

TANDBERG

10X STEREO



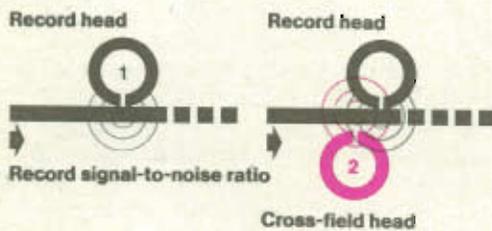
A refinement of what is possible in 1/4 inch tape recording format today



The 10X is the refinement of what is technologically possible to achieve in standard 1/4 inch recording format today. We started to build this instrument for the home. But we know that because of its many professional features and its performance it is destined to become the standard field recording instrument for the professional and semiprofessional industry as well. The 10X has all the essential requirements for the most critical applications: first of all Tandberg legendary recording quality, secondly extreme reliability, dependability, flexibility and convenience. As with the electronics so with the mechanism: all the parts have been designed and produced to precise limits and are therefore extremely stable.

- Tandberg Cross-field recording technique
- 3 motors
- 15 i.p.s., 7 1/2 i.p.s. and 3 3/4 i.p.s.
- Complete integrated electronic controls
- Servo tape drive and tensioning systems
- Equalized peak indicating instruments
- Self-adjusting input circuits
- Special editing facilities
- Remote controllable

Tandberg Cross-field recording technique
These Norwegian recording instruments have become famous for their use of the Tandberg Cross-field recording technique. In this system the tape passes between the record head and a special Cross-field head. During recording the Cross-field head provides transverse bias magnetization which means that the tape is thoroughly magnetized. The result is that the tape can accept much stronger signals than with conventional techniques and reproduce the same signals without audible distortion. The most important criterion for achieving top quality recording is the full reproduction of the highest tones. It is exactly in this situation where the Cross-field technique makes its biggest impact and contributes most to the sound quality!



1) Recording with a conventional recording technique.
To achieve an optimum signal-to-noise ratio, low distortion, and a wide frequency range the tape should be magnetized right

through. Here the tape has not been magnetized completely.
2) Recording with the Tandberg Cross-field technique.
The tape has been magnetized thoroughly.

Tandberg Cross-field recording head (A).
The special Cross-field head is located opposite the record head, and the magnetic

tape passes between the two heads. The Cross-field head allows the tape to accept much stronger signals than is possible with conventional recording techniques, thereby improve the dynamic range and extending the frequency response.

15 i.p.s. tape speed - of course.

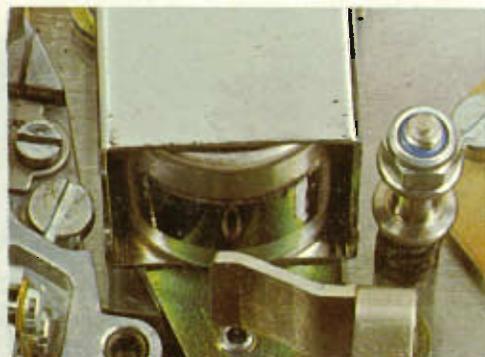
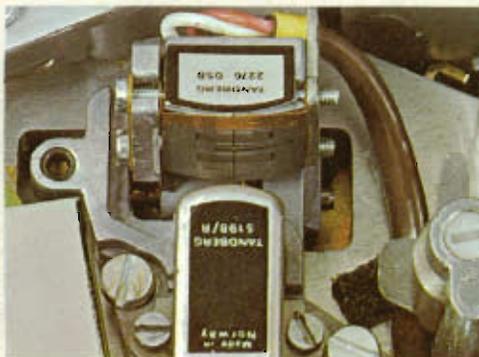
A tape speed of 15 i.p.s. for record and playback has long been taken for granted on professional tape recorders. This speed is ideal for editing work because it spreads out the recording over a very large tape surface.

The 10X has three speeds.

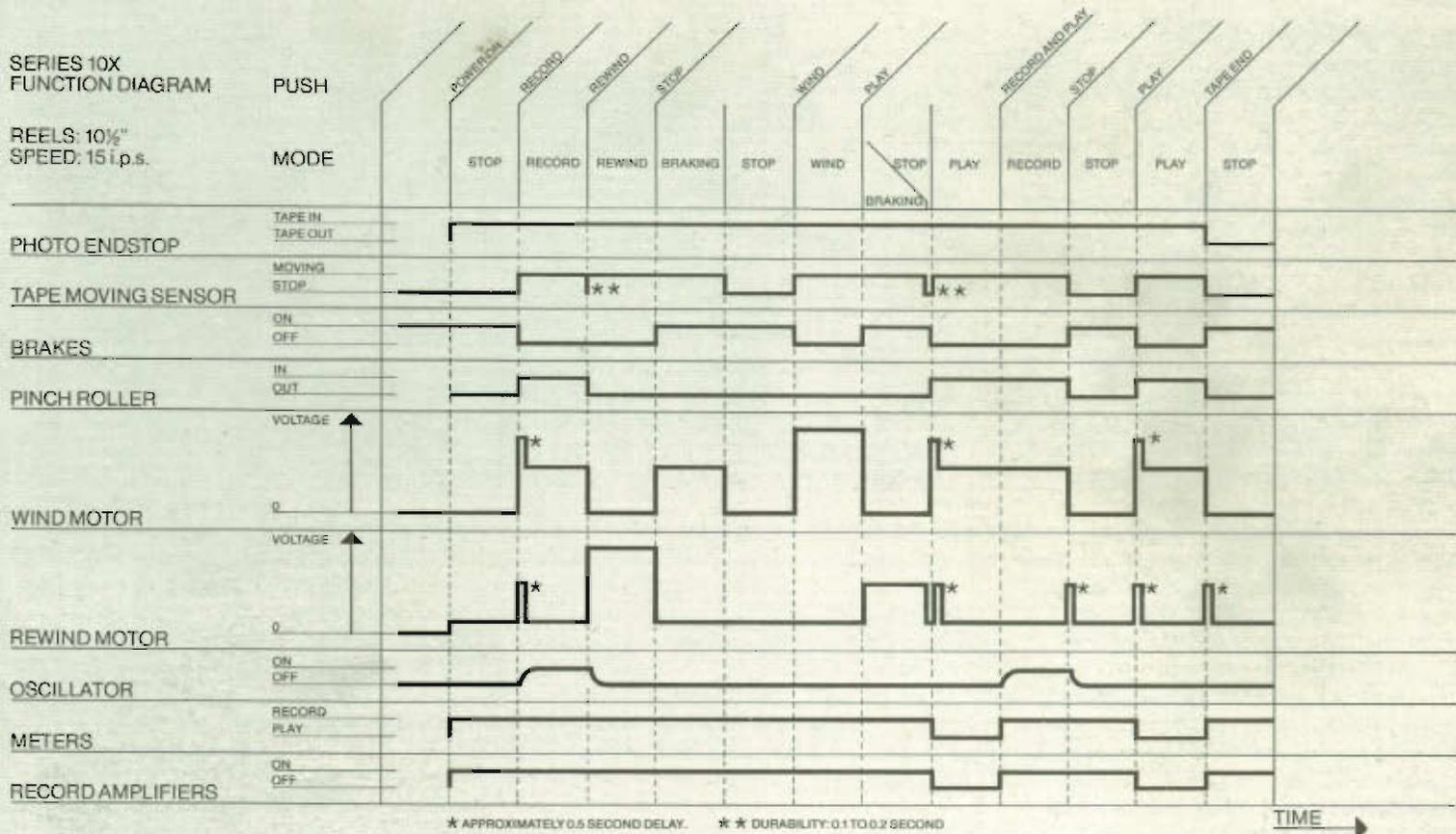
The Tandberg 10X is today one of the few tape recording instruments with a speed of 3 3/4 i.p.s. For most recording 7 1/2 i.p.s. will give sufficient quality. The majority of manufacturers have adopted this speed as the lower limit because they cannot achieve an acceptable performance at lower speeds. With the 10X Tandberg has broken this barrier. The use of Cross-field results in a 3 3/4 i.p.s. performance from this machine which matches or surpasses 7 1/2 i.p.s. recording quality on other devices. At 3 3/4 i.p.s. the frequency response goes from 30 to 20000 Hz and the maximum speed variation is 0.15% measured according to DIN 45511.

Tandberg ferrite playback head (B).

As a material for magnetic heