through rising production.

  - Introduction of the 3880 Models 11 and 13 will likely accelerate the migration of data files from 3350s to 3380s to resolve this problem.

- Another source of 3350 type disk drives has appeared. Hitachi-made units are being marketed by National Advanced Systems, with first deliveries scheduled in early 1982. Hitachi also intends to develop and supply to NAS a 3380 type product. The Hitachi 3350 equivalent will be marketed as the NAS 7360.

B. TAPES

- IBM has had a new tape product ready for announcement for some time. A marketing support team for this new product was assembled, then disbanded when the 3380 delivery problems surfaced.

  - Apparently IBM feels the product will not sell in required volumes until 3081 processors and 3380 disk drives are in volume delivery.

- This product was described in the April residual value report on 3420 series tape drives (18-track format, 20,000 bits per inch recording density, thin-film read/write heads, cartridge media).

  - The controller would be the same 3880 device used with the 3380 disk drives (i.e., there would be an optional feature code at an appropriate price with which the 3880 would support the new tape drives).

- A decision must now be made whether to announce the product this year or delay again. IBM would like to assert leadership in this area and retard PCM encroachment on market share - arguments supporting an earlier rather than later announcement.

C. PRINTERS

- IBM has remained dormant in the area of page printing systems since its 6670 announcement.

- During this period, Xerox has added the 48-page-per-minute 5700 system and the 12-page-per-minute 8044 system to its product line (supplementing the 120-page-per-minute 9700 printing system).

  - Xerox now has a reasonable product series, that will be expanded with other product offerings in the coming months.

- Unfortunately, the IBM Office Products Division developed 6670 page printer is incompatible with the Data Products Division 3800 page printer, although the recent move to permit flexibility in how type fonts are loaded in the 6670 is a step in the right direction.

  - INPUT expects IBM to announce a printer product within 12 months that will provide for true electronic printing; i.e., ability to intermix variable type fonts and type sizes on a given page.

- In October, IBM also announced two new desk-top printers, each priced at $4,150 in quantities of 24 or less. Scheduled for delivery in the current quarter, they are available at a 15% discount in quantities of 25 or more. They provide bi-directional serial printing of up to 450 characters per second, triple the speed of the IBM 3287, and use an electromatrix printing process to produce characters on aluminum-coated roll paper. The print head removes dots from the aluminum coating, exposing character images from the contrasting dark underlayer.

- The IBM 3230 is a receive-only printer, one model of which is used with the 8100 system and the other with the 3270 information display system. The 3230 provides printouts of display screens on operator command.

- The IBM 3232 is a keyboard printer designed for use with the 8100, 4300, and larger machines, and can be used for a variety of interactive applications such as data entry and update, data inquiry, program testing, and message switching.

- Both printers appear designed to reduce central site printer equipment workloads by encouraging distributed printing of low-volume hard copy output.

- Two new developments by other manufacturers that may have significant future impact are the ion-deposition imaging process developed by Delphax Systems, and an M68000 based controller for the table top Canon LBP page printer developed by Imagen Corporation.

- The ion-deposition imaging process uses ions rather than light to form an image on a dielectric drum. The process does not require heat to fuse the toner to the paper, nor does it require darkness since the drum is not photosensitive. The developers claim this process is simpler, more reliable, and less costly than the laser xerography approach now used in most page printing systems.

- The controller developed by Imagen (a high-technology firm located near Stanford University) can turn a low-cost laser page printer such as the Canon LBP10 (under $10,000 in quantity orders to OEMs) into a multifont, flexible (e.g., character rotation, some graphics capability) printing device. When available (the product is in beta-test), it will offer a quiet, letter quality, 10-page-per-minute multifont printer that can attach locally or remotely to a computer mainframe, or with less capability in font selection and graphics, to a word processor.

III RESIDUAL VALUE FORECASTS FOR SELECTED IBM PERIPHERALS

- The three principal forces influencing the residual values of IBM peripheral products are:

  - New product announcements.

  - Price changes on current generation products.

  - Availability, either new from IBM or in the used market.

- This report is an update to previous residual value forecasts for IBM high-end disk, tape, and printing products. There have been no significant new product announcements by IBM in these peripheral areas since publication of these prior reports. Some price increases have been announced but they have been simply adjustments for inflation (on a schedule predicted by INPUT). The availability of tape and printing products has corresponded to INPUT expectations, and thus actual residual values for tapes and printers have reasonably followed INPUT's prior predictions - and the updated forecasts summarized in Exhibit III-1 represent only minor tuning from prior forecasts through the 1985-1986 timeframe.

- The availability of IBM 3350 disk products has not followed prior expectations, caused by the delay in deliveries of the newer generation 3380 product. The used market for 3350 disk drives has been chaotic, with retail prices moving quickly from near 100% of IBM list just prior to the first slippage announce-

EXHIBIT III-1

PROJECTED USED MARKET RETAIL PRICES FOR SELECTED IBM PERIPHERALS

EQUIPMENT TYPE	MODEL NUMBER	CURRENT LIST (10-1-81)	PROJECTED USED MARKET RETAIL PRICE AT JANUARY 1 OF:				
			1982	1983	1984	1985	1986
Disk	3350A2	$40,000	$52,000	$ 40,000	$ 26,000	$ 20,000	$ 16,000
	3350B2	31,500	40,950	31,500	20,475	15,750	12,600
	3380A04	97,650	–	146,475	97,650	83,000	68,355
	3380B04	81,000	–	121,500	81,000	68,850	56,700
Tape*	3420-003	18,795	6,000	4,000	1,500	1,000	500
	3420-005	23,685	9,000	7,000	3,500	2,500	2,000
	3420-007	25,995	12,500	11,000	7,000	4,500	3,500
	3420-004	21,090	14,000	12,500	7,500	5,000	4,000
	3420-006	24,190	17,000	16,000	11,500	9,000	8,000
	3420-008	26,540	21,000	19,500	13,500	11,000	10,000
Printer	1403-N1	40,040	7,000	6,000	4,000	2,500	2,000
	3211-001	40,080	21,000	17,000	15,000	11,000	8,000
	3800-001	358,800	244,000	219,000	180,000	126,000	75,000

*PRICES LISTED INCLUDE FEATURE 6631 (1600 BPI DENSITY) FOR MODELS 003, 005, AND 007 AND FEATURE 6420 (6250 BPI DENSITY) FOR MODELS 004, 006, AND 008.

THE VALUES SHOWN ARE RETAIL PRICES PROJECTED IN A FUTURE USED MARKET.

THE DOLLAR SPREAD BETWEEN THE RETAIL ("BUY") AND WHOLESALE ("SELL") PRICE LEVELS DEPENDS UPON THE VALUE OF THE TRANSACTION. FOR THE RANGE OF VALUES SHOWN ABOVE, THE WHOLESALE PRICE WILL TYPICALLY BE 70% TO 90% OF THE RETAIL PRICE.

ment (March 1981) to 150% to 170% by early summer, then back to near IBM list by late August/September.

- The impact of the second slippage announcement (September 30, 1981) is yet to be seen. Certainly prices will go up, with some predictions from used computer equipment brokers going as high as 200% of list.

- INPUT's revised projections for IBM 3350 and 3380 disk products are given in Exhibits III-2 and III-3. Exhibit III-2 shows another sharp rise in 3350 used market prices, to peak in the March/April 1982 timeframe (at 140% to 150% of IBM list).

  - This projection assumes IBM will not be successful in persuading customers to release 3350 delivery positions in the first half of 1982 (thus causing a two- to six-month delay in 3350 scheduled deliveries in that time period), but that 3380 deliveries to customers with DOD priority ratings will release 3350s into the used market (because many need the machine room floor space thus generated).

- Both 3350 and 3380 longer term residual value projections have been raised over prior estimates, due to the 3380 slippages and the expectation that the follow-on product to the 3380 will now not appear until the 1985-1986 timeframe.

- Exhibits III-4 through III-9 covering models 003, 005, 007, 004, 006, and 008, respectively, of the IBM 3420 Magnetic Tape Drive Series show relatively minor changes for these mature products from the previous forecasts of April 1981, and should be read in conjunction with that report.

- Residual values for IBM fast printers, previously forecast in March 1980, have been revised and conformed to the percent of list price convention used for other INPUT residual value forecasts, and are shown in Exhibits III-10 through III-12 for models 1403N1, 3211, and 3800, respectively.

