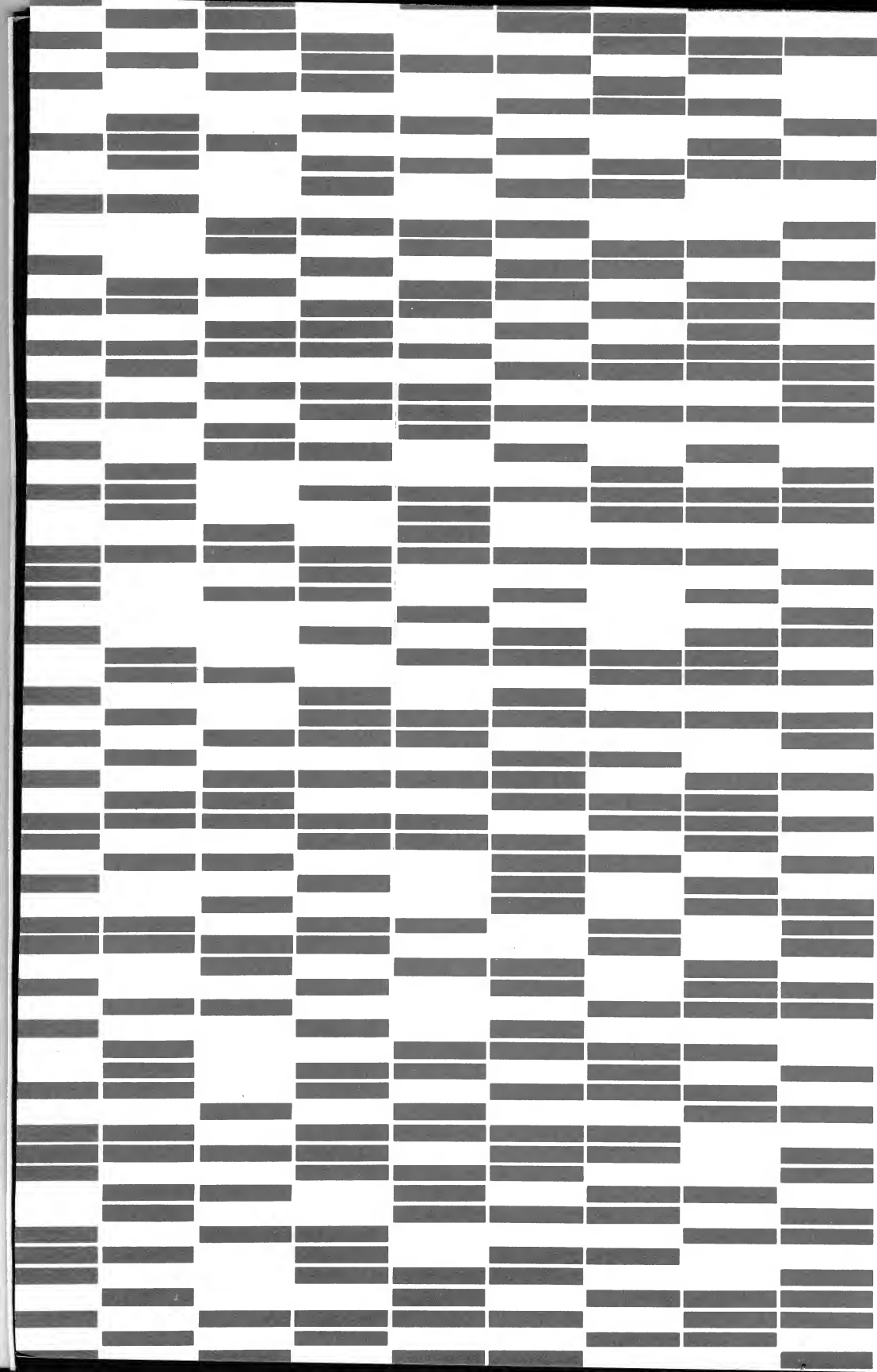


**the
Memory
Business**

**Audio
Devices,
Inc.**





Ever since the first primitive story-pictures were painted on the walls of a cave, men have been working to extend the powers of memory. Recent generations, armed with the tools of modern science, have made extraordinary advances—with the pace of progress constantly accelerating. Sounds, pictures and mountains of information are recorded today with amazing accuracy and accessibility. And the newest memory media are of such a dynamic character that they serve not only to store information but also in acquiring and processing it.

For more than a quarter of a century, Audio Devices, Inc., has been deeply involved in this remarkable progress. As a manufacturer of recording media, the Company has been in "the memory business" since 1937. These years of successful experience have given Audio a unique insight—an ability to put extra precision into the memory products of today and a strong understanding of what will be required in the future.

In its earliest days, Audio provided the means for recording only sounds—through Audiodiscs. With the advent of magnetic recording, Audiotape was born—a superior medium for sound recording. Soon magnetic recording went far beyond the recollection of

sound. Indeed, it was magnetic tape that provided the dynamic memory element for some of the most significant technological advances of our time.

Magnetic tape has been spoken of as "barn paint on plastic." And in a superficial sense this is true. Magnetic tape is essentially an iron oxide bonded to a ribbon of plastic film. The manufacturing operation—in the same superficial sense—is simply a coating and slitting procedure.

But Audio Devices serves the computer operator, the sound engineer, the missile tracker, the television broadcaster, the petroleum geologist, the medical researcher—and each has a unique and demanding

recording requirement. To meet the varied needs of these and others, Audio has built a highly-specialized integrated modern production facility.

The installation, which is in Glenbrook, Connecticut has been constantly modernized and expanded through the years. Today, over 141,000 square feet are in active use in factory buildings which for the most part are "brand" new. And new growth plans are already being put into effect.

A tour of these facilities reveals the complexity of modern magnetic tape. At Audio "barn paint on plastic" is a highly sophisticated product, scientifically developed, meticulously engineered and precisely controlled.



Audio Devices started in "the memory business" with Audiodiscs—lacquer coated aluminum discs for instantaneous sound recording—which were introduced by Audio over 25 years ago and remain "the standard" for phonograph record mastering. Audiotape, a superior medium for sound recording, followed later and opened new recording horizons. Eventually, not only sound but also information and pictures were stored on magnetic recording tape by a variety of instrumentation recorders, computers and TV recorders. Audio Devices' products now serve all these fields.





Audio Devices and Data Processing

A key factor in the technological growth of the magnetic tape industry was (and is) the demands posed by high speed data processing equipment. That Audio Devices successfully met this challenge is evidenced by the fact that computer tapes now account for a major portion of the Company's sales.

With the growth of the computer tape market, Audio's research staff has increased more than 300%. This expanding scientific team employed new equipment, filled new buildings and generated further growth.

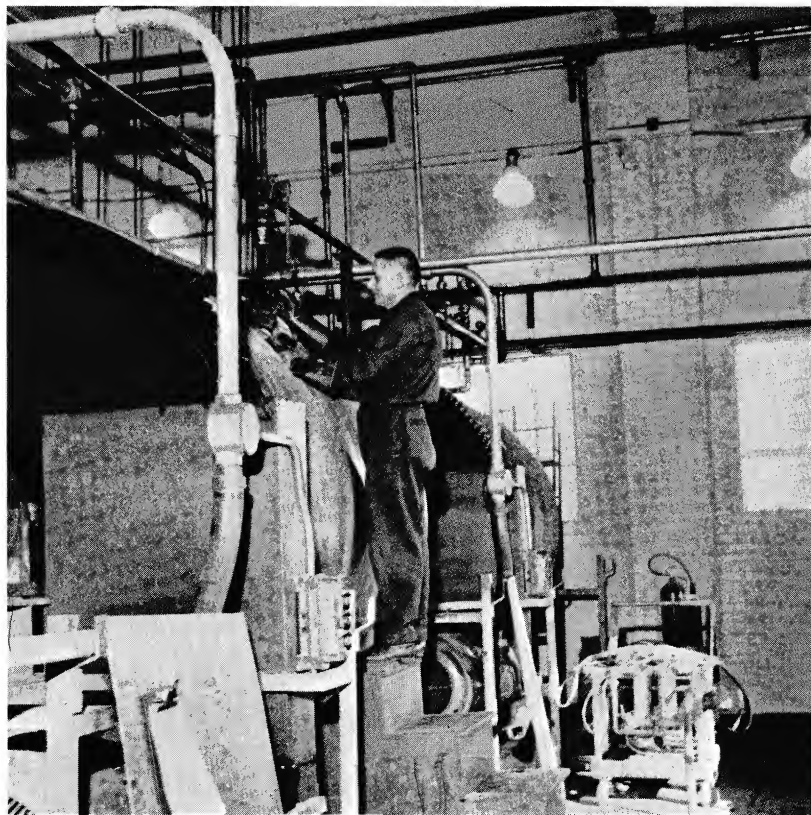
One indication of the high degree of acceptance enjoyed by Audio Devices Computer Tape is the fact that it is being sold to literally hundreds of the nation's leading companies. These companies include top industrial firms, insurance companies, banking institutions and utilities. For example, Audio now sells Computer Tape to 7 of the 10 "Largest Industrial Corporations" in the United States (as listed in Fortune Magazine's top 500)—and to 18 of the first 25. The fact that these knowledgeable organizations select Audio Devices Computer Tape is a tribute to the quality of the product.

