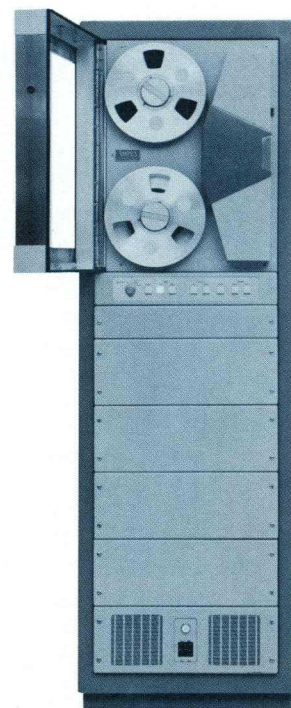
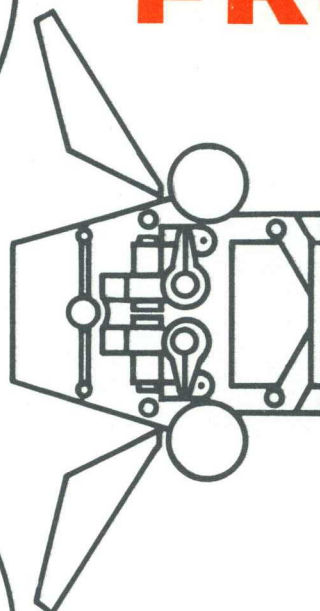
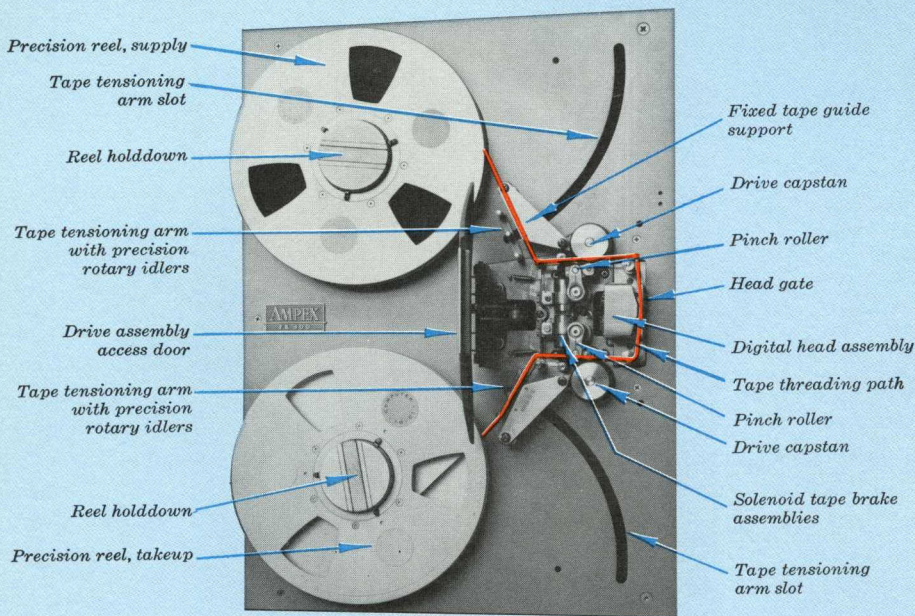


AMPEX FR-400

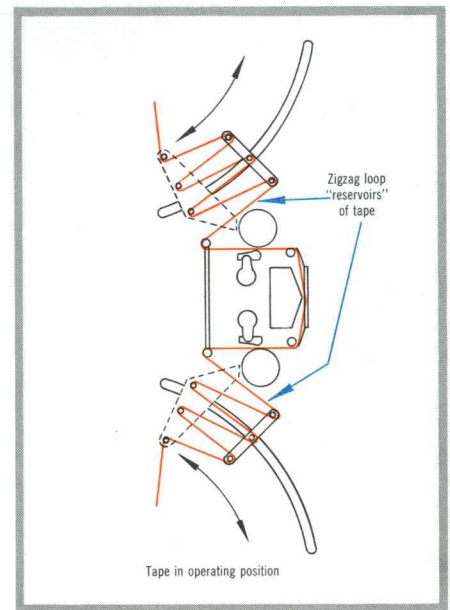
DIGITAL TAPE HANDLER



*Instantaneous selection of
75 or 37½ inch-per-second tape speed
Less than 5-millisecond start and stop times
Automatic end-of-tape sensing
Servo-controlled, tape takeup and supply system
Simplified, straight-line tape threading*