EXHIBIT III-2

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3350 DISK DRIVE

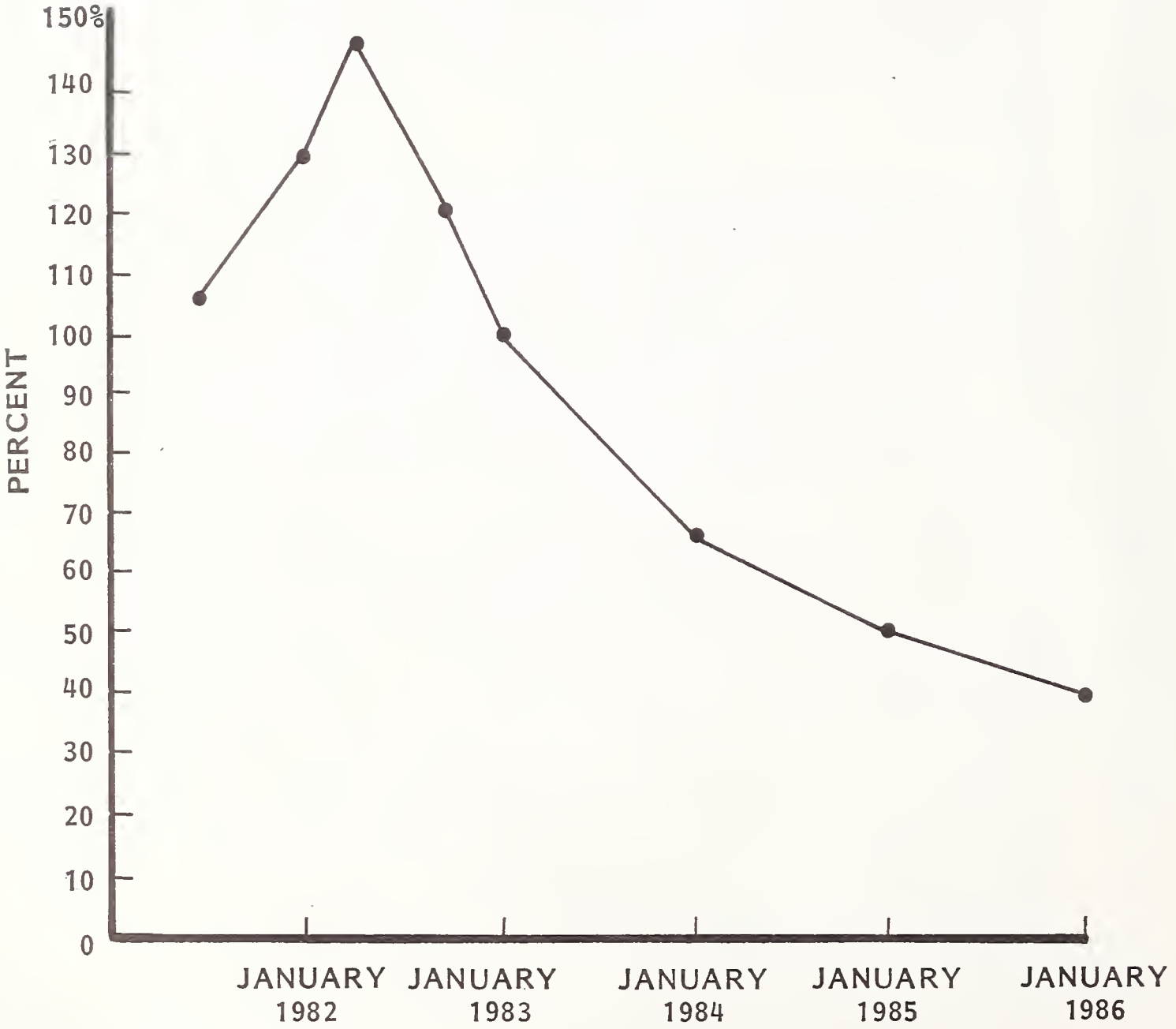


EXHIBIT III-3

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3380 DISK DRIVE

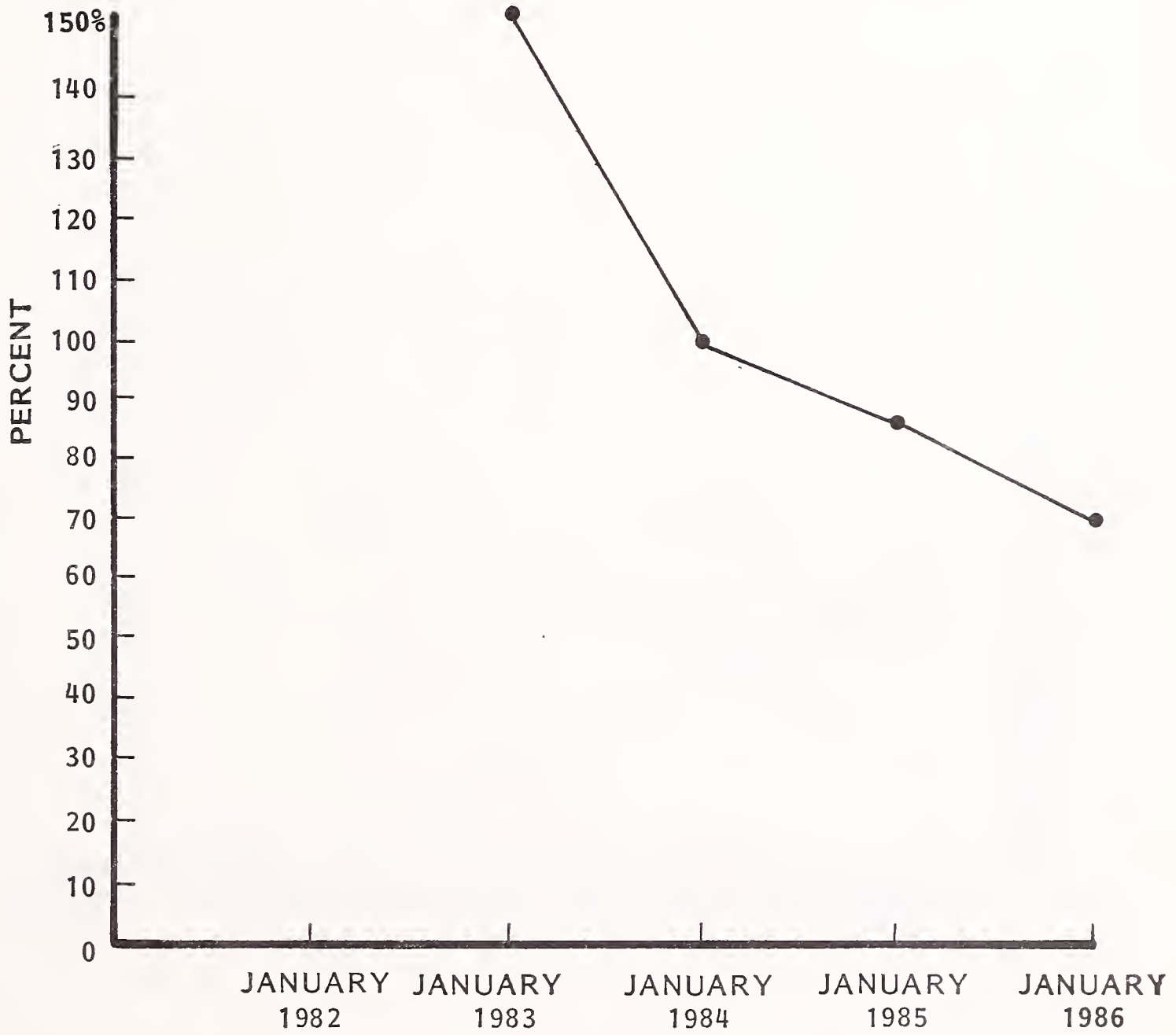


EXHIBIT III-4

PROJECTED RESIDUAL VALUES AS A PERCENT OF LIST
FOR THE IBM 3420-003 TAPE DRIVE

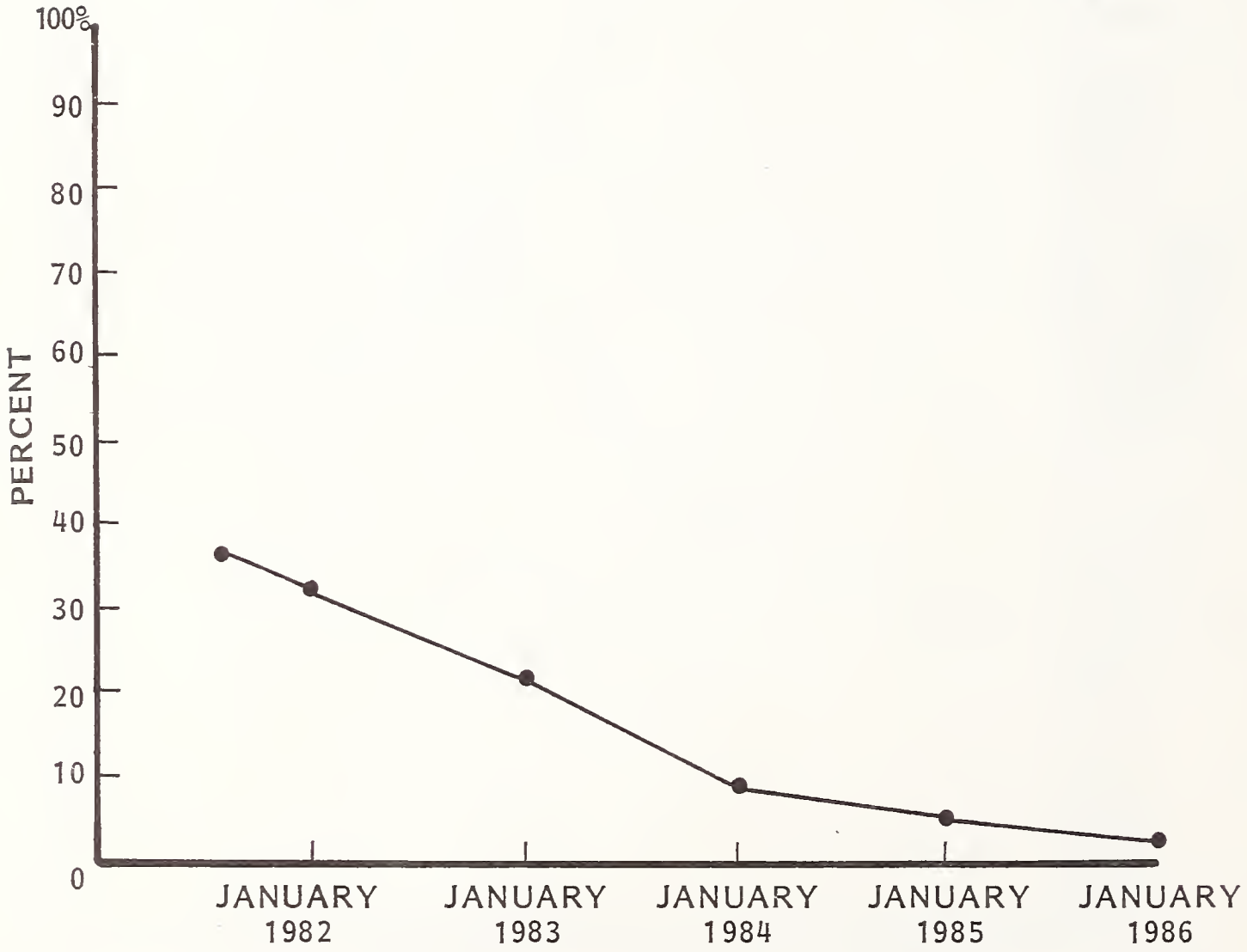


EXHIBIT III-5

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3420-005 TAPE DRIVE

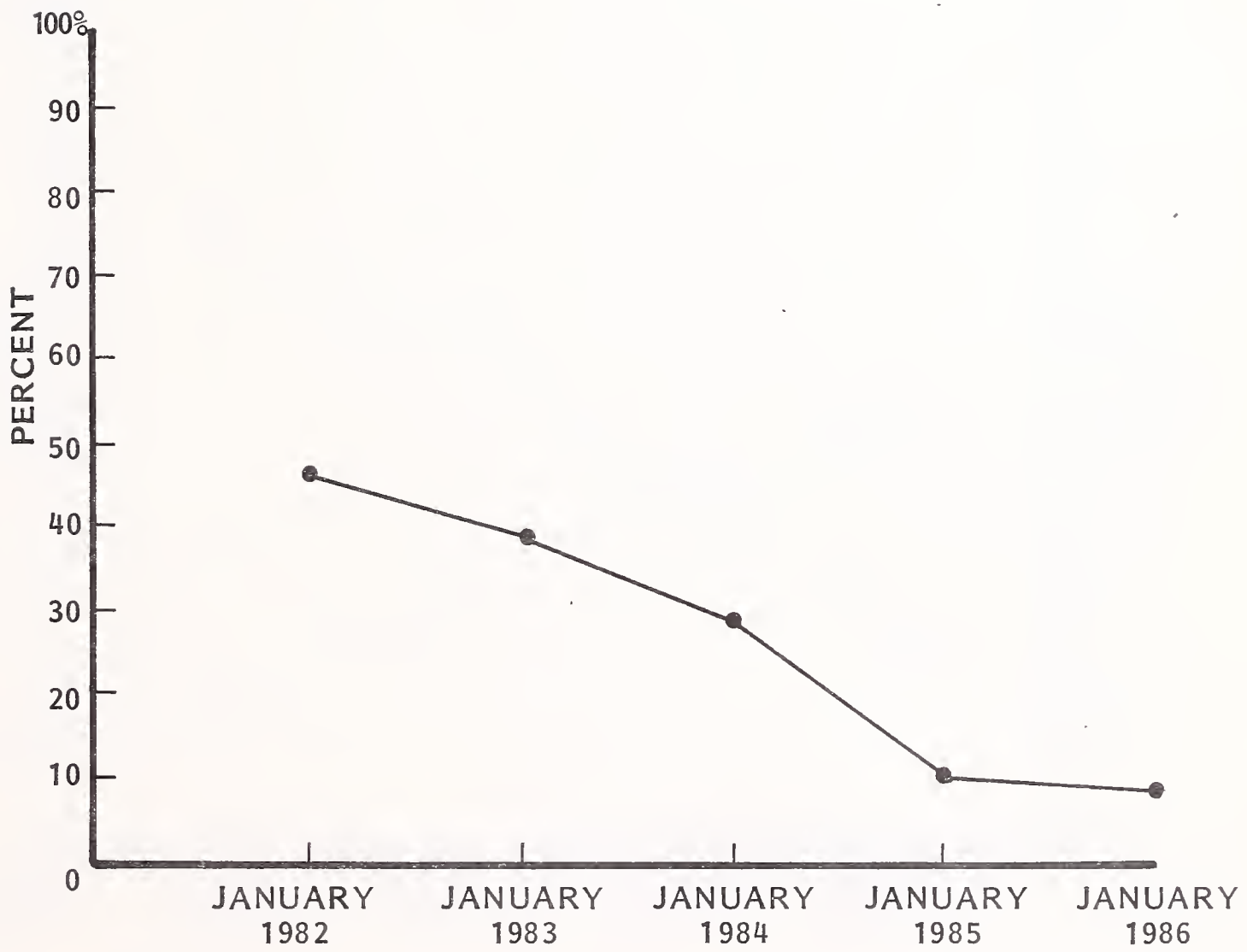


EXHIBIT III-6

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3420-007 TAPE DRIVE

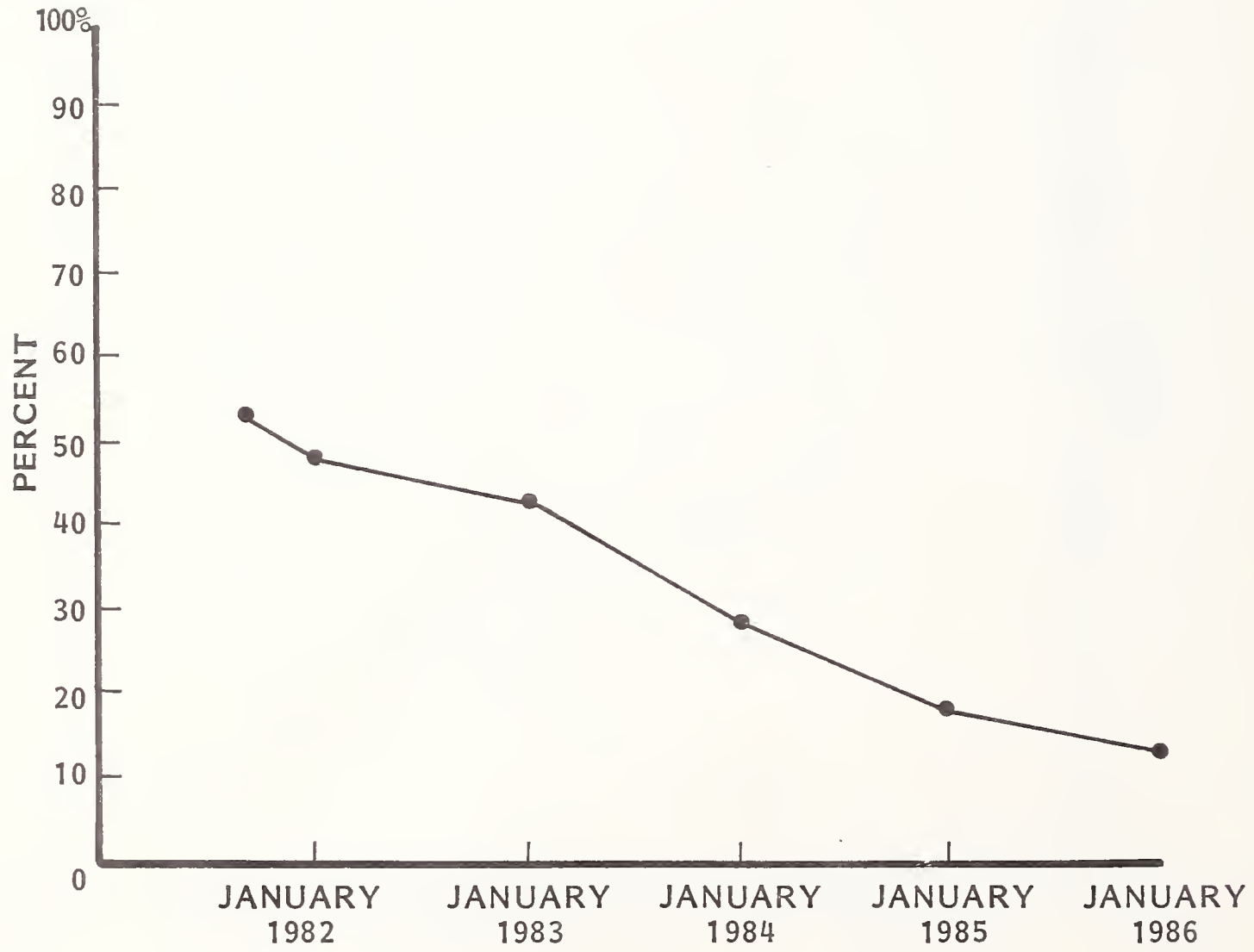


EXHIBIT III-7

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3420-004 TAPE DRIVE

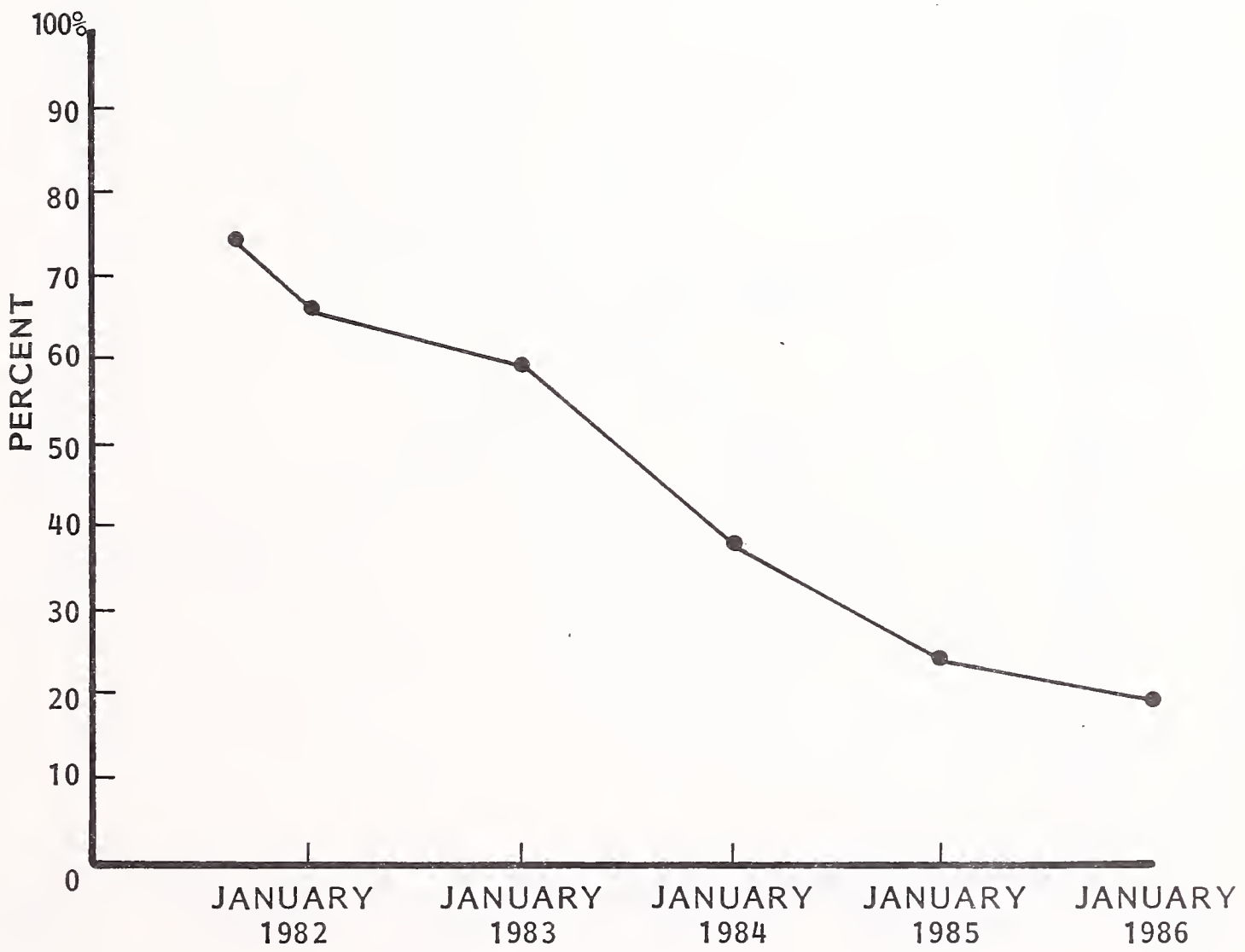


EXHIBIT III-8

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3420-006 TAPE DRIVE

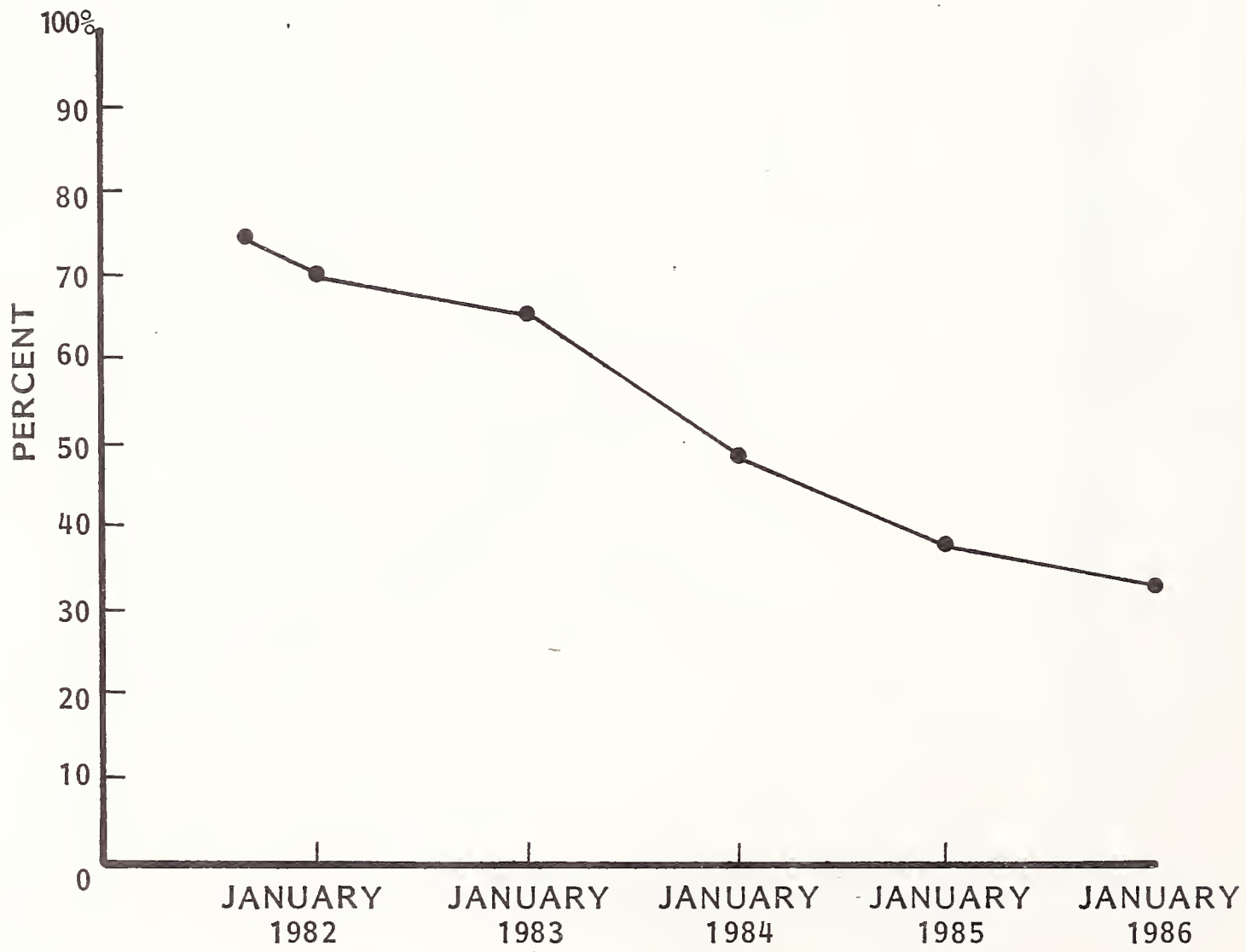


EXHIBIT III-9

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3420-008 TAPE DRIVE

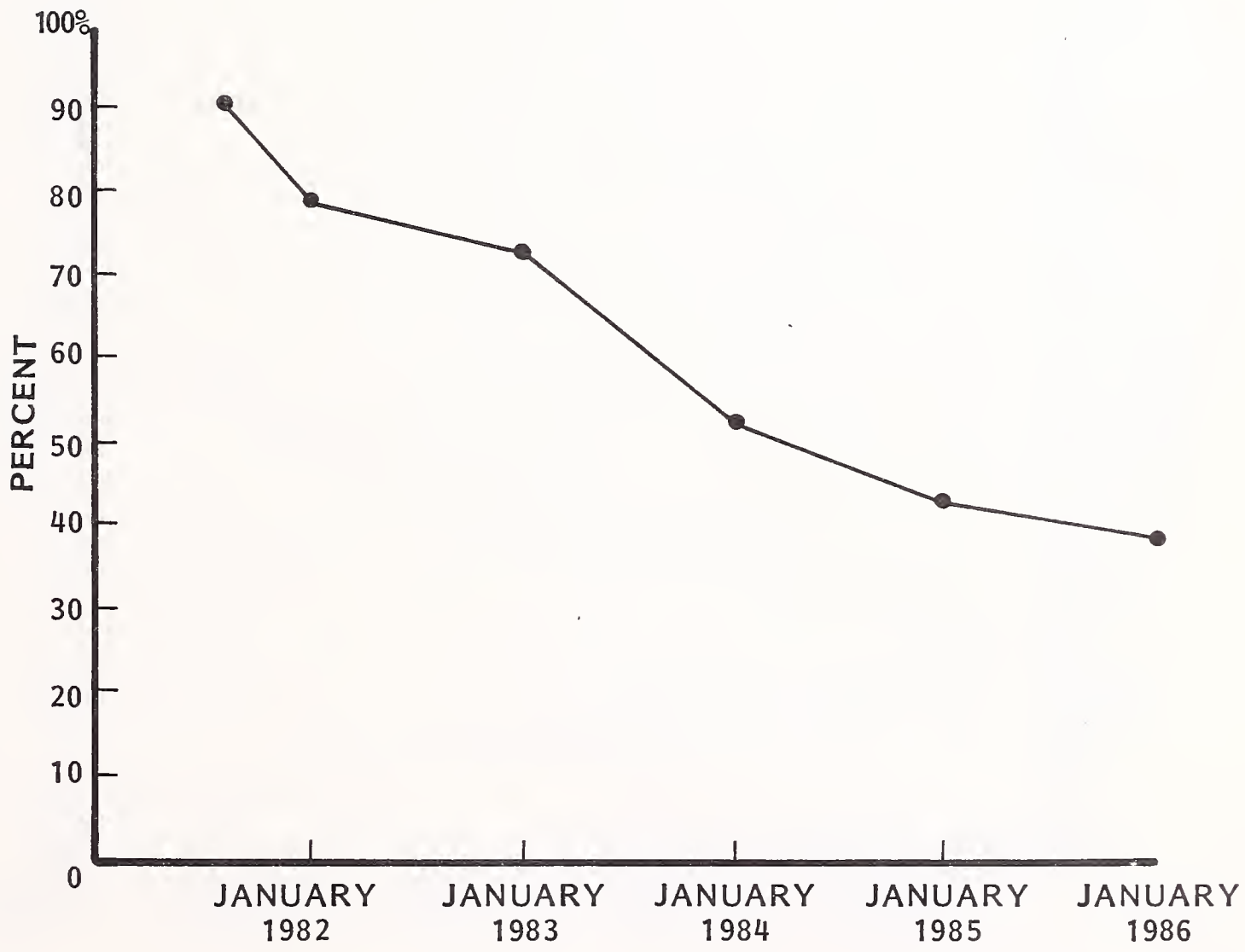


EXHIBIT III-10

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 1403-N1 PRINTER

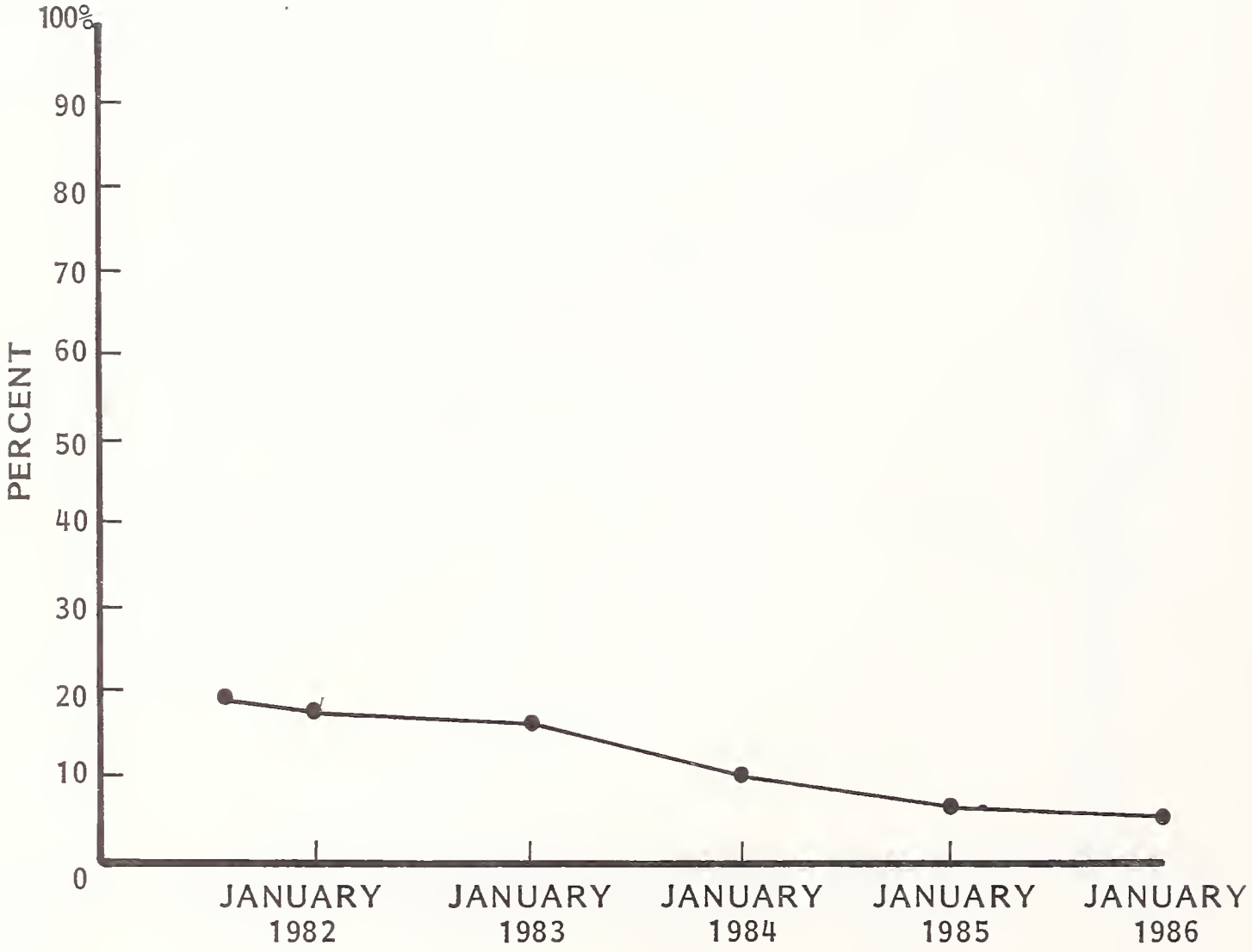


EXHIBIT III-11

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3211 PRINTER

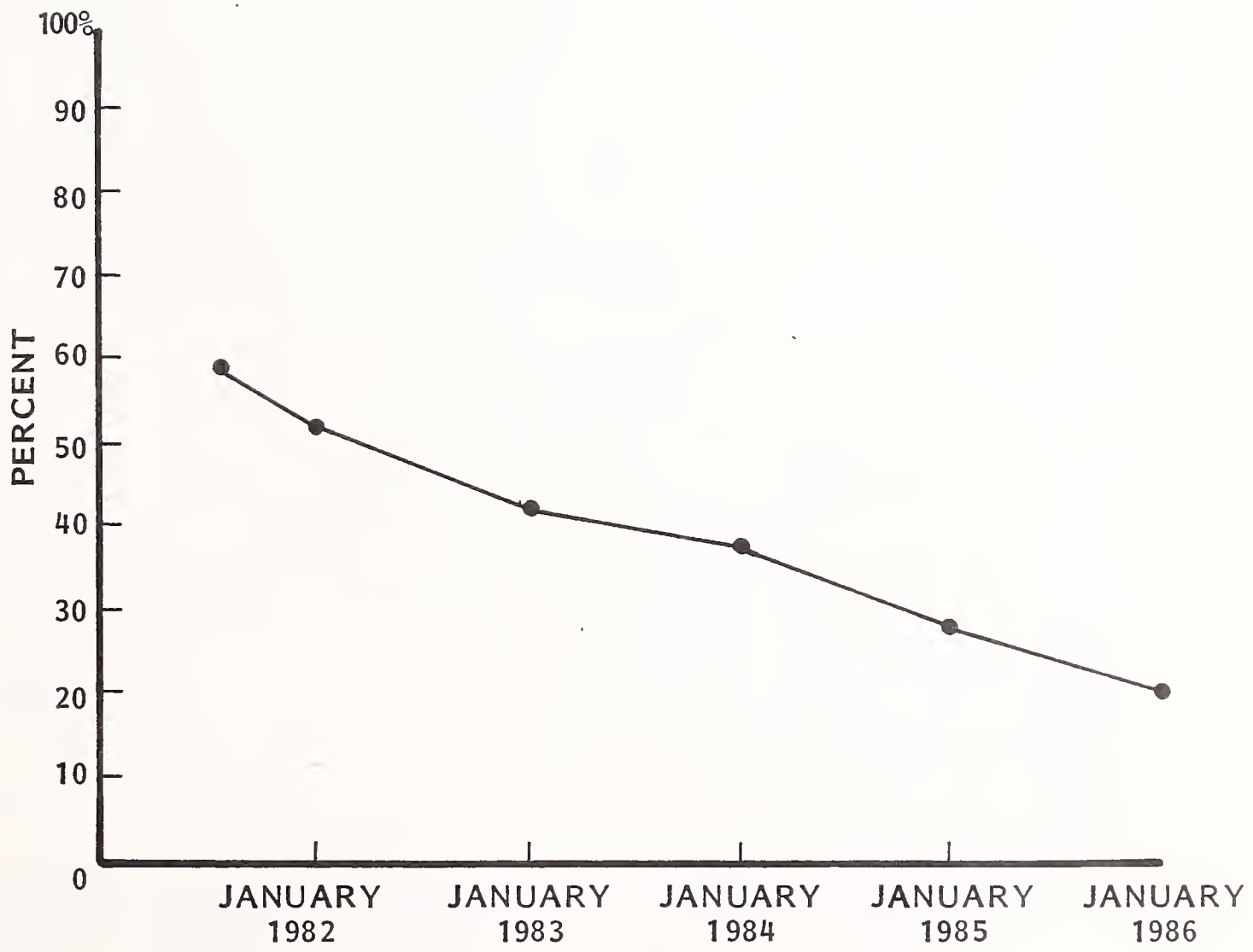
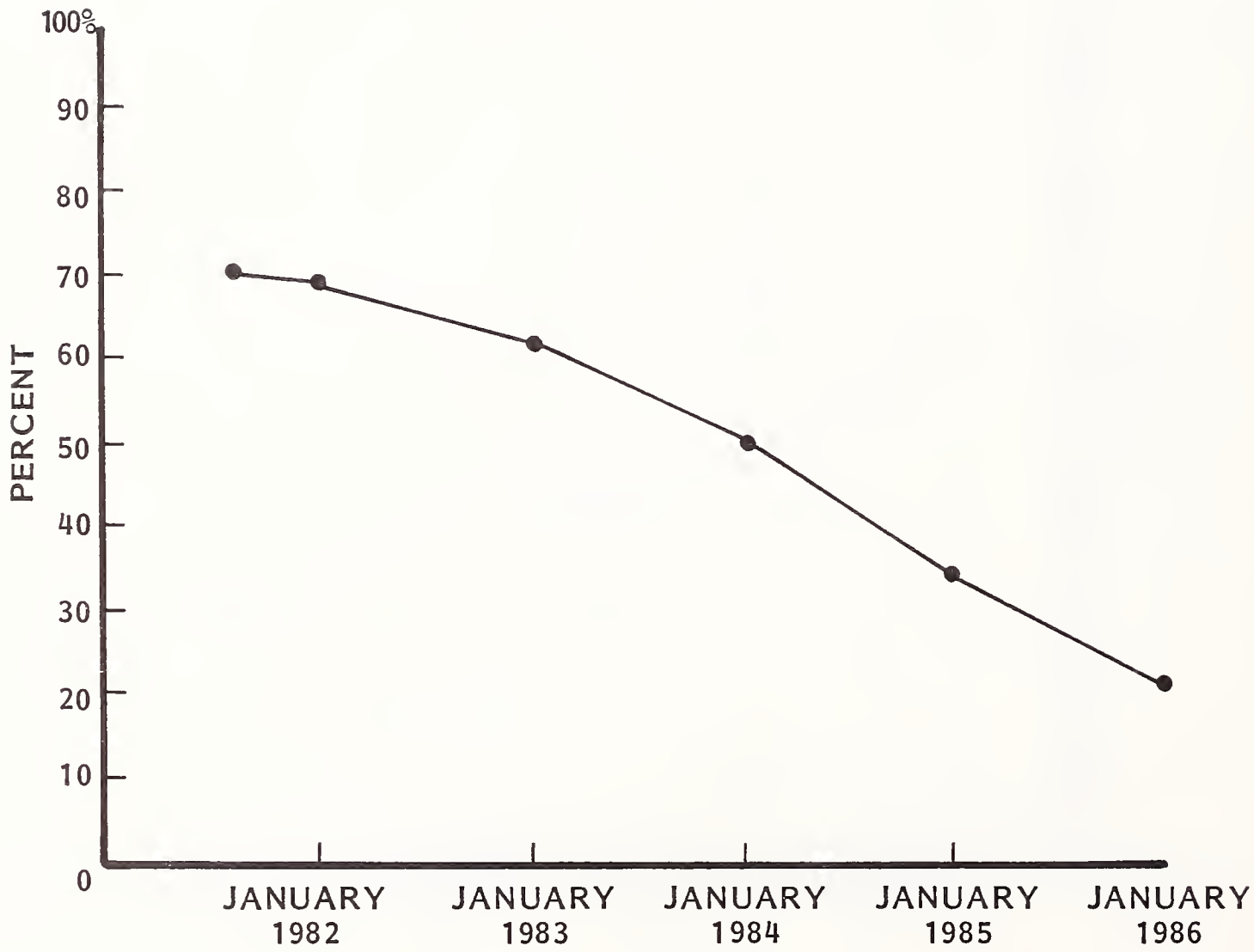


EXHIBIT III-12

PROJECTED RESIDUAL VALUES AS A PERCENT
OF LIST FOR THE IBM 3800 PRINTER



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RESIDUAL VALUE FORECASTS
FOR LARGE IBM AND
SOFTWARE-COMPATIBLE MAINFRAMES

DECEMBER 1981

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INFORMATION SYSTEMS PROGRAM

RESIDUAL VALUE FORECASTS
FOR LARGE IBM AND
SOFTWARE-COMPATIBLE MAINFRAMES

DECEMBER 1981

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

ABSTRACT

This report updates INPUT's five-year residual value forecasts for large-scale systems, and incorporates the December 14, 1981, price changes announced by IBM. It includes a discussion and examples of some of the factors affecting residual values, such as leasing leverage, maintenance costs, and energy and space requirements.

U-R13-20
December 1981

INPUT

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2471 EAST BAYSHORE ROAD, SUITE 600, PALO ALTO, CA 94303 (415) 493-1600

January 26, 1982

Dear Client:

Enclosed is the final report in your 1981 subscription to INPUT's Residual Value Forecasts. The report covers large-scale systems, and incorporates IBM's December 14, 1981, price change announcements.

It has been a pleasure to serve you in 1981, and we look forward to seeing you again as a subscriber to the 1982 Residual Value series. We are in the process of evaluating how we might make the 1982 reports even more useful. Any suggestions you may have are welcome, and will receive our full consideration.

Very truly yours,

George Heidenrich

George Heidenrich
Director, Management Planning Program
in Information Systems

GH:ml

Enclosure

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

CONTENTS

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

EXHIBITS

I INTRODUCTION

- This Residual Value Forecast is produced as part of the Management Planning Program in Information Systems. Data contained in this series of reports are updated periodically. Key issues, such as the future of IBM hardware and software and major product announcements, are the subjects of various other INPUT reports including the Technology and Management Issues Briefs, another part of the Information Systems Program.

- In June 1981, INPUT published the seventh report in its continuing series on residual values of large IBM and software-compatible mainframes. This report reviews significant events since June and updates the earlier residual value forecasts based on an analysis of recent developments.

- Forecasted residual values are provided for IBM, Amdahl and National Advanced Systems (NAS) processors. This report focuses on large-scale mainframes but includes residual value forecasts for the 43XX CPU product series.

- Chapter II reviews recent used-market activity for IBM, Amdahl and NAS processors. The used computer industry does not publish records of transactions. Information in this chapter was obtained by interviewing people active in market trading.

- Chapter III reviews vendor activity since INPUT's June 1981 report. Significant announcements are summarized, with INPUT commentary where appro-

priate. Both IBM and Amdahl introduced new products during this reportng period. Although NAS did not introduce new systems, they are expected to announce new products in early 1982.

- Residual value projections for the various processors covered by this report are given in Chapter IV. The used computer industry, by convention, always lists used equipment as a percentage of the manufacturer's current list price. The projections in Chapter IV follow this convention. Readers are cautioned to consider past price changes when analyzing their own unique situations.

II REVIEW OF RECENT USED MARKET ACTIVITY

- Overall values for IBM mid- to large-scale processors in the used market have been declining in recent months. The market was in a state of paralysis in the late summer and early fall as potential buyers awaited the rumored announcements by IBM of new CPU products and price decreases on older product lines. Trading activity increased noticeably toward year end following the October/November IBM announcements (reviewed in the next section of this report).

- The IBM 370 series CPU products are fading away quickly. The market has all but disappeared. One used market dealer reported several 370/158 and 370/168 processors are available (with no buyers in sight) at "bargain basement prices," e.g., $30,000-$40,000 for 158s and $80,000-$100,000 for 168s. Prices for these machines are dependent on a number of factors, such as model number (1 versus 3), memory size and type (non-IBM memory is worth significantly less), inclusion of "desirable" extra features with the CPU, etc. Asking prices for the better configured processors with all IBM memory are in the 5% to 9% range of current list price.

- The market for IBM 3031 processors slipped significantly during this reporting period. Current asking prices are under 30% of list price. The high electrical power and maintenance costs when compared to 43XX alternatives have caused further rapid erosion in 3031 values. The shrinking lead time in obtaining 43XX processors from IBM was a major factor in the plummet of 3031 used market values.

- The infrequent trading in IBM 3032 processors makes it difficult to generalize on market values for this CPU. Historically the percentage of list price for 3032 sales has followed that of the 3031. This trend is predicted to continue. Current used market value for the 3032 is estimated to be about 30% of list price.

- The June, 1981 "Residual Value Forecasts" had projected a sharp decline in IBM 3033 used market prices beginning in the third quarter. The rate of decline is slightly greater than projected in June. Used market prices for the 3033U have gone from 85% of list price in June, to 75% in September, to 65% (of the IBM October revised prices) in December. The 3033 model N and S machines are trading at a percentage of list higher than the "U" series CPUs (4 to 8 points).

- The IBM 3081 is available at a 5% to 15% premium over IBM list price from dealers with favorable delivery positions. The exact premium is difficult to determine because these machines are typically offered only under a leasing arrangement. This premium will evaporate as the delivery rate of 3081s grows in 1982 (IBM plans to deliver at least 400 machines in 1982).

- The market for IBM 43XX series processors has been fairly stable. Although IBM's favorable leasing terms have led to a majority of customers leasing rather than purchasing, there still remains an active used market for 43XX CPUs. Many customers who purchased have outgrown their initial 43XX systems and are upgrading. Both 4331-1 and 4341-1 processors are frequently traded. Recently, few 4331-2 processors have appeared in the used market.

- Amdahl V/5 and V/6 systems are traded infrequently; it is difficult to provide meaningful data on market values. These machines were trading at about the 50% level in June. They are estimated to have slipped 15 to 20 percentage points since then.

- A few Amdahl V/7 and V/8 systems have traded recently. Values reported are surprisingly low (lower than INPUT projections), with V/7s at the 50%-55%

range and V/8s in the 60%-70% range. This raises suspicions that Amdahl is discounting list pricing as part of its marketing strategy (a practice reportedly used with Amdahl V/5 and V/6 systems at a similar point in their product life).

- As reported before, National Advanced Systems handles the remarketing of NAS processors. Customer loyalty remains very strong, and thus almost all of the "surplus" machines become trade-ins on more powerful NAS processors.

III REVIEW OF VENDOR ANNOUNCEMENTS (JUNE-DECEMBER, 1981)

- IBM again made its major CPU product announcements in the fourth quarter of this year, a pattern it has followed in recent years. Amdahl was consistent with its tradition of very quickly responding to IBM announcements, suggesting they continue to have good intelligence sources on IBM product planning. NAS remained relatively silent during this reporting period with nothing new to announce, but they are expected to have some new product announcements in 1982. Trilogy, the Gene Amdahl venture to produce a processor for the large CPU market by 1984, is well financed and on-track toward this goal.

A. IBM ANNOUNCEMENTS

- September 1981:

  - IBM announced a sweeping reorganization to integrate its separate product-oriented groups into a unified operation in the U.S. The logic is simple - how can IBM expect to sell integrated systems that span a customer's organization when IBM itself is disaggregated at the customer interface? The major markets of the 1980s are outside the DP shop, a fact IBM recognizes. Thus the attempt to reorganize to effectively present a unified set of products. The "Statement of Direction," announced a year ago, was the first step; this reorganization is the second. All marketing and service activities will be under a

single entity called the Information Systems Group. Development and manufacture of computer systems (43XX processors through 3081 processors and associated peripherals) resides now with the Information Systems and Technology Group. The Information Systems and Communications Group is responsible for development and manufacture of IBM's other remaining product lines.

- October 1981:

  - A second model in the 3081 series was introduced in October: the 3081 Group K (with an advertised 40% performance improvement over the Group D predecessor). The improvement came from doubling cache memory size and improving the pipeline processing algorithms. It was clear the Group D model introduced the previous October had lots of room for performance enhancement (indeed, there is even room inside the cabinet to bolt in another pair of dyadic processors). The Group D system halved the machine cycle time of the 3033 and added a second processor, and thus should have produced a machine with about four times the performance of the 3033, not two times. IBM plans to unveil available performance enhancement in steps - each at a price. The Group K was the first in this planned series of performance upgrades, all of which will be housed in the 3081 cabinet. A "native mode" architecture, was also introduced using 31 bits for addressing; this extends real memory addressing from 16 million to over two billion characters.

  - The October announcement also included:

    . Two new versions of the 3033s: 12MB and 16MB of memory respectively and a doubling of the cache memory from 512 to 1,024 bytes on all versions adds about 10% to performance.

    . A price reduction of about 10% on purchase of 3033 CPU models and about 15% on contract maintenance for 303X processors.

- A cache memory front end for the 3350 and 3380 disk products.

- A remote control facility over 43XX processors.

- November 1981:

  IBM announced a realignment of the 43XX product series with new models, price changes, a modified operating system for the low end CPUs, and increased memory available for the high end CPUs. The 4331-1 was replaced by the 4321 (the 4331-1 will be discontinued as a product in the first quarter of 1982). Exhibit III-1 lists the new 43XX series of products in order of increasing estimated relative performance.

B. AMDAHL ANNOUNCEMENTS

- August 1981:

  - Amdahl announced a "Direct Support" program that "permitted" customers to do more of their own system diagnostics. End users may dial directly into the remote diagnostic facilities at Amdahl headquarters without the on-site attendance of an Amdahl service representative. This is a clever method for shifting a greater burden of diagnostic work to the customer, and the program is successful. At trial sites, over 50% of all customer-initiated calls resolved the problem without calling out a service engineer.

  - Amdahl also announced support of IBM's MVS/SP3 program product for their CPUs.

- October 1981:

EXHIBIT III-1

PERFORMANCE ESTIMATES OF NEW 43XX SERIES MODELS

MODEL NUMBER	RELATIVE PERFORMANCE ESTIMATE	PURCHASE PRICE OF MINIMUM CPU CONFIGURATION	
		(dollars)	(megabytes/second)
4321	1.0	$ 85,000	1Mbps
4331-11	1.5	110,000	1
4331-2	2.0	125,000	1
4341-10	3.3	178,000	2
4341-1	4.0	256,000	4
4341-2	7.0	390,000	4

- In reaction to IBM's 3081 Model K announcement, Amdahl introduced the 5870 product, an attached processor version of the uniprocessor 5860 CPU. The 5870 will be available in the third quarter of 1983 and will provide added flexibility in competing with the IBM 3081 series. Amdahl also cut prices on both the 470 V/7 and V/8 CPUs by 10%, and on the 5860 and 5880 CPUs by 5%.

- Third quarter operating results reported in October showed continuing improvement in the financial health of the company. Revenues and profits were up nicely over the prior year, with nine-month figures showing profits of $20.5 million (versus 1980 profits of $8.6 million) on revenues of $319 million (versus $286 million in 1980).

IV PROJECTED RESIDUAL VALUES FOR LARGE IBM AND SOFTWARE-COMPATIBLE PROCESSORS

- Computer equipment residual value forecasting is based upon:

  - Analysis of historical events and trends leading to judgments about whether (and in what way) such trends may change.

  - Predictions by computer industry experts on expected actions by IBM and responding strategies by the software-compatible mainframe manufacturers.

  - Analysis of variables affecting residual values as listed in Exhibit IV-1.

- The dominant determinent of used market value for a given piece of equipment is supply and demand. A good example is the rapid rise in price for used IBM 3350 disk drives (more than 150% of IBM list price) this past summer when demand substantially exceeded supply. There are many factors that influence supply versus demand for a given product. The forecasts contained herein are based upon an analysis of such factors and judgments by INPUT professionals on the anticipated actions of IBM and the resulting reactions of the competing software-compatible manufacturers.

EXHIBIT IV-1

FACTORS AFFECTING COMPUTER EQUIPMENT RESIDUAL VALUES

- IBM practices and policies
  - New product announcements
    - . Price/performance ratios relative to existing products.
    - . Ease of conversions, transitions, and lead time in obtaining new products.
    - . Ease of installation and maintenance.
    - . Effect on perceptions about IBM's technical direction.
  - Pricing policies
    - . Price increases or decreases on existing products.
    - . Rental versus purchase breakeven ratios.
    - . Lease plans and penalty provisions for lease termination.
    - . Purchase option accruals.
  - Maintenance policies
    - . Availability and cost.
    - . Attitude toward other vendor modifications to IBM equipment.
- Alternative equipment services
  - Price/performance of plug (software) compatible alternatives.
  - Third-party leasing options.
- Other Variables
  - Environmental support considerations, e.g., electrical power consumption, air conditioning needs, space requirements.
  - Tax considerations, e.g., income tax incentives such as investment tax credit and accelerated depreciation and also property taxation rates.
  - General economic conditions, e.g., cost and availability of capital and overall demand for computing capacity.

- Projected future values for IBM, Amdahl, and National Advanced Systems (NAS) processors are presented in table format in Exhibit IV-2. Graphical presentations of projected values for selected mainframes (IBM 3033 and 3081, Amdahl 5860, and NAS AS/9000) are given in Exhibits IV-3 through IV-6.

- The values shown represent wholesale prices; i.e., the amount a used computer industry dealer will pay for equipment for subsequent resale to an end user at a higher price.

- Some of the values shown in Exhibit IV-2 have been revised downward from the June 1981 projections. Generally the revisions apply to the 303X and Amdahl 470 Series CPUs and range from four to ten points. Although INPUT correctly predicted that these values would commence a rapid decline in mid 1981, the projected rate of decline was slightly underestimated.

- Exhibit IV-1 lists the various factors affecting residual values. Recently, the impact of the cost of capital, cost of energy and space, and differential maintenance cost have assumed a much greater significance. Some simple examples best demonstrate the impact of these considerations.

- Example one: impact of higher cost of capital and greater conservatism in future residual value assumptions.

  - An important component of the used computer market is the purchase of used computers to fulfill leasing transactions. Such leases must compete favorably with IBM's own leasing programs. The combination of high interest rates and greater conservatism in future residual value assumptions has been a strong force in declining 370 and 303X values, since the purchase price necessary to package a competitive yet profitable leasing transaction has shrunk substantially. For example, the purchase price necessary to produce a simplified cash flow outgo of $1,915,000 over four years (sum of interest and principal payments less

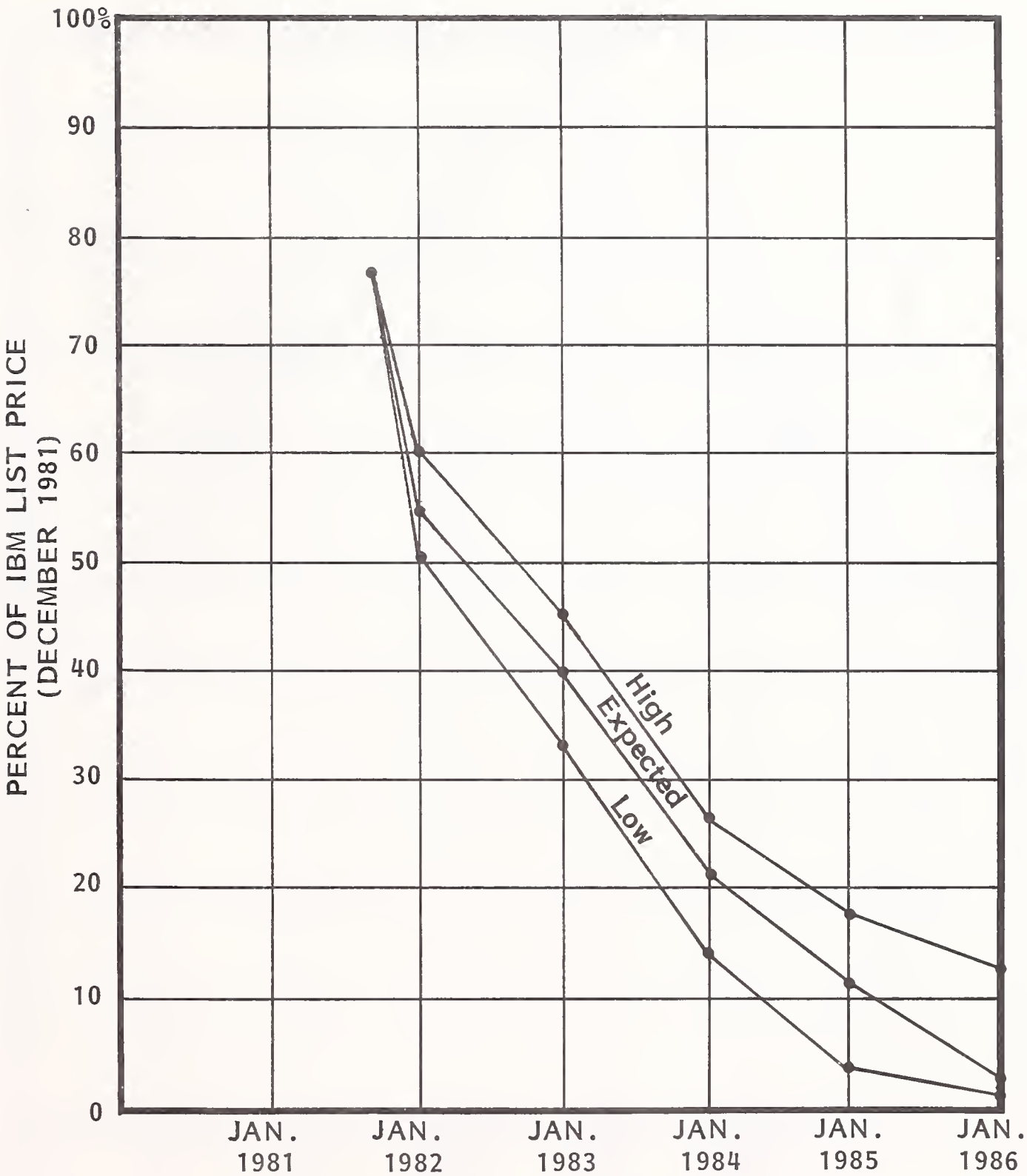
EXHIBIT IV-2

PROJECTED RESIDUAL VALUES FOR IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

VENDOR	PROCESSOR MODEL	PROJECTED RESIDUAL VALUE AS PERCENT OF VENDOR LIST PRICE (DECEMBER 1981)				
		JANUARY 1982	JANUARY 1983	JANUARY 1984	JANUARY 1985	JANUARY 1986
IBM	370/158-3	5%	4%	2%	1%	-
	370/168-3	6	5	3	2	1
	3031	28	19	11	7	4
	3032	30	20	10	6	3
	3033-S	67	45	26	15	6
	3033-N	64	43	24	14	5
	3033	60	40	21	11	3
	4321	-	74	59	43	22
	4331-1	60	50	43	37	19
	4331-2,11	85	70	65	45	23
	4341-1,10	80	73	51	46	24
	4341-2,11	88	76	57	50	27
	3081-D	100	87	78	57	40
Amdahl	470 V/5	35	21	14	6	2
	470 V/6	36	18	12	5	1
	470 V/7	50	38	20	10	4
	470 V/8	60	45	25	12	6
	5860	-	85	78	56	40
	5880	-	-	85	63	44
NAS	AS/5000	43	27	17	8	3
	AS/5000N,E	67	46	27	14	6
	AS/7000	39	23	13	6	2
	AS/9000	80	72	63	40	28

EXHIBIT IV-3

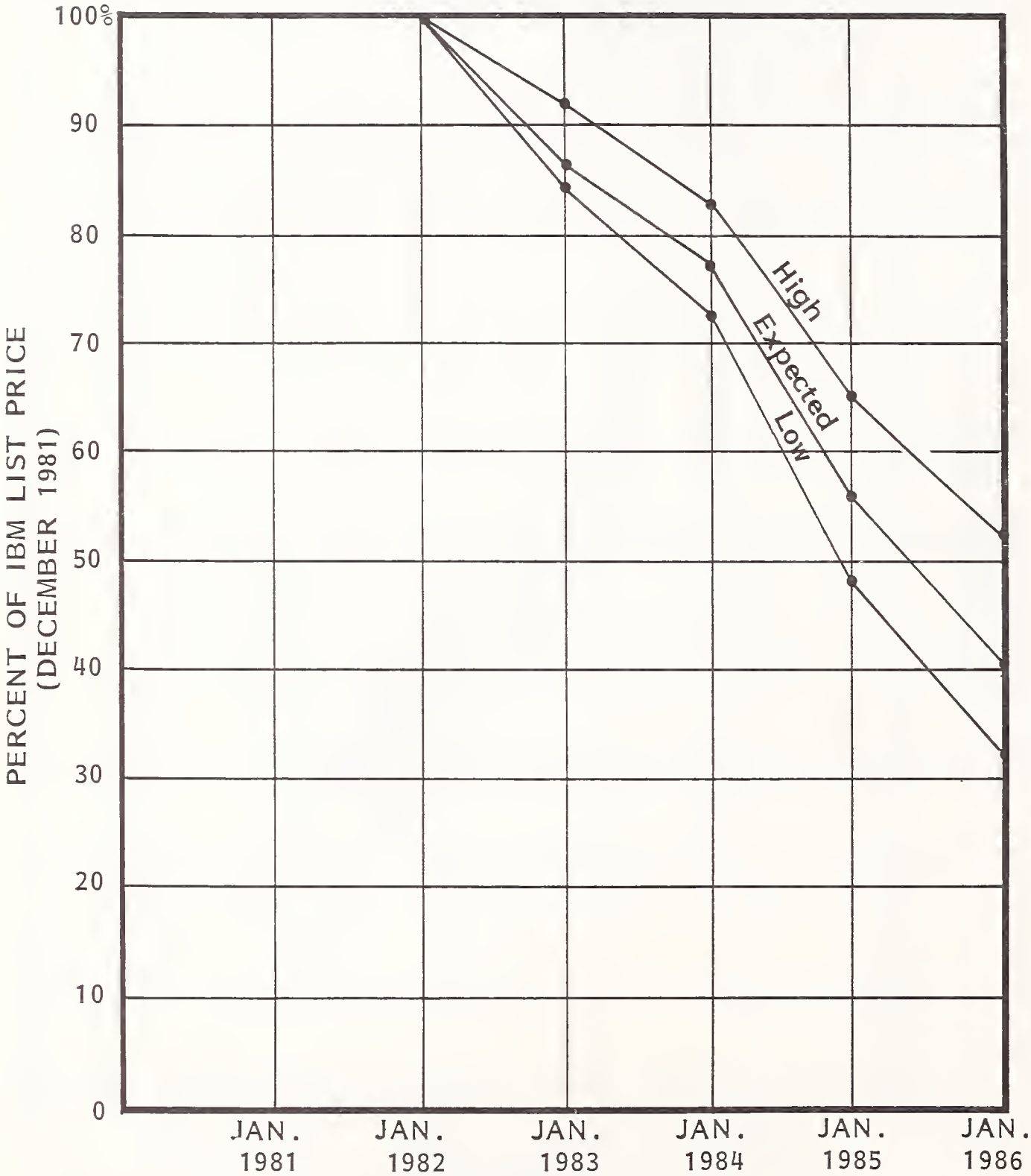
PROJECTED RESIDUAL VALUES FOR THE
IBM 3033 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1982	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986
HIGH	60%	45%	27%	18%	12%
EXPECTED	55	40	21	11	3
LOW	51	34	14	4	1