What determines quality in a computer tape? There are many complex factors, of course, but the characteristic that distinguishes the finest products is reliability. And reliability is a direct outgrowth of the precision with which a tape is manufactured.

The raw materials used in Audio Devices Computer Tape are probably not very different from those used in other computer tapes. But the most rigorous standards are applied to these materials, beginning with incoming inspection and continuing throughout every step of the process that converts them into a sealed package of fully-tested computer tape, ready for delivery.

Perhaps the most dramatic and successful application of magnetic recording tape is in the data processing field. File rooms full of information are reduced to individual reels of tape—such as the type shown on the tape transport on the right. Storage capacity is vastly expanded by reducing data to magnetically recorded information. The accessibility of information is constantly being accelerated by advances in computer technology. Audio Devices Computer Tape plays an important role in the world of data processing.

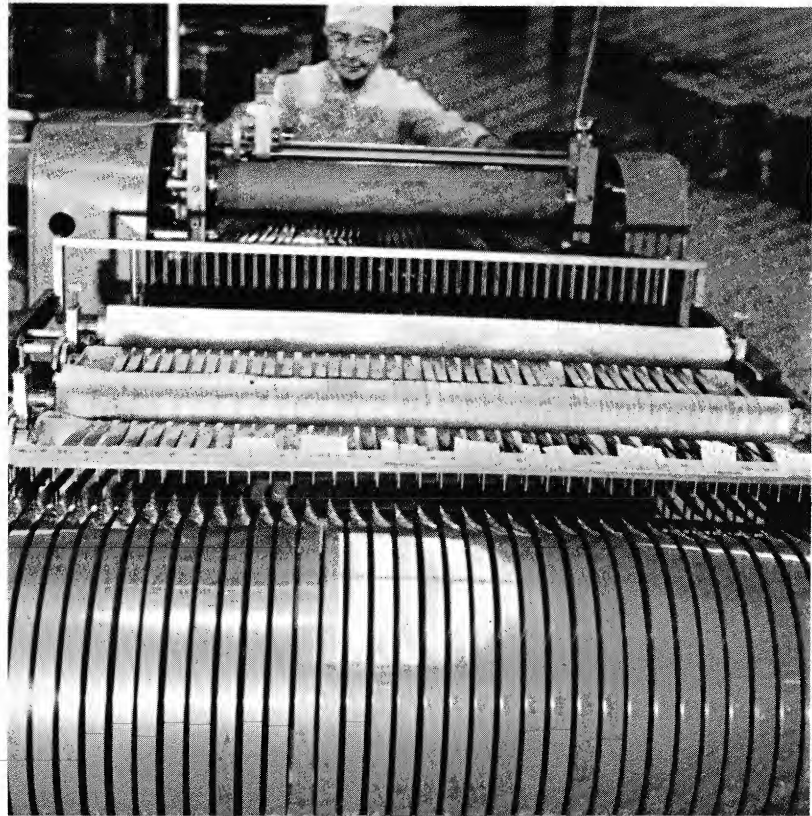
The manufacture of magnetic recording tape, regardless of its ultimate application, is a coating and slitting operation. The preparation of the coating "slurry" begins with a milling process. Carefully selected iron oxide powders and other chemical components are measured (accord-



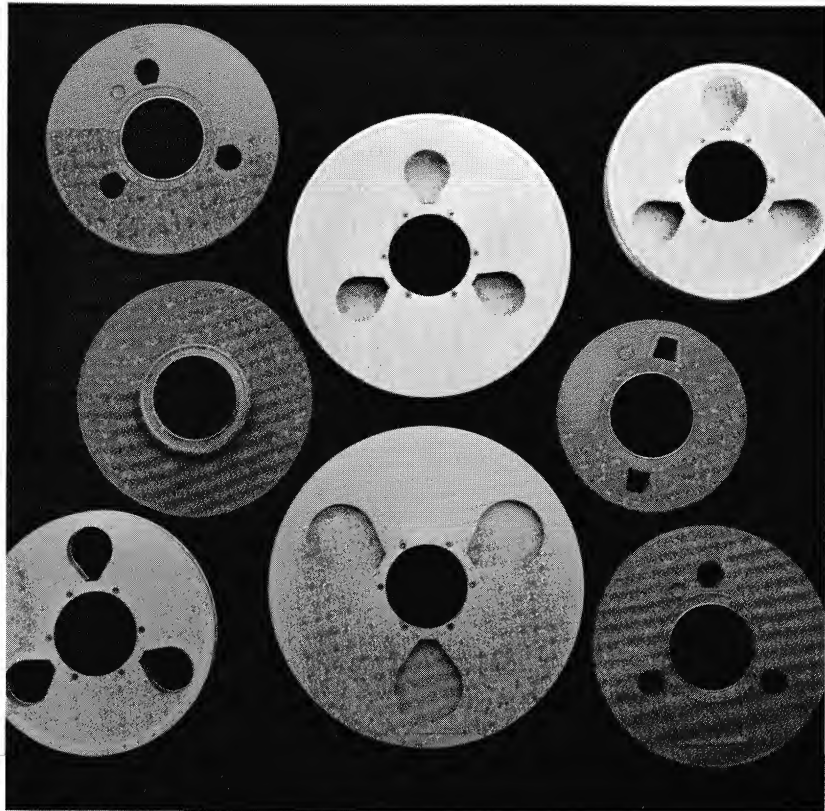
ing to a precise formulation based on application) into one of the many huge, cylindrical "ball mills" in Audio's milling plant (far left). Inside each mill thousands of small pellets intimately mix and grind the materials. Each mill "batch" is constantly checked to avoid the dangers of both

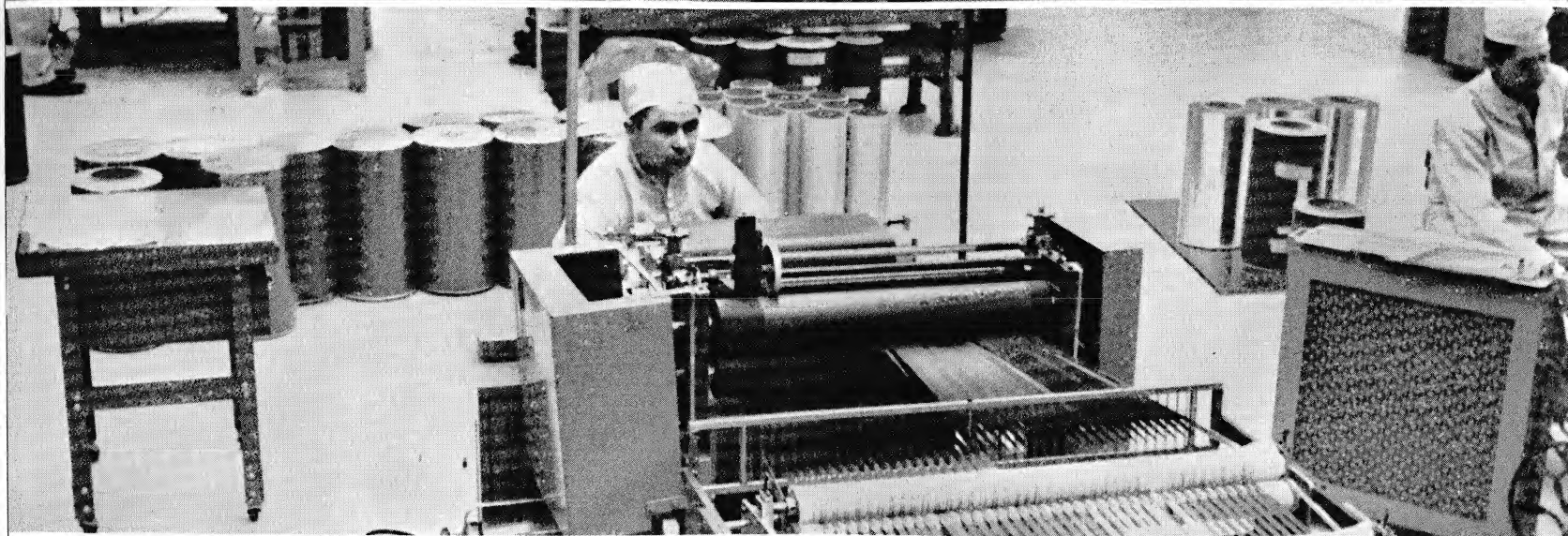
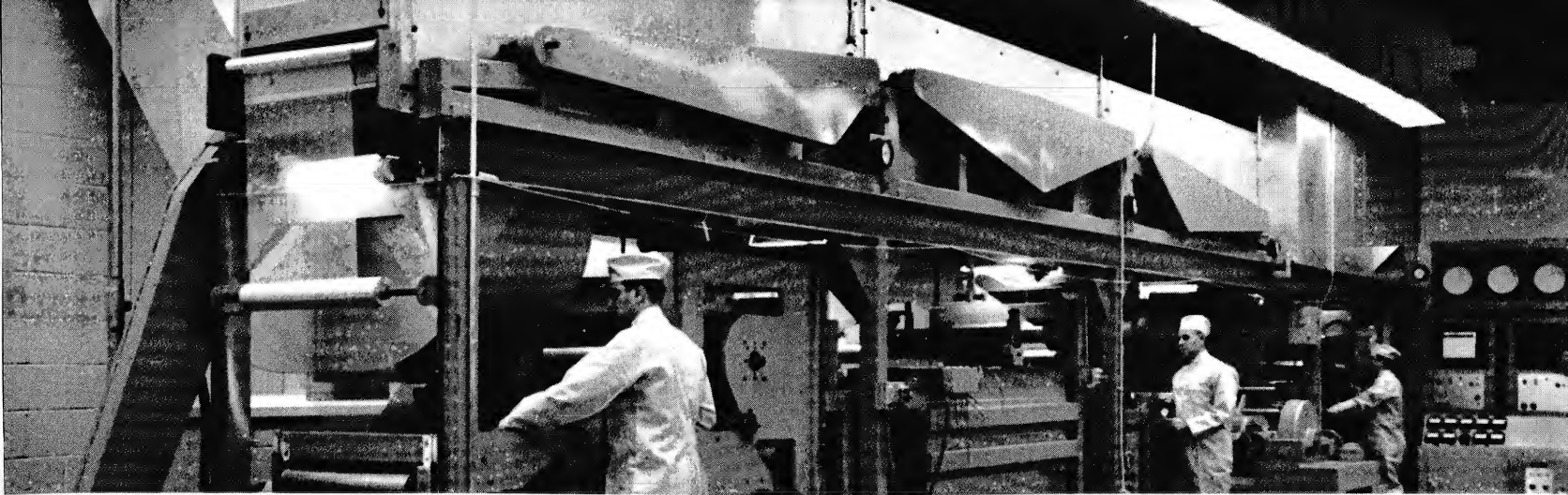