Front View



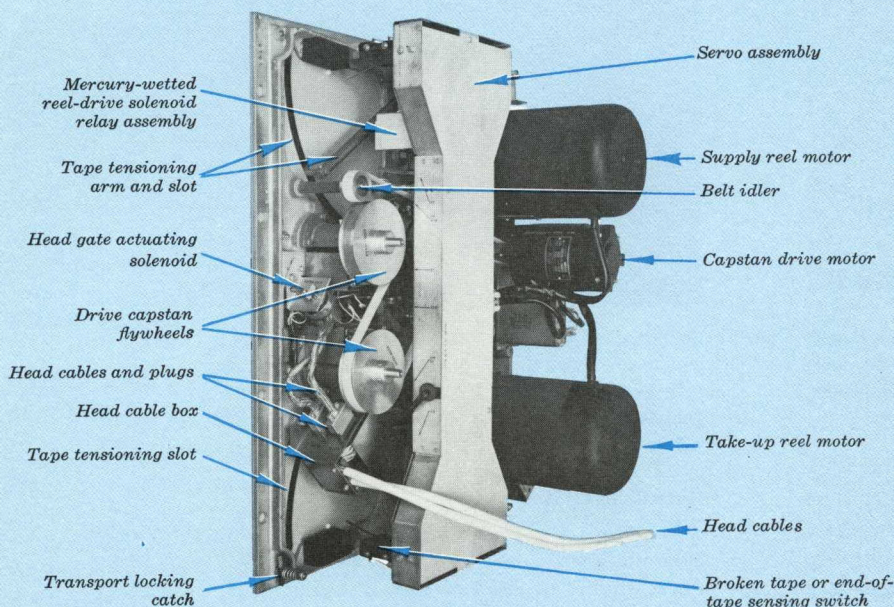
Mechanical Highlights

The tape takeup and tensioning system on the Ampex FR-400 uses balanced, virtually frictionless zigzag-threaded tension arms, with four fixed and three floating tape idlers on either side. The tension assembly is designed for minimum inertia, and supplies a "reservoir" of tape six times the length of travel of the movable arm—more than adequate to insure perfect performance under the heaviest programming conditions.

The tape idlers used on the FR-400 utilize precision bearings, lifetime-lubricated and sealed against oxide particles, dust and moisture. As a natural consequence these special idlers last longer, give superior performance, and reduce maintenance to a minimum, as well as reducing wear on the tape.

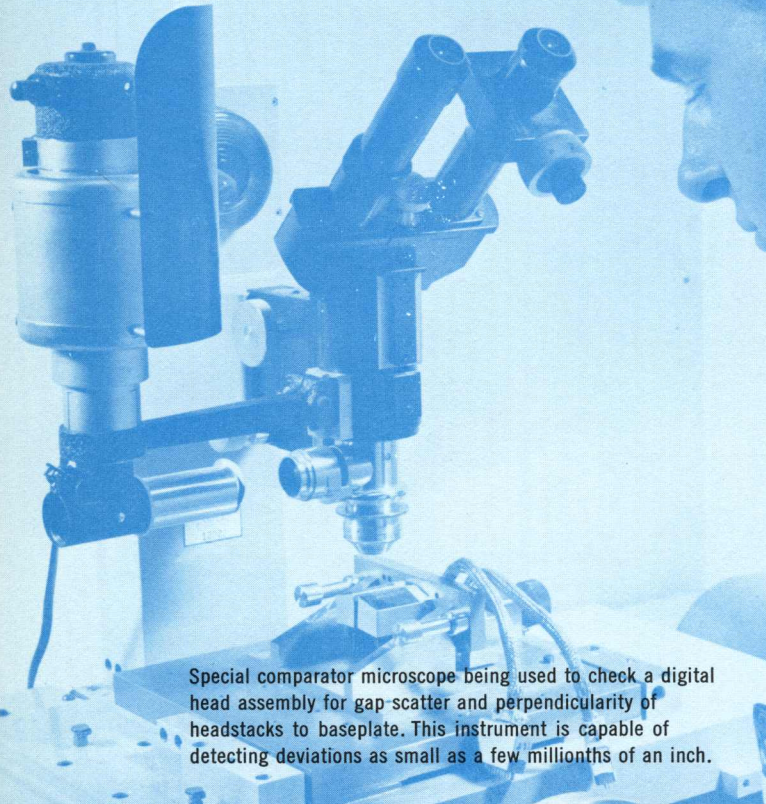
Rewind times in either direction are less than four minutes for a 3600-foot reel of 1-mil-base Mylar* tape. Operating push-buttons are so interlocked that damage to either tape or transport is virtually impossible. For example, while it is possible to go directly from any normal mode to any fast mode, it is necessary to first press the stop button when going from a fast mode to a normal mode—thereby insuring that the tape is always handled gently.