EXHIBIT IV-4

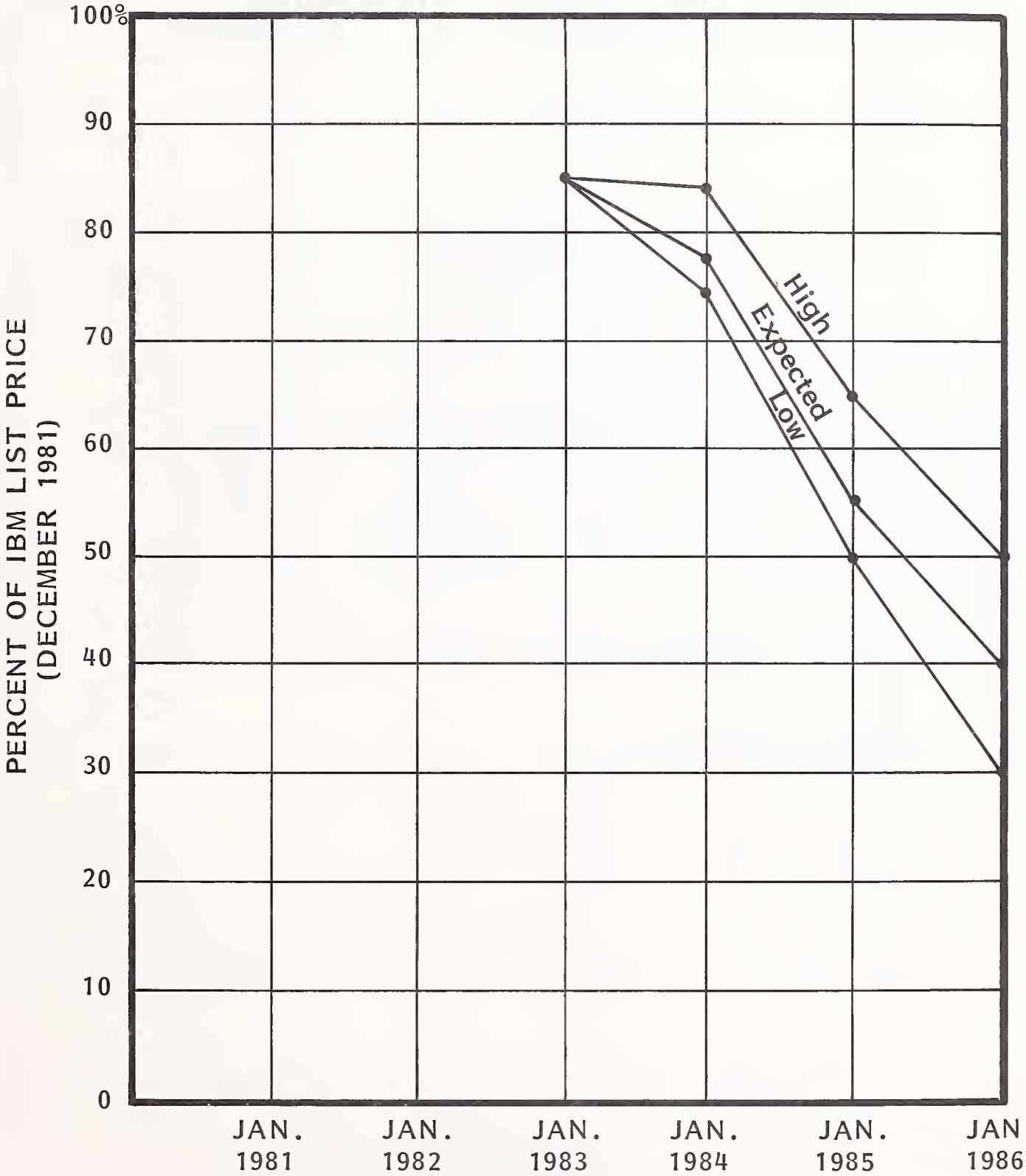
PROJECTED RESIDUAL VALUES FOR THE
IBM 3081 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1982	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986
HIGH	-	92%	83%	65%	52%
EXPECTED	100%	87	78	57	40
LOW	-	85	73	49	32

EXHIBIT IV-5

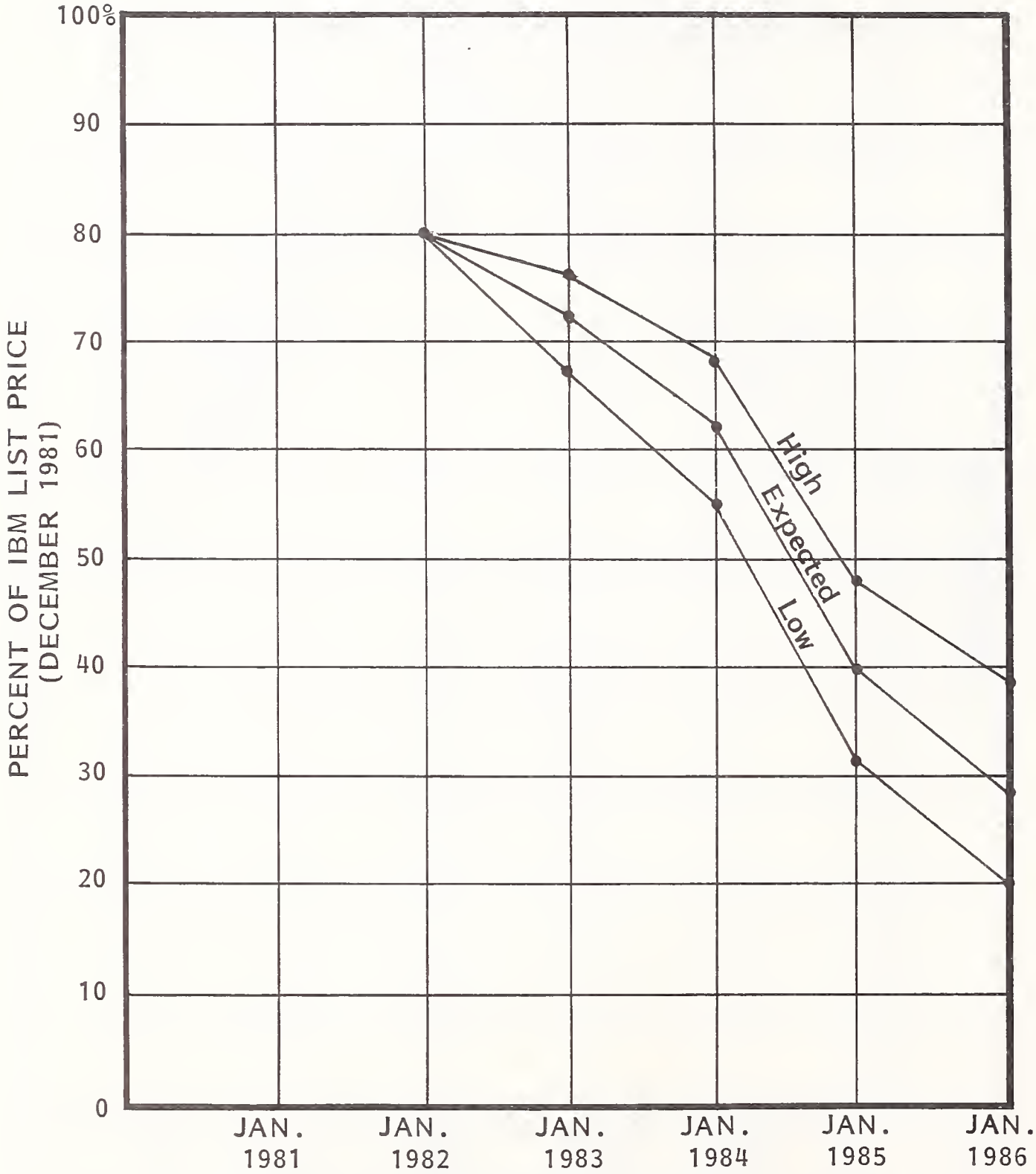
PROJECTED RESIDUAL VALUES FOR THE
AMDAHL 5860 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986
HIGH	-	84%	65%	50%
EXPECTED	85%	78	56	40
LOW	-	75	50	30

EXHIBIT IV-6

PROJECTED RESIDUAL VALUES FOR THE
NAS AS/9000 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1982	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986
HIGH	–	76%	69%	48%	38%
EXPECTED	80%	72	63	40	28
LOW	–	67	55	31	20

residual value at end of four years - and ignoring the time value of money), given differing interest rate and residual value assumptions, are as follows:

Interest Rate Assumptions	Residual Value Assumptions	Necessary Purchase Price
10%	$500,000	$2,000,000
20%	$200,000	$1,472,000

- Example two: differences in energy and space requirements for alternatives providing approximately ten MIPS processing power.

  - This example compares the electrical power, air conditioning, and space requirements between four IBM 370/168 computers, two IBM 3033 computers, and one IBM 3081 computer. These three alternatives each provide about ten MIPS processing power. INPUT predicts a tripling in electric power costs by 1987. The cost of power and machine floor space additions are not insignificant and should be carefully considered when evaluating life cycle costs of competing alternatives.

	Comparable Systems		
Computer	(4) 370/168s	(2) 3033s	3081
Electrical power (KVA)	601.2	166.6	37.1
Air conditioning (BTU/hr)	1,333,820	436,300	80,300
Floor space (sq. ft.)	919.2	277.4	96.7

- Example three: differential costs of hardware maintenance.

  - The cost of maintenance between competing alternatives can be significant. Older generations of equipment become more difficult (and thus more costly) to maintain as the pool of skilled technicians for that equipment declines and parts inventories are depleted. The example below shows the difference in monthly maintenance cost between equipment generations of roughly equivalent processing power.

	Monthly Difference	5-Year Cumulative Difference
4341-2 versus 3031*	$2,200	$132,000
3081 versus 3033mp**	$9,150	$549,000

* 9 a.m. to 5 p.m. maintenance coverage for 4-megabyte, 6-channel configuration.

** 9 a.m. to 5 p.m. maintenance coverage for 24-megabyte, 24-channel configuration.

- The above examples demonstrate the importance factors other than IBM new product announcements have assumed in recent years. However, new product announcements still strongly affect future residual values.

- In the 1982-1985 timeframe, INPUT predicts IBM will "adjust" performance of the 3081 dyadic processors to generate additional models (as was recently done with the 4331 and 4341 CPUs). A second pair of dyadic processors can be bolted into the present 3081 cabinet increasing the processor count to four and thereby providing flexibility to generate additional models - all easily field upgradable from one version to another.

  - Projected IBM announcements are therefore:

    . The ability to add the second pair of (dyadic) processors in the present IBM 3081 cabinet will be announced in mid to late 1982. This will tightly couple four processors in a single cabinet with 26 to 30 MIPS (Millions of Instructions Processed per Second) processing power.

    . The ability to loosely couple these four-processor modules will be announced at the same time or in 1983.

  - Also expected in 1982 are higher performance versions in the uniprocessor 4300 series (4351). These will help bridge the gap between the 4300 series and the 3081 series.

  - In order to provide an upward compatible growth path for IBM customers from the 4331 through the 3081, a scaled-down version of the 3081 will be announced in late 1982.

- Significant price reductions on 3033s are expected to clear the way for the new production in mid to late 1982.

- In the longer term IBM believes it can build a 35 MIPS uniprocessor using silicon technology. It also speculates that six such processors could be tightly coupled in a single cabinet, creating a raw MIPS rating of 150. This is at least an order of magnitude increase over the recently announced 3081 Group K system.

o The price per MIPS has been approximately halved with each new large CPU product series introduced by IBM. The 370 series costs about $1.5 million per delivered MIPS, the 303X series about $0.7 million, and the 3081 series about $0.35 million. This trend suggests the next generation product series (1985-1986 timeframe) should be priced at about $0.15 million. INPUT predicts the actual number will range between $0.1 and $0.17 million per MIPS.

o Trilogy Ltd., Gene Amdahl's new venture, is predicting its initial product offering, in 1984 to 1985, will be a 35 MIPS processor that will cost about $3.5 million, or $0.1 million per MIPS.

o INPUT expects both Amdahl and NAS to remain viable alternatives in the large mainframe market. Amdahl recently announced it had sold twelve 470 and 580 series computer systems to the military, and is enjoying good profitability and cash flow. NAS has orders to install (with some already in place) about one dozen AS/9000 systems and will soon have Hitachi's latest processor technology (M280H system) as a product offering.

- The projections contained in this report assume IBM will now focus on marketing the 43XX and 3081 products, and will bring forth additional derivatives as needed. There is now a gap between the high end 4341 and low end 3081 that must be closed. The 3033 is dropping quickly in value, and thus a used 3033 becomes an attractive choice that IBM must counter. If IBM does not move quickly to cover this gap, the used 3033 market could rebound when demand for these CPUs expands.

- The major markets of the 1980s are software, local processing (including office automation) and telecommunications. INPUT projects IBM will achieve revenue growth in these areas such that significant price reductions in the 3081 CPU series can be made in 1984 (in anticipation of a new product generation) without suffering profit degradation. These price reductions are the primary cause of the steep residual value declines shown in exhibits IV-4 through IV-6 during 1984.

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RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE SYSTEMS

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RESIDUAL VALUE FORECASTS
FOR IBM MULTIPLATTER, MOVING
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June 1, 1982

Dear Client:

Enclosed is the May 1982 report, Residual Value Forecasts for IBM Multiplatter, Moving Head, Disk Storage Systems. The systems included are Models 3330-11, 3350, and 3380.

The report contains a review of recent activity in the used market, with special emphasis on the effects of 3380 delays, and provides an overview of plug-compatible disk drives.

Sincerely,

George Heidenrich

George Heidenrich
Vice President

GH:ml

Enclosure

RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE SYSTEMS

ABSTRACT

This report provides residual value forecasts for IBM disk storage systems. The systems covered are Models 3330-11, 3350, and 3380.

In addition, this report contains a review of recent activity in the used market, with special emphasis on the effects of 3380 delays. An overview of plug-compatible disk drives is also provided.

U-R14-413
May 1982
INPUT

RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE SYSTEMS

CONTENTS

RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE SYSTEMS

EXHIBITS

TABLES

I INTRODUCTION

- This report on IBM multiplatter, moving head, disk storage systems is issued as part of the Residual Value Forecasting Series in INPUT's Management Planning Program in Information Systems. These reports are meant to provide an overview and understanding of the technology useful in equipment acquisition decision-making, rather than a detailed technical analysis of the selected peripheral product area.

- The used market for IBM disk storage products (especially the IBM 3350 disk drive) has been unsettled and volatile in recent months because of delays in initial shipment schedules for the newer generation 3380 disk drive. The 3380 is now being manufactured and delivered in volume, causing 3350 prices to decline rapidly. INPUT believes the used market is now stabilizing and that used market prices will follow more predictable patterns in the foreseeable future.

- Chapter II of this report reviews used market activity since September 1981. During this period, the used market retail price of 3350 disk drives rose from 100% of IBM list price (September 1981) to 150% (December 1981) and then fell to 75% (March 1982).

- A review of the plug-compatible products offered by the major vendors in this market (Storage Technology Corporation, Control Data Corporation, and Memorex) is provided in Chapter III. The delays in 3380 deliveries have caused many formerly all-IBM end-user sites to try other brands. This dispersion of

PCM disk products into a broader base of customers may facilitate a used market in these devices. Presently, trading in used non-IBM manufactured disk drives is very infrequent. Higher trading volume would establish a market for which the prediction of future values within acceptable confidence levels would be possible (INPUT does not now attempt such forecasts because of the lack of trading information).

- Residual value forecasts for IBM 3330-11, 3350, and 3380 product families are given in Chapter IV, along with the assumptions that underpin the projections. Magnetic disk storage systems will remain the most cost-effective technology for on-line access to large information files, certainly for the next five years, and perhaps for the next ten years. The follow-on generation to the 3380 will incorporate thin-film technologies both in improved read/write head designs and in the magnetic plating in which suspended magnetic domains form "bits" of stored information. This new generation will be announced by IBM in late 1985 or early 1986.

II REVIEW OF RECENT USED-MARKET ACTIVITY

- Since INPUT's last update on IBM multiplatter disk storage systems (October 1981), the used market has been both active and volatile. The announcement by IBM in October 1981 of another delay in first shipments of 3380 disks caused a surge in demand for both IBM 3350 drives and PCM equivalent products. The sharp increase in used market prices for 3350 disks was predicted by INPUT to peak at 150% (which it did) but INPUT incorrectly projected that peak to occur in the March 1982 timeframe.

- The table below shows fluctuations in used market pricing for selected IBM disk models since September 1981. The values are average retail prices as a percent of the IBM list price in effect during this period.

	1981		1982	
Model	September	November	January	March
3330-1	42%	36%	33%	19%
3330-11	47	60	44	40
3333-11	57	71	55	48
3350-A2	103	140	95	75

- The price for 3350s peaked in early December at 150% of IBM list. Prices then dropped very rapidly. This rapid decline was caused by two factors. First, IBM shipment volume for 3380 units exceed INPUT's projections, causing a flood of displaced 3350s to appear on the used market. Second, when it

became evident that IBM had solved its problems with the 3380 technology and was accelerating product deliveries, many end users opted to wait for the 3380, thus lessening market demand for used 3350s.

- Some end users had ordered more 3380s than they really needed, not expecting IBM would be able to meet fourth quarter 1981 delivery schedules. This was a dangerous assumption given IBM's motivation to improve 1981 earnings by getting as much product out of the door as possible before fiscal year-end. Such users were thus in a surplus disk situation, leading to the dumping of 3350s as fast as possible to avoid unnecessary costs and to capitalize on high 3350 market prices. This phenomenon also led to the appearance of a few 3380 disk drives in the used market.

- The 3330-11 used values followed the 3350 market on its up and down journey. These devices enjoy the advantage of removable media and thus will always be in demand where such flexibility is desired.

  - It is interesting to note that the 3330-1 did not increase in value during the 1981 year-end demand surge, suggesting this product is near the end of its product life.

III OVERVIEW OF PLUG-COMPATIBLE DISK DRIVES

- The overall demand for storage space on large multiplatter, moving head, disk storage systems is growing at a rate of 45% to 65% per year at most end-user sites. This growth in demand is expected to continue for several years as interactive access by knowledge workers to corporate data bases increases, and magnetic disk storage systems remain the most cost-effective storage medium for such data.

- IBM's principal competitors in the disk market today are Storage Technology Corporation (STC), Control Data Corporation (CDC), and Memorex. These companies are well established and have been active competitors in this market for several years. They currently offer 3350 equivalent devices at both single density (equal to IBM's standard of 635 megabytes per unit) and double density (i.e., 1,270 megabytes per unit). A review of STC's and CDC's products in comparison to IBM's is given in Tables III-1 and III-2. (Memorex was not willing to provide this information.)

- Memorex and CDC recently set up two joint ventures to supply components for their next generation products. These companies are:

  - Peripheral Components, Inc. - A company to manufacture thin film heads.

  - Disk Media, Inc. - A company to develop and manufacture advanced recording media for use with thin film heads.

TABLE III-1
COMPARATIVE COSTS OF IBM, STC, AND CDC DISK DRIVES*

Model	Purchase Price (dollars)	Monthly Lease Price (dollars)	Minimum Monthly Maintenance (dollars)	Capacity (megabytes)	Bytes Per $1 Purchase
IBM 3380					
Model A04	$101,550	$ 2,340	$ 285	2,520	24,815
Model B04	84,240	1,940	240	2,520	29,915
String	354,270	8,160	1,005	10,080	28,453
IBM 3350					
Model A02	41,500	1,455	170	635	15,301
Model B02	31,180	1,160	128	635	20,366
String	135,040	4,575	554	2,540	18,809
STC 8380					
Model A04	99,515	1,708	285	2,520	25,323
Model B04	82,555	1,412	240	2,520	30,525
String	347,180	6,949	1,005	10,080	29,034
STC 8650					
Model A02	50,010	1,389**	218	1,270	25,394
Model B02	37,235	1,062**	155	1,270	34,108
String	161,715	4,660**	948	5,080	31,413
STC 8360					
Model A02	60,880	1,676**	276	635	10,430
Model B02	51,335	1,481**	224	635	12,370
String	214,885	6,119**	948	2,540	11,820
CDC 33800					
Model A04	83,000	1,560	285	2,520	30,361
Model B04	66,115	1,195	240	2,520	38,115
String	281,345	5,145	1,005	10,080	35,828
CDC 33502					
Model A02	50,000	1,410	220	1,270	25,400
Model B02	41,680	1,210	175	1,270	30,470
String	175,040	5,040	745	5,080	29,022
CDC 33501					
Model A02	40,000	975	170	635	15,875
Model B02	31,680	775	128	635	20,044
String	135,040	3,300	554	2,540	18,809

* It should be noted that plug compatible vendors frequently provide discounts to list prices when marketing their products to end users.

** Thirty-month lease rates; STC may offer significant discounts from their published list prices depending upon the marketing situation.

TABLE III-2
COMPARATIVE FEATURES OF IBM, STC, AND CDC DISK DRIVES

Vendor/Model	Actuators Per Unit	Capacity Per Actuator (megabytes)	Capacity Per Unit (megabytes)	Average Access Time (ms)	Average Latency (ms)	Data Rate (MB/Sec.)
IBM						
3350	2	317	635	25	8.4	1.2
3380	4	635	2520	16	8.3	3.0
STC						
8360	2	317	635	18	-	1.2
8650	4	317	1270	23	-	1.2
8380	4	635	2520	16	-	3.0
CDC						
33501	2	317	635	18	8.4	1.2
33502	4	317	1270	24	8.4	1.2
33800	4	635	2520	16	8.4	3.0

- This cooperation emulates the practice followed by the Japanese for some time; i.e., pooling resources in developing state-of-the-art technology.

- STC, CDC, and Memorex all report their 3380 equivalent disk drives will be more compact and lighter than the IBM product. Prototype devices now exist with beta site testing slated for the latter part of this year. First customer shipments are scheduled for mid-1983.

- The Japanese will soon be a significant PCM disk drive competitor in this country. In December 1981, National Advanced Systems announced they will market single- and double-density 3350 plug-compatible units manufactured by Hitachi. Amdahl is currently negotiating with Fujitsu to market Fujitsu-made 3350 plug-compatible devices in the United States before the end of this year. Both Hitachi and Fujitsu are developing 3380 equivalents, and expect to be selling this product in Japan in 1983 and in the U.S. by 1984.

- A new face in the PCM community is a California company named Ibis. Founded in 1980, they announced their first products in April 1982 - a series of three IBM 3380 plug-compatible disk drives.

- The largest, the 5 gigabyte Ibis 5000, contains four head-disk assemblies as compared with two in the 2.5 gigabyte IBM 3380. Their other two disk drive products are the Ibis 2500 (2.5 gigabytes) and Ibis 1250 (1.25 gigabytes).

- The products use a proprietary thin-film media and standard ferrite read/write heads. Initial production will be marketed to OEMs, with end-user marketing planned in 1984.

- It is believed that their products will be the first to use vertical recording technology. This technology involves orienting the magnetic domains on the disk surface vertically (into the surface) instead of horizontally (along the surface) thereby increasing the number of bits per inch the head can detect as it moves over the media surface.

IV RESIDUAL VALUE FORECASTS FOR IBM 3330-11, 3350, AND 3380 DISK STORAGE SYSTEMS

- The three principal forces influencing the residual values of IBM disk products are:
  - New product announcements.
  - Price changes on current generation products.
  - Availability, either new from IBM or in the used market.
- Major new product generations have been announced at about five-year intervals, with model enhancements occurring between those intervals. These major product generations have been:
  - 2314 disk series announced in 1965.
  - 3330 disk series announced in 1970.
  - 3350 disk series announced in 1975.
  - 3380 disk series announced in 1980.
- The 3380 incurred unexpected problems when the head flying height was lowered to the 10- to 15-microinch range. These problems delayed first

customer shipments by over a year. This may cause a similar delay in announcement of the next generation disk series to permit cumulative revenue flows from the 3380 to reach product objectives. INPUT projects a new product series announcement in late 1985 or early 1986.

- Exhibit IV-1 presents comparative characteristics for the IBM 2314 through 3380 disk generations. Many experts predict that magnetic-disk recording will continue to be the dominant storage medium through this decade, and perhaps into the 1990s as well.

  - Thin-film technology can provide significant improvements for both read/write heads and the media over which the heads pass. Vertical recording (aligning the magnetic domains suspended in the media vertically into the surface rather than horizontally along the surface) will permit increasing the linear density (bits per inch along the disk track) by at least a factor of 10.

  - Improved head controller design and use of magnetic materials with stronger field strength will also increase the number of bits per square inch that can be recognized.

- Exhibit IV-2 provides a price history of IBM disk products since 1970. INPUT projects that the pattern since 1979 of frequent small price increases will continue for the next two years. The 3370 product has had five such increases since its 1979 introduction. These are inflation adjustments kept small enough so that the impact on the end user is not too painful.

- The next generation announcement (expected in late 1985 or early 1986) should fall on the price trend curve as graphed in Exhibit IV-3. This predicts a purchase price per megabyte for the next generation product of about $8 to $10. IBM is likely to reduce 3380 prices starting 12 to 18 months before planned new product announcement to encourage conversion of the existing rental/lease base to purchase. This was done with the 3350s in 1978 and 1979 in anticipation of the 3380 announcement.

EXHIBIT IV-1

COMPARATIVE CHARACTERISTICS OF IBM
2314, 3330-11, 3350, AND 3380 DISK DRIVES

IMPROVEMENT AREA	2314 DEVICE (ANNOUNCED 1965)	3330-11 DEVICE (ANNOUNCED 1973)	3350 DEVICE (ANNOUNCED 1975)	3380 DEVICE (ANNOUNCED 1980)
Head Positioning	Hydraulic actuator with mechanical track hold; Ferrite heads	Voice coil actuator with electronic track hold; Ferrite heads	Voice coil/rotary actuator with electronic track hold; Ferrite heads	Voice coil/rotary actuator with electronic track hold; Thin film heads
Head Flying Height	100 microinches	45 microinches	20 microinches	12 microinches
Media	Removable: Non-oriented Magnetic	Removable: Non-oriented Magnetic	Nonremovable: Horizontally Oriented Magnetic	Nonremovable: Horizontally Oriented Magnetic
Rotational Speed	2,400 RPM	3,600 RPM	3,600 RPM	3,600 RPM
Data Transfer Rate (megabytes/second)	312	809	1,198	3,000
Areal Density (bits/square inch)	220,000	1,500,000	3,058,000	12,000,000
Average Access Time (milliseconds)	60	30	25	16

EXHIBIT IV-2

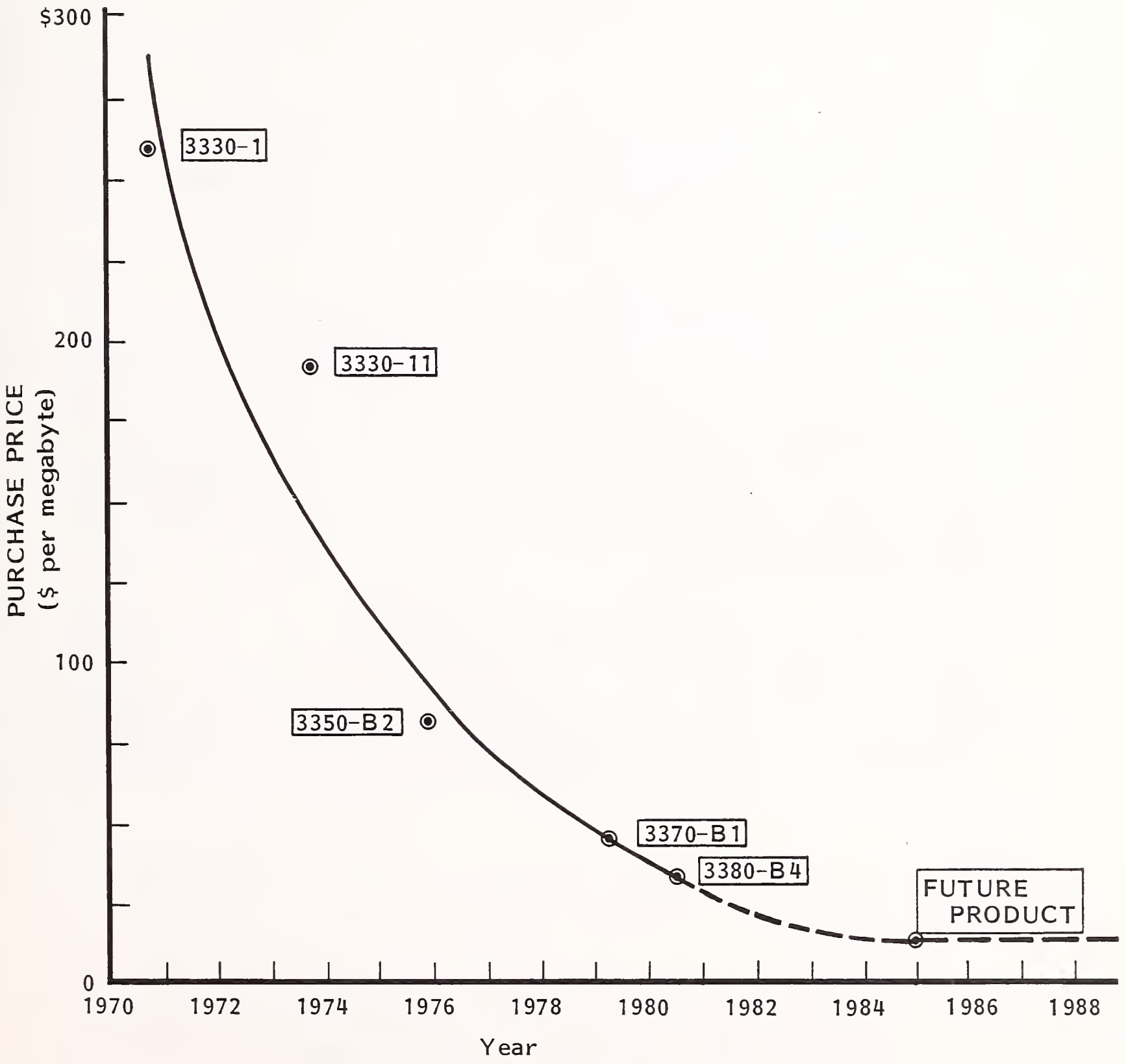
PRICE HISTORY OF

IBM 3330-1, 3330-11, 3350-B2, 3370-B1, 3375-B1, AND 3380-B4 DISK DRIVES

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3330-1 200 MB (6/70) $51,940 $260/MB			(10/73) $52,900 $265/MB		(7/75) $47,610 $238/MB		(4/77) $40,470 $202/MB		(5/79) $32,380 $162/MB			(4/82) $33,670 $168/MB
			3330-11 400 MB (7/73) (10/73) $74,000 $75,400 $185/MB $189/MB		(7/75) $67,860 $170/MB		(4/77) $57,610 $144/MB		(5/79) $46,090 $115/MB			(4/82) $47,920 $120/MB
					3350-B2 635 MB (7/75) $49,500 $78/MB			(10/78) $39,600 $62/MB	(5/79) $31,680 $50/MB			(4/82) $32,940 $52/MB
									3370-B1 571 MB (2/79) (12/79) $23,400 $24,570 $41/MB $43/MB	(6/80) $25,790 $45/MB	(4/81) (10/81) $27,070 $28,420 $47/MB $50/MB	(4/82) $29,550 $52/MB
										3375-B1 820 MB (6/80) $31,000 $38/MB	(10/81) $32,550 $40/MB	(4/82) $33,850 $41/MB
										3380-B4 2520 MB (6/80) $81,000 $32/MB		(4/82) $84,240 $33/MB

EXHIBIT IV-3

IBM DISK STORAGE PRICING TREND



- IBM has expanded its disk manufacturing capacity and hopes to reach and maintain a 60- to 120-day delivery lead time for disk products. The residual value forecasts in this report assume that IBM will be reasonably successful in this effort.

- Projected used market retail prices for selected IBM disk drives are given in Exhibit IV-4. These values as a percentage of current IBM list prices are graphed in Exhibits IV-5 through IV-8. These projections assume a new product generation announcement in late 1985 or early 1986, small price increases for present disk products through 1984, then price reductions to encourage conversion of leases to purchase, and reasonable availability both from IBM and in the used market.

- Projections are not given for all members of a given product series. Calculations for other members of a series can be made by referring to Exhibit IV-9. It is assumed that residual values for other members of a given product family will be proportional to the ratio of the respective list prices. For example, the forecasted residual value of the 3350-A2 (list price $41,600) on January 1, 1985, is $18,720. The forecasted value on January 1, 1985, for the 3350-C2F (list price $53,340) would be:

$$\frac{\$53,340}{\$41,600} \times \$18,720 = \$24,003$$

- It is important to note that the projected values are the expected retail price in the used market. At any given point in time, three price levels exist. These are:

  - Retail Price - the amount an end user would pay for the equipment.

  - Dealer Price - the amount a dealer or broker would pay another dealer to acquire equipment to complete a contracted sale obligation. (A dealer will buy for inventory, a broker acts solely as a middleperson between buyer and seller.)