too-long and too-short a milling cycle. When the desired magnetic characteristics are precisely achieved, the mixture is transferred to the coating area where it is applied (left center) to large rolls of plastic film—generally cellulose acetate or a polyester film. After drying, these large



rolls are ready to be divided into individual ribbons of a particular width. This takes place on special slitting equipment (right center) which discards the "edge cuts" and loads the individual tapes on reels or hubs of the appropriate type and size (far right). The tape is now ready for final testing and packaging.





Audio's production facilities include a great deal of equipment which has been specially designed for some particular phase of magnetic tape production or processing. By creating this special apparatus and by modifying standard equipment, Audio engineers have been able to achieve tighter controls throughout the manufacturing process. In addition, Audio's production lines are studded with a wide variety of quality control and quality assurance devices.

In subtle but numerous ways, Audio's background as a producer of recording media contributes additional refinements to the production of computer tape. An intimate awareness of the problems of recordists in all fields is a constructive tool in the manu-

facture of magnetic tape for computers.

This "awareness" is evident not only in the physicists, chemists and engineers in Audio's laboratories, but also in the production foremen and the rank and file operators at Audio. These are truly "tape men." They have worked with magnetic tape for years; they know the product. Their experience contributes to the quality of every reel.

The breadth of Audio's magnetic tape activities also contributes to successful computer tape production. Experimental developments for instrumentation, television, seismic or sound recording may provide the key to a computer tape improvement. Success in one area nourishes success in the other.

Computer tape is coated on Audio's specially designed equipment (top) which applies oxide on Mylar polyester films to exact specifications. Immediately after coating, the base material flows into a lengthy series of sealed drying tunnels and is finally rewound at the other end of

the same giant unit. The coated "butt" rolls are then transported to the computer slitting area to be precision slit and wound on computer reels (middle). In Audio's "Computer Customizing" area (bottom) various types of photo-sensing markers and leaders, as required, are applied to each reel of tape.

To build a computer tape, very specific standards are required. Audio's standards are always set to exceed the required specifications of the application. A product manufactured to these standards will perform effectively even under difficult conditions.

To maintain these high standards with a product as sensitive as computer tape, Audio has established a 100% certification program rather than rely on sampling or spot checks. Every reel of Audio Devices Computer Tape is "certified" before it is released for distribution.

The certification program is "total" testing not merely in the sense that every reel is checked but beyond that in the sense that all of every reel is checked end to end.

For example, a reel of tape intended for use on a computer which can read/write 800 bits per track-inch and has seven recording tracks will be tested by actually recording 800 separate impulses (bits) per inch on each of the seven tracks throughout the entire 2400 foot length of the tape. This recording is then "played back" or "read" and complex electronic equipment checks to see that each of the 161 million separate impulses recorded on the tape reproduces properly. Any "errors" that are encountered are analyzed. If they are of temporary nature, the cause (a particle of loose foreign matter, etc.) is removed and the questionable section is rechecked. If the "error" is of a permanent nature—just 1 out of 161 million—the entire reel is rejected.

Certification in this fashion far exceeds user requirements. In the actual use of a computer of the 800-bit, 7-track type, even the heaviest programs would never involve anywhere near 161 million impulses. As a matter of fact,

they would probably never approach even half that number.

For many digital computer applications, even more rigorous tape certification practices are already routine at Audio. Highly sophisticated equipment is in full-scale operation, providing full-width certification—a precise system for checking the entire surface of the tape from edge to edge as well as end to end.

Certification takes place in a closely-controlled immaculate environment at Audio. Batteries of test equipment including IBM, Honeywell, Univac, Ampex, Midwest Instrument and Potter transports line the walls of the "white room." Optimum temperature and humidity are constantly maintained. Electro-static air filtration provides a minimal dust-count. No one—whether worker, manager or visitor—is permitted to enter the certification area unless clothed head to foot in a special white, lint-free uniform. Anyone leaving the certification area, even for a short time, must leave the uniform behind in the adjoining dressing room.

And quality checks do not end with certification. Afterwards as an additional quality assurance measure, computer tapes are tested under actual use conditions on machines like the IBM 729 VI transport. After this final test, tapes are immediately moved to the packaging section of the "white room" where they are placed in vacuum-cleaned polystyrene containers. The containers are, in turn, sealed into dust-free polyethylene bags. In these sealed plastic bags, the tapes ride a short conveyor belt through a special passage out of the white room and are immediately placed in individual white boxes and then into shipping containers. (Corrugated board and other such

lint-producing materials are never permitted in the same areas with exposed tapes.)

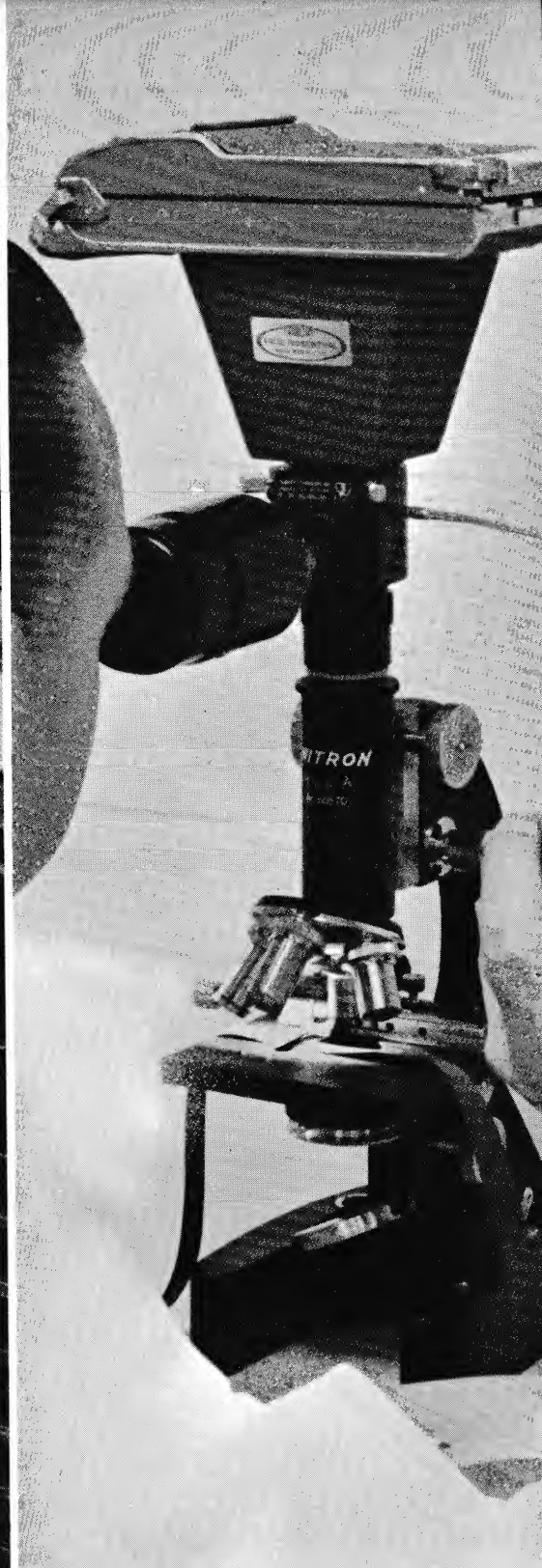
These severe certification practices are merely the final link in a long chain of tests which Audio Computer Tape must pass. Throughout production there are 126 individual Quality Control procedures, checking not only magnetic and electrical properties but chemical and physical characteristics as well.