* TM DuPont Corporation

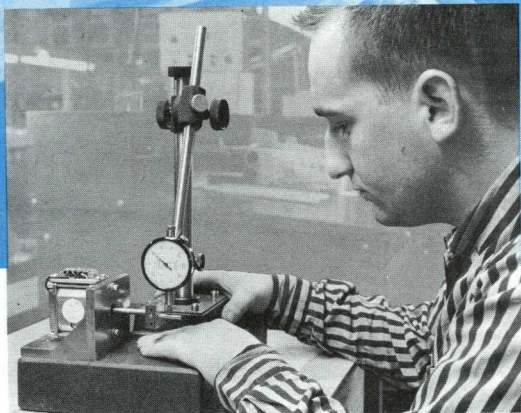


Back View

QUALITY AND PRECISION



Special comparator microscope being used to check a digital head assembly for gap scatter and perpendicularity of headstacks to baseplate. This instrument is capable of detecting deviations as small as a few millionths of an inch.



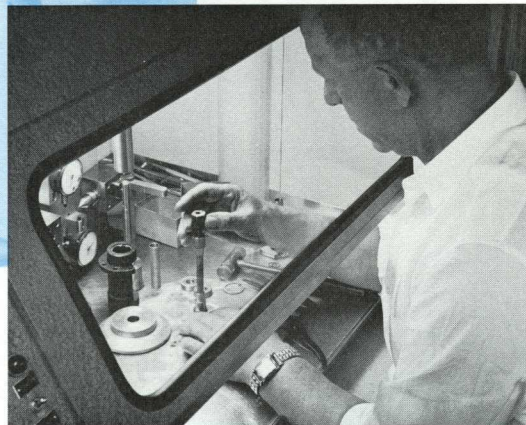
A comparator is used to measure the throw of a pinch-roller actuator. The dial indicator is accurate to 0.0005 inch. Tolerance of throw is in the thousandths of an inch.

From production...

Where the FR-400 digital tape handler is expertly assembled by Ampex' skilled technicians. Backing up the high personal skills of the Ampex workers is a great variety of specialized top-quality test and manufacturing equipment.



Capstan for an FR-400 being turned on a high-speed precision lathe. Coolant fluid enables faster and more accurate cutting of the stainless steel, while prolonging the life of the cutting bit. After machining the capstan is finished on a precision grinder to final tolerances.



Craftsman assembles the vital capstan units. The work is performed inside a special, dust-free protective hood, insuring that the critical and delicate bearings will remain free of potentially harmful dust or other air-borne contaminants.

Take a drive capstan...

This vital part moves the tape across the heads on the tape handler, and like most of the other important components of the FR-400, it is machined in Ampex' own shops. Vastly experienced journeymen machinists, working with modern high-accuracy lathes, produce the capstans and other parts for Ampex machines to the precision you would expect of a fine watch. After machining, the capstans are mirror-finished on grinding equipment to a tolerance, for both diameter and eccentricity, of less than 0.0005 inch.