EXHIBIT IV-4

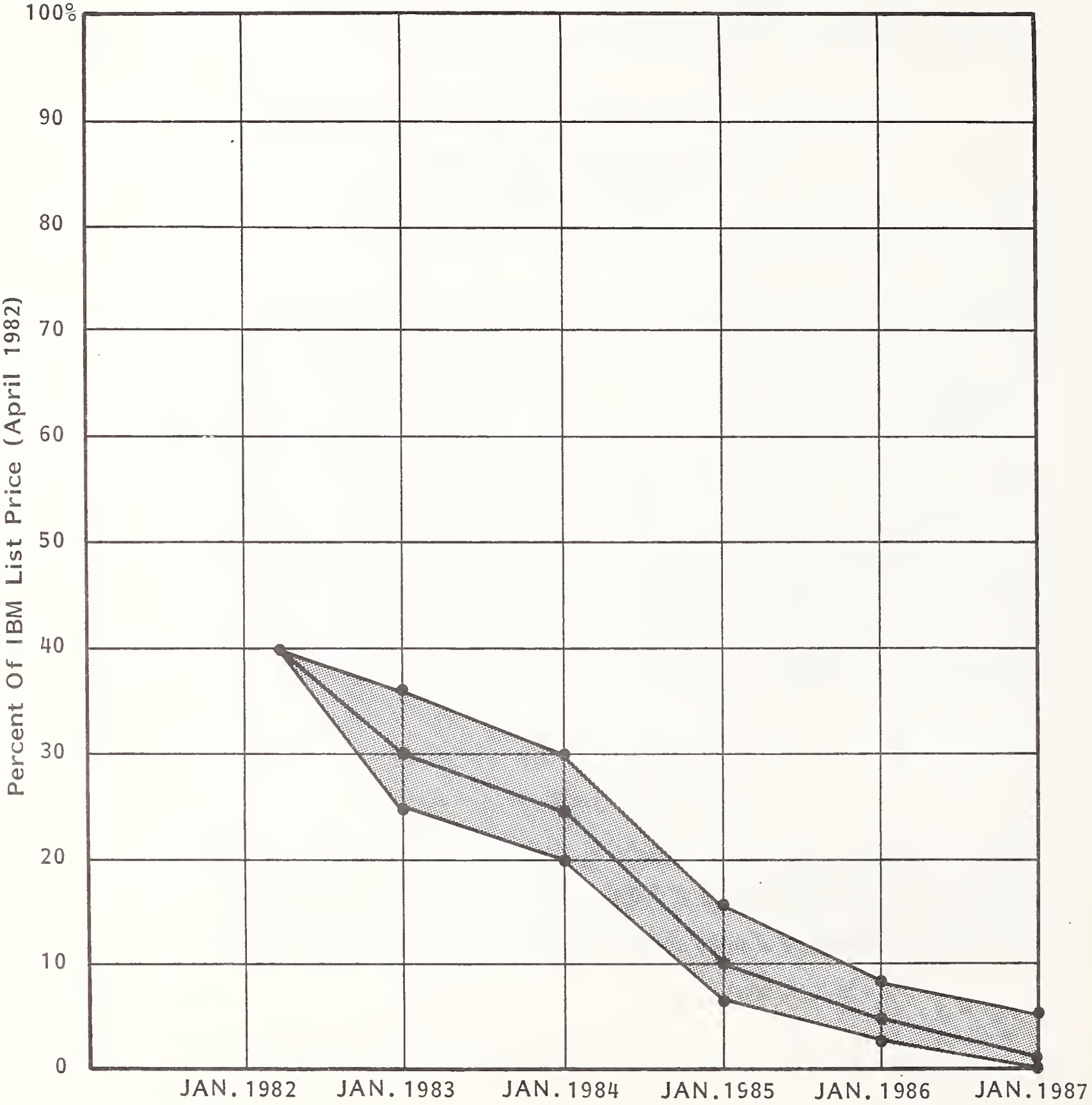
PROJECTED USED MARKET RETAIL PRICES FOR
SELECTED IBM DISK DRIVES
(current dollars)

MODEL NUMBER	CURRENT LIST (4/1/82)	PROJECTED USED MARKET RETAIL PRICE AT JANUARY 1 OF:				
		1983	1984	1985	1986	1987
3330-11	$ 47,920	$14,375	$11,980	$ 4,790	$ 2,395	$ 1,000
3333-11	56,450	22,580	18,063	10,160	5,645	2,820
3350-A2	41,600	24,960	20,800	18,720	10,400	8,320
3350-B2	32,940	19,765	16,470	14,825	8,235	6,590
3380-A4	101,550	91,395	86,320	81,240	60,930	50,775
3380-B4	84,240	75,815	71,605	67,390	50,545	42,120

THE VALUES SHOWN ARE RETAIL PRICES IN A FUTURE USED MARKET. THE DOLLAR SPREAD BETWEEN THE RETAIL ("BUY") AND WHOLESALE ("SELL") PRICE LEVELS DEPENDS UPON THE VALUE OF THE TRANSACTION. FOR THE RANGE OF VALUES SHOWN ABOVE, THE WHOLESALE PRICE WILL TYPICALLY BE 70% TO 90% OF THIS RETAIL PRICE.

EXHIBIT IV-5

PROJECTED RESIDUAL VALUES FOR THE IBM 3330-11 DISK DRIVE

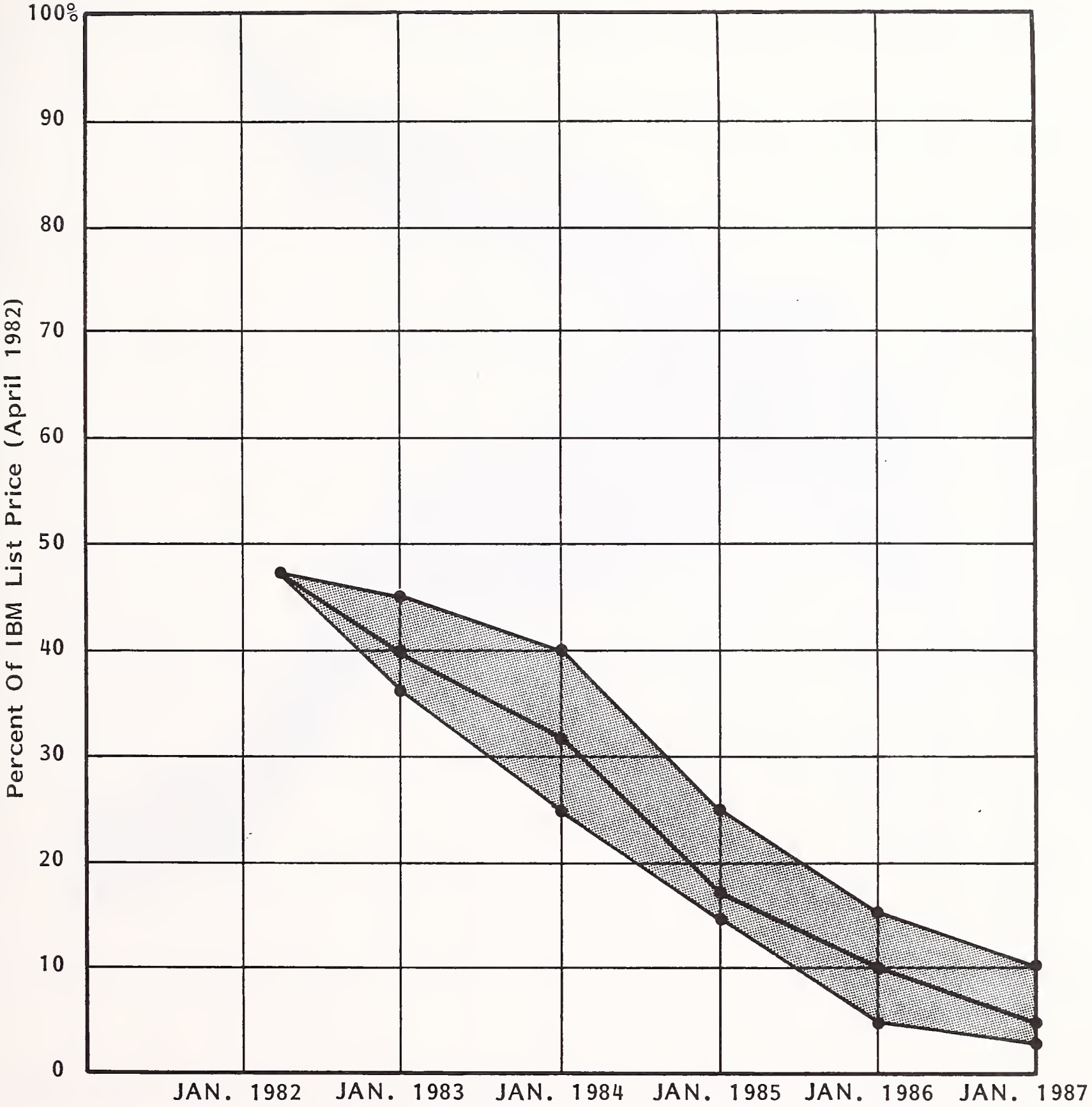


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
HIGH	37%	30%	15%	8%	5%
EXPECTED	30	25	10	5	2
LOW	25	20	7	3	1

EXHIBIT IV-6

PROJECTED RESIDUAL VALUES FOR THE IBM 3333-11 DISK DRIVE

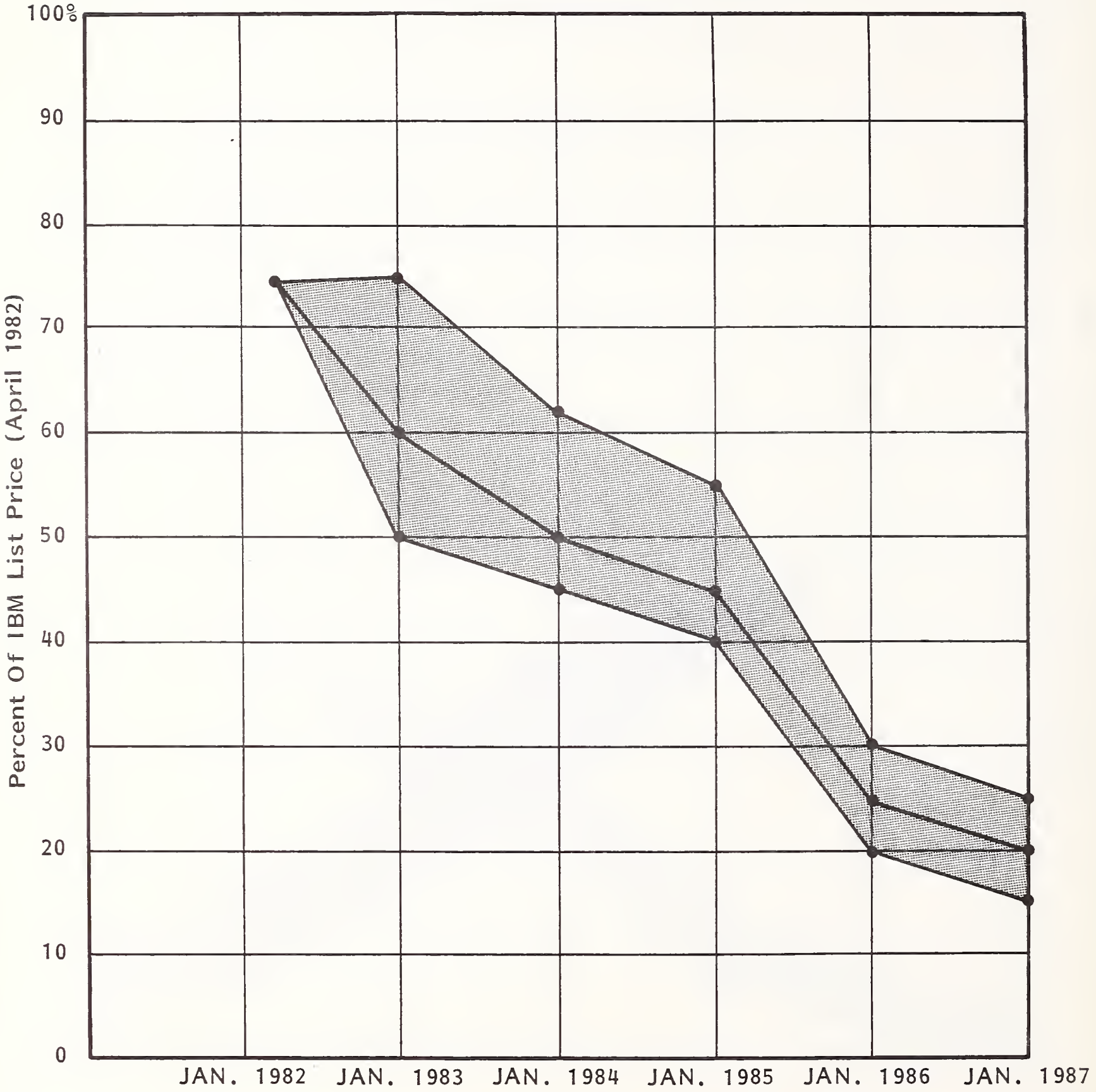


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
HIGH	45%	40%	25%	15%	10%
EXPECTED	40	32	18	10	5
LOW	37	25	15	5	3

EXHIBIT IV-7

PROJECTED RESIDUAL VALUES FOR THE IBM 3350 DISK DRIVE

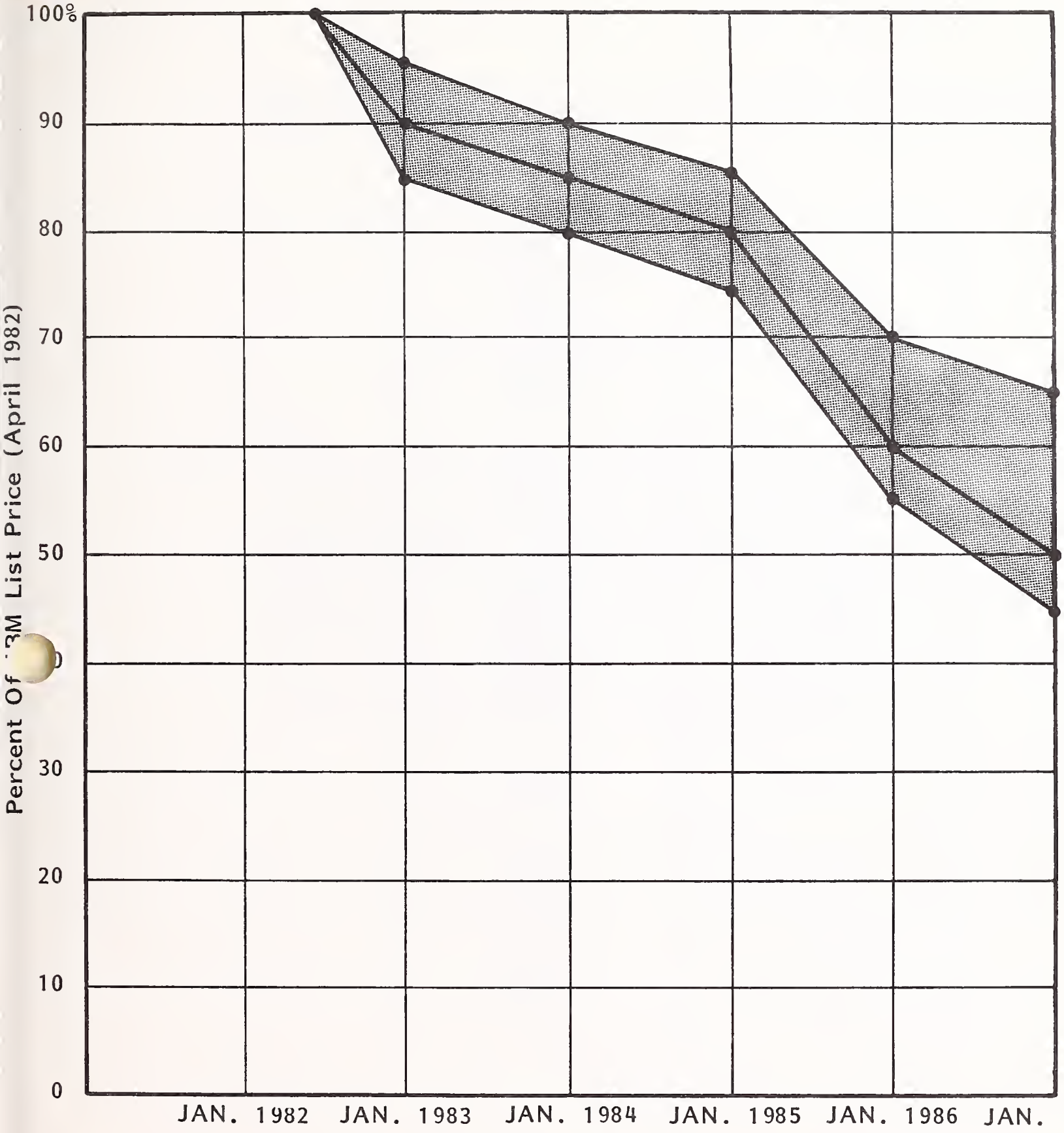


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
HIGH	75%	62%	55%	30%	25%
EXPECTED	60	50	45	25	20
LOW	50	45	40	20	15

EXHIBIT IV-8

PROJECTED RESIDUAL VALUES FOR THE IBM 3380 DISK DRIVE



PROJECTED VALUES

PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
HIGH	95%	90%	85%	70%	65%
EXPECTED	90	85	80	60	50
LOW	85	80	75	55	45

EXHIBIT IV-9

LIST PURCHASE PRICES FOR IBM DISK PRODUCTS (APRIL 1982)

PRODUCT	PURCHASE PRICE (dollars)
3330-1	$ 33,670
3333-1	42,200
3330-11	47,920
3333-11	56,450
3350-A2	41,600
3350-A2F	51,910
3350-B2	32,940
3350-B2F	43,250
3350-C2	43,030
3350-C2F	53,340
3370-A1	44,350
3370-B1	29,550
3375-A1	50,720
3375-B1	33,850
3380-A4	101,550
3380-AA4	116,050
3380-B4	84,240

- Wholesale Price - the amount a dealer/broker would pay an end user to acquire the equipment.

- As an example, in mid-August 1980, the respective prices for a 3330-11 disk drive were:

  - Retail - $20,500.

  - Dealer - $18,000.

  - Wholesale - $15,000.

- Residual values for plug-compatible manufacturers (e.g., STC, Memorex, CDC, etc.) are too volatile to predict with acceptable confidence levels. Trading is much less frequent. In general, used prices will be 60% to 80% of comparable IBM disk products; however, there have been instances where a PCM product has traded at a higher price than its IBM equivalent. This has occurred where an end user needed capacity very quickly and wanted to maintain vendor consistency while the used market supply was negligible.

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INFORMATION SYSTEMS PROGRAM

RESIDUAL VALUE FORECASTS
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RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

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1	RV Forecasts for Large IBM and Software-Compatible Mainframes (U-R15)
-	Executive Summary

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INPUT
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August 6, 1982

Dear Client:

Enclosed is the latest semi-annual update of residual values for large-scale IBM, Amdahl, and NAS processors for the period January 1983 through January 1987.

The report discusses the recent decline in the used market for IBM 370 and 303X processors, and the impact of new pricing changes for other large-scale processors. Performance problems of the IBM 3081 under certain operating conditions are also discussed.

INPUT would be pleased to hear any comments or questions you may have about this report.

Very truly yours,

George Heidenrich

George Heidenrich
Vice President
Director, Management Planning Program
In Information Systems

GH:jd

Enclosure

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

EXHIBITS

I INTRODUCTION

- This Residual Value Forecast is produced as part of the Management Planning Program in Information Systems. Projections contained in this series of reports are updated periodically. Key issues, such as trends in computer technology, future hardware and software developments and expected product announcements, are the subjects of various other INPUT reports in this Information Systems Program.

- In December 1981, INPUT published the eighth report in its continuing series on residual values of large IBM and software-compatible mainframes. This report reviews significant events since December and updates the earlier residual value forecasts based on an analysis of recent developments.

- Forecasted residual values are provided for IBM, Amdahl and National Advanced Systems (NAS) processors. This report focuses on large-scale mainframes, although the distinction is blurring as the number of processor models continues to expand. A trend is clear - to build a basic processor unit and then create a product line about this unit. The product series is created by tightly coupling additional like processors and/or "tuning" performance (creating additional models) by adjustments to the instruction pipeline and/or cache memory size and paging algorithms.

- Section II reviews recent used-market trading activity in IBM, Amdahl and NAS processors. The used computer industry does not publish records of transactions. Information in this chapter was obtained by interviewing people active in market trading.

- Section III reviews vendor activity since INPUT's December report. Significant announcements are summarized, with INPUT commentary where appropriate. Both IBM and National Advanced Systems introduced new processor models during this reporting period.

- Residual value projections for the various processors covered by this report are given in Section IV. The used computer industry, by convention, always lists used equipment as a percentage of the manufacturer's CURRENT list price. The projections in Section IV follow this convention. Readers are cautioned to consider past price changes when analyzing their own unique situations, as significant price reductions have occured with 370 and 303X series processors.

- In the Appendix to this report, INPUT provides an analysis of an alleged shortfall in 3081 performance. A group of West German users that were early installation sites for the 3081 expected throughput roughly twice that of a 3033 processor. Benchmark testing for their particular applications did not meet expectations and their concerns were reported in some trade publications. INPUT investigated this matter and our findings are given in this appendix.

II REVIEW OF RECENT USED MARKET ACTIVITY

- The used market for IBM 370 and 303X processors declined sharply during the past six months. The primary cause is a surplus of machines in a market where demand is very weak. Increased sensitivity to the differential costs of energy and hardware maintenance between the older 370 and 303X systems (compared to 4300 and 3081 processors) is a contributing factor to this lessening demand.

- The 370 systems are now extinct. Virtually no market exists. A 370/168, without channels, recently sold for $19,000. There is still some minor activity in attached processors and MP processors, but even well configured systems with channels are not selling well. Some 168s were sold in the Spring in the $60,000 to $70,000 range, with 158s selling at under $30,000.

- The 3031 and 3032 market is also weak. Very few trades have been reported. One source indicated a 3031 recently sold for about $50,000. This same source thought a 3032 had recently traded in the $100,000 to $125,000 range. There has been no confirmation of these figures so their validity is subject to question.

- The values of 3033s dropped from 55% to 60% of list price in January, to 38% by the end of March, and to about 28% in June. There are mixed feelings in the broker community about where 3033 values are headed. There is a group who believe values will stabilize at current levels until about January 1983, then move downward again. Others believe values will continue to drift downward, but at a slower rate than the past six months. INPUT subscribes to the latter

view. Deliveries of 3081 processors are continuing at a brisk pace (INPUT projects IBM will install 800 to 1,000 3081s in 1982) releasing 3033s into an already soft market.

- The leadtime for acquiring a 3081 processor from IBM, assuming a competitive bidding situation, is reported to be only a few weeks. Premiums for early delivery positions have disappeared. Increased manufacturing capacity, higher than expected chip yields, and deferments in scheduled deliveries from industries hard hit by the recession are reasons given for the ready availability of the 3081.

- The market for Amdahl V/5 and V/6 systems is also soft, with systems trading at 15% to 20% of list price. The V/7 and V/8 market is stronger. A V/8 recently traded at near $1.4 million, or close to 60% of list price. This market should weaken when 5860s are delivered in quantity; i.e., sometime in 1983.

- NAS processors continue to elude the established used market and thus no data exists on trading values. National Advanced Systems handles the remarketing of these processors, most of which are acquired as tradeins on processor upgrades to more powerful NAS systems.

III REVIEW OF VENDOR ANNOUNCEMENTS (JANUARY - JUNE, 1982)

- During this period, the U.S. Department of Justice announced settlement of the antitrust suits against AT&T and IBM. INPUT believes that the AT&T restructuring will have more profound, more visible, and more long-lasting effects on the large-scale system environment than the dismissal of the IBM antitrust suit. INPUT believes IBM policy with respect to ethical business conduct will remain as it was before, during, and now subsequent to, dismissal of the suit. The most important consequence for IBM will be the availability of senior management time previously absorbed by the demands of the trial.

- The restructuring of AT&T and its freedom to compete in the computing marketplace will have long term consequences that will be explored in a forthcoming INPUT report. AT&T has resources that will make it a formidable competitor in the telecommunications/computing amalgamation of the future.

A. IBM ANNOUNCEMENTS

- Year End 1981:

  - IBM closed out the year with announcement of price increases of 4% on hardware, 8% on rental and lease prices, and 15% on program products. The increase on program products was much higher than prior price

increases and reflects the large labor component in software development and maintenance. INPUT predicts software prices will increase by at least double the pace of hardware over the next several years.

- February 1982:

  - On February 2, IBM reentered the computer service bureau business. The IBM Information Network incorporates a coast to coast data communications network providing access to more than 100 IBM program products. It provides a source of interactive services intended to supplement current resources in existing corporate computing centers. The timesharing business, a four billion dollar industry, is presently growing at about 21% per year. The backlog of applications development work in large corporations is huge, offering a significant opportunity for the right combination of interactive development tools and computer resources. This is also an opportunity for IBM to gain experience in developing a national network supporting a variety of computing applications.

  - Also in February, the purchase option accrual rate for 303X and 3081 series processors was reduced from 50% to 40% of monthly rental or lease payments. The maximum accrual rate remains at 50% of list price; thus the effect is to lengthen the time required to reach maximum accruals. Under IBM's long term pricing strategy, this should slightly increase total revenues from the 3081 product line.

- April 1982:

  - The 3083 series (models E, B, and J) was announced with availability in early to mid 1983. The processors are architectually identical to the 3081, and fill a gap between the 4341 and 3081. The MIPS ratings are estimated at 3.5, 5.5, and 7.5 respectively. The units are upgradable (in only a few hours for each upgrade) from E to B to J to 3081 K. The 3081D can also be upgraded to the 3081K but, as yet, IBM has not

announced a direct upgrade capability from 3083 to 3081D. Per IBM, "the advanced technology 308X family provides the greatest span of field-upgradable, non-disruptive growth ever offered by IBM."

- Also announced was the 3087 Coolant Distribution Unit Model 2, which offers the 3083 user the option of dissipating heat into the air of the computer room. The machines are capable of operating (like their 3081 big brother) in both System/370 and 370-XA modes. INPUT believes these processors complete the lower end of the 308X series. Additions to the upper end of the 4300 will be announced later this year - forming a complete spectrum of processing power from less than one MIPS to 14 MIPS (and that upper limit will also be extended later this year when the ability to install additional processors into the 3081 cabinet is announced).

B. AMDAHL ANNOUNCEMENTS

- March 1982:

  - Amdahl slipped initial deliveries of its 5860 processor by about three months. A late change in the Input/Output (I/O) processor design -to better match channel performance to CPU speed - caused the delay. Although such a delay was not surprising given the new channel architecture (in the 3081 channels are not assigned to a specific processor) and the need for Amdahl to emulate this feature, it was the first time Amdahl has slipped an announced delivery date. Amdahl expects to catch up to its initial delivery schedule by the end of first quarter, 1983. Other products, such as the 5880, will not be delayed.

- May 1982:

- In an effort to increase the attractiveness of its V/7 and V/8 processors, Amdahl announced it would support IBM's MVS/Extended Architecture (MVS/XA) on these now older generation processors. The price for the upgrade is $250,000, with availability to be announced after MVS/XA is released by IBM (sometime in first quarter, 1983).

C. NATIONAL ADVANCED SYSTEMS (NAS) ANNOUNCEMENTS

- Year End 1981:

  - NAS reduced purchase and lease prices on its AS/9000 processors. This brought pricing back into line with IBM and paved the way for the product announcements planned in early 1982.

- April 1982:

  - NAS announced two processor models designed and manufactured at their San Diego facility. The AS/6130 is rated at about 1.5 MIPS, sells for $325,000 (4 MB memory, 6 channels), and can be upgraded in the field to the more powerful (about 2 MIPS) AS/6150. First shipments are expected by the end of this year for the 6130 and early in 1983 for the 6150. These products provide NAS with a modern technology product in the upper 4300 power range.

- May 1982:

  - Lengthy negotiations between NAS and Hitachi were finally concluded with an agreement under which NAS will market IBM software-compatible versions of the Hitachi-made M280H large scale processor. The first two versions were labeled the AS/9060 (uniprocessor rated at 12 MIPS - priced at $3.55 million with 16 MB memory and 16 channels) and AS/9080 (dual processor rated at 20 MIPS - priced at $5.25 million

with 16 MB main memory and 16 channels). The processors will be deliverable prior to year end. However, MVS/XA operating system support is not expected until first quarter, 1984. This action strengthens the ties between Hitachi and NAS, and provides Hitachi with an experienced marketing and customer service organization for their products. The Hitachi M240H is a mid-range processor that could be added to the NAS product line in the future.

D. OTHER ANNOUNCEMENTS

- Trilogy appears to be on target with plans to have a large-scale (in the range of 35 MIPS) processor ready for delivery in 1984. Construction of a 100,000 square foot manufacturing facility will begin in July in Dublin, Ireland. Trilogy will design and manufacture the logic chips for their processors. Memory chips will be bought from U.S. or Japanese sources.

- The Japanese government is coordinating and partially sponsoring an effort to build a scientific computer capable of performing 10 billion floating point operations per second. This effort is a joint venture among six Japanese firms - Fujitsu, Hitachi, Mitsubishi, Nippon Electric Company, Oki and Toshiba. The project has a $300 million budget and is expected to take eight years. INPUT believes they are likely to be successful, and that this country must find ways to facilitate such (very expensive) joint research if it is to keep pace.

IV PROJECTED RESIDUAL VALUES FOR LARGE IBM AND SOFTWARE-COMPATIBLE PROCESSORS

- Computer equipment residual value forecasting is based upon:

  - Analysis of historical events and trends leading to judgments about whether (and in what way) such trends may change.

  - Predictions by computer industry experts on expected actions by IBM and responding strategies by the software-compatible mainframe manufacturers.

  - Analysis of variables affecting residual values as listed in Exhibit IV-1.

- At any instant in time, the used market value of a piece of equipment is determined by supply and demand. Although a small portion of computer equipment purchases are for dealer inventory, most transactions are the matching of a buyer and a seller. There is constant communication among brokers and dealers of used computer equipment as they acquire and reconfigure equipment to meet buyer requirements. An electronic messaging service was recently initiated within this industry to further facilitate communications.

EXHIBIT IV-1

FACTORS AFFECTING COMPUTER EQUIPMENT RESIDUAL VALUES

- IBM practices and policies
  - New product announcements
    - . Price/performance ratios relative to existing products.
    - . Ease of conversions, transitions, and lead time in obtaining new products.
    - . Ease of installation and maintenance.
    - . Effect on perceptions about IBM's technical direction.
  - Pricing policies
    - . Price increases or decreases on existing products.
    - . Rental versus purchase breakeven ratios.
    - . Lease plans and penalty provisions for lease termination.
    - . Purchase option accruals.
  - Maintenance policies
    - . Availability and cost.
    - . Attitude toward other vendor modifications to IBM equipment.
- Alternative equipment services
  - Price/performance of plug (software) compatible alternatives.
  - Third-party leasing options.
- Other variables
  - Environmental support considerations, e.g., electrical power consumption, air conditioning needs, space requirements.
  - Tax considerations, e.g., income tax incentives such as investment tax credit and accelerated depreciation and also property taxation rates.
  - General economic conditions, e.g., cost and availability of capital and overall demand for computing capacity.

- Projected future values for IBM, Amdahl, and NAS processors are presented in table format in Exhibit IV-2. Graphical presentations of projected values for selected mainframes (IBM 3033 and 3081, Amdahl 5860, and NAS AS/9000) are given in Exhibits IV-3 through IV-6.

- The values shown represent wholesale prices; i.e., the amount a used computer dealer will pay for equipment for subsequent resale to an end user at a higher price.

- The value assigned to a specific date is the cash transaction that is expected to occur on that date (typically the point where title changes hands). This can be very different from quotations for purchase if the equipment is rapidly declining in price, for there is normally a 60 to 120 day (or longer) lead time from contract negotiation to equipment delivery. INPUT in its last mainframe report listed a 60% of list price value for a 3033 processor at January 1, 1982. This was an accurate figure for transactions occuring in late December and early January (under contracts agreed to in the fall of 1981). However, quotations for 3033s in January were at MUCH lower prices as brokers anticipated a very sharp decline in 3033 values that did indeed occur.

- In December, INPUT projected the following announcements would be made by IBM in 1982:

  1. A scaled down version of the 3081 to provide an upward compatible growth path for IBM customers from the 4331 through the 3081.

  2. Significant price reductions on 3033s.

  3. Ability to add a second pair of dyadic processors into the present 3081 cabinet.

  4. Higher performance uniprocessors in the 4300 series.

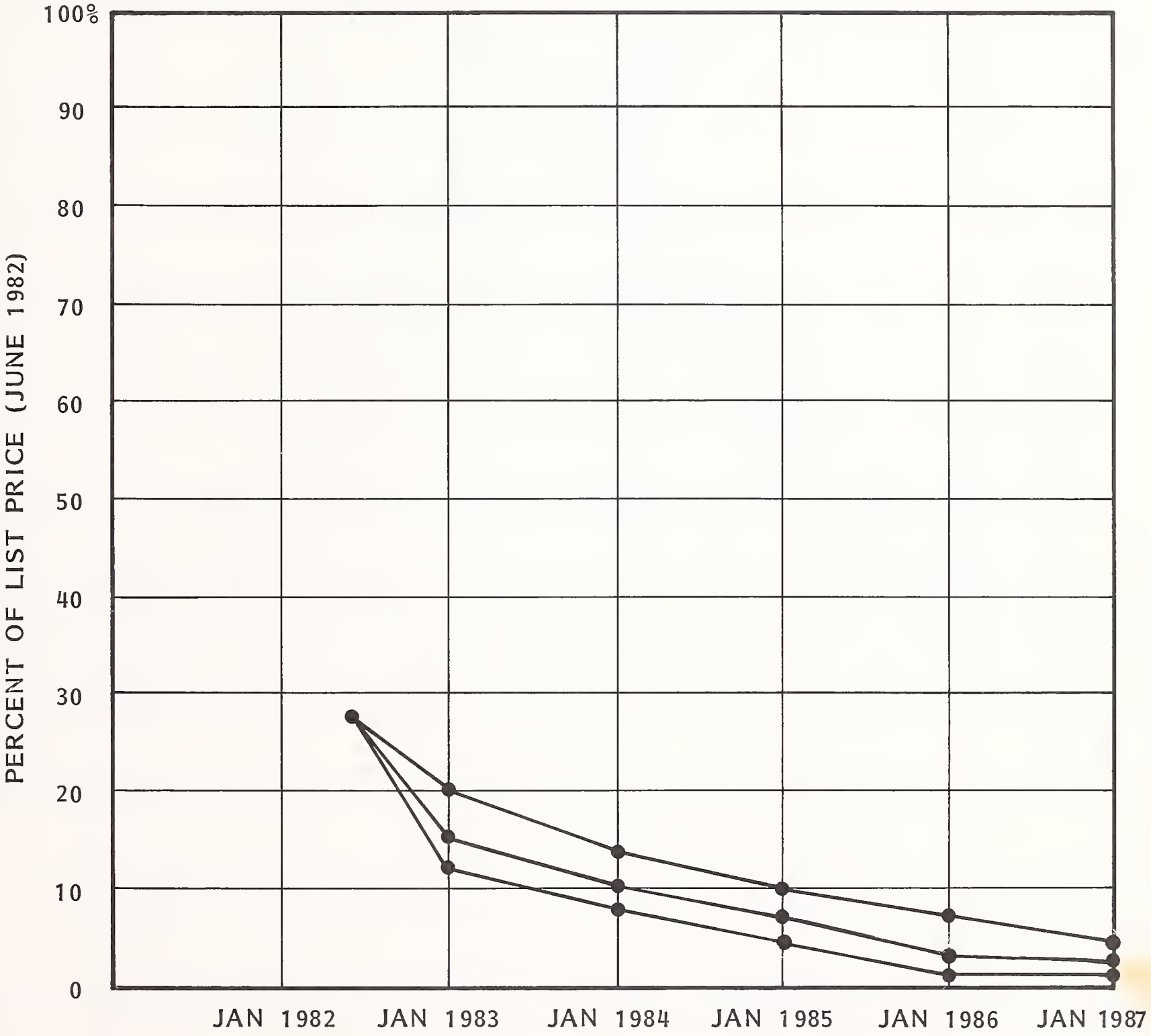
EXHIBIT IV-2

PROJECTED RESIDUAL VALUES FOR IBM AND
SOFTWARE-COMPATIBLE MAINFRAMES

VENDOR	PROCESSOR MODEL	PROJECTED RESIDUAL VALUE AS PERCENT OF VENDOR LIST PRICE (JUNE 1982)				
		JANUARY 1983	JANUARY 1984	JANUARY 1985	JANUARY 1986	JANUARY 1987
IBM	3031	11%	8%	5%	3%	1%
	3032	22	15	8	5	2
	3033-S	50	38	22	12	6
	3033-N	17	11	6	2	1
	3033	15	10	7	3	2
	4321	51	38	29	18	7
	4331-1	47	38	26	18	9
	4331-2, 11	64	55	42	30	12
	4341-1, 10	68	52	40	28	14
	4341-2, 11	70	58	44	28	15
	308 X	90	80	50	35	20
Amdahl	470 V/5	15	12	6	2	1
	470 V/6	16	10	5	1	1
	470 V/7	18	12	7	3	1
	470 V/8	25	15	9	4	2
	5860	100	85	57	40	24
	5880	-	85	63	44	30
NAS	AS/5000	21	16	7	3	1
	AS/5000N, E	23	18	10	6	2
	AS/61 XX	-	70	45	35	20
	AS/7000	16	12	5	2	1
	AS/9000	75	65	43	30	18
	AS/90 XX	100	80	50	35	20