Quality may be the prime reason for product acceptance but variety is another. Audio has introduced data processors to many new developments in computer tape, reels and accessories. Extra length Computer Tape, for example, was an important Audio "first" which provided 50% more tape on the same size reel. It provides data processors with a means of saving storage space, tape and machine time. Audio continues to search for new and improved items for more efficient computer operation.

Beta-ray gauge instrumentation (shown at right) provides a continuous, precise measure of coating thickness to prevent any deviation from tight specifications.

A basic but very critical test for computer tape is tape width. The width of Computer Tape is precisely checked on specially designed "optical comparators" (center). Width is held to the extremely close tolerance of plus or minus two thousandths of an inch (.002).

Tests of tape surfaces include "visual" tests (far right) using Unitron Biological microscopes with Polaroid Land Camera attachment, Bausch & Lomb Metallurgical microscopes, and other such equipment. Color slides of oxide and base surfaces are taken before and after sample tapes are subjected to test recordings. Microscopic examination indicates how successfully a formulation is bonded on the base material. It also reveals the smoothness of the surface and the degree of microscopic oxide "rub-off."





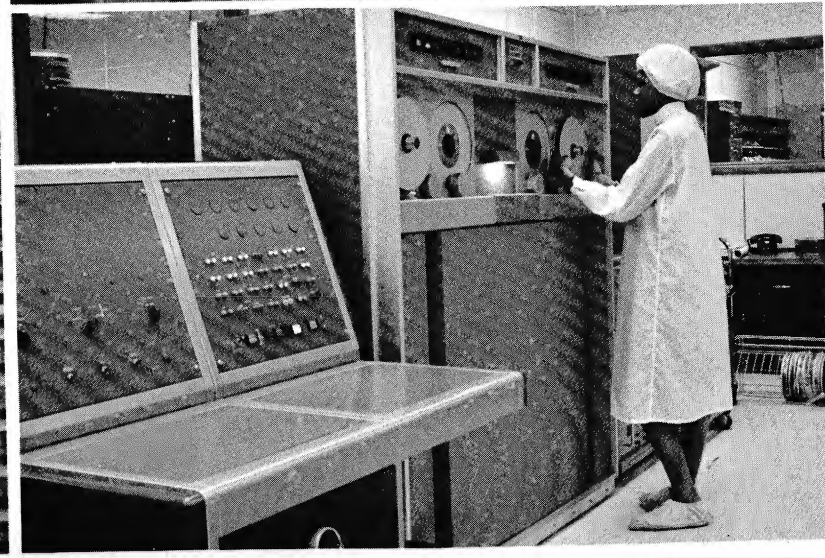
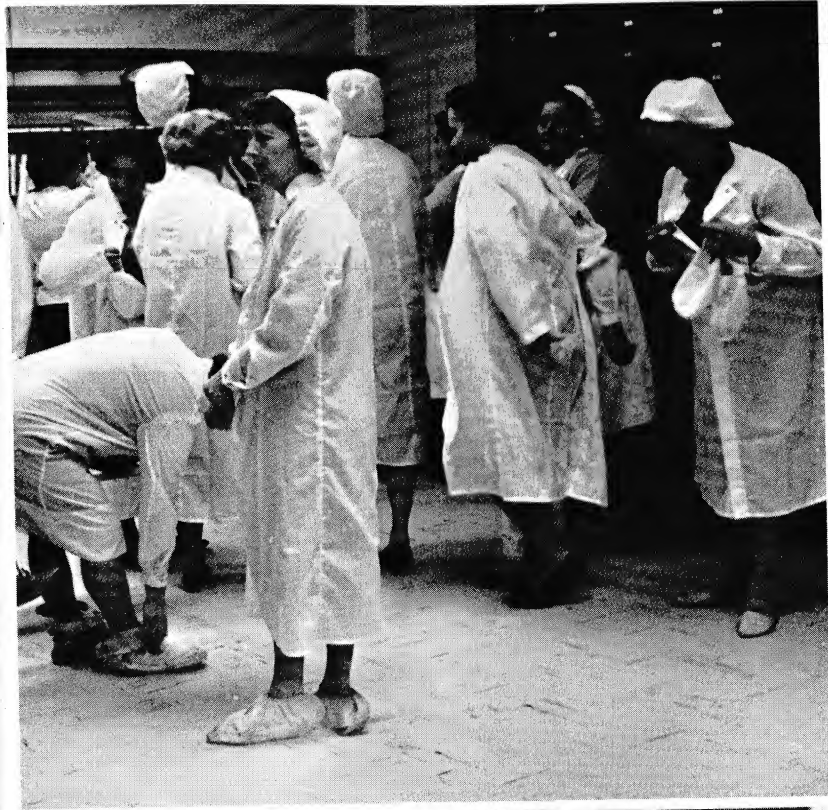
The most severe quality test for Audio Devices Computer Tape is 100% Certification. Here, in Audio's "white room," Computer Tape is tested on IBM, Univac, Honeywell, Ampex, Midwest and Potter tape transports.

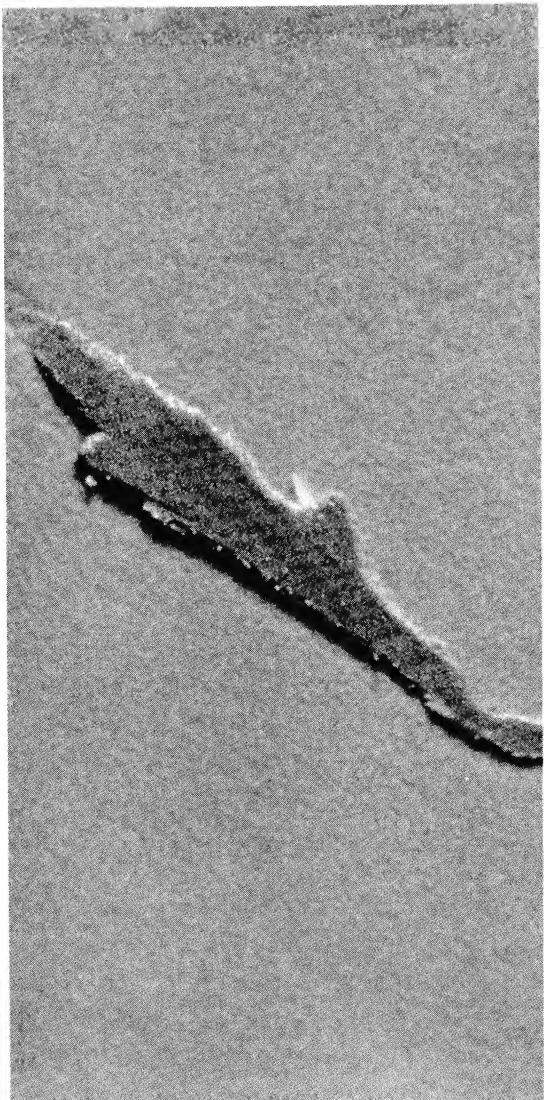
Tapes are tested at performance levels that exceed user requirements in order to completely assure the reliability of tape leaving the Audio plant. Finished reels are mounted on the batteries of tape transports and systematically recorded from start to end of reel.

For example, tapes certified for use at 800 bits per inch on 7-track IBM transports have 5600 individual bits recorded on every inch of tape. This far exceeds "actual use" requirements and enables Audio to guarantee every reel confidently. Yet, certification equipment and techniques have already been further refined to keep ahead of the increasing packing densities of modern computers. Full-width testing, for instance—100% checking of the entire surface of a computer tape—is now an established technique at Audio.