ARE THE WATCHWORDS

...or a reel-drive motor

When the high-precision electric motors for the FR-400 arrive from the vendor they undergo an immediate, critical inspection before acceptance. Trained personnel examine the motors for shipping damage or any visible deviation from the rigid engineering specifications. Those that pass are then tested for speed accuracy, starting current, torque and other factors that could affect final performance of the tape recorder. The torque is tested with the aid of scales sensitive to a tenth of an ounce, and the speed is checked stroboscopically. Motors that do not test within the specified tolerances are never accepted, and every part of the FR-400 is tested at least once before shipment to a customer. Critical parts may be checked half a dozen times or more during assembly.

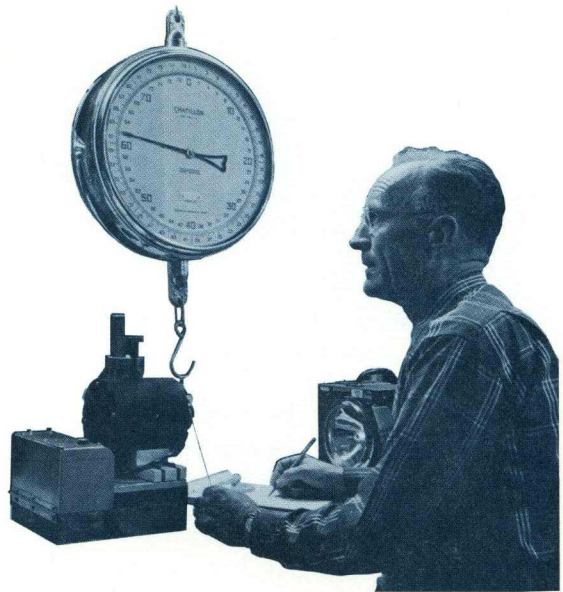
On the assembly line...

Here the instrument takes form, and it is here that utmost care and skill must be combined to insure that the completed recorder will perform as required. As the first step of assembly, the baseplate for the FR-400, a precision-ground, rugged aluminum casting, is mounted on a special mobile handling rack. It is not removed again until the FR-400 has been completely assembled and thoroughly tested as a functioning unit.

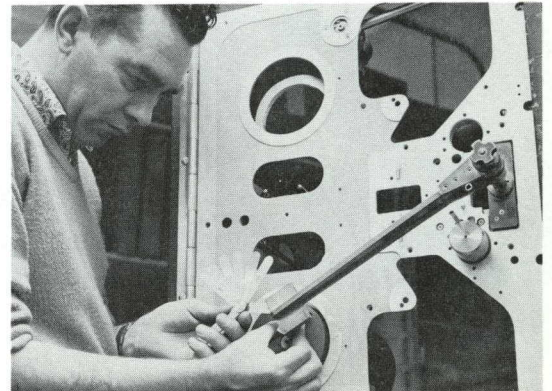
The motors, capstan assemblies, holddown knobs and the scores of other parts and sub-assemblies that go into the FR-400 are now fastened to the baseplate. The requirements for precision are as stringent here as in the actual production of the individual parts. The reel drive motors are attached to the baseplate, with the height of the motor turntable—the part to which the reel holddown devices will be attached—having a tolerance of a hundredth of an inch. The motor turntable height is measured with reference to the flat on the baseplate where the head assembly will be installed. This guarantees alignment of the tape reels with the headstacks, an important feature in reducing tape guidance and skew problems.

At the end of the assembly procedure the finished tape handler is tested and adjusted so that it will meet all performance requirements, including speed accuracy and start/stop times, and that it functions and responds properly to control signals. After completing the checkout tests, the finished tape handler is packaged and carefully stored.

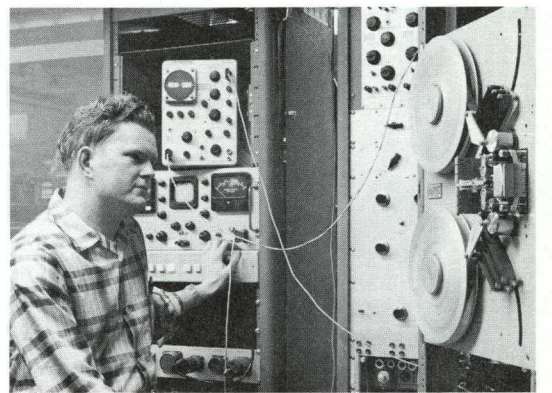
To fill customer orders, transports are drawn from stores as needed. Before shipment to the customer the FR-400 receives a final and even more exhaustive checkout, guaranteeing to the purchaser that the machine he receives is as fine as can be made.



High-accuracy scales measure the torque of capstan drive motor (not for an FR-400). A pattern attached to the test pulley on the motor is used in conjunction with stroboscopic light (at right) to check speed.



Assembly line technician uses a feeler gage to measure the height of a reel drive motor turntable. The swinging arm is a precision height gage. It is fastened to the same flat on which the head assembly will be mounted, assuring accurate relationship between tape reels and magnetic heads.



Assembly line checkout of a completed FR-400. The machine is thoroughly tested to insure compliance with Ampex specifications. This is the final step in assembly; after completing checkout the tape handler will be stored until needed to fill an order.

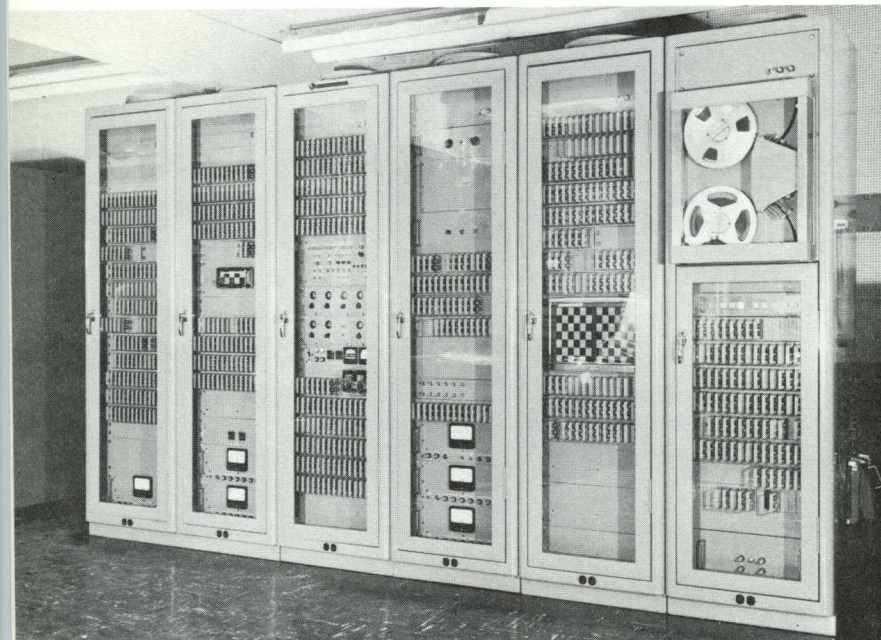
... to application

When a customer receives his FR-400 he has the assurance of careful manufacture; of matchless precision with superb engineering. This is a machine that is versatile and accurate, handsome and durable.

The FR-400 is equally at home in a military blockhouse or in the front office of a great corporation. The tasteful Ampex blue and gray fits into almost any laboratory, and special paints of the customer's choosing may be factory applied, permitting the FR-400 to blend into any color scheme. Shown here are two of the many installations using the FR-400.



Multiple FR-400 tape transports installed in a GE-100 data-handling system. The GE-100 will provide high-speed, accurate, automatic processing of bank accounts and transactions.



Computer Language Translator built by Electronic Engineering Corporation of California, and installed at North American Aviation Missile Division, Downey, California. Ampex FR-400 at right is an integral part of system.

Listed here are some of the many Ampex customers—military, academic and industrial—who use the FR-400. The organizations below include foreign as well as United States concerns, and their usage of the FR-400 ranges from pure research to straight commercial applications. Such a list of users is, without question, the best possible testimonial to the quality of the FR-400.

- Beckman Instruments Incorporated
- Bell Telephone Laboratories
- Bendix Aviation Division
- Bendix Radio Corporation
- Digitronics Corporation
- Electronic Engineering Corporation of California
- Epsco Incorporated
- Federal Telecommunication Laboratory
- General Electric Company
- General Mills, Incorporated
- Lockheed Aircraft Corporation
- Radiation, Incorporated
- Radio Corporation of America
- Ramo-Wooldridge Corporation
- Remington Rand Univac
Division of Sperry Rand Corporation
- Sandia Corporation
- Stromberg-Carlson Corporation,
A Division of General Dynamics Corporation
- Sylvania Electric Products, Incorporated
- Technitrol Engineering Company
- Telemeter Magnetics, Incorporated
- Teleregister Corporation
- United States Air Force
- United States Army
- University of Illinois
- University of Washington

FOREIGN

- Ing. C. Olivetti & C., S. p. A., Italy
- Regnecentralan,
Dansk Institut for Matematikmaskiner, Denmark
- Swedish Board for Computing Machinery,
Stockholm
- Weapons Research Establishment,
Woomera Range, Australia

specifications

Standard speed ranges

75 or 37½ ips forward or reverse. 60/30 ips speed range optional at no extra cost.

Speed variations

Long term: Nominal 75 or 37½ ips $\pm 2\%$; measured over one-second minimum period.

**Short term:* $\pm 1\%$ for an averaging period of 33.3 milliseconds or longer; measuring all frequencies from 0 to 30 cps.

$\pm 2\%$ for an averaging period from 3.3 to 33.3 milliseconds; measuring all frequencies from 30 to 300 cps.

**Maximum flutter measured over the passbands indicated, using a flutter bridge.*

Fast mode times

3600-ft. tapes	2400-ft. tapes
Less than 4 minutes	Less than 2½ minutes

Start, Stop times

Under 5 milliseconds

Start distance

0.31 \pm 0.05 inches at 75 or 60 ips

Stop distance

0.20 \pm 0.05 inches at 75 or 60 ips

Total interchannel time displacement error

At 75 ips tape speed:	½-inch tape	¾-inch tape	1-inch tape
	14 microseconds	20 microseconds	26 microseconds

This is the time band within which all bits of a character will arrive when reading any tape made on another FR-400 tape handler (worst case). It does not include error contributed by electronic assemblies.

Tape widths

Handlers available for either ½-, ¾-, or 1-inch magnetic tape.

Tape reels

Handlers take 10½-inch-diameter Ampex Precision Reels (recommended) or other NAB reels. Can be fitted for other types of reels.

Program requirements

2.5 milliseconds required between any two commands.

"Stop" command required between tape-direction changes.

Program repetition rates

	Forward, start, stop	Forward, fwd stop, reverse, rev stop
Maximum rate at 50% duty cycle for 15 minute period*	90/sec.	50/sec.
Continuous rate	50/sec.	30/sec.

*Note: 50% duty cycle is defined as any sequence

of on-off operating times in a 50-50 ratio, up to and including a 7½ minute on, 7½ minute off sequence.

Controls

Drive forward • Drive reverse • Fast forward • Fast reverse • Power • Stop • High Speed • Low speed
Automatic/Manual-write/Manual-read selector.

Remote-control input requirements

Level change of not less than 10 volts DC into 10K ohms; rise time to be no longer than 10 microseconds with a minimum pulse duration of 2.5 milliseconds.

Remote signals from tape handler

Ready-to-operate • Broken tape • Manual-Automatic operation • Power on • Manual write circuit engaged

Weight

Tape handler, 150 lbs. Cover door, 25 lbs. Manual control panel, 10 lbs.