EXHIBIT IV-3

PROJECTED RESIDUAL VALUES FOR THE IBM 3033 PROCESSOR

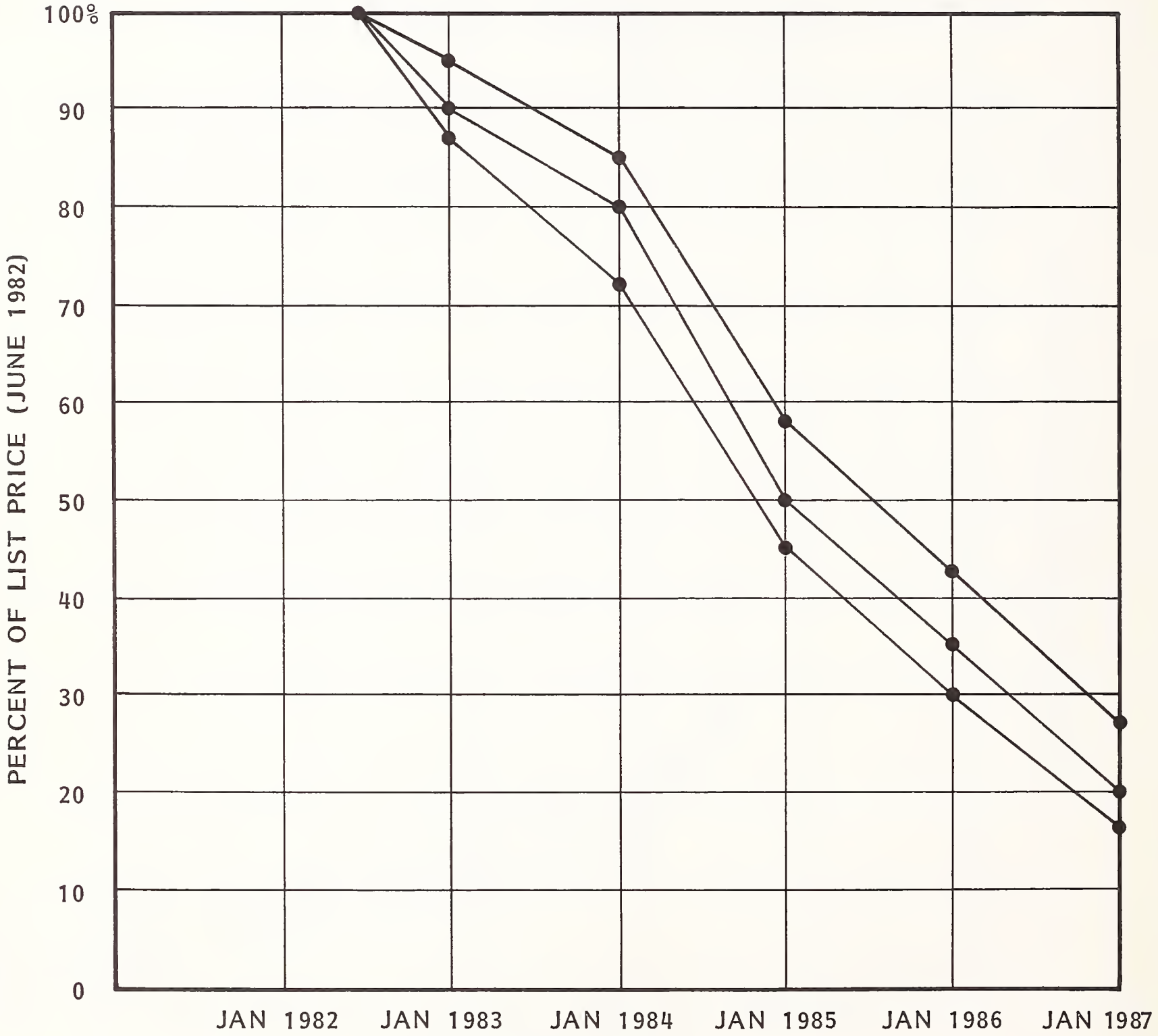


PROJECTED VALUES

PROJECTED VALUES RANGE	1983	1984	1985	1986	1987
HIGH	20	14	10	7	4
EXPECTED	15	10	7	3	2
LOW	12	8	4	1	1

EXHIBIT IV-4

PROJECTED RESIDUAL VALUES FOR THE IBM 3081 PROCESSOR

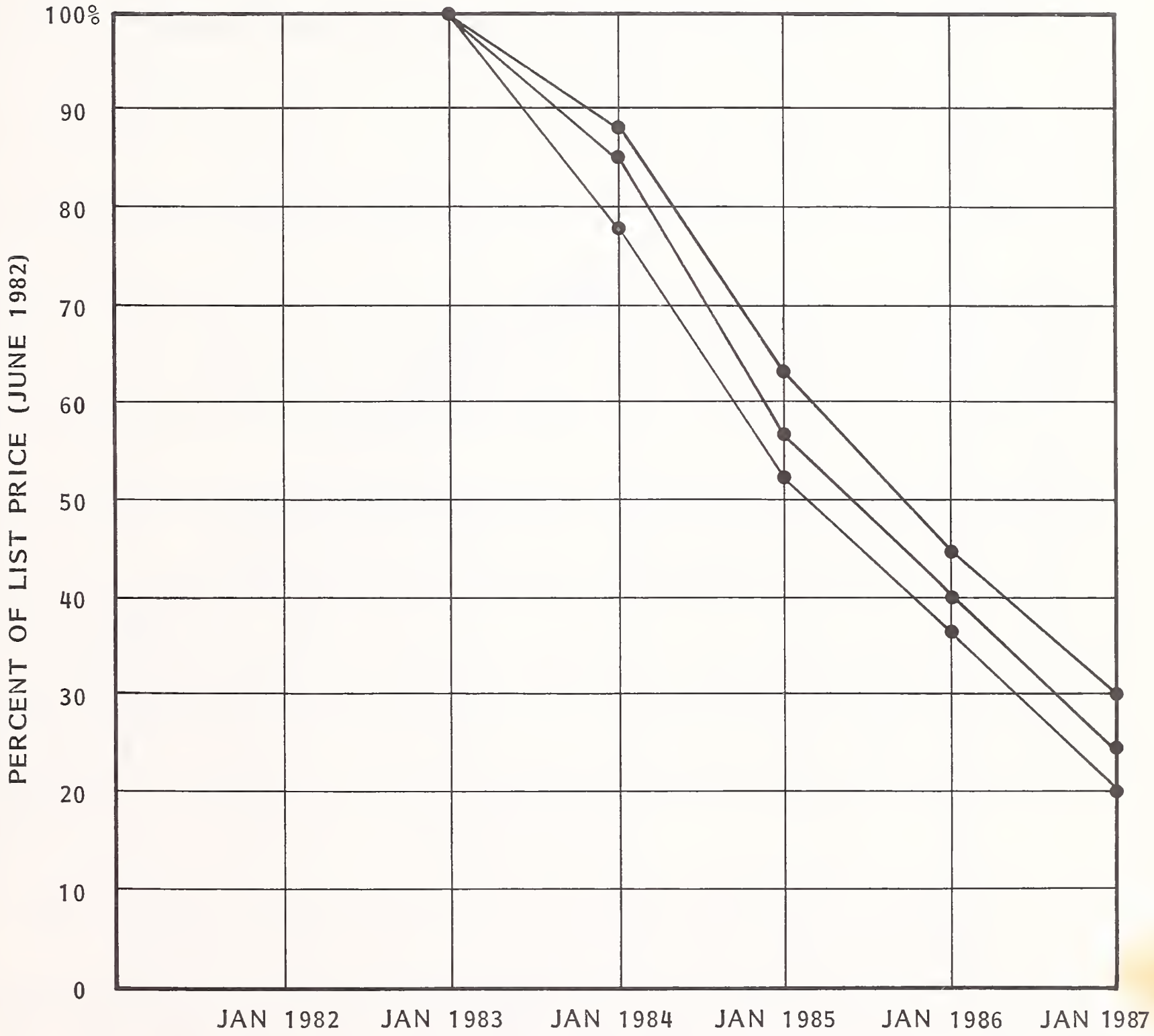


PROJECTED VALUES

PROJECTED VALUES RANGE	1983	1984	1985	1986	1987
HIGH	95	85	58	42	28
EXPECTED	90	80	50	35	20
LOW	87	72	45	30	17

EXHIBIT IV-5

PROJECTED RESIDUAL VALUES FOR THE AMDAHL 5860 PROCESSOR

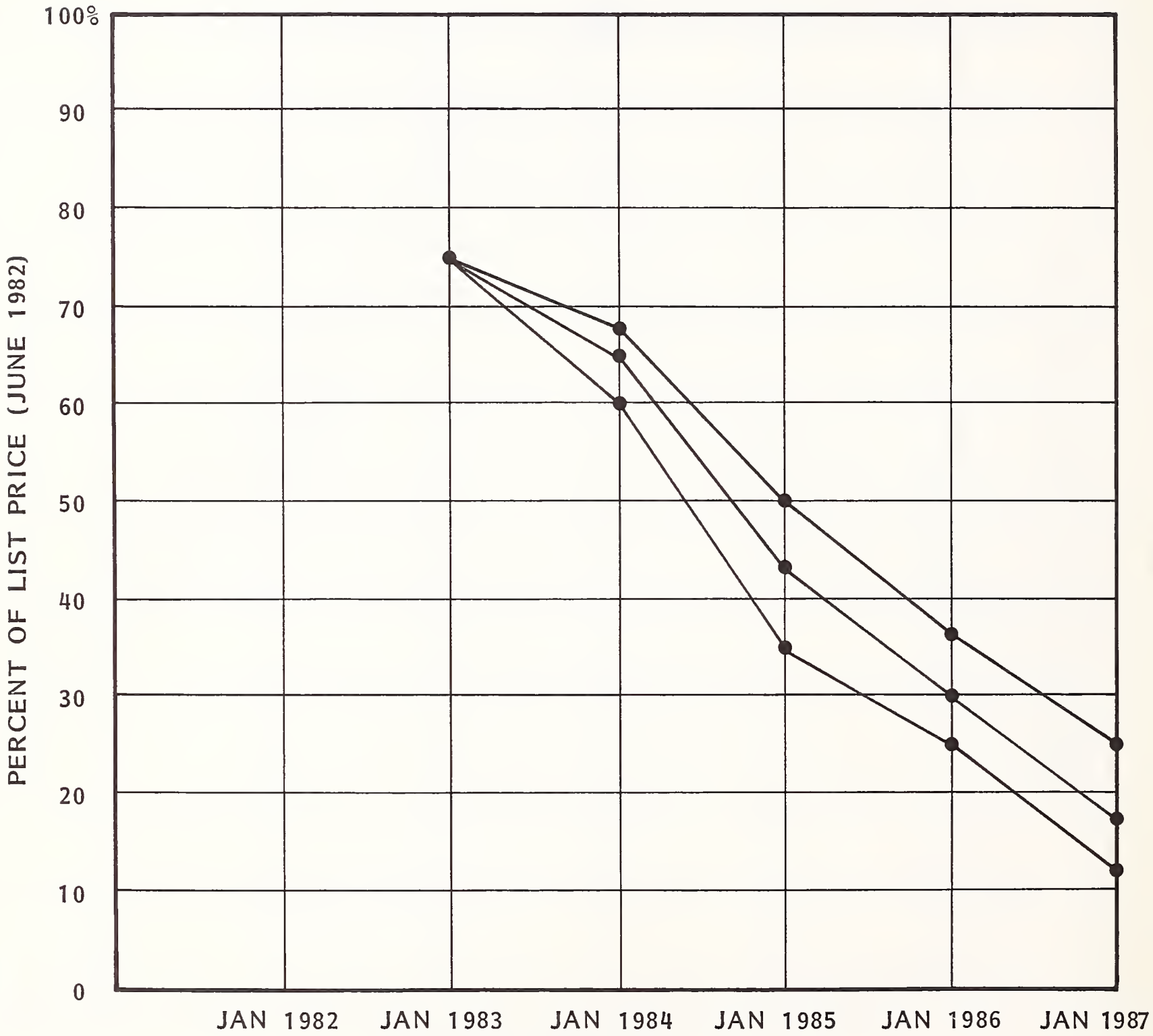


PROJECTED VALUES

PROJECTED VALUES RANGE	1983	1984	1985	1986	1987
HIGH	–	88	63	45	30
EXPECTED	100	85	57	40	24
LOW	–	78	52	37	20

EXHIBIT IV-6

PROJECTED RESIDUAL VALUES FOR THE NAS AS/9000 PROCESSOR



PROJECTED VALUES

PROJECTED VALUES RANGE	1983	1984	1985	1986	1987
HIGH	-	68	50	36	25
EXPECTED	75	65	43	30	18
LOW	-	60	35	25	12

- Items 1 and 2 have occurred. INPUT projects items 3 and 4 will occur in the second half of 1982.

- INPUT's assessment of IBM's long-range strategic directions are given in the Technology Brief, Beyond 3081: The Large Systems Issue, January 1982. Some important predictions in that report include:

  - IBM will, by explicit intent, become more efficient in designing and manufacturing computer systems, leading to lower unit costs permitting aggressive price competition.

  - IBM will make outright box-for-box replacement of their large-scale processors by PCM equivalent versions increasingly difficult through its firmware/software policies.

  - Customer dependence will be strengthened by distributing the 3081 central site architecture to support smaller systems (e.g., 43XX) at remote sites and also linkage to office support systems.

  - Movement towards a System/38-like architecture for future large scale systems providing integrated data base capability (combining aspects of relational, hierarchical, and network data bases) within a single-level storage management environment where all storage (main and auxiliary) is part of a uniform address space.

- IBM's next large-scale processor product generation is projected to be announced in late 1985 or early 1986. The basic processor "building block" will be in the 20 to 30 Million Instructions Per Second (MIPS) range using either CMOS silicon or Gallium Arsenide logic chips. Main memories will extend into the hundreds of megabytes using 256K memory chips. Up to six processors (three dyadic pairs) will be available in a single cabinet sharing channels and main memory.

- The projected price per MIPS will range between $0.1 and $0.17. This follows the trend of IBM in prior generations to divide the price per MIPS roughly in half with each new processor generation, as shown below:

Product Generation	$ per MIPS at Announcement
370 series	$1.5 million
303X series	0.7 million
3081 series	0.35 million

- INPUT also projects that price declines for the 3081 series will follow the patterns of the 370 and 303X, where list prices are approximately halved over a roughly five year (from announcement) time frame. This trend can be seen from the price changes over time for the 370/168 and 3033 processors as listed below:

370/168 V38		3033 V08	
Date	Purchase Price	Date	Purchase Price
3/25/75	$5,011,200		
5/20/76	4,560,100		
3/25/77	3,098,700	3/25/77	$3,515,000
12/04/78	2,853,700	12/04/78	3,375,000
11/01/79	2,678,700	11/01/79	2,825,000
		11/12/80	2,370,000
		10/21/81	2,113,000
		3/31/82	1,761,000

- INPUT predicts that IBM will aggressively reduce 3081 series prices in the 1984 to 1985 time frame to encourage purchase of rented or leased machines (thus paving the way for the forthcoming new product generation) and to protect market share from PCM competition (both Trilogy and STC will then be entering the large-scale mainframe marketplace). The manufacturing, marketing and product servicing efficiencies that IBM has and will be investing heavily in, combined with much higher revenues from software products, will allow significant reductions in hardware prices without sacrificing profitability targets.

- INPUT expects both Amdahl and NAS to remain viable alternatives in the large mainframe market. Amdahl has an excellent product and a loyal customer base. They have developed considerable strength in operating systems and other software areas, and are moving towards greater independence from compatibility requirements with IBM's MVS. The weakness of IBM/MVS for interactive applications is well known. Amdahl hopes to turn this weakness to its advantage by bringing forth a new timesharing operating system offering strong interactive processing - where MVS would simply run in the background.

- NAS, after experiencing early difficulty in selling its top-end AS/9000 series processors, appears now to be doing reasonably well. Since June of 1981, they reportably have sold about 50 of the 9000 series processors (with approximately 70% of that business coming from repeat NAS customers). NAS plans to expand its current installed base of about 700 machines (525 AS/3000s and AS/5000s, 125 AS/6000s and AS/7000s, and 50 AS/9000s) to more than 1,800 machines by 1987. The addition of the locally (San Diego) manufactured AS/6100 series processors and the new AS/9060 (12 MIPS uniprocessor) and AS/9080 (20 MIPS dual processor) from Hitachi have considerably strengthened the NAS product line. NAS is also attempting to expand its for-fee software product offerings, with most products being acquired from independent software houses.

- Both Trilogy and STC are expected to be serious large mainframe competitors by the 1985 time frame. Both have the necessary financing to develop and manufacture a competitive machine. Their success in marketing and customer support (a costly area to develop and maintain) will be key factors in gaining market share. INPUT questions whether the market will support five major independent producers and sellers of large mainframes (IBM, Amdahl, NAS, Trilogy, and STC) for very long and would not be surprised to see mergers among these companies in the second half of this decade, if not sooner.

- In the December 1981 Residual Value Report, INPUT said that IBM must move quickly to close the MIPS gap between the 4300 and 3081 or the rapidly

declining costs of used 3033s would make them an attractive short term alternative. This could bolster the demand for 3033s causing values to stabilize or increase. The 3083 series announcement did close the gap and the continuing drop in 3033 used market prices is the result. INPUT now sees no forces at work to halt the slide in 3033 values, given that machine's relatively expensive operating costs (energy and maintenance) compared to the 3083s. The projections shown in Exhibit IV-3 reflect that pessimism.

- The forecasts for the 3081 (Exhibit IV-4) are also more pessimistic than previous projections. INPUT believes IBM will use pricing to hold and perhaps recapture large accounts, as production efficiencies and higher chip yields lower unit costs and thus protect profit margins. Tying integration of remotely supported processors and linking office support computers to the central site will strengthen IBM product dominance in large corporations. The growing direct use of computer tools by knowledge workers will expand requirements for distributed computing resources. Such users will demand integration with corporate data bases. IBM intends to capture a significant portion of this market and will adjust mainframe pricing to both protect and expand its large mainframe position. The rather sharp declines in 3081 (and the resulting effect on Amdahl 5860 and NAS AS/9000 series processors as shown in Exhibits IV-5 and IV-6) are largely the result of downward price adjustments as part of this strategy.

APPENDIX: AN ANALYSIS OF ALLEGED IBM 3081 PERFORMANCE SHORTFALL

- The trade press has carried stories of dissatisfaction on the part of five West German users of IBM 3081D systems with the performance of these systems.

  - Details are sketchy, but in brief it appears that these users are disappointed because their 3081s have been delivering less than twice the performance of the 3033U that they had been led to expect.

- INPUT believes that the shortfall in performance is attributable to a mismatch between system software that has been optimized for the 3033U and the architecture of the 3081.

- Figure 1 is a schematic representation of the 3081 architecture.

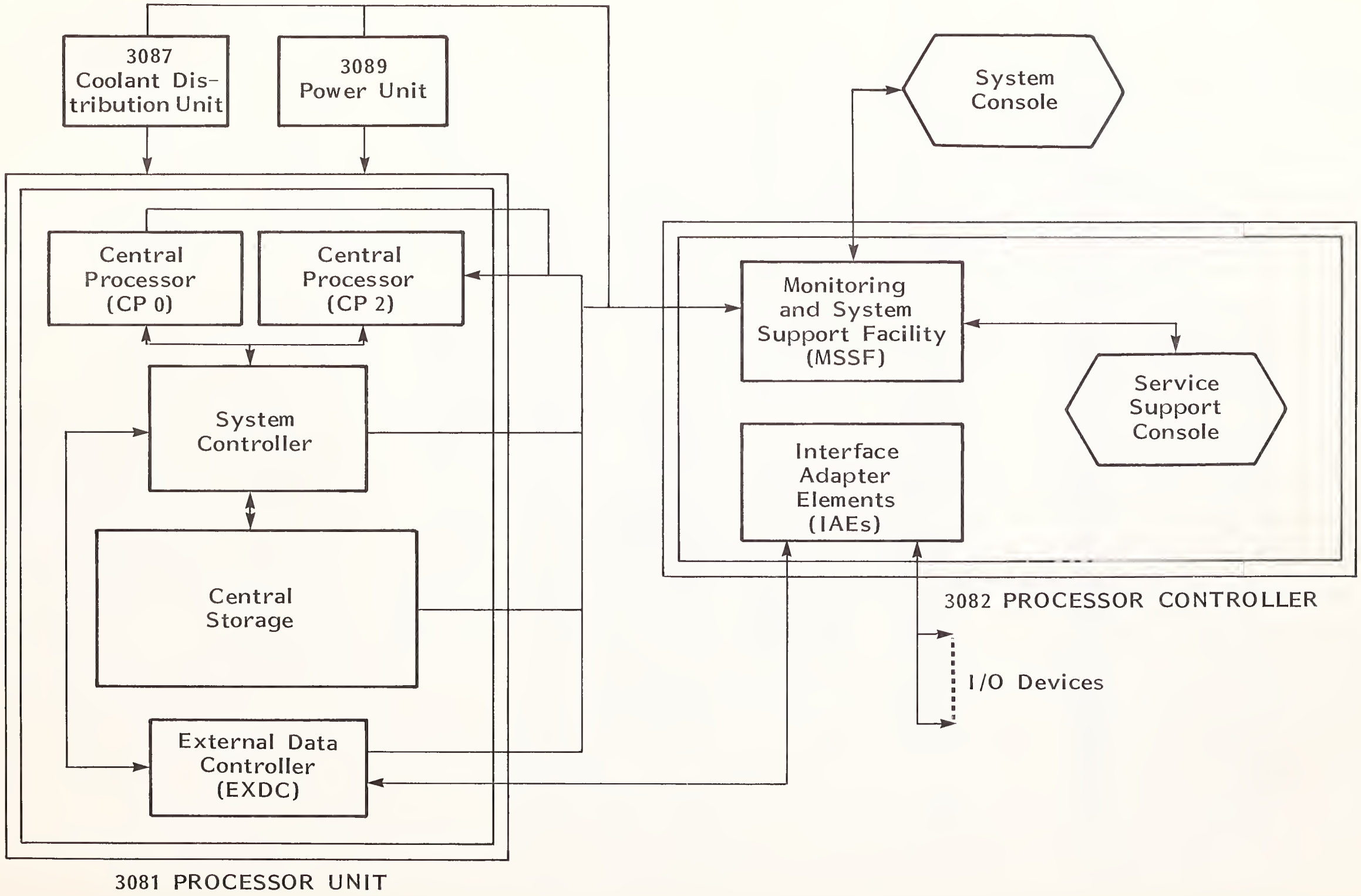
  - Unlike the 3033, the 3081 uses a separate I/O controller, known as the External Data Controller (EXDC) for dispatching and processing I/O commands.

  - Additionally, the 3081 has a new I/O instruction, Start I/O Fast Release (SIOF) which apparently can affect the timing with which certain functions are accomplished.

    . On the 3033, when a Start I/O (SIO) is issued and the channel toward which it is directed is busy, a busy indication is returned immediately.

FIGURE 1

LOGICAL COMPONENTS OF THE IBM 3081 PROCESSOR COMPLEX



. On the 3081, on the other hand, when an SIOF is issued and the channel is busy, the busy indication is returned to the EXDC which then sets a ten-millisecond timer. If the channel becomes available prior to the expiration of the ten milliseconds, the I/O command is re-tried.

- Thus, on a 3033 the system control functions that are performed on a channel busy condition are executed immediately, whereas on a 3081 they may be deferred for up to ten milliseconds - or they may not be performed at all, if the re-try is successful.

- Another architectural difference that INPUT suspects is capable of affecting system performance in unexpected ways is the fact that virtual machine assist (VM assist) is a standard feature on the 3081, whereas in the 3033 VM assist is an RPQ feature. There are not many VM assist RPQs installed in 3033s.

  - When VM/370 is executing on a processor without VM assist, the guest operating systems controlling the virtual machines execute all privileged instructions (such as I/O instructions) in the problem state.

  - When execution of a privileged instruction in problem state is attempted, and the system mode does not permit it, an interrupt occurs, which transfers control to the command processor (CP) element of VM.

    . CP performs certain validation functions, and if the attempted privileged instruction passes the necessary validation tests, CP then modifies and executes the privileged instruction in supervisor state.

    . In a processor without VM assist, the time spent in CP is system overhead time and is not charged to the virtual machine which caused the transfer of control to CP.

- On a system with VM assist, however, the feature attempts the full or partial execution of approximately 30 privileged instructions before control is relinquished to CP.

  . Thus, under VM/370, VM assist significantly reduces CP overhead time but increases the time chargeable to the virtual machine. In some cases, virtual CPU time can increase very disproportionately to the reduction in CP time, especially if the interactive work load is heavy.

- Other architectural differences are known to exist, particularly those related to the 370/XA architecture, details of which are unlikely to be released prior to the 1983 fourth quarter.

  - INPUT suspects that not even IBM may have a full comprehension of the performance implications of such changes.

- It therefore appears that the true performance potential of the 3081 may not become evident until its real architecture is revealed.

- It also appears certain that modifications to the MVS supervisor are necessary to achieve the two-to-one performance improvement claimed for the 3081 over the 3033.

- Before such modifications are effected, 3033 users upgrading to 3081s may reconsider their intentions to dispose of their 3033s as quickly as originally planned.

  - Such reconsiderations might work against a continuing price decline for used 3033s as the supply of such machines might be sparser than formerly anticipated.

- The preceding discussion presents specific information with respect to operating surprises VM/SP users have encountered when installing a 3081 (on which

VM assist is standard) to replace a 3033. INPUT is not suggesting that MVS assist (also standard on the 3081) will cause identical operating differences. Nevertheless, equivalent transitional difficulties with MVS/SP may reasonably be expected when MVS/SP is fine-tuned to account for the architectural differences between the systems.

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- Study of the Specialty Terminal Market
- Evaluate Information Industry Innovations

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INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

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MANAGEMENT PLANNING PROGRAM IN INFORMATION SYSTEMS

RESIDUAL VALUE FORECASTS FOR IBM DISK, TAPE, AND PRINTER SYSTEMS

SEPTEMBER 1982

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INFORMATION SYSTEMS PROGRAM

RESIDUAL VALUE FORECASTS
FOR IBM DISK, TAPE, AND
PRINTER SYSTEMS

SEPTEMBER 1982

RESIDUAL VALUE FORECASTS FOR IBM DISK, TAPE, AND PRINTER SYSTEMS

This report updates residual value forecasts for the IBM model series 3350 and 3380 disk drives, model series 3420 tape drives, and printer models 1403N1, 3211, and 3800. The last major product announcements targeted toward large data processing sites were the 3380 disk drive products, the 3800 printer, and the 3420 tape products. INPUT predicts new printer and tape systems to be announced in the near future. The report reviews recent developments and describes IBM's directions in these peripheral areas. Included are residual value forecasts of selected IBM peripherals and a review of recent used market activity.

U-R16-413
September 1982

INPUT

RESIDUAL VALUE FORECASTS FOR IBM DISK, TAPE, AND PRINTER SYSTEMS

CONTENTS

RESIDUAL VALUE FORECASTS FOR IBM DISK, TAPE, AND PRINTER SYSTEMS

EXHIBITS

I INTRODUCTION

- This report on selected IBM disk, tape, and printer products is issued as part of the Residual Value Forecasting Series in INPUT's Management Planning Program in Information Systems. Information contained in these reports is updated semiannually. INPUT has been forecasting detailed residual values for IBM and software compatible mainframes since 1977, and for selected IBM peripheral products since 1979.

- IBM products covered in this report are the model series 3350 and 3380 disk drives, model series 3420 tape drives, and printer models 1403N1, 3211, and 3800. This report updates forecasts provided in an October 1981 report of the same title, and a May 1982 report on IBM Multiplatter, Moving Head Disk Storage Systems. Other reports on IBM peripheral products, that include a technology overview of the selected peripheral category, are:

  - Residual Value Forecasts For IBM Multiplatter, Moving Head Disk Storage Systems (June 1979, September 1980).

  - Residual Value Forecasts For Printers (March 1980).

  - Residual Value Forecasts For IBM 3420 Series Magnetic Tape Systems (April 1981).

- The last major product announcements in disk, printer, and tape systems targeted towards large data processing sites were the 3380 disk drive products

(June 1980), the 3800 printer (1975), and the 3420 tape products (March 1973). INPUT predicts new printer and tape systems will be announced in the near future. Chapter II provides a review of recent developments and describes IBM's directions in these peripheral areas.

- Chapter III provides residual value forecasts of the selected IBM peripherals. Recent used market activity is reviewed. Important considerations in developing the forecasts are described.

II A REVIEW OF DEVELOPMENTS AND DIRECTIONS IN DISK, TAPE, AND PRINTER TECHNOLOGY

A. DISKS

- IBM has announced new disk product generations at five-year intervals. The major product generations have been:

  - 1965 The 2314 product series.
  - 1970 The 3330 product series.
  - 1975 The 3350 product series
  - 1980 The 3380 product series.

- This five-year product cycle has two phases. The design and prototype construction phase typically takes about three to three and a half years. Product design goals are developed and tested. IBM policy is that the new generation product must have better price/performance and higher reliability than its predecessor. The second phase, product testing and refinement, typically takes about one and a half years.

- Product design and prototype development for the 3380 follow-on generation are well under way. INPUT predicts IBM's next major disk product will be

announced in late 1985. Exhibit II-1 presents comparative characteristics of prior generations, showing changes in improvement areas between product generations. The next product generation will see major improvements in the media and in the rotational speed.

- Media for the 3380 consist of a man-made variant of iron oxide (cigar-shaped particles instead of the cubic-shaped particles found in nature) suspended in an epoxy material sprayed onto a highly polished aluminum platter. The cigar-shaped iron oxide particles are aligned horizontally before the epoxy is cured to create uniform magnetic field characteristics and thus improve the quality of the signal as seen by the read/write heads.

- Three changes in media are being tested. It is not yet certain whether all three will be incorporated into the next generation product. INPUT believes product design specifications can be achieved by incorporating the first two only, and that is the likely outcome. The three are:

  - A thinner coating of magnetic material on the base platter.

  - A magnetic particle with greater field strength per given mass than iron oxide.

  - A vertical rather than horizontal orientation of the magnetic particle.

- A thinner coating decreases the average distance between the magnetic particle and the read/write head, improving overall system performance. A replacement technique for the current spraying method is thin-film technology; i.e., applying the same electroplating methodology used in producing computer chips.

- Although some problems remain, a good deal of R&D effort is focused on replacing iron oxide. Chromium dioxide, with greater magnetic strength than iron oxide, is most likely to replace iron in future media products (both tape and disk).

EXHIBIT II-1

COMPARATIVE CHARACTERISTICS OF IBM
2314, 3330-11, 3350, AND 3380 DISK DRIVES

IMPROVEMENT AREA	2314 DEVICE (ANNOUNCED 1965)	3330-11 DEVICE (ANNOUNCED 1973)	3350 DEVICE (ANNOUNCED 1975)	3380 DEVICE (ANNOUNCED 1980)
Head Positioning	Hydraulic actuator with mechanical track hold; Ferrite heads	Voice coil actuator with electronic track hold; Ferrite heads	Voice coil/rotary actuator with electronic track hold; Ferrite heads	Voice coil/rotary actuator with electronic track hold; Thin film heads
Head Flying Height	100 microinches	45 microinches	20 microinches	12 microinches
Media	Removable: Nonoriented Magnetic	Removable: Nonoriented Magnetic	Nonremovable: Horizontally Oriented Magnetic	Nonremovable: Horizontally Oriented Magnetic
Rotational Speed	2,400 RPM	3,600 RPM	3,600 RPM	3,600 RPM
Data Transfer Rate (megabytes/second)	312	809	1,198	3,000
Areal Density (bits/square inch)	220,000	1,500,000	3,058,000	12,000,000
Average Access Time (milliseconds)	60	30	25	16

- Orienting the magnetic particle vertically into the surface, rather than horizontally along the surface, would permit spacing the particles much closer together. This would allow a much higher (perhaps as much as 10 times) linear bit density.

- As mentioned above, INPUT predicts IBM will use electroplating techniques to achieve thinner coatings and will replace iron oxide probably with chromium dioxide in its next disk product (to be announced in 1985). IBM is experimenting with vertical orientation but does not need this technique to meet product objectives.

- Ibis Corporation, the first new U.S. entrant into the large IBM-compatible disk drive market since Storage Technology Corporation's (STC's) entry in 1969, will use advancements in media (as described above) in their products. Thus IBM and the other major plug-compatible manufacturers (Memorex, STC, NAS using Hitachi-made disks, and Amdahl using Fujitsu-made disks) will be able to observe the viability of these improvements when taken out of the laboratory and packaged as commercial products.

- The plug-compatible manufacturers (PCMs) are aware of future requirements for advanced media and are conducting R&D efforts to remain competitive. Control Data Corporation (CDC) and Memorex have joined forces by forming a joint venture called Disk Media, Inc. - funded to conduct research and development work in magnetic media for future products.

- The other area IBM will significantly improve in the next generation disk family is the rotational speed. As shown in Exhibit II-1, the speed has been constant at 3600 revolutions per minute (rpm) since the 3330 family was introduced. (The Model I was announced in 1970; the Model II was announced in 1973).

- A higher rotational speed (INPUT predicts an increase to 6000 rpm) will require the disk controller to perform speed matching between the host computer channels and the disk drive. A higher linear bit density and higher rotational speed will produce data transfer rates in the range of 12 to 15 megabytes per second. Although the next generation mainframes may be able to handle such data rates, backward compatibility with the 308X series will require speed matching.

- Most experts now predict rotating magnetic storage will remain the dominant random access storage technology through the 1980s. Optical disk and bubble memory - the likely contenders to displace rotating magnetic storage systems - will continue to evolve and will be used in certain market niches.

- Optical disk technology requires a cost-efficient read/write capability before it will seriously erode magnetic disks' dominance. Optical disk products used for read-only archival document storage will appear in 1983 and be in widespread use by 1984. Erasable optical disks as commercial products with a price/performance profile that is competitive with magnetic media are unlikely in the next five years.

- Optimism about bubble memory as a major factor in the storage hierarchy has faded. The availability of low-cost yet much higher-speed random access memories (RAMs) has supplemented bubble memory technology in many potential applications. The ability to retain storage when power is removed remains an important advantage of bubbles over RAM. However, battery packs in RAM-based systems have offset this advantage in products such as solid state paging systems. Bubbles will be used where the relatively high cost per character stored (compared to floppy disks) is more than offset by the higher speed and compactness; e.g., in the GRID Compass portable personal computer.

- Mass storage systems, such as the IBM 3850, also will not be a threat to the disk drive market. The product is bulky and complex (over three million lines

of microcode in the device) and not cost effective for most data processing shops. IBM has abandoned development work on enhancements or a follow-on product.

B. TAPES

- In the early 1970s, IBM thought the 3420 tape family would be the last tape product they would introduce. Since top management felt tape would be phased out by disk technology, the Boulder, Colorado, tape development facility was closed in 1974. Those people who did not relocate with PCMs such as STC were moved to the disk "center" in San Jose, California.

- However, tape refused to die. By the latter 1970s, IBM realized it had made a mistake and began planning for a follow-on product. In 1979, tape development activities moved to a large development center in Tucson, Arizona.

- IBM has developed one new tape product generation to be announced in the near future - and has already begun development work on another expected to be announced in the 1986-1987 time frame.

- Tape performance is judged by how quickly information can be moved to or from the tape system. A major use of tape is as a file backup system for disks. The large storage capacities of 3380 disks now demand a tape backup system with higher performance capabilities.

- Data transfer rate from tape is a function of:

  - Track density -- the number of individual tracks, each with its assigned read/write head, that reside in parallel along the surface of the tape media. The 3420 product has nine tracks (eight bits per character and one bit for parity error checking).

- Linear bit density -- the number of bits that can be read or written along the track per given distance interval. The 3420 product can read or write up to 6250 bits per inch (bpi).

- Tape speed -- the velocity at which the tape is passed under the read/write heads. The 3420 product supports a maximum speed of 200 inches per second (ips).

- The maximum data transfer rate for the 3420 product is shown below along with some future expected combinations for reaching IBM target data transfer rates for tape systems.

	Track Density	x	Linear Density (bpi)	x	Tape Speed (ips)	=	Data Transfer Rate (megabytes/ second)
3420 Tape System	9		6250		200		1.25
Expected Future Products	18		12,500		100		2.5
	18		20,000		75		3.0
	18		20,000		150		6.0
	27		50,000		100		15.0

- The 12,500 bpi linear density is near the upper limit of flux changes per second with iron oxide (up to 100,000 flux changes is thought possible with chromium dioxide). Thus the first "expected future product" shown above is a fall back position if chromium dioxide does not prove to be viable for the next generation product.

- As data transfer rates increase, the requirement for a speed matching function by the device controller becomes important. As mentioned in the disk section earlier, speed matching will also be required with disk systems. INPUT predicts a common controller will be used for disk and tape systems. This controller will also deal with error handling, relieving the host system from this chore.

- A major cost component in tape systems is the mechanical machinery that accelerates or decelerates the tape as records are transferred to and from the tape device. This expensive componentry is eliminated in the "streaming" tape systems where the tape rotates continuously at a fixed rate of speed. A compromise is to have both modes of operation, with a relatively slow stop/start mode that requires less expensive hardware.

- IBM typically tests new concepts on smaller systems where the relative risk is much lower. Thus it is noteworthy that the 8809 tape system developed for small processor systems has both modes -- a start/stop mode at 12 1/2 ips and a streaming mode at 100 ips.

- The next tape product generation, expected very soon, will include the following characteristics:

  - One-half inch tape housed in a small square cartridge. The tape will use chromium dioxide as the magnetic material, replacing the traditional iron oxide, unless unsolvable difficulties are encountered.

  - Data transfer rate of up to three megabytes per second.

  - Both start/stop and streaming modes.

  - Use of the 3880 controller (also used for 3380 disks).

- In the future, IBM realizes it must make tape systems more reliable by eliminating vacuum columns and capstan motors, and by reducing the overall part count. It also plans to reduce the labor component in tape handling through automated tape loading and fewer tape mounts (by increasing the storage capacity per tape).

C. PRINTERS

- IBM issued a "Statement of Direction" in 1980 announcing its intention to make all of its hardware products compatible; i.e., the ability to move information from one system to another electronically. This had a major impact on its printer product line, where incompatibility was the rule rather than the exception. For example a file could not be readily moved for printing between the 6640 ink jet printer, 6670 laser printer/copier, and 3800 high speed laser printer -- IBM printers typically installed in many large organizations.

- IBM has taken specific actions to insure that future printer products adhere to this Statement of Direction. Two of interest are the Sherpa project and the Composed Page Data Stream (CPDS) concept.

- The Sherpa project was an outgrowth of changes in the architecture of the 6670 laser printer that placed character fonts under software control rather than hardwired in the machine. Under this internal IBM research project, an Intel 8086 microprocessor-based printer controller was constructed and programmed to take advantage of the point addressability now available in the 6670 printer. This effort recognizes a demand for nonimpact computer printing devices that can generate and print various faces, shapes and sizes of characters (and with some graphics printing capability also) quietly in an office environment. IBM will introduce such a product within a year.

- CPDS is a software program that melds various input streams (e.g., formated text or graphics) and delivers the resulting blend to a page-oriented output device such as a laser printer. In some internal IBM experimentation, the graphics attachment feature (graphics software driving a Tektronix graphics terminal) has been used to preview composed documents before committing to printing.

- IBM is not oblivious to the expanding market for quiet nonimpact printers that produce quality output with flexibility in type fonts and type sizes. This market, growing at 40% per year, is expected to reach $5 to $6 billion in total revenue by 1986. Xerox is forging ahead with its 2700 through 9700 product line -- aimed at gaining market dominance. IBM will be competitive in this market -- and that requires new printer products.

- One probable new printing product from IBM is the Electro Erosion Printer developed in Germany and "shown" (although not as a commercial product) at a graphic arts exposition this summer. This printer produces masters for press reproduction at a rate of one page in about a minute and a half. The printing process involves the evaporation of a very thin film of aluminum from a black varnish-coated paper. The resolution is 600 dots per inch, producing very crisp character definition at a cost of five to ten cents per page. A series of 32 electrodes sweeps across the aluminum coated paper, firing when a black dot is required to form the desired character image.

- The Electro Erosion Printer will be the forerunner of a new computer peripheral that sits quietly in a corner producing typeset quality masters without human attention or chemical processing.

- IBM is also devoting significant research efforts towards refining ink jet printing technology. The use of ink jet printers for color printing is being tested.

- A compatible family of future IBM printers is expected to permit printing documents with various fonts and type sizes. Thus drafts would be printed on locally installed low-cost (starting at about $15,000) low-volume (10 to 15 pages a minute) printers. Final copy could be printed as typeset masters for press runs, or on a high-volume (100 to 200 pages a minute) laser printer.

- Xerox recognizes that the filing cabinet filled with paper documents will be supplanted in the future by the magnetic disk, and that reproduction will then

be done on a computer printer rather than the paper copier. Thus its future is tied to its success in gaining a large share of that future on-demand printing market. It is well ahead of IBM in implementing a compatible product line for that market.

- InterPRESS is the name of Xerox's standard printer control language. Now in final development, it will permit a file prepared on any system to be printed on a Xerox printer, using preprocessing software to convert whatever format specification language the file contains to InterPRESS.

- The Japanese will be a factor in the distributed printing market through supplying OEMs. For instance, they provide the printing engine for Datapoint and Hewlett-Packard laser printers. The combination of solid state lasers with low-cost xerographic copying engines and with microprocessor-based controllers provides an inexpensive package with significant capability. The Japanese have such products now. As with copiers, the Japanese intend to focus on the low-end market.

III RESIDUAL VALUE FORECASTS FOR SELECTED IBM PERIPHERALS

- Although many factors are considered in forecasting future residual values, the most important are projected new product announcements, anticipated price changes, and availability of the equipment (either new from IBM or in the used market) at selected future times.

- New product announcements set price/performance standards in outright cost per unit of performance delivered and also in operating costs for power, space, air conditioning, maintenance, and human operator attention. New products generally also offer greater functionality to encourage customer migration to the newer technology.

- Price changes can be either increases or decreases. Exhibit III-1 presents a price trend history for the selected IBM peripherals included in this report. IBM alters prices to maximize revenue and to protect market share. In general, prices for products such as disks (and mainframes -- see the July, 1982 report) have been reduced significantly during their typical five-year product life. Rapidly changing performance capabilities require recovering high development costs quickly, and thus early pricing is very high relative to manufacturing cost. This permits significant reductions when PCM competition appears or when a new generation announcement approaches.

- Availability in the used market is the supply factor in the supply versus demand equation. At any given instant, it is supply versus demand that establishes the used market price for a specific piece of equipment. Avail-

EXHIBIT III-1

PRICE TREND HISTORY FOR SELECTED IBM PERIPHERALS

EQUIPMENT TYPES	1964	1969-1971	1973-1975	1977-1979	1980-1981	1982
Printers:						
1403N1	$39,965	$33,970	$38,140	$40,040	-	-
2821-2	27,100	23,040	25,900	27,190	-	-
3211	-	69,360	63,630	53,440	$40,080	-
3811	-	30,600	28,080	23,580	17,685	-
3800	-	-	310,000	341,750	358,800	$373,150
Tapes:						
3420-3	-	13,580	12,420	14,340	-	14,910
3420-5	-	18,170	16,650	19,230	-	19,990
3420-7	-	22,380	20,520	21,540	-	22,400
3420-4	-	-	24,000 21,960	23,050	18,440	19,170
3420-6	-	-	28,000 25,650	26,930	21,540	22,390
3420-8	-	-	31,000 28,440	29,860	23,890	24,840
Disks:						
3350	-	-	49,500	31,680	-	32,940
3375	-	-	-	-	32,550	33,850
3380	-	-	-	-	81,000	84,240

NOTE: PRICES SHOWN WERE THE IBM LIST PRICES IN EFFECT AT THE END OF THE DESIGNATED TIME PERIOD. THE TWO FIGURES SHOWN FOR THE 3420 MODELS 4, 6 AND 8 ARE THE INTRODUCTORY PRICE AND THE PRICE IN EFFECT AT THE END OF 1975.

ability from IBM can strongly influence the demand side of the equation. This was graphically demonstrated when availability of 3350 and 3380 disks from IBM last year was well below market demand, sending customers in droves to the used market. Used market prices rapidly climbed above 150% of IBM list prices.

- INPUT's most recent peripheral projections (October 1981 for tape and printers, May 1982 for disks) have followed actual used market activity closely. Exhibit III-2 shows used market average retail values (as a percent of IBM list price) at October 1981 and January, April, and July 1982 for the disk, tape, and printer products included in this report.

- Exhibit III-3 projects future average used market retail values at January 1, 1983 through 1987 for the selected disk, tape, and printer products. Exhibits III-4 through III-14 graph these projected residual values as a percent of current IBM list price.

- INPUT has lowered somewhat future projections for disk and tape equipment. Printer projections remain virtually unchanged.

- The production volume of 3380s has been higher than INPUT projected, causing 3350 disks to enter the used market at an accelerated rate. This has caused used 3350 values to drop more sharply than expected. INPUT expected IBM to reach a 60 to 90 day lead time on 3380 disk deliveries from time of order in early 1983. It has already achieved this objective.

- Demand for 3420 tape equipment has softened considerably over the past nine months. Since expectation of a new product announcement is very high, customers are waiting to see what the new product will offer. A key element will be the pricing, typically the last decision IBM makes when introducing a new product. INPUT projects that improvement in overall price/performance will be modest, and that IBM will attempt to sell the improved functionality, data transfer rate, and labor savings in tape handling to offset the higher

EXHIBIT III-2

USED MARKET AVERAGE RETAIL PRICES FOR SELECTED IBM PERIPHERALS

MODEL	1981 OCTOBER	1982 JANUARY	1982 APRIL	1982 JULY
3330-1	35%	33%	18%	10%
3330-11	52	44	38	23
3350-A2	140	95	73	65
3350-B2	140	95	73	65
3380-A4	-	-	130	108
3380-B4	-	-	130	108
3420-003	35	26	19	11
3420-005	36	24	17	13
3420-007	44	35	29	23
3420-004	68	61	54	47
3420-006	70	66	66	64
3420-008	87	80	80	76
1403-N-1	19	16	14	11
3211-001	59	59	55	55
3800-001	68	65	65	63

THE VALUES SHOWN ARE USED MARKET RETAIL PRICES. AT ANY GIVEN TIME, THREE PRICE LEVELS EXIST:

RETAIL PRICE - THE AMOUNT AN END USER WOULD PAY FOR THE EQUIPMENT.

DEALER PRICE - THE AMOUNT A DEALER WOULD PAY ANOTHER DEALER TO ACQUIRE EQUIPMENT TO COMPLETE A CONTRACTED SALES OBLIGATION.

WHOLESALE PRICE - THE AMOUNT A DEALER WOULD PAY TO ACQUIRE THE EQUIPMENT.

THE DOLLAR SPREAD AMONG LEVELS IS A FUNCTION OF THE TOTAL VALUE OF THE TRANSACTION. FOR PERIPHERAL EQUIPMENT, THE WHOLESALE PRICE WILL TYPICALLY BE 70% TO 90% OF THE RETAIL PRICE.

EXHIBIT III-3

PROJECTED USED MARKET RETAIL PRICES FOR SELECTED IBM PERIPHERALS

EQUIPMENT TYPE	MODEL NUMBER	CURRENT LIST (9-1-82)	PROJECTED USED MARKET RETAIL PRICE AT JANUARY 1 OF:				
			1983	1984	1985	1986	1987
Disk	3350 A02	$ 41,600	$ 21,600	$ 16,600	$ 11,600	$ 8,300	$ 5,000
	3350 B02	32,940	17,100	13,200	9,200	6,600	4,000
	3380 A04	101,550	86,300	75,100	68,000	50,800	38,600
	3380 B04	84,240	71,600	62,300	56,400	42,100	32,000
Tape*	3420-003	18,495	1,800	1,300	900	600	200
	3420-005	23,575	2,600	1,700	1,200	700	500
	3420-007	25,985	5,200	3,600	2,600	1,800	1,000
	3420-004	21,170	8,900	6,400	4,200	2,500	1,100
	3420-006	24,390	14,600	11,700	7,800	4,400	2,000
	3420-008	26,840	19,300	15,300	12,100	8,100	3,200
Printer	1403-N-1	40,040	3,000	1,500	800	400	-
	3211-001	40,080	19,200	14,800	11,200	7,600	4,000
	3800-001	373,150	216,400	186,600	129,300	77,000	36,000

*PRICES LISTED INCLUDE FEATURE 6631 (1600 BPI DENSITY) FOR MODELS 003, 005 AND 007 AND FEATURE 6420 (6250 BPI DENSITY) FOR MODELS 004, 006, AND 008.

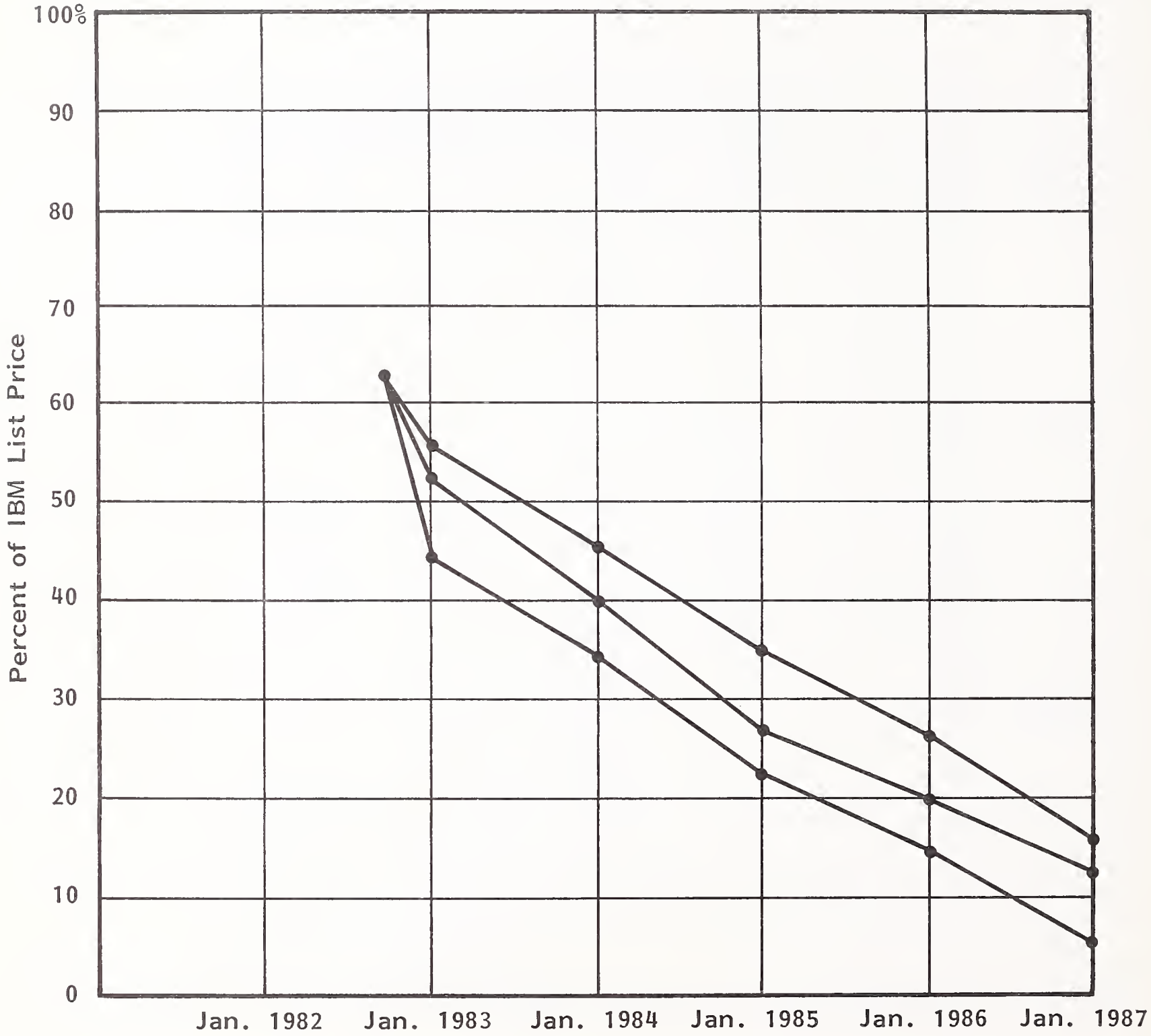
THE VALUES SHOWN ARE AVERAGE RETAIL PRICES IN A FUTURE USED MARKET.

THE DOLLAR SPREAD BETWEEN THE RETAIL ("BUY") AND WHOLESALE ("SELL") PRICE LEVELS DEPENDS UPON THE VALUE OF THE TRANSACTION. FOR THE RANGE OF VALUES SHOWN ABOVE, THE WHOLESALE PRICE WILL TYPICALLY BE 70% TO 90% OF THE RETAIL PRICE.

EXHIBIT III-4

PROJECTED RESIDUAL VALUES FOR THE

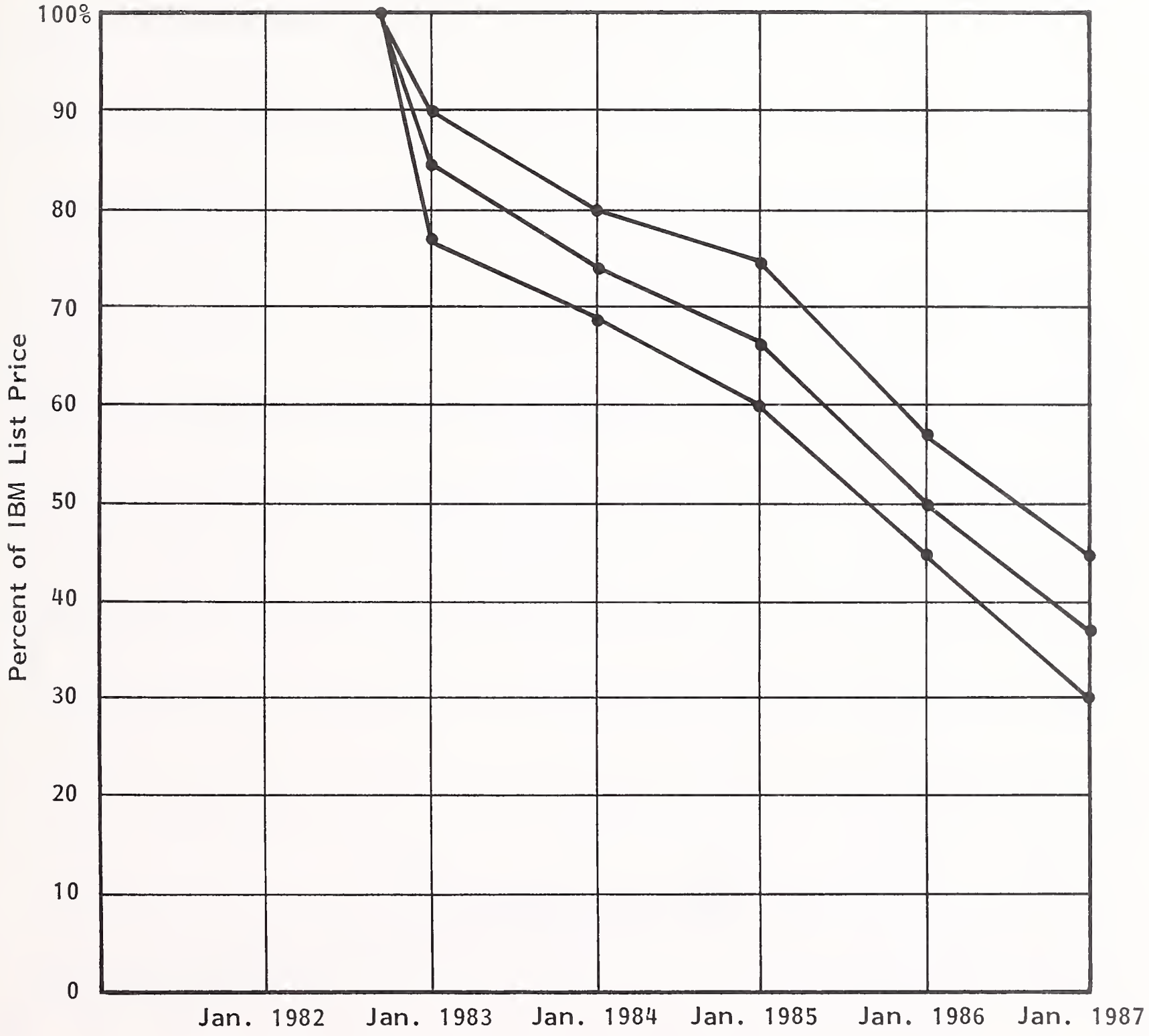
IBM 3350 DISK DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	56	46	35	27	16
Expected	52	40	28	20	12
Low	45	36	23	15	7

EXHIBIT III-5

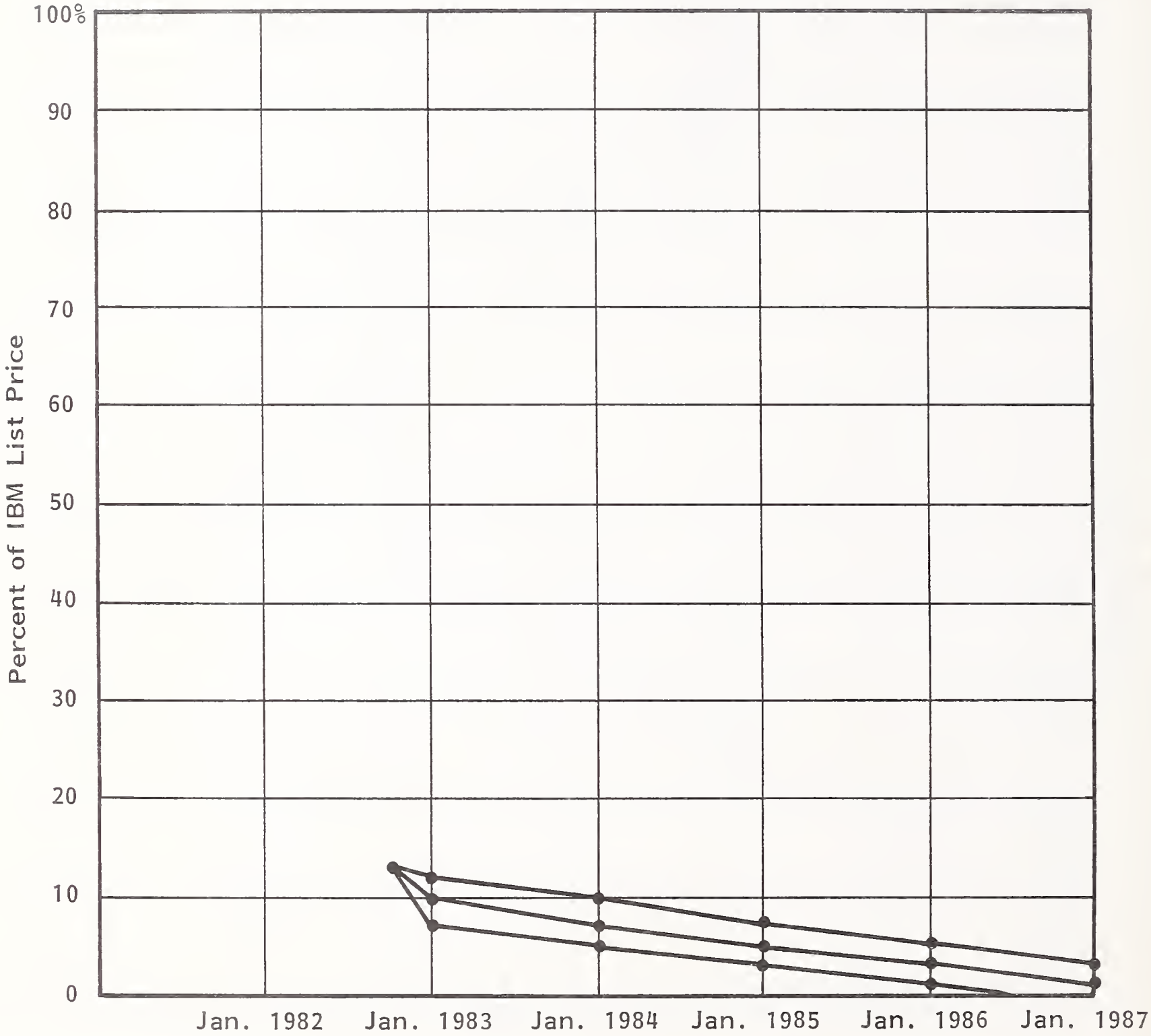
PROJECTED RESIDUAL VALUES FOR THE IBM 3380 DISK DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	90	80	75	57	45
Expected	85	74	67	50	38
Low	78	69	60	45	30

EXHIBIT III-6

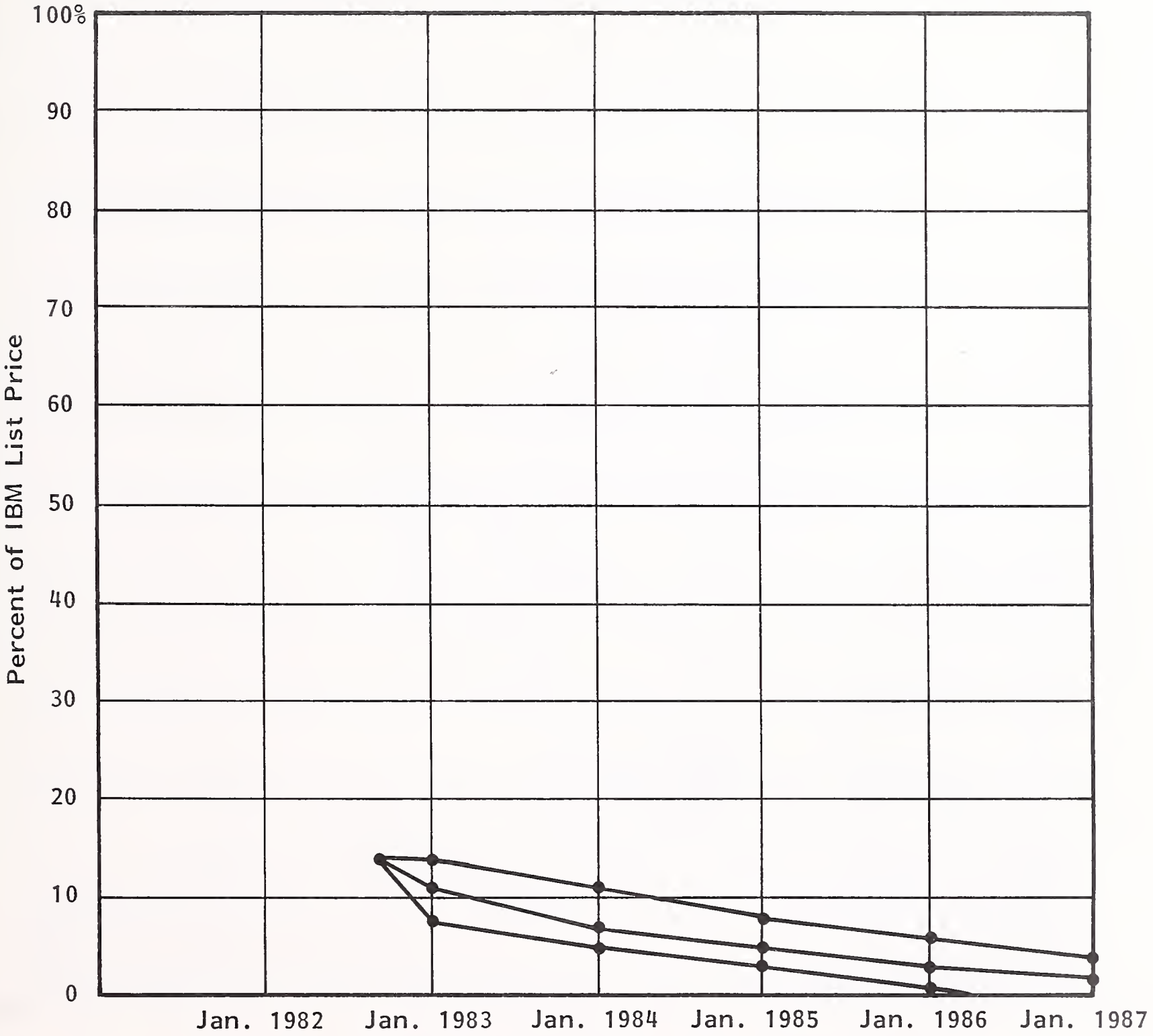
PROJECTED RESIDUAL VALUES FOR THE IBM 3420-003 TAPE DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	12	10	7	5	3
Expected	10	7	5	3	1
Low	8	5	3	1	–

EXHIBIT III-7

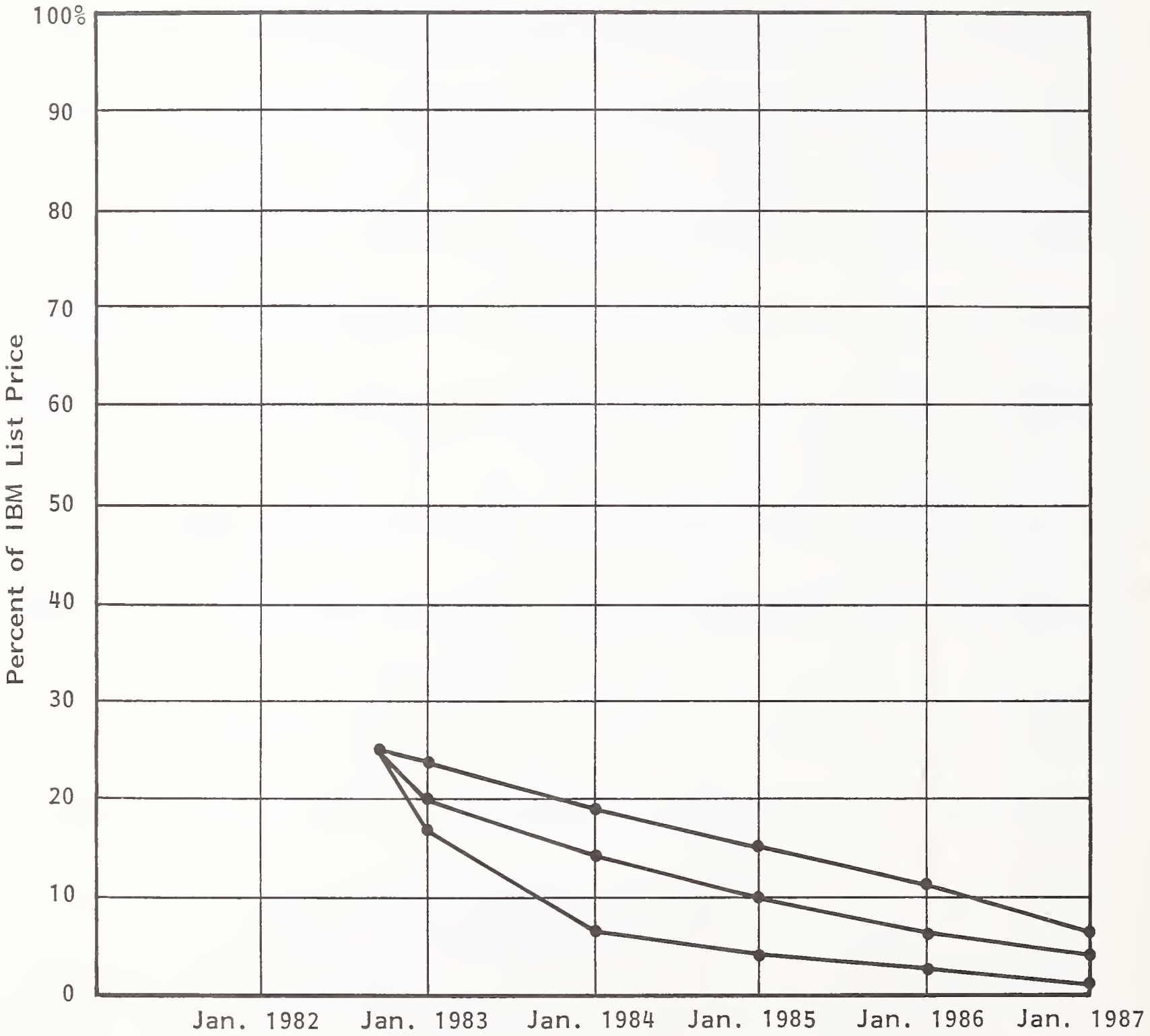
PROJECTED RESIDUAL VALUES FOR THE IBM 3420-005 TAPE DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	14	11	8	6	4
Expected	11	7	5	3	2
Low	8	5	3	1	–

EXHIBIT III-8

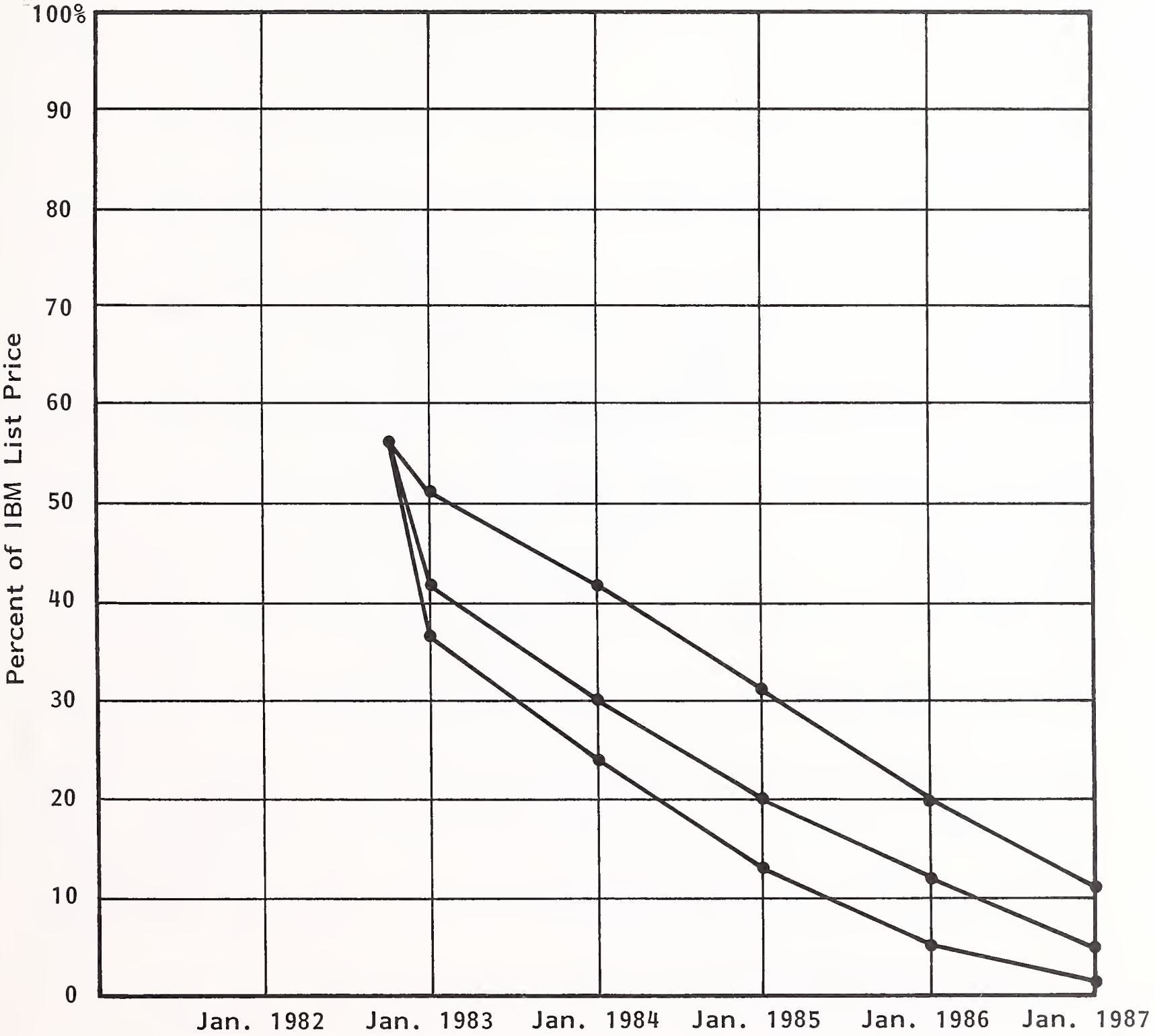
PROJECTED RESIDUAL VALUES FOR THE IBM 3420-007 TAPE DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	24	19	15	11	7
Expected	20	14	10	7	4
Low	17	7	4	3	1

EXHIBIT III-9

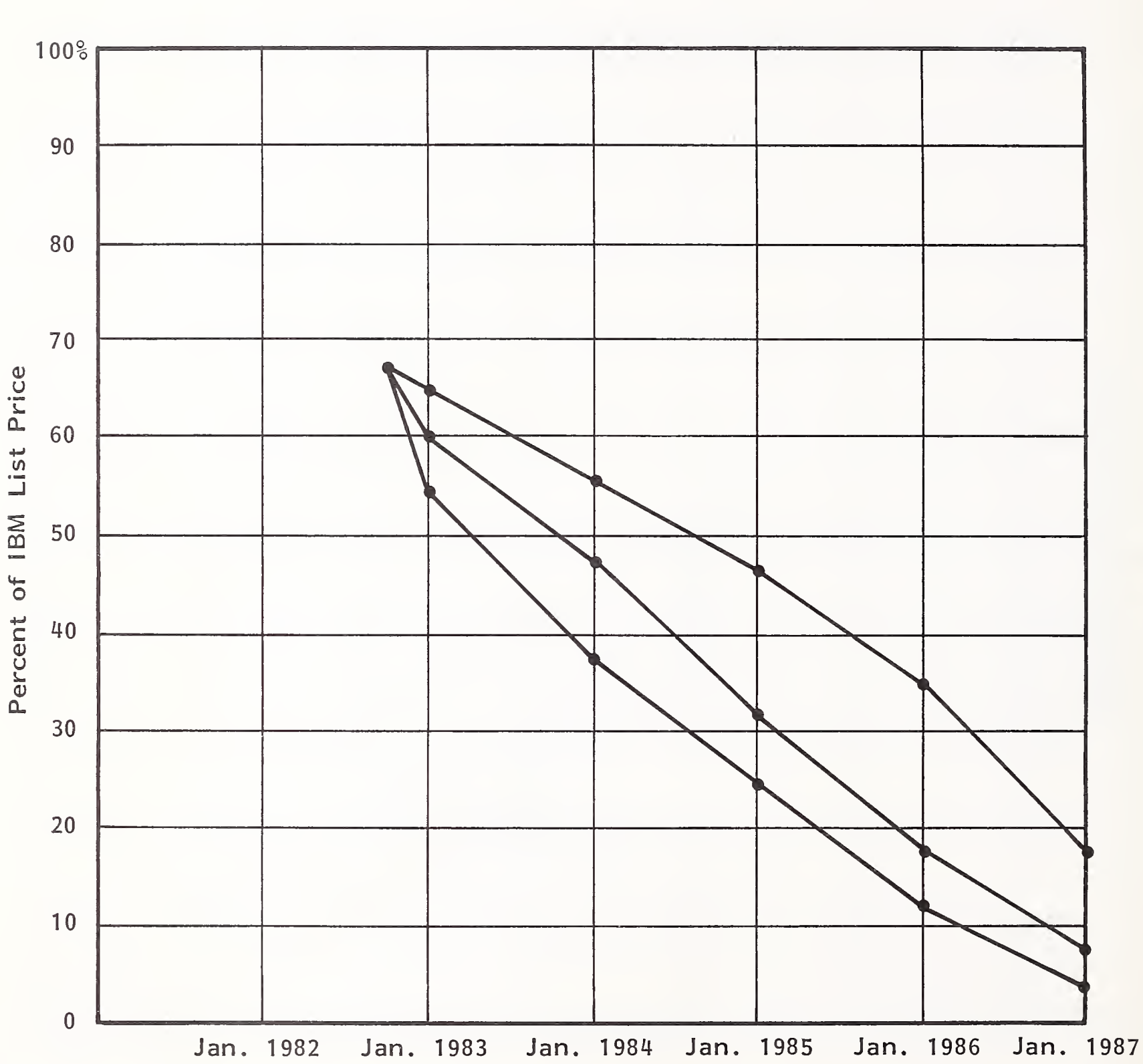
PROJECTED RESIDUAL VALUES FOR THE IBM 3420-004 TAPE DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	51	42	31	20	11
Expected	42	30	20	12	5
Low	37	24	13	6	2

EXHIBIT III-10

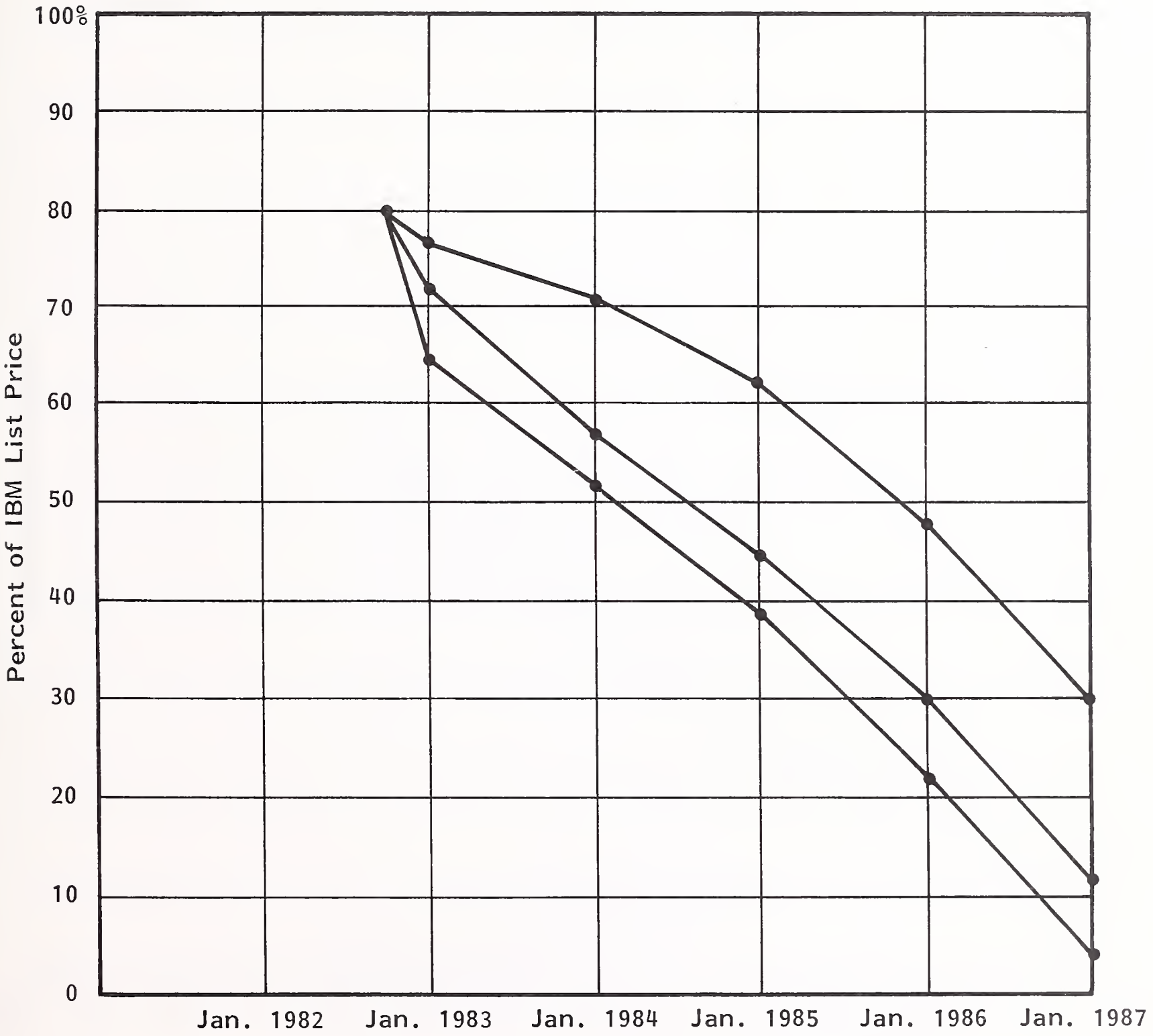
PROJECTED RESIDUAL VALUES FOR THE IBM 3420-006 TAPE DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	65	56	47	35	18
Expected	60	48	32	18	8
Low	54	38	25	12	4

EXHIBIT III-11

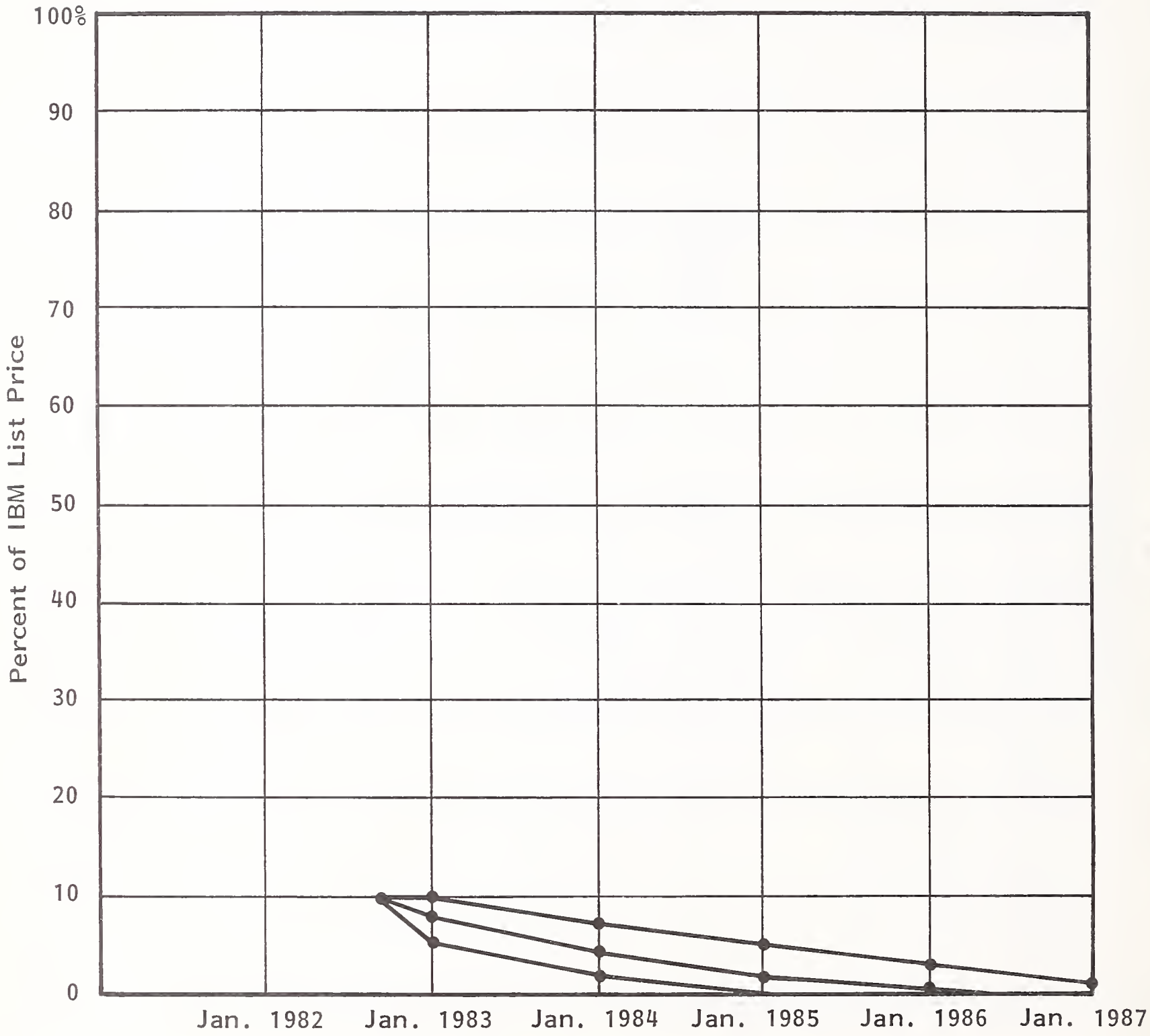
PROJECTED RESIDUAL VALUES FOR THE IBM 3420-008 TAPE DRIVE



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	77	71	62	48	30
Expected	72	57	45	30	12
Low	65	52	39	22	5

EXHIBIT III-12

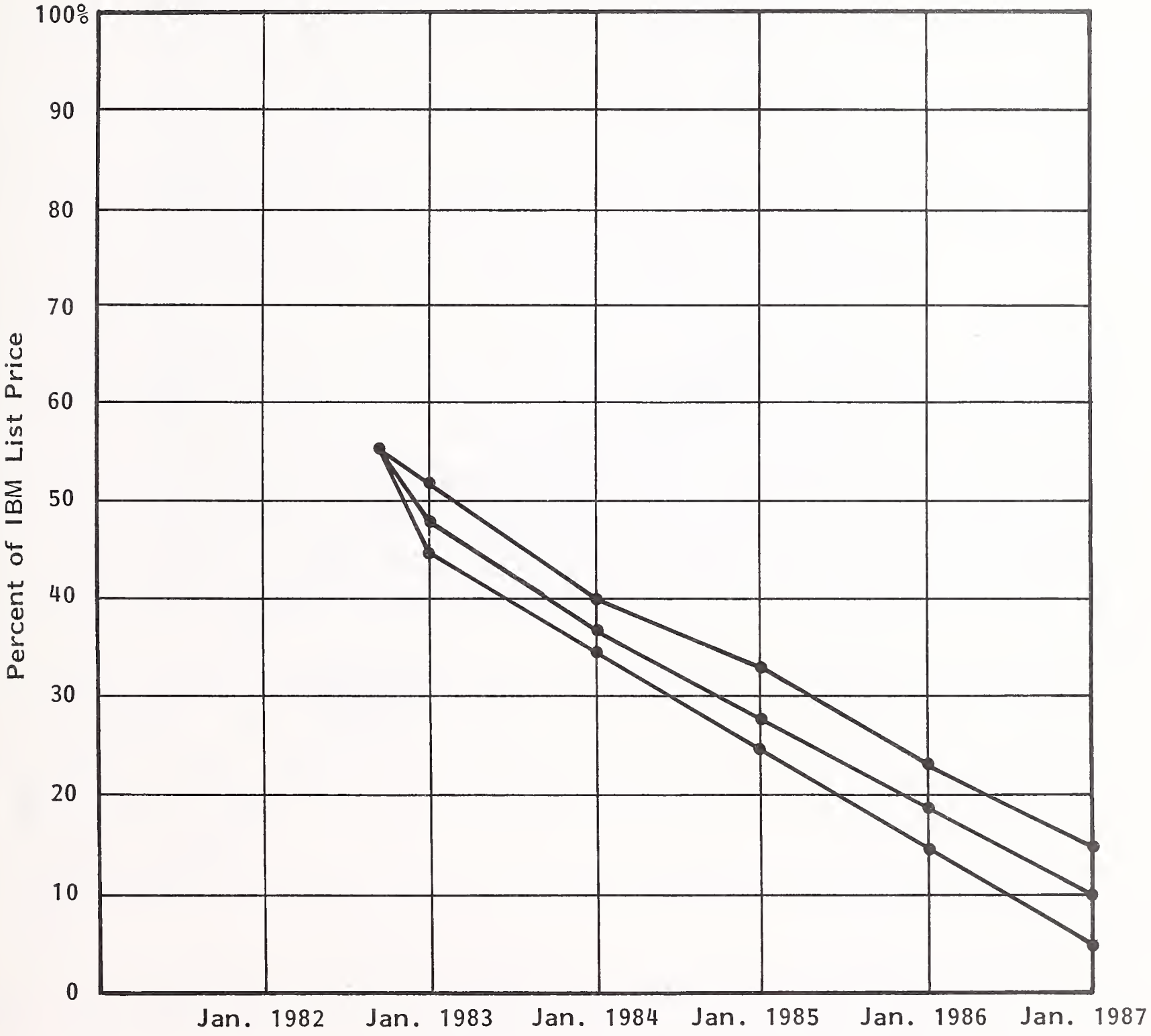
PROJECTED RESIDUAL VALUES FOR THE IBM 1403-N1 PRINTER



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	10	7	5	3	1
Expected	8	4	2	1	–
Low	5	2	–	–	–

EXHIBIT III-13

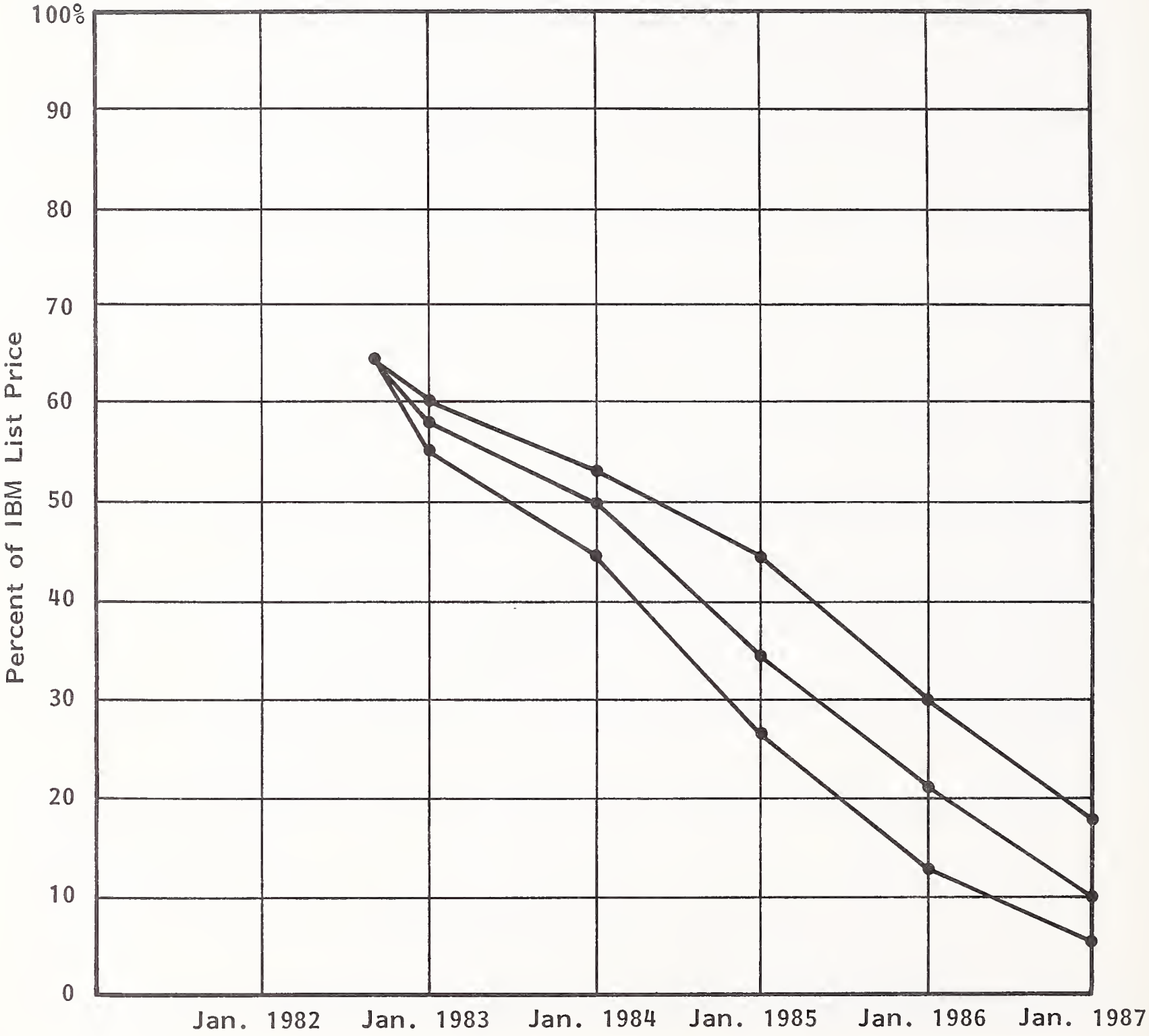
PROJECTED RESIDUAL VALUES FOR THE IBM 3211 PRINTER



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	52	40	33	23	15
Expected	48	37	28	19	10
Low	45	35	25	15	5

EXHIBIT III-14

PROJECTED RESIDUAL VALUES FOR THE IBM 3800 PRINTER



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	60	53	45	30	18
Expected	58	50	35	21	10
Low	55	45	27	13	6

comparative cost to the 3420. INPUT believes IBM will be successful in this effort and that the 3420 line will fade away over the next few years.

- As described in Chapter II, INPUT projects IBM will introduce a new family of compatible printer products over the next two years. There will be low-cost yet high-function locally installed printers, high volume central site laser printers (a 3800 follow-on), and typeset quality printers. The traditional highly mechanical line printers will disappear. Prices for locally installed printers will follow a downward pricing trend, based on expanding volumes. However the central site printers will remain static; i.e., do not expect future IBM 3800 type (or Xerox 9700 type) printers to decline in price.

- Exhibit III-15 provides current list prices for IBM disk products. Projections are not given in this report for all members of the IBM 3350 and 3380 families. INPUT predicts the residual values for other members of a given product family will be proportional to the ratio of the respective list prices. For example, the forecast residual value of the 3350 A2 (list price $41,600) on January 1, 1986 is $8,300. The forecast value at that same date for the 3350 C2F (list price $53,340) would be:

$$\frac{\$53,340}{\$41,600} \times \$8,300 = \$10,642$$

EXHIBIT III-15

LIST PURCHASE PRICES FOR IBM DISK PRODUCTS (SEPTEMBER 1982)

PRODUCT	PURCHASE PRICE (dollars)
3330-1	$ 33,670
3333-1	42,200
3330-11	47,920
3333-11	56,450
3350-A2	41,600
3350-A2F	51,910
3350-B2	32,940
3350-B2F	43,250
3350-C2	43,030
3350-C2F	53,340
3370-A1	44,350
3370-B1	29,550
3375-A1	50,720
3375-B1	33,850
3380-A4	101,550
3380-AA4	116,050
3380-B4	84,240

INDEX

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- User Communication Networks and Needs
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RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

DECEMBER 1982

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INFORMATION SYSTEMS PROGRAM

RESIDUAL VALUE FORECASTS
FOR LARGE IBM AND
SOFTWARE-COMPATIBLE MAINFRAMES

DECEMBER 1982

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

CONTENTS

RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

EXHIBITS

I INTRODUCTION

- This residual value forecast is produced as part of INPUT's Management Planning Program in Information Systems. Projections contained in this series of reports are updated periodically. Key issues, such as trends in computer technology, future hardware and software developments, and expected product announcements are the subjects of various other INPUT reports in this Information Systems Program.

- In July 1982, INPUT published the ninth report in its continuing series on residual values of large IBM and software-compatible mainframes. This report reviews significant events since July and updates the earlier residual value forecasts based on an analysis of recent developments.

- Forecasted residual values are provided for IBM, Amdahl, and National Advanced Systems (NAS) processors. This report focuses on large-scale mainframes, although the distinction is blurring as the number of processor models continues to expand. A trend is clear - to build a basic processor unit and then create a product line around it. The product series is created by tightly coupling additional like processors and/or "tuning" performance (creating additional models) by adjustments to the instruction pipeline and/or cache memory size and paging algorithms.

- Chapter II reviews recent used-market trading activity in IBM, Amdahl, and NAS processors. The used-computer industry does not publish records of transactions. Information in this chapter was obtained by interviewing computer dealers and end users who have recently bought or sold equipment.

- Chapter III reviews vendor activity since INPUT's July report. Significant announcements are summarized, with INPUT commentary where appropriate. IBM, Amdahl, and National Advanced Systems introduced new processor models during this reporting period.

- Residual value projections for the various processors covered by this report are given in Chapter IV. The used-computer industry, by convention, always lists used equipment as a percentage of the manufacturer's current list price. The projections in Chapter IV follow this convention. Readers are cautioned to consider past price changes when analyzing their own unique situations, as significant price reductions have occurred with 370 and 303X series processors. The values listed are projected wholesale prices, i.e., the amount a used-computer dealer will pay for equipment for subsequent resale at a higher price to an end user.

- Chapter V provides a special discussion of the IBM 308X product line. The method of packaging and therefore the manner in which these processors can be upgraded will have a significant impact on the traditional used-computer market and hence the residual values of the 308X product line.

II REVIEW OF RECENT USED-MARKET ACTIVITY

- The used market for 43XX and 303X processors was relatively stable during this reporting period (July - December, 1982). This period marked the beginning of the 308X used market, with the first 3081 processor sales occurring at values forecasted by INPUT in recent residual value reports.

- The 370 market is virtually nonexistent. 370/158 and 370/168 processors are now attractive mainly to scrap dealers or those seeking spare parts. The very low prices and a recent reduction in maintenance costs from IBM have caused a minor revival in interest, but the relative bulkiness and high energy costs associated with these machines limit demand.

- The 3031 and 3032 market remains very weak. These close relatives to the 370/158 and 370/168 suffer the same bulkiness and energy cost problems that more than offset low purchase or leasing prices.

- The 3033 market was relatively stable over the past several months. The expected downward drift in used-market values did not occur because of a relative shortage of 3033 processors. The recession has apparently caused some end users to delay replacing 3033 machines with newer generation hardware. Also, the very rapid decline in prices during the first half of 1982 resulted in some firms, those who took delivery of 3081s during this year, holding on to 3033s to avoid showing a large loss on the sale in the current year.

- A recent 3081 sale was reported at around 92% of list price. INPUT had projected a January 1, 1983 price of 90%. The volume of transactions has been small and will remain so for quite a while (see Chapter V). INPUT expects the short lead time in acquiring 3081s direct from IBM will continue through 1983, thus eliminating any premiums for preferred delivery positions and causing used machines to sell in the 80-90% range (equivalent new pricing discounted for loss of Investment Tax Credit and warranty maintenance savings).

- The 4300 market has not fluctuated greatly in recent months. The 4341 group remains attractive, with good demand for all models. The low-end 4331 market has remained weak due to sluggish demand.

- Amdahl's intent to support IBM's Extended Architecture (XA) on the V/7 and V/8 products has helped maintain market values. The older V/5 and V/6 used-market prices have declined. The number of transactions is small, and thus it is hard to generalize about values as a percent of list price. The V/5 and V/6 models are in the 10% range, while V/7 and V/8 models are in the 40% range, although significant variance from these numbers can occur for any given transaction.

- National Advanced Systems is the remarketer for virtually all used NAS processors, acquiring these used processors as trade-ins on customer upgrades to more powerful NAS systems. Recently they acquired an IBM 3081 in trade when installing an NAS 9000 processor. This practice may increase where manipulating trade-in value has advantages over discounting list price in negotiating a final package. Further, other vendors including IBM may engage in this practice. INPUT has learned that IBM, in at least one competitive situation, has offered to accept Amdahl equipment on a trade-in basis as part of a large-scale change in machine room configuration.

III REVIEW OF VENDOR ANNOUNCEMENTS (JULY-DECEMBER, 1982)

- During this period all three suppliers in the large mainframe market announced both new products and price reductions on existing products. This was a period of product line solidification prior to entering the 1983 marketing battlefield. Each vendor sought to array a range of products to ensure complete market coverage.

A. IBM ANNOUNCEMENTS

- Most recent IBM announcements support a strategic direction toward direct purchase of hardware by end users.

- In July, rental and lease prices on the 4300 processor line were increased by about 8%, and the purchase option accrual rate on rental and lease payments was reduced from 60% to 40%.

- In August, maintenance rates for purchased mainframes was reduced for most models.

- In September, IBM extended the upper end of the 308X family by announcing the quadra-processor 3084. Some highlights of this new system are:

- Four central processors tightly coupled (requires MVS/XA) with up to 1.9 times the performance of the 3081 Model K. In this mode the system can be shifted to a three-processor configuration and continue to operate in the event of a processor failure.

- Two dyadic processor sets running independent operating environments.

- Forty-eight channels and up to 64 megabytes of main memory.

- Upgradable in the field from the 3081 Model K.

- First shipments in the fourth quarter, 1983.

- Announced concurrently with the 3084 was a replacement for the first 3081 model (the Model D) and price changes for the 3081 models D and K. The new model (designated G) is compatible with the 3083 processors and thus provides a uniform upgrade path from the entry level 3083 Model E through the 3084. The initial Model D was brought to market before refinements incorporated in the 3083 series were completed.

  - For further analysis of the 308X line, see Chapter V.

- In October, the 4341 Series was expanded by adding two new processor models. The new entry-level machine is the Model 9, rated at about 0.5 million instructions per second (MIPS) and targeted toward the engineering/scientific market now dominated by Digital Equipment Corporation, Hewlett Packard, and Data General. The new high-end model is the Model 12, rated at about 1.5 MIPS. INPUT believes this completes the 4341 Series and that a new series will be introduced in the near future (the 4351) with a basic uniprocessor CPU rated at about 2.5 MIPS.

B. AMDAHL ANNOUNCEMENTS

- In early September, a plug-compatible 3350 disk system was formally announced by Amdahl. Designated the 6280 Disk Storage Unit and 6880 Storage Control Unit, it represents a move toward broader product diversification.

- In late September, a slowed-down version of the 5860 processor was announced. Called the Model 5850, this unit has about 75% of the 5860's performance and can be converted back to a 5860 in about eight hours. First customer shipments are scheduled for the second quarter of 1983. The processor can support up to 32 channels and 16 megabytes of main memory. Amdahl at the same time announced an 11% price reduction on the 5860 and a 10% lease price increase, closely following the early September actions of IBM.

- Amdahl continues to develop and sell operating system enhancements. In September they announced three software items: a CMS/Accelerator to improve performance in a VM/SP environment, an MVS/SP Assist product, and a new release of the UNIX system adapted to VM called the Universal Timesharing System. Amdahl has substantial systems programming expertise and is working on an advanced timesharing operating system offering powerful interactive processing - where MVS would run in the background.

C. NATIONAL ADVANCED SYSTEMS (NAS) ANNOUNCEMENTS

- In late September, NAS added three processor models to its 9000 Series (model numbers 9040, 9050, and 9070) to fill in the slots between the previously announced (May 1982) 9060 and 9080. These new processors are modified versions of the Hitachi-made M280H, the same basic engine used in the 9060 and 9080 products. All except the 9040 are available now, with the 9040 to be

available the first quarter of 1983. The 9070 and 9080 are dual-processor systems. Three- and four-processor systems will be announced, although this will require successful implementation of MVS/XA. NAS is tentatively scheduling the availability of MVS/XA by first quarter of 1984.

- NAS is diversifying into the distributed office environment by marketing a modified version of Paradyne Corporation's Response System, a combination network controller and remote batch processing system. The product has been labeled the AS/1100 and will communicate with other peers or IBM (and software-compatible) hosts. The product was announced in early September and provides a useful addition to the NAS product line. However, the distributed office market is highly competitive, and skillful marketing will be required if NAS is to gain significant market share.

D. OTHER ANNOUNCEMENTS

- Storage Technology Corporation (STC), in its 1982 third quarter report to shareholders, stated it will begin shipments of its mainframe computer in the first quarter of 1984. The lack of any qualification in the statement would suggest the project is on schedule and that STC may beat Trilogy in getting a product out the door and to the customer. It also suggests the product will not vie for state-of-the-art architecture and very high performance (MIPS) levels but will compete on an improved engineering and price basis.

- Trilogy is aiming for first shipments of its very high performance uniprocessor (35-50 MIPS range) by the fourth quarter of 1984. Trilogy is also investigating multiprocessor versions to compete with industry trends in that direction. Using subnanosecond emitter-coupled bipolar logic circuits, Trilogy is seeking major performance gains by very significantly reducing the time requirements to transport bits between chips.

IV PROJECTED RESIDUAL VALUES FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

- Computer equipment residual value forecasting is based upon:
  - Analysis of historical events and trends leading to judgments about whether (and in what way) such trends may change.
  - Predictions by computer industry experts on expected actions by IBM and responding strategies by the software-compatible mainframe manufacturers.
  - Analysis of variables affecting residual values as listed in Exhibit IV-1.
- Projected future values for IBM, Amdahl, and NAS mainframes are presented in table format in Exhibit IV-2. Graphical presentations of projected values for selected mainframes (IBM 3033 and 3081, Amdahl 5860, and NAS AS/9000) are provided in Exhibits IV-3 through IV-6.
- The values shown are wholesale prices, i.e., the amount a used-computer dealer will pay for equipment for subsequent resale to an end user at a higher price.
- INPUT projects the following trends will influence future residual values:

EXHIBIT IV-1

FACTORS AFFECTING COMPUTER EQUIPMENT RESIDUAL VALUES

- IBM practices and policies
  - New product announcements
    - . Price/performance ratios relative to existing products.
    - . Ease of conversions, transitions, and lead time in obtaining new products.
    - . Ease of installation and maintenance.
    - . Effect on perceptions about IBM's technical direction.
  - Pricing policies
    - . Price increases or decreases on existing products.
    - . Rental versus purchase break-even ratios.
    - . Lease plans and penalty provisions for lease termination.
    - . Purchase option accruals.
  - Maintenance policies
    - . Availability and cost.
    - . Attitude toward other vendor modifications to IBM equipment.
- Alternative equipment services
  - Price/performance of plug (software) compatible alternatives.
  - Third-party leasing options.
- Other variables
  - Environmental support considerations, e.g., electrical power consumption, air conditioning needs, space requirements.
  - Tax considerations, e.g., income tax incentives such as investment tax credit and accelerated depreciation and also property taxation rates.
  - General economic conditions, e.g., cost and availability of capital and overall demand for computing capacity.

EXHIBIT IV-2

PROJECTED RESIDUAL VALUES FOR IBM AND
SOFTWARE-COMPATIBLE MAINFRAMES

VENDOR	PROCESSOR MODEL	PROJECTED RESIDUAL VALUE AS A PERCENT OF VENDOR LIST PRICE (DECEMBER 1982)				
		JANUARY 1983	JANUARY 1984	JANUARY 1985	JANUARY 1986	JANUARY 1987
IBM	370/158-3	4%	2%	1%	-	-
	370/168-3	5	3	2	1	-
	3031	9	6	4	3	2
	3032	7	5	3	2	1
	3033-S	25	19	11	6	3
	3033-N	22	15	8	5	3
	3033-U	20	12	7	4	2
	4321	51	39	29	20	10
	4331-1	47	38	26	18	9
	4331-2, 11	64	55	42	30	12
	4341-1, 10	72	54	41	30	14
	4341-2, 11	75	61	50	32	17
	3081-D	85	70	50	35	20
	3081-G	90	80	55	40	28
	3081-K	90	85	58	45	30
	3083-B	-	80	55	32	24
	3083-E	90	80	55	33	26
	3083-J	90	80	55	35	28
	3084	-	-	90	75	50

Continued

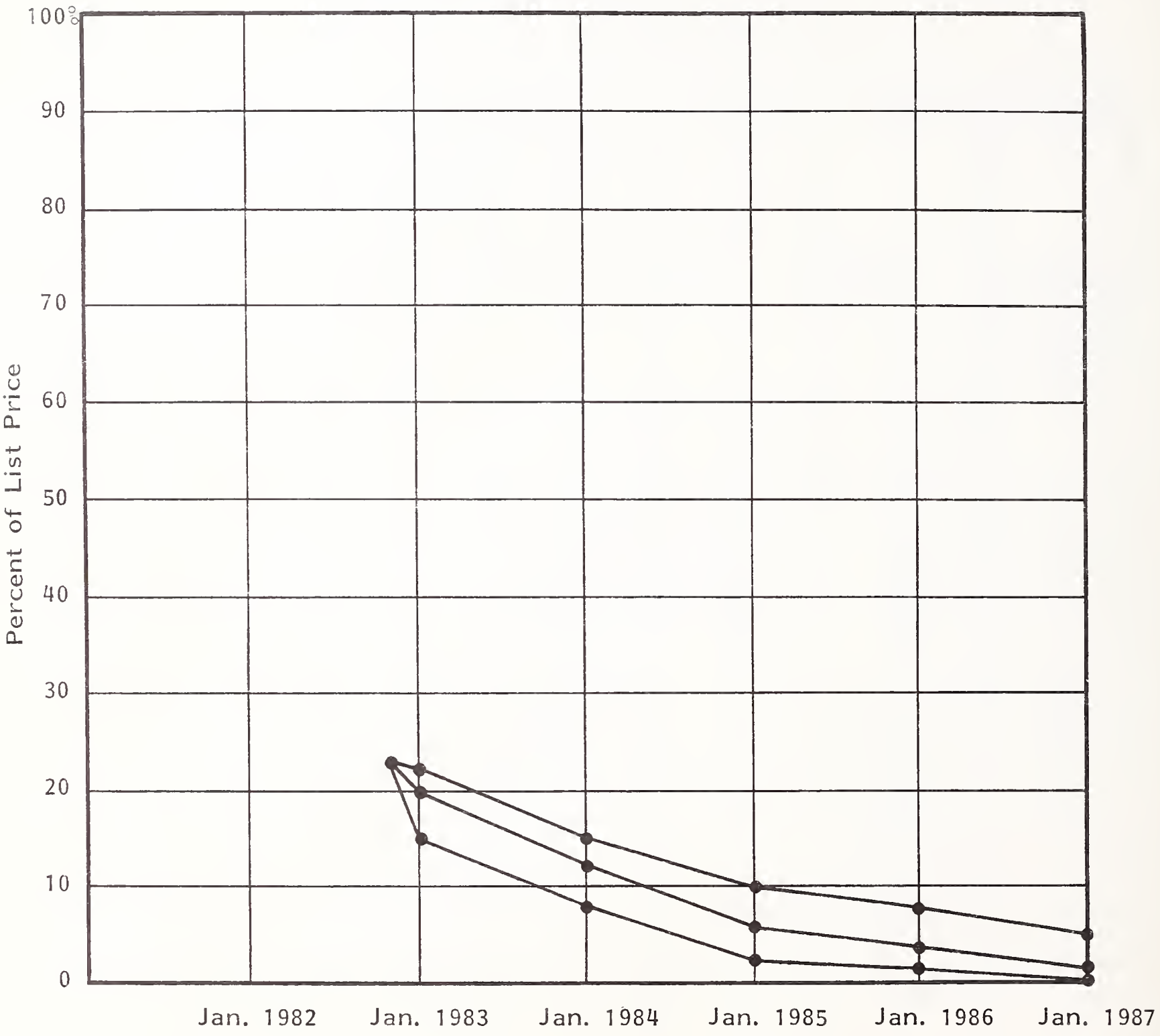
EXHIBIT IV-2 (Cont.)

PROJECTED RESIDUAL VALUES FOR IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

VENDOR	PROCESSOR MODEL	PROJECTED RESIDUAL VALUE AS A PERCENT OF VENDOR LIST PRICE (DECEMBER 1982)				
		JANUARY 1983	JANUARY 1984	JANUARY 1985	JANUARY 1986	JANUARY 1987
AMDAHL	4/70 V/5	7%	4%	2%	1%	–
	4/70 V/6	9	6	3	1	1%
	4/70 V/7	12	9	4	2	1
	4/70 V/8	14	10	6	3	2
	5850	–	85	60	42	27
	5860	90	85	57	40	24
	5880	–	85	63	44	30
NAS	AS/5000	19	12	5	3	1
	AS/5000 N, E	20	14	8	5	2
	AS/61 X X	–	70	45	32	20
	AS/7000	16	11	4	2	1
	AS/9000	75	65	43	30	18
	AS/90 X X	–	80	50	35	20

EXHIBIT IV-3

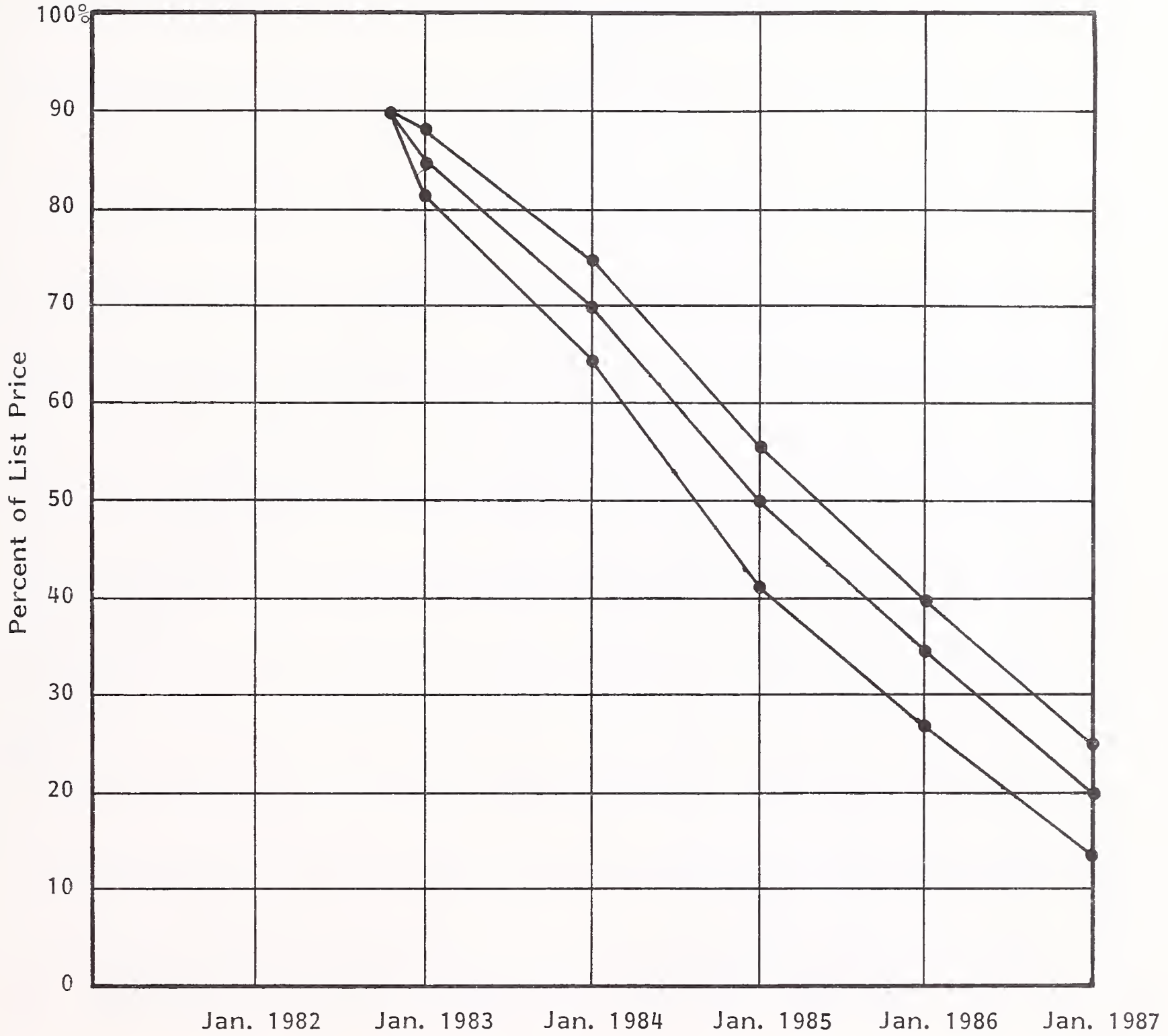
PROJECTED RESIDUAL VALUES FOR THE IBM 3033 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	23	16	10	8	5
Expected	20	12	7	4	2
Low	15	9	5	2	1

EXHIBIT IV-4

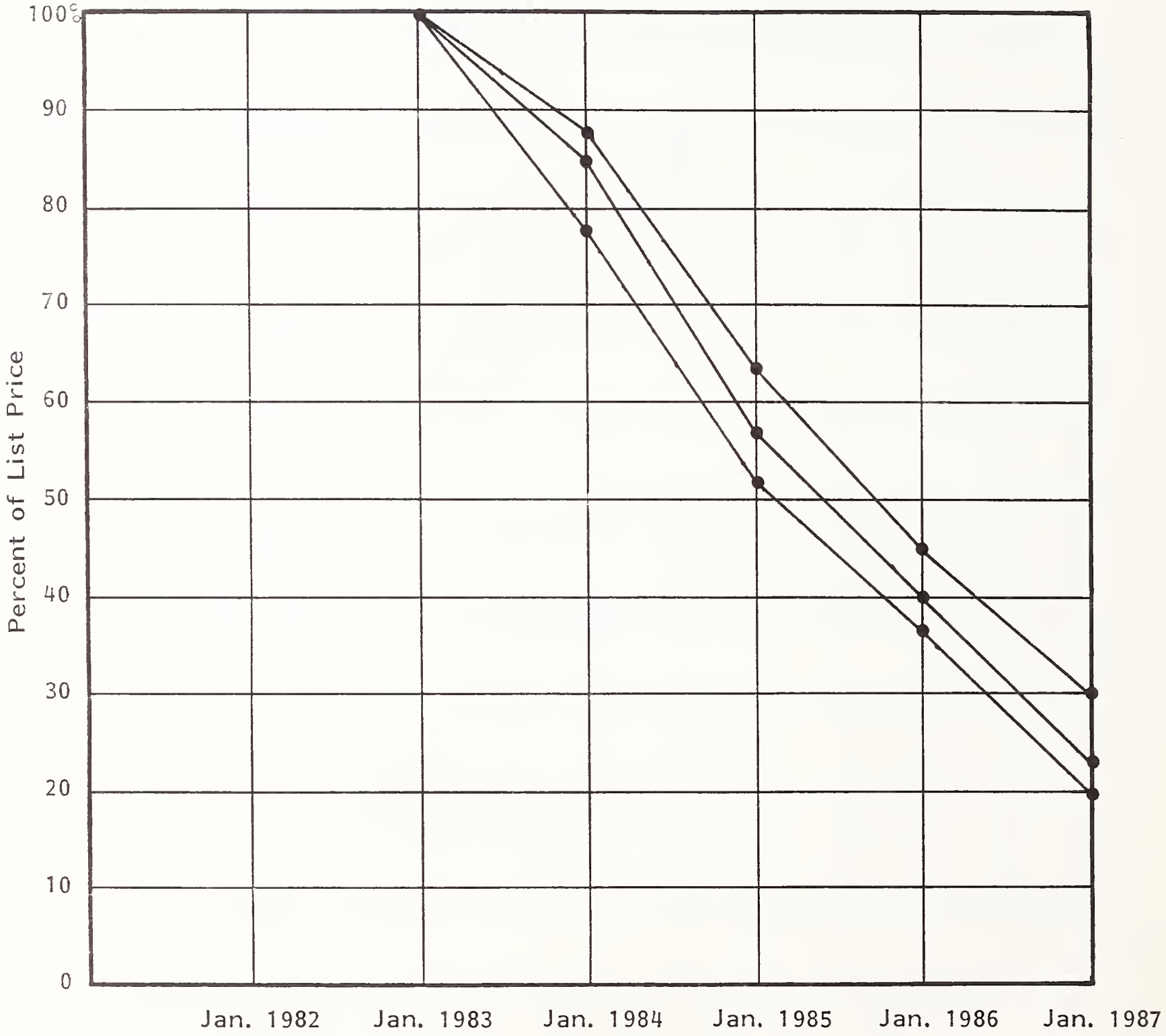
PROJECTED RESIDUAL VALUES FOR THE IBM 3081 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	88	75	56	40	25
Expected	85	70	50	35	20
Low	82	65	42	27	14

EXHIBIT IV-5

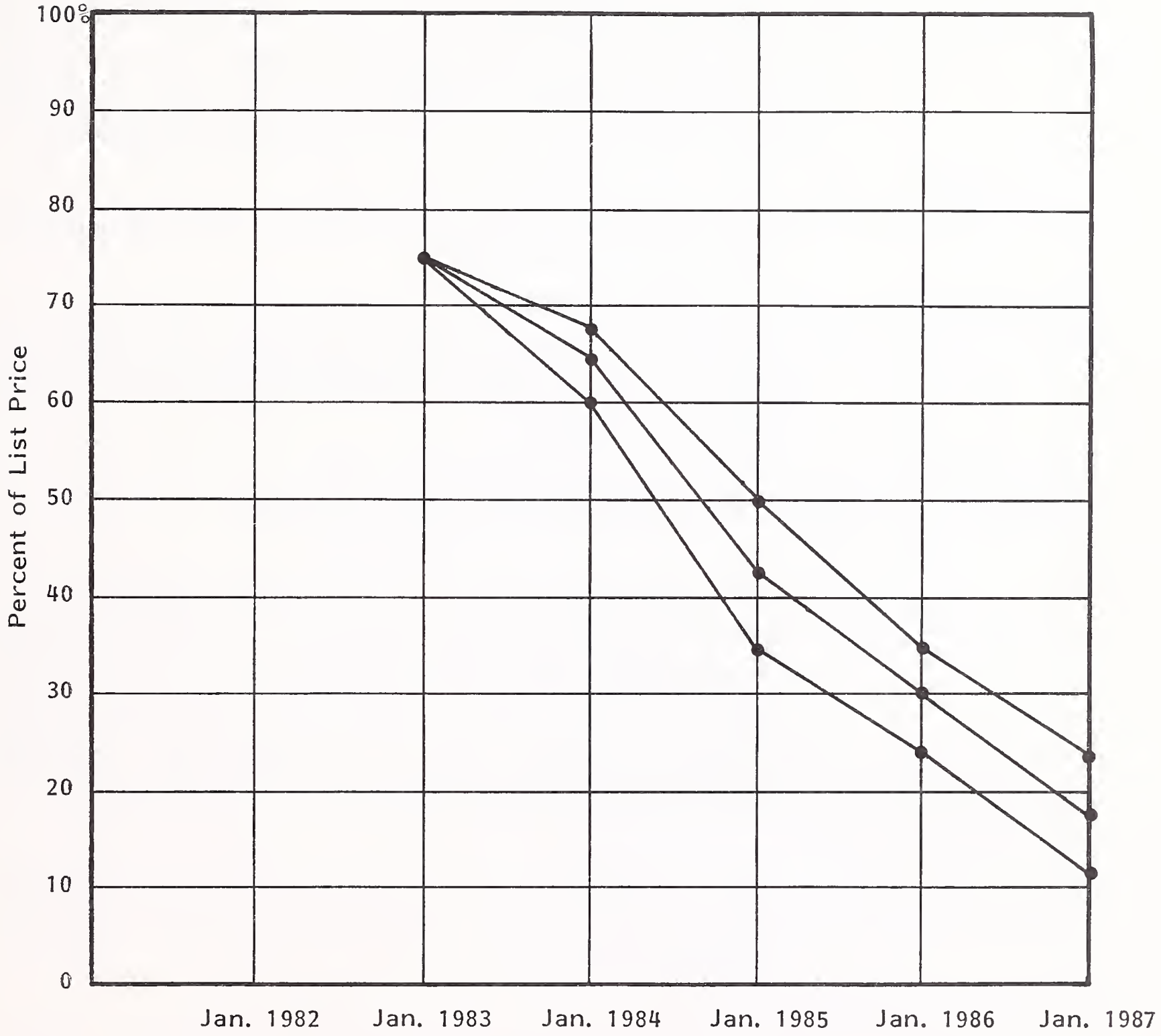
PROJECTED RESIDUAL VALUES FOR THE AMDAHL 5860 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	-	88	63	45	30
Expected	100	85	57	40	24
Low	-	78	52	37	20

EXHIBIT IV-6

PROJECTED RESIDUAL VALUES FOR THE NAS AS/9000 PROCESSOR



PROJECTED VALUES RANGE	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986	JAN. 1987
High	-	68	50	36	25
Expected	75	65	43	30	18
Low	-	60	35	25	12

- Declining cost of hardware per measured performance unit. The computer industry typically uses millions of instructions per second (MIPS) as a standard when comparing the relative power of processors. MIPS, however, may not relate precisely to the useful work performed for the end user as other factors impact this, such as I/O efficiency and amount of overhead consumed by the System Control Program (sometimes called the Operating System). A better standard is needed, but MIPS will continue to be used until such a standard is developed.

  . IBM has cut the dollars per MIPS roughly in half with each new mainframe product generation.

  . INPUT expects this trend will continue and that the next product generation will be priced at time of announcement at about $175,000 per MIPS.

- Price reductions on announced mainframe products.

  . IBM reduced the prices of 370 and 303X generations via a number of incremental steps to arrive at a cumulative reduction of about 50% of initial list price at the end of the products' average five-year lifetime. Thus, the old generation and new generation hardware were on an approximately equivalent dollars-per-MIPS basis upon new generation announcement.

  . INPUT projects this pattern will be followed with the 308X generation (and indeed has already begun with the September 1982 3081 price reduction).

- Creating a product generation around a single basic engine. Amdahl pioneered this concept, which is now an accepted practice among large mainframe manufacturers. This permits efficiency in product design

and manufacture and minimizes maintenance costs through reduced training requirements for service people and reduced spare parts inventories.

  - The low end of a product family will be slowed-down versions of the basic processor while the high end will be tightly coupled multiprocessor configurations.

  - This trend will continue, with the number of processors in multiprocessor systems growing beyond the current limit of four.

- Moving System Control Program (SCP) components into firmware, with corresponding fees for their usage. Software development is a major expense component in new product development.

  - IBM is moving to protect this investment as an income-producing asset and to make it difficult for competitors to reproduce functionality.

  - IBM will limit and, in some cases, eliminate the distribution of source code for its software products.

- Encouraging purchase rather than lease of hardware. IBM has aggressively moved in this direction in recent years: to obtain revenues from purchase early in the product cycle before planned price reductions, to provide capital during periods of very high interest rates, and to eliminate the costs involved in disposing of returned obsolete hardware.

  - IBM is very astute in managing its finances and will alter rent/lease versus purchase ratios and other pricing policies (e.g., discounting and third-party leasing) to maximize return on investment and to protect market share.

  - Thus this trend is transitory and will continue only if it continues to be in IBM's best interest. Current forces suggest it will continue at least through the middle of this decade.

- Eliminating the need for an intermediary between the computer and the end user. IBM recognizes that demand for computer resources will grow at a rate related to the ability of end users to directly access and use computer-based tools. This is a complex area involving distribution of both hardware and software resources, networking standards, security, and many other issues.

  - The large mainframe will continue to exist, and indeed INPUT projects demand for centralized services will continue to grow for many years to come.

  - In the short term, IBM is focusing on providing tools and functions for programmers that will allow developing easy-to-use applications for end users, and on developing simple ways for end users to directly obtain the information and reports they need.

  - IBM is testing new concepts toward these objectives in the System/38 architecture. INPUT provides an in-depth analysis of the System/38 architecture and its applicability to large mainframes in the report, New Directions in Operating Systems, Data Base Management, and Communications, December 1982.

- These trends suggest that IBM's next-generation large-scale processor will serve as the base for a new product family where up to six processors (three dyadic pairs) will reside in a single cabinet sharing channels and main memory. The basic processor will be in the 20-40 MIPS range with main memories extending into the hundreds of megabytes. It will incorporate many of the attributes now being tested in the System/38 architecture and is expected to be announced in late 1985 or early 1986.

- The 308X Series will receive a "mid-life kicker" in mid to late 1984 when a 10-12 MIPS uniprocessor using current chip technology and packaging is introduced. This will extend the upper limit of the 308X family (in a four-processor configuration) to about 40 MIPS, thus making it competitive with expected products from Trilogy and others.

- In the December 1981 Residual Value Report, INPUT forecast the 1982 announcements of the 3083 and 3084 processors, the price reductions on 3033 processors, and new 4300 Series models. Exhibit IV-7 provides performance estimates for large mainframes announced in 1982. These were logical actions for IBM. In 1983, INPUT projects IBM will focus on marketing the 308X hardware and will limit announcements in the large mainframe area to software extensions to MVS/XA and new software products. The lower end will be extended by adding a new processor in the 4300 Series rated at about 2.5 MIPS, thus closing the gap between the 1.5 MIPS 4341 Model 12 and the 3.5 MIPS 3083 Model E.

- Both Amdahl and NAS are expected to be viable alternatives in the large mainframe market during this forecast period. Both are diversifying into new product areas, and both are marketing software packages as well as hardware. They have built strong marketing and service support groups and have in place highly competent software development people.

- New competition in the large-mainframe marketplace will emerge from Trilogy and STC. It takes time, however, to develop market share, and neither is expected to have a serious effect on the residual values forecast in this report.

- For most processor types, the values projected in this report differ only very slightly from those in our previous (July 1982) report. Short-term 3033 values have been modestly increased to reflect the shortage of these processors in the used market - a situation projected to change in 1983 if the recession abates as expected. Many sites have also temporarily retained 3033s that will not be needed when anticipated performance increases from installation of

EXHIBIT IV-7

PERFORMANCE ESTIMATES FOR LARGE MAINFRAMES
ANNOUNCED IN 1982

VENDOR	MODEL NUMBER	MEMORY (megabytes)	RELATIVE PERFORMANCE ESTIMATE*	MIPS	PURCHASE PRICE OF MINIMUM CPU CONFIGURATION (dollars)
IBM	3083-E16	16	.35	3.4	$1,741,515
	3083-B16	16	.51	5.0	2,441,515
	3083-J16	16	.68	6.7	3,041,515
	3081-G16	16	1.02	10.0	3,581,515
	3084-Q32	32	2.65	26.0	7,140,000
Amdahl	580/5850	16	1.0	9.8	2,750,000
NAS	AS/9040	16	.67	6.6	2,350,000
	AS/9050	16	.85	8.3	2,920,000
	AS/9060	16	1.10	10.8	3,550,000
	AS/9070	16	1.98	19.4	4,150,000
	AS/9080	32	2.10	20.6	5,950,000

*3081,D16 used as a base is rated at 9.8 MIPS

MVS/XA are realized or upgrades from 3081 Model D to Model K are made. The 3032 forecast has been revised downward to reflect a sharp weakening in used-market values in recent months.

- IBM has invested heavily in streamlining and automating its manufacturing facilities and has placed stronger emphasis in manufacturing as a growth path to higher responsibilities for its personnel. It is also unbundling a greater portion of its software. These actions will permit aggressive hardware price competition leading to a rapid decline in residual values, as reflected in this report's projections.

V THE IBM 308X PRODUCT LINE: A BRAND NEW BALL GAME

- The modular architecture of the IBM 308X processors enables a new method of central processor complex upgrading that strongly suggests a permanent restructuring of the secondary market for large-scale IBM systems.

- Historically, an upgrade from, for example, an IBM System/370 Model 168 to an IBM 3033 involved the physical removal of the Model 168 central processor unit and its physical replacement with the 3033 central processor unit. If the Model 168 had been purchased, its owner had the option of offering the displaced CPU for sale.

- In marked contrast with prior experience, however, upgrades within the 308X product line involve only additions and/or replacements of components contained within the 308X processor complex.

  - Exhibit V-1 is a schematic representation of the 3081 processor complex architecture.

  - Exhibit V-2 illustrates the organization of thermal conduction modules (TCMs) - the basic building blocks of the 308X processors - on multilayer planar boards to form central processors (CPs), system controllers (SCs), and external data controllers (EXDCs).

    . Each CP consists of eight TCMs on a 24" x 28" board that has 33 separate layers through which the TCMs are interconnected by over half a mile of wiring.

EXHIBIT V-1

LOGICAL COMPONENTS OF THE IBM 3081 PROCESSOR COMPLEX

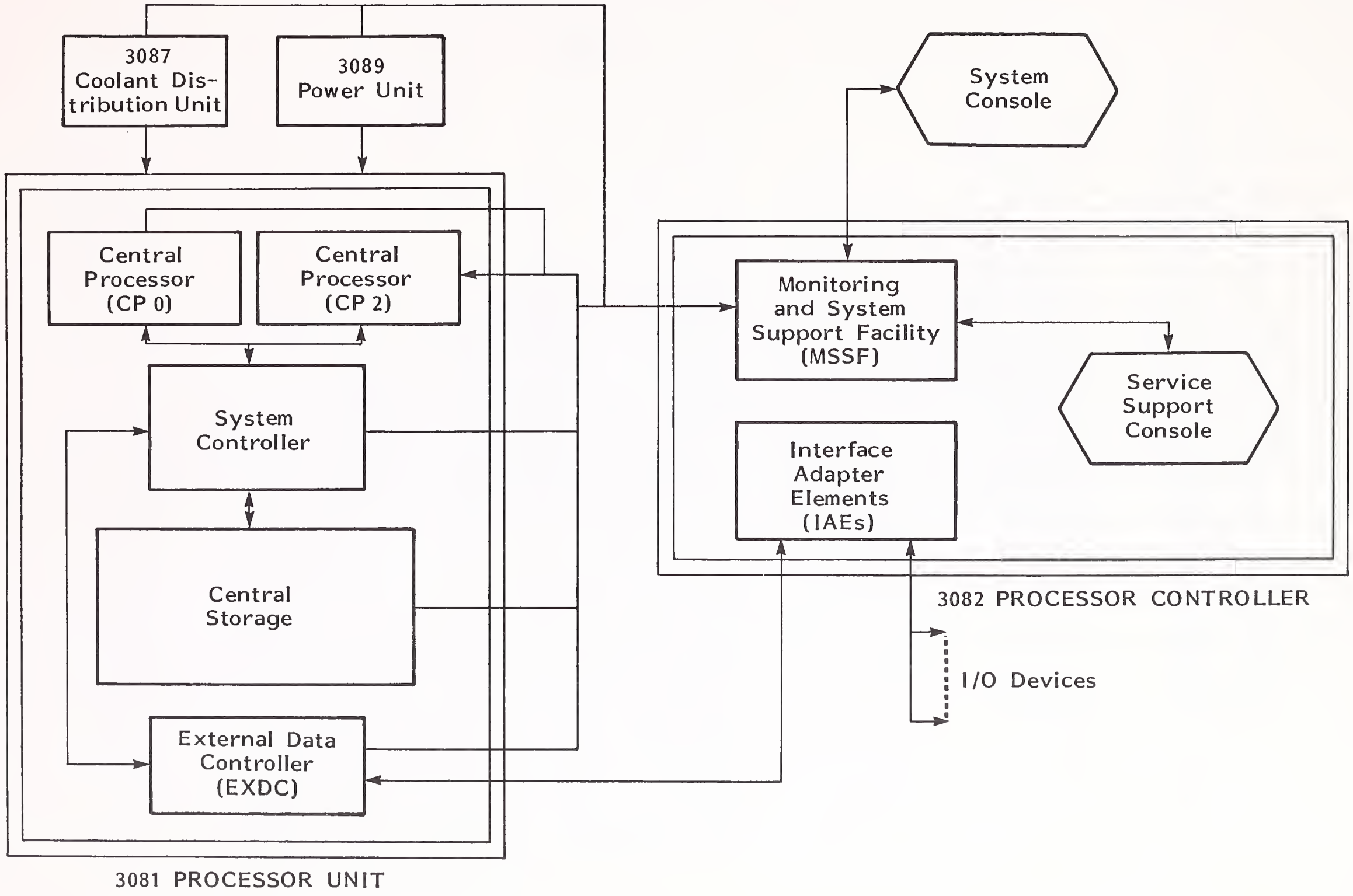
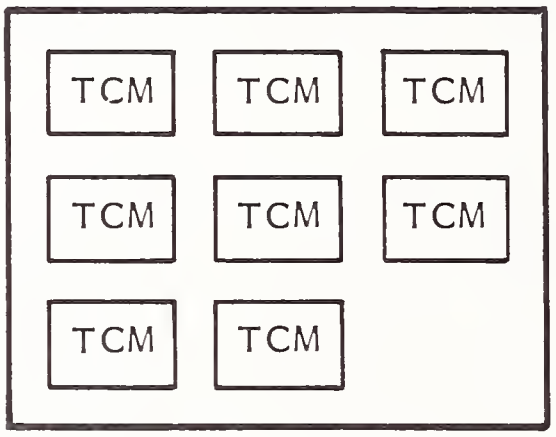
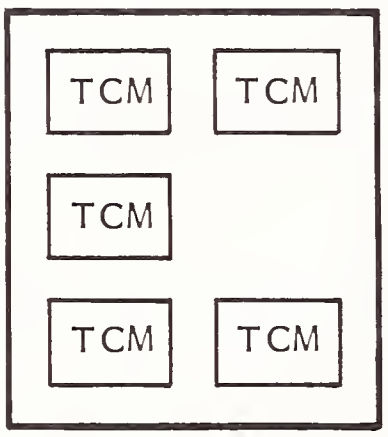


EXHIBIT V-2

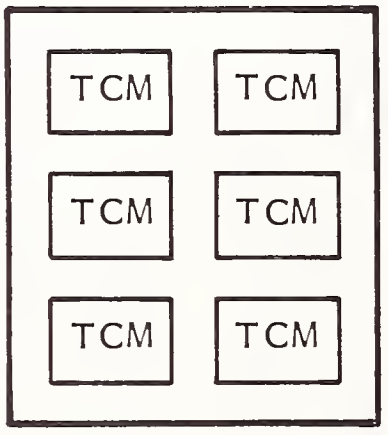
ORGANIZATION OF 308X PROCESSOR COMPONENTS



Central Processor (CP)



System Controller (SC)



External Data Controller (EXDC)

        - Each TCM has up to 133 logic chips mounted on a 23-layer ceramic tile which contains over 400 feet of internal wiring to interconnect the chips. Construction of SCs and EXDCs is similar to that of the CPs.

- Exhibit V-3 shows the upgrade migration paths from the 3083 Model E to the 3084 Model Q. The relatively short upgrade times shown reflect the simplicity of the upgrade procedure, namely, replacement and/or addition of CP components.

    - Terms and conditions of the upgrades - including upgrades of purchased machines - specify that parts removed or replaced during the upgrade process become the property of IBM and must be returned to IBM.

- The fact that upgrades are accomplished through replacement and/or addition of components, coupled with complete IBM control of components that are removed or replaced, portends the elimination of an important source of used IBM systems, namely, purchased systems that become redundant when users upgrade to more powerful models. By INPUT's estimate, this source has accounted for 80-90% of the supply of used systems in the past.

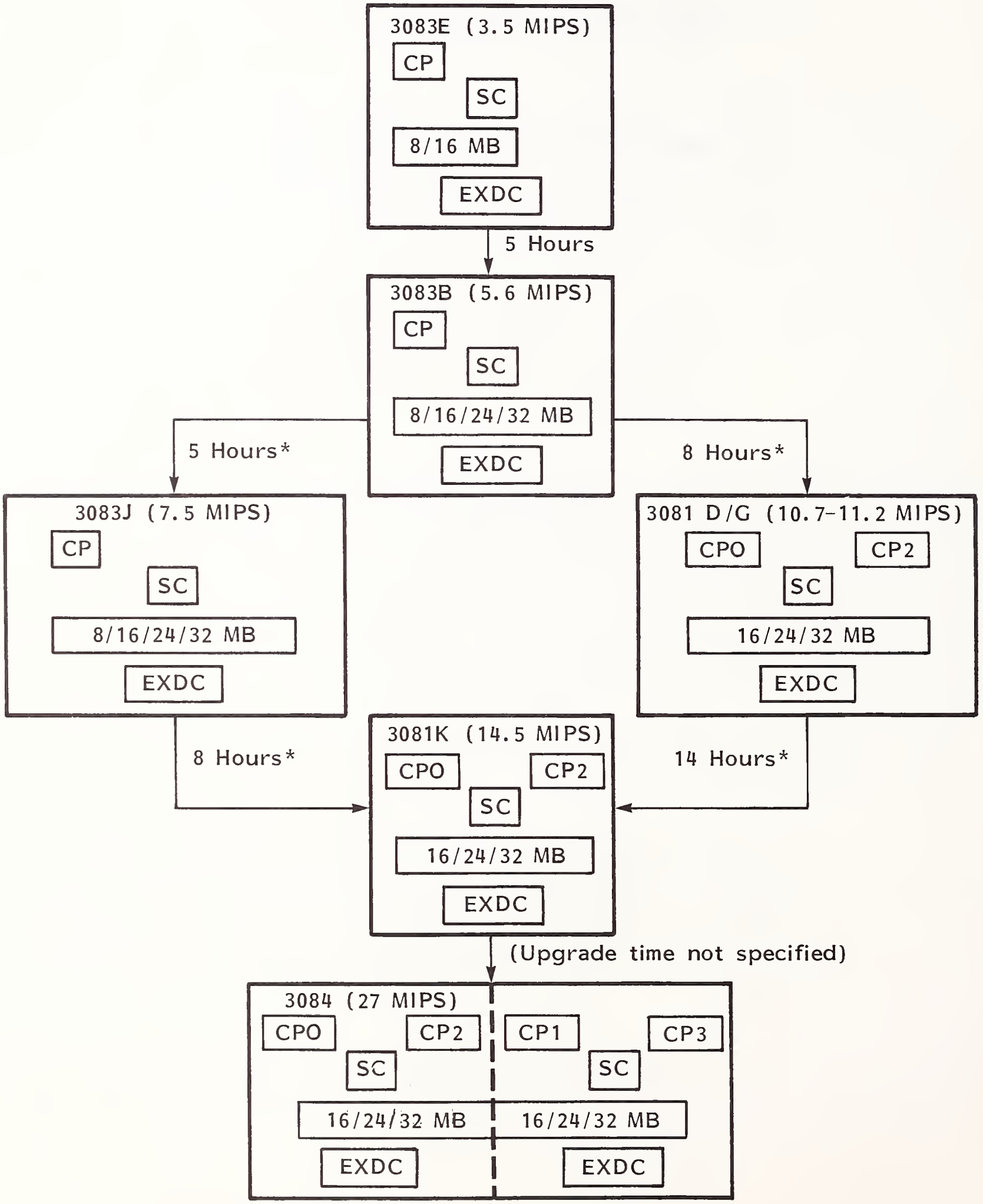
- The residual value forecast for an IBM 308X system therefore has different criteria than for earlier models.

    - For the purpose of establishing the depreciable life of a system, a prudent approach would be to work back to the present from a projected residual value of zero as of the time when a 27-MIPS configuration must be replaced, capitalizing system upgrades as they occur.

        - This implies that equipment planners must develop a time-phased forecast of the organization's requirements for computing power expressed in terms of MIPS.

EXHIBIT V-3

UPGRADE MIGRATION PATH FOR 308X SYSTEMS



- Whether or not the residual value projection will still be an estimate of the price of a used 308X processor complex will depend upon two contrary influences:

  - On the one hand, a sharp curtailment in the supply of used systems is indicated, which would suggest that a seller of an item in relatively short supply could charge what the market will bear.

  - On the other hand, as INPUT has noted in several recent publications, IBM has expanded production significantly over the past few years. Moreover, INPUT's perception that IBM is beginning to price along the learning curve has been reinforced by the September 1982 reduction in 3081 purchase prices and the December 1982 purchase price cuts for 3380 disk drives and 3880 disk drive controllers.

  - Together, these two factors argue for a reduction (rather than an increase, as has been anticipated in some quarters) in IBM's list prices at a far more aggressive pace than conventional wisdom expects. Thus, improved availability (compared with previous product cycles) from IBM coupled with declining list prices would likely have a depressant effect on used-system prices.

- The projected residual values for 308X processors shown in Exhibits IV-2 and IV-4 reflect INPUT's expectation that the major variable influencing the resale value of a used 308X system will be IBM's list price at the time the used system is offered for sale. As these two exhibits show, INPUT expects IBM to cut list prices for 308X systems as much as 65% over the next five years.

- Financial planners should therefore base their estimates of useful lives for 308X processors on projections of the length of time it will take to grow from a specific MIPS rating to a point where 27 MIPS (or 40+ MIPS, if the expected mid-life kicker is considered) will be outgrown. All other things being equal,

this means that longer useful lives can be estimated for 3083 Model Es than for 3081s.

- The anticipated IBM list price reductions argue strongly in favor of adopting accelerated depreciation schedules.

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