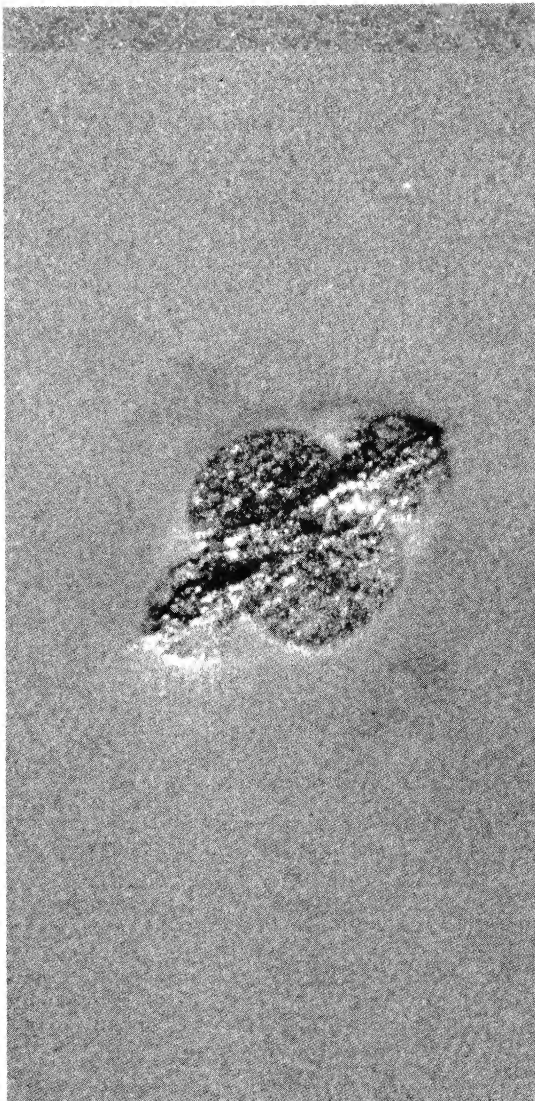
The certification area at Audio Devices provides an "antiseptically" clean and controlled atmosphere. Technicians working in the area wear white lint-free uniforms from head to foot and are not allowed to enter the area until they are "in uniform." Virtually all technicians working in the certification area are women. Studies have shown that women are particularly skilled at detailed precision work of this type.



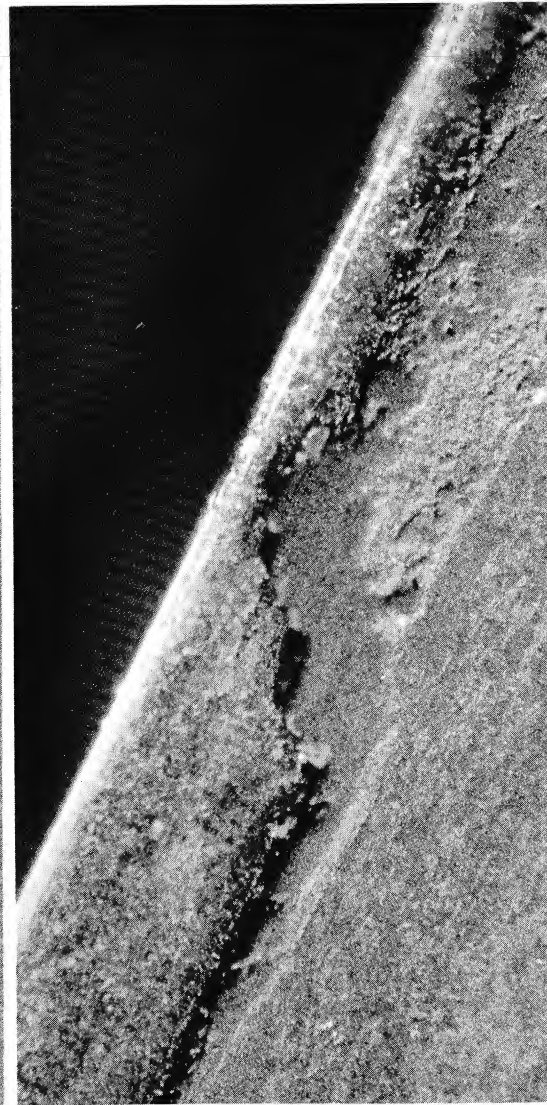




Laboratory studies of "rejected" tapes and field problems frequently help point the way to improved techniques for both the manufacturer and user. Here the microscope shows a minute piece of oxide stuck to the tape surface. In this case a damaged head "dug up" a fragment of the coating and deposited it elsewhere on the surface.



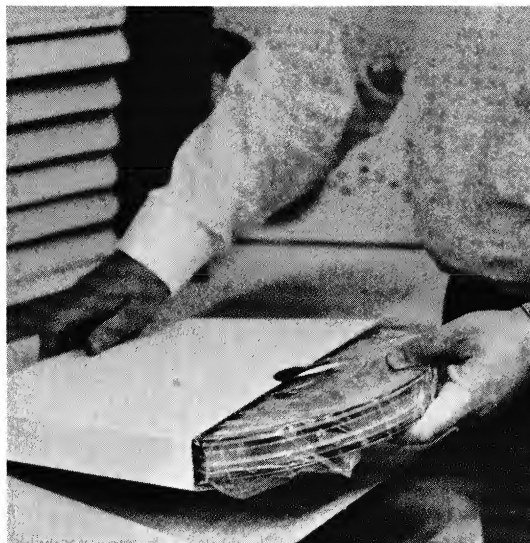
A piece of foreign matter is trapped in the oxide coating of this rejected tape. The lump created in the tape surface "lifted" the tape as it passed over the recording or "write" head. This reduction of head-to-tape contact caused loss of signal (dropouts) in the playback or "read" operation on an Audio Devices certifier.



Improper mounting of tape on a computer can cause edge breakdown and leave tape unusable. The oxide coating has been scraped off, leaving the Mylar base completely exposed at many points. Not only is this portion of the tape a total loss, but, in addition, the oxide particles and Mylar dust generated by this abrasion can cause further difficulties on the computer.