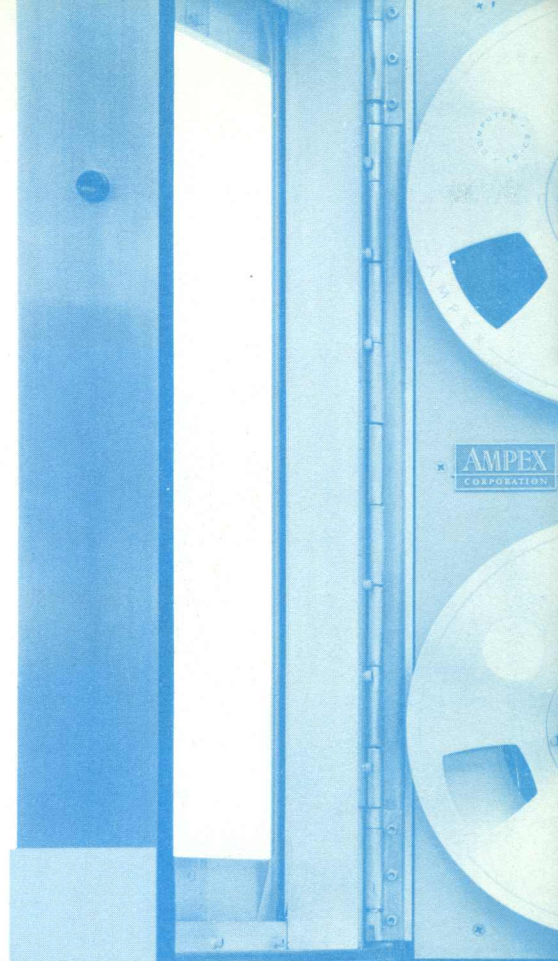
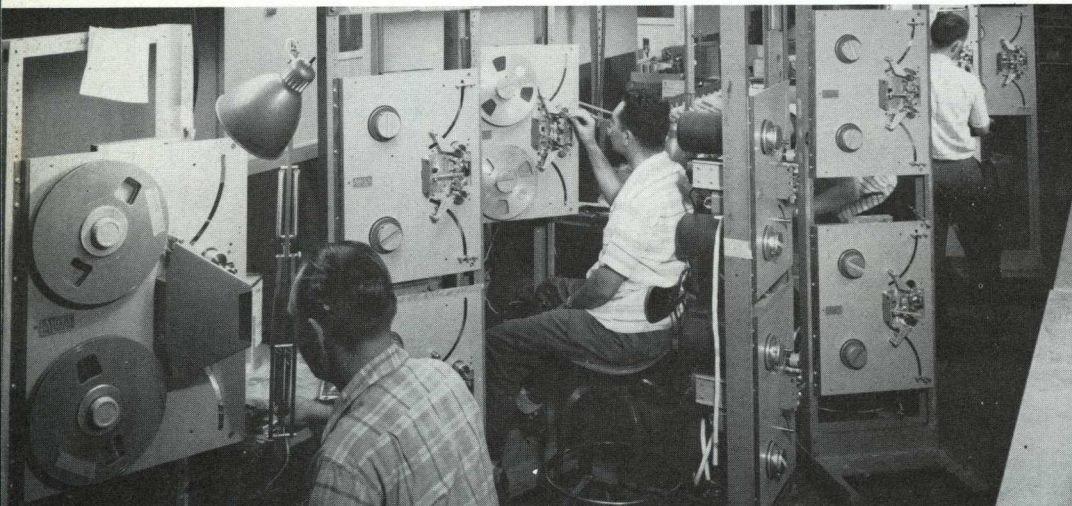
Dimensions

Tape handler, width: 19 inches—height: 24½ inches—depth: 14 inches
Cover door, width: 19 inches—height: 24½ inches—depth 3¾ inches
Control panel, width: 19 inches—height: 3½ inches—depth: 8½ inches.

Input power requirements

Voltage, 117 volts AC, $\pm 10\%$. Frequency, 60 or 50 cps (specify which), plus 0.5 cycle, minus 1.0 cycle.
Current: standby, 1.2 amps rms—steady run, 1.5 amps rms—heavy cyclic programming, 4 amps rms maximum.

FR-400 assembly line at the Ampex manufacturing facilities in Redwood City, California. The partly completed transports are shown mounted in mobile assembly racks. Transport in left foreground has been modified to use IBM-type reels.



INSTRUMENTATION
DIVISION

AMPEX
CORPORATION

MEMORY IS OUR BUSINESS

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