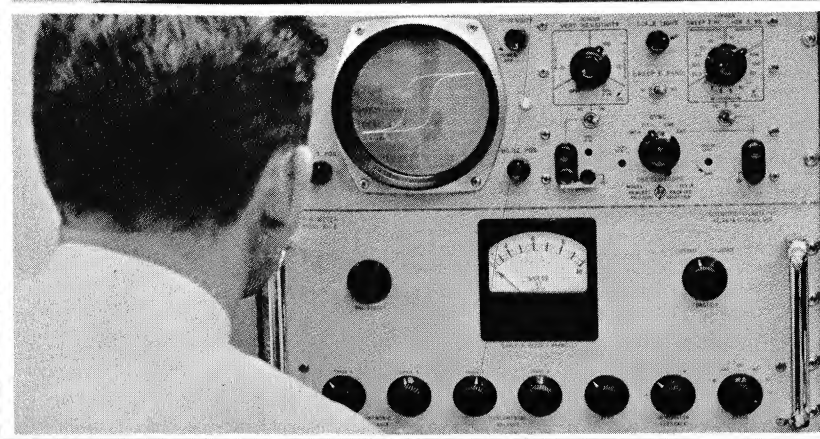
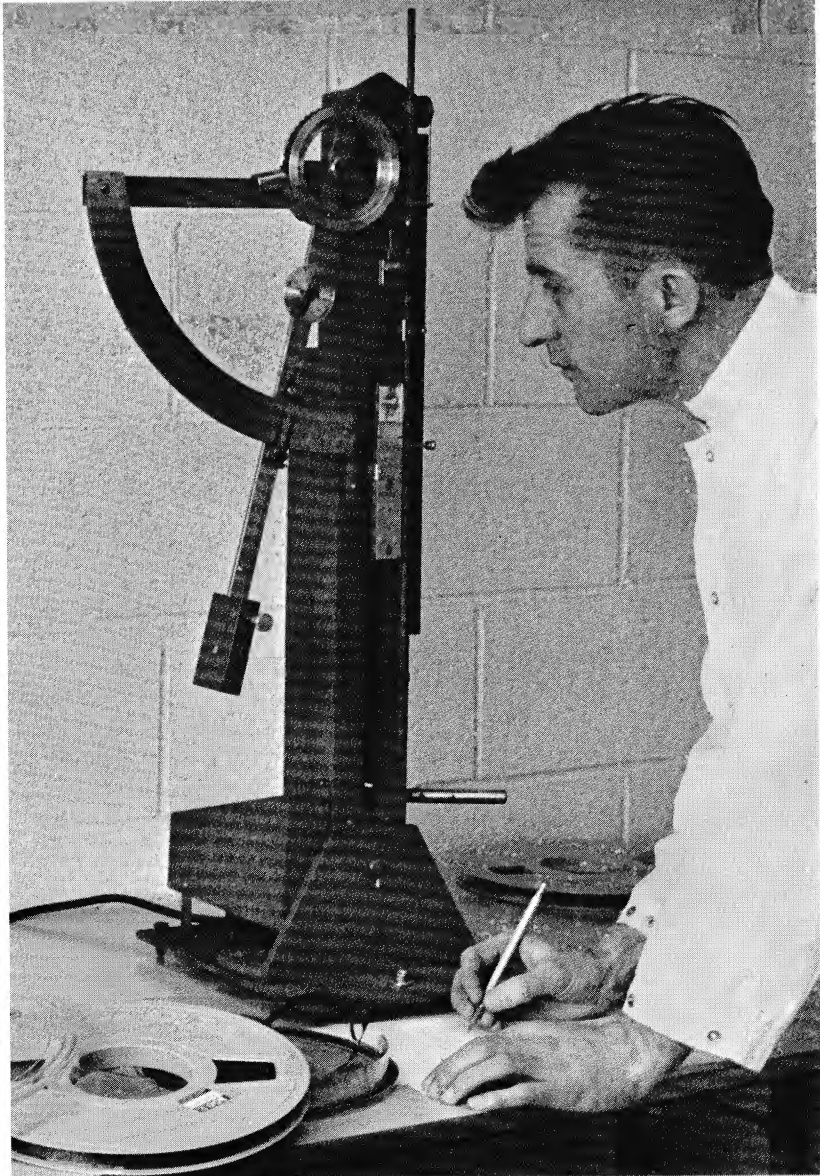
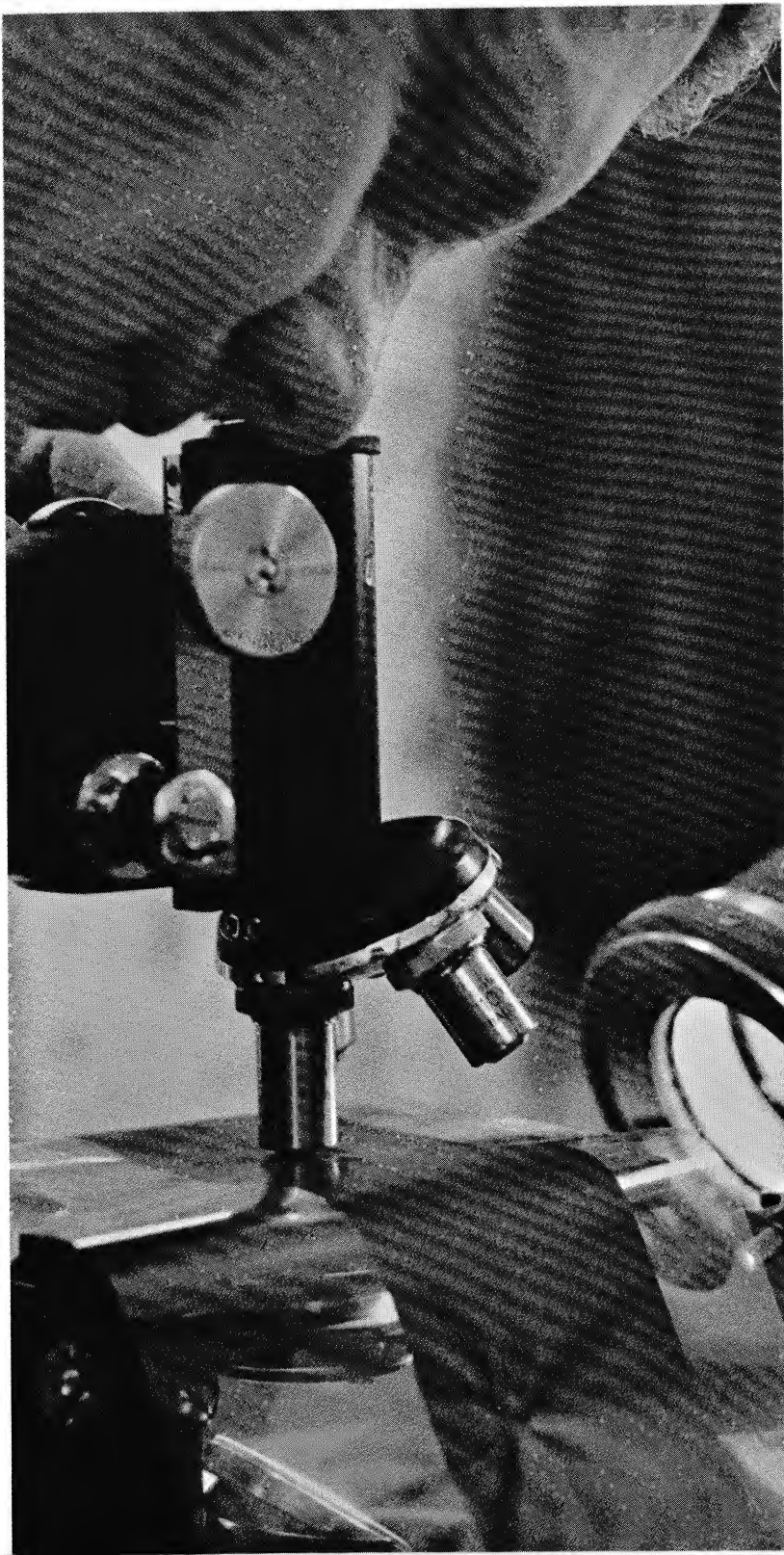
This is a single track from a typical digital computer tape (photographed after a special chemical treatment which makes the magnetic patterns recorded on the tape visible). An 800 bpi certifier has recorded impulses or "bits" in every available position—800 to the linear inch. The actual width of this track is 48 thousandths of an inch.



Audio Devices Computer Tape is available through Audio's Regional Offices and Factory Representatives located throughout the United States. Audio Representatives cover every state in the Continental United States, Canada, Hawaii and through Audio's Export Department, virtually every country in the world, providing complete and convenient service. Warehouse facilities are strategically located throughout the country enabling swift and efficient service for both normal requirements and emergency needs as well. Of prime importance is the fact that Audio Devices Computer Tape is supplied direct to users. There are no intermediate marketing costs.

(left) To preserve the factory-clean condition of computer tape every "finished" reel and case is individually vacuum cleaned. The entire reel and case is then hermetically sealed in a dust-free plastic bag. The sealed cases are passed out of the "white room" area and immediately placed in individual boxes and shipping cartons. The entire packaging operation is conducted in a controlled atmosphere to insure the quality of the product that is shipped.





What Lies Ahead?

Throughout its brief history, the technology of magnetic tape has never been static, but rather in a constant state of refinement. Advancement has been spurred in a large measure by machine manufacturers. The designers of recorders and computers have frequently confronted tape manufacturers with equipment that required "impossible" tape types — or at least completely unprecedented ones.

In rising to this constant challenge, Audio engineers undertook a broad program of research into the basic principles and phenomena involved in magnetic recording. The resulting know-how has lifted tape technology to a new high. Audio's research and development personnel are now equipped not only to continue to upgrade existing products but also to actually "design" tapes to meet specific requirements.

Of course, basic research continues as part of the constant effort to be prepared for the

tape requirements of tomorrow. What will future tape products be like? The stress will be primarily on higher packing densities — with no sacrifice in reliability. Although 800 bit tapes are now in common use, some digital operations are already up to 1,000 BPI and future requirements are expected to far exceed that level.

The search by tape manufacturers is for higher output coatings which can be applied in thinner layers to provide the better resolution characteristics required for higher packing densities. The ultra-thin coatings of the future will place great demands on the technology of dispersion and coating. This becomes more apparent when one considers the fact that present standards at Audio require that throughout a roll of tape almost a half mile in length, the coating thickness must be held within a tolerance of plus or minus 10%. On a conventional computer tape this amounts to 40 millionths of an inch or 40 micro-inches. By

contrast, Audio engineers foresee future tapes with a **total** thickness of only 100 micro-inches — with the same tight 10% limits.

At Audio, extensive research is being done not only on new magnetic materials but also on new base materials. Better base materials could eliminate many of the machine tape-handling problems presently encountered.

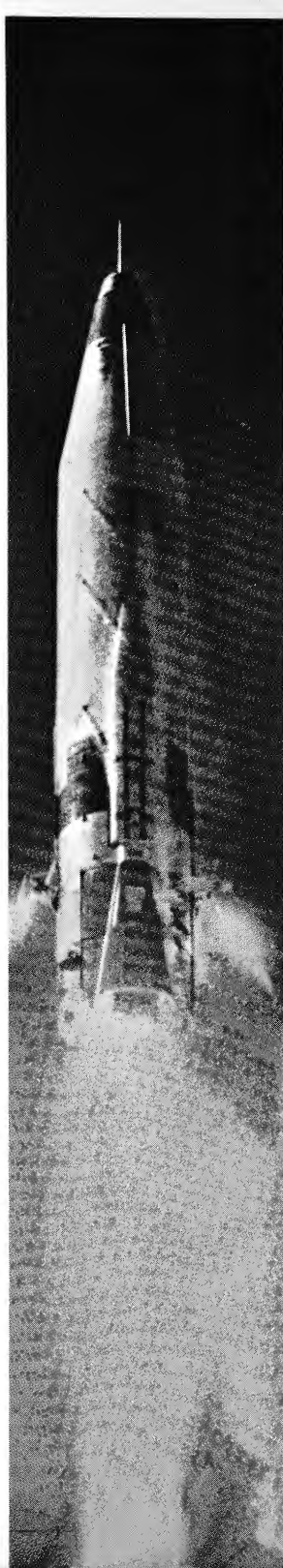
As the demands on tape increase, the need for gentler handling and better protection from foreign matter becomes more critical. Consequently, tape handling and storage accessories are of great interest. Substantial improvements in reel designs have been made in recent years and more are forthcoming. In the future, cartridges will probably assume great importance since they can provide the maximum tape protection and minimum handling.

Audio is determined to maintain its position as a leader in the tape field by anticipating the needs of its customers.

Some of the most dramatic developments in tape recording are taking place in the field of instrumentation. The techniques of modern instrumentation are finding applications in virtually every area of contemporary science — in both pure and applied research. At every rocket launching for example, a tremendous array of instruments feeds information into a vast battery of recorders. Though the launching may last only minutes, it will yield literally miles of recorded tape carrying data which will be evaluated and re-evaluated long afterward.

Compared with a conventional commercial computer, advanced instrumentation recorders pack more information into less space. The rocket launching situation may involve tapes which are packed with 175,000 cycles per inch and some digital instrumentation applications are currently operating at 1,000 bits per track-inch with up to 33 tracks on a one-inch wide tape.

Audio produces a complete line of tapes for all forms of instrumentation, including Direct, Frequency Modulation, Pulse Code Modulation, and all other specialized



Dropout and wear tests (above) literally run tapes "to death" to determine the effective life of a sample. Tapes with low dropouts, not only on the first pass but also on the 100th pass and far beyond, are vital in many present-day applications. This Audio engineer (below) is testing the physical properties of tapes under unusual conditions which may be encountered in space vehicles.





Dropout and wear tests (above) literally run tapes "to death" to determine the effective life of a sample. Tapes with low dropouts, not only on the first pass but also on the 100th pass and far beyond, are vital in many present-day applications. This Audio engineer (below) is testing the physical properties of tapes under unusual conditions which may be encountered in space vehicles.



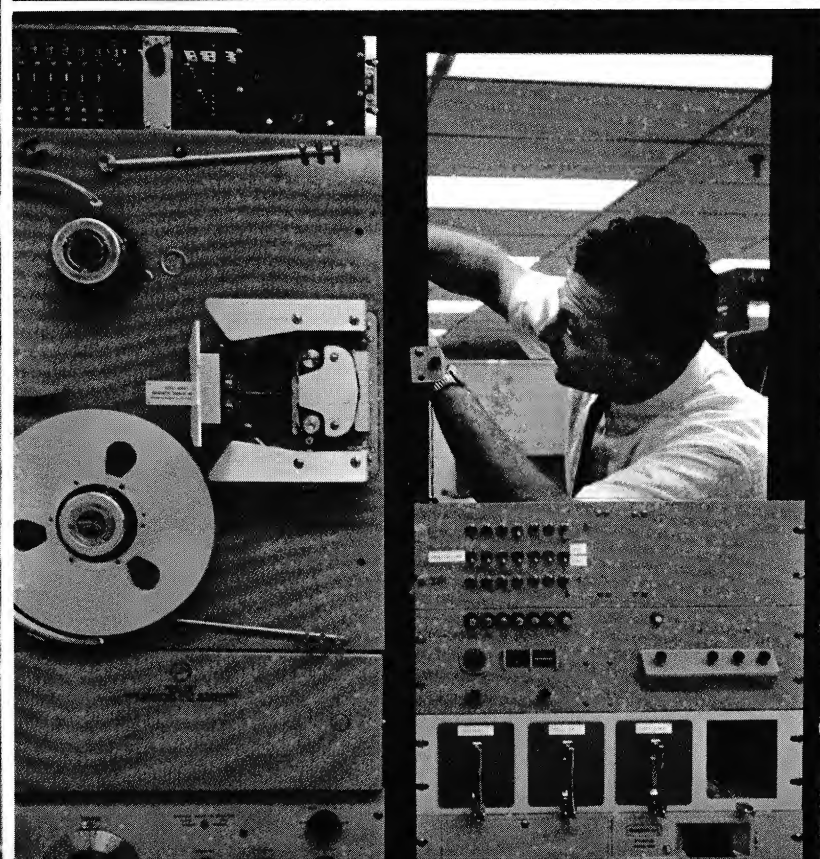
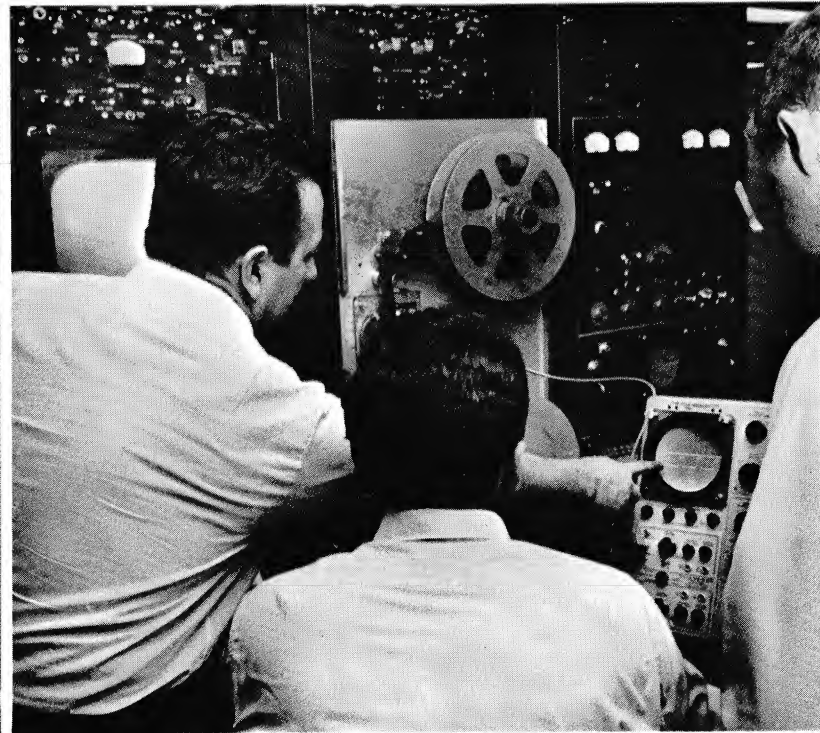
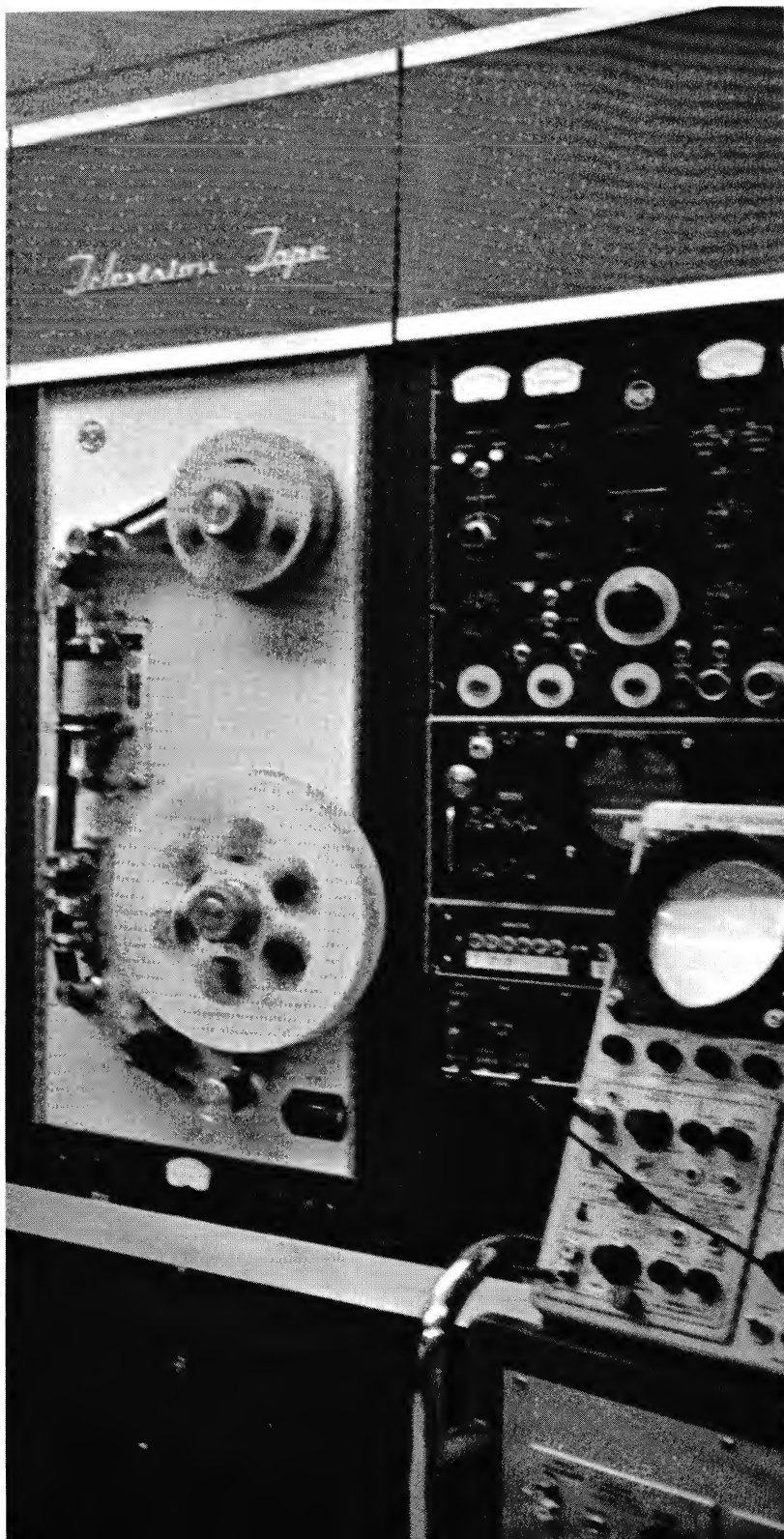
Seismic Tapes: Large rolls of seismic tapes are shipped to the Indel Supply Company for customizing and distribution to specialists in oil prospecting and other geological exploration. These tapes are generally used with special seismic equipment and frequently take a form similar to a mimeograph stencil for mounting on a single drum rather than a conventional reel-to-reel arrangement.



techniques. Audio's instrumentation tapes include General Purpose, Analog, High Resolution "B" Oxide, High Resolution Heavy Duty and Wideband Heavy Duty Types. Since recording equipment requirements vary widely, Audio Devices offers a broad range of reel types, and can provide special leaders, reversal strips and the like. In addition, Audio's instrumentation specialists are prepared to evaluate individual installation requirements and then "prescribe" proper tapes for the job.

Seismographic science has provided one unique use for instrumentation tape. Magnetic tapes are used, in conjunction with elaborate seismic instruments, to help modern oil "prospectors" find oil. "Raw" magnetic tape, especially formulated and processed for this application, is manufactured by Audio and then shipped to Indel Supply Company in Oklahoma and Texas to be customized and distributed.

Tremendous investment rests on the accuracy of seismic recordings. Extra Precision Tape from Audio provides geologists with the reliability they require.



**Television
Tape...
"Pictures"
on
Tape**

Improved television tapes are now under development at Audio Devices. With the growth of the television field Audio implemented a research program to produce the best possible tape-product. To guide research and production toward successful commercial television tape, Audio created what is, in essence, a complete television studio. These facilities permit the television department at Audio to study the performance of product under actual studio conditions. One major goal of Audio's TV efforts is to provide TV tape with a life span far exceeding contemporary tapes — tape that can function effectively after many exposures to the brutal abrasive action of a professional television recorder. (Television tape is run from reel to reel at high speed while the heads are rotating across it at 14,000 rpm.)

Television Tapes are tested in Audio's specially built "television studio." Here, television programs are recorded and played back, new formulations are tried, and stringent wear tests are conducted to determine the quality and life of tapes.

Audiotape, Audiofilm and Audiopak

Audiotape — sound recording tape — is another distinct area within Audio's production facilities. The sound recording tape line has been a part of Audio Devices much longer than computer tape, instrumentation tape or any of the other tape lines. It is regarded as the "first tape" in the evolutionary development of magnetic recording and as such has provided many touch-stones in the techniques used to produce other magnetic recording tapes.

The Audiotape sound tape line has achieved international recognition. A dynamic research program continually yields improved sound tape products. An example is a new high energy sound tape currently being introduced.

Audiofilm is another "standard" in the Audio line. For years motion picture and television production studios have used Audiofilm to make "original" sound tracks. Audiofilm is clear, perforated film that is coated with an oxide formulation similar to sound tape. Recently it has gained significant acclaim as a record mastering medium with many sound studios preferring it to conventional tape for original recording.

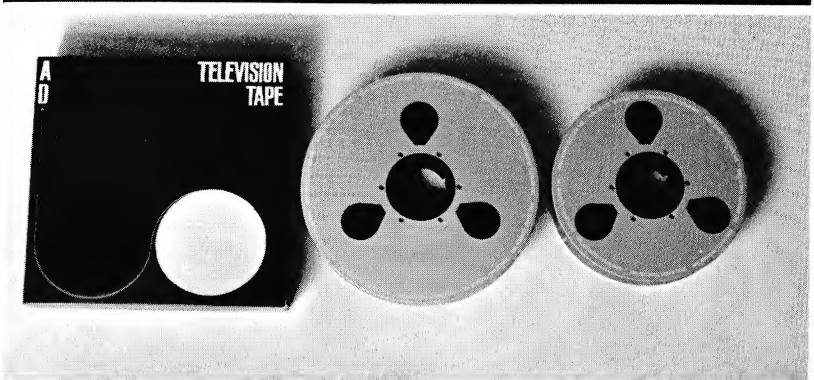
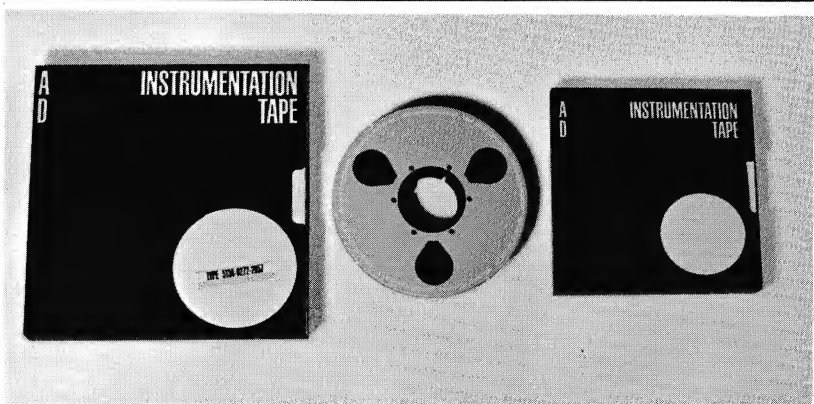
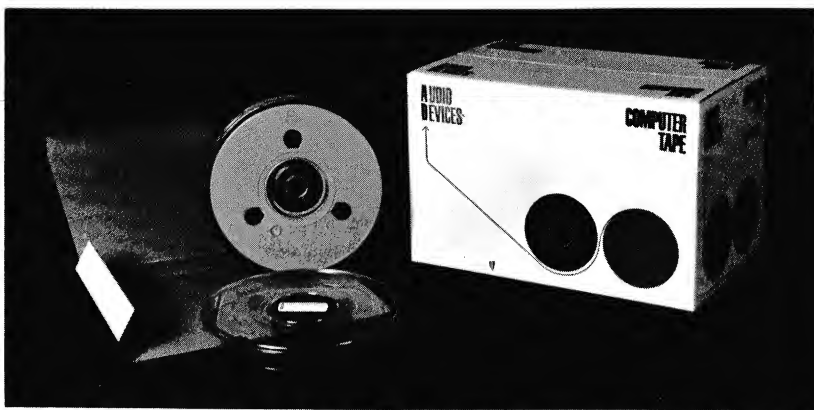
Audiopak is a new Audio product. It is a continuous-loop cartridge for use in radio stations, language laboratories, background music, and many other fields where continuous-loop recording offers special advantages. One unusual and interesting

area is the development of tape cartridge units for recording and playback in automobiles.

Audiorecords, which is where it all began, continue to serve the recording industry as a medium for phonograph record mastering. They represent the "standard" throughout the world in their function as the critical link between "original" sound, recorded magnetically, and the ultimate production of fine phonograph records.

The memory business feeds on new ideas. Perhaps future memory products will differ drastically from those used today. Perhaps they will operate with a greater reliance on electronics and less physical movement, or on machines that more closely simulate man's natural memory processes. In any case, new and fascinating developments are certain to continue and Audio Devices intends to continue as a pioneer in this unique world of total recall.

Audiotape (top left) is widely used by both professional sound recording studios and by audiophiles. A complete line, in different tape types and lengths, provides a tape for every recording need. Audiopak (lower left) is a new continuous-loop tape cartridge that offers remarkable quality and reliability for the broadcasting field. Continuous-loop cartridges are becoming increasingly popular with the growing trend toward "automated" broadcasting. Audiofilm, another successful Audio product, is clear, perforated motion picture film coated with magnetic oxides and used to make original sound tracks for motion pictures and television.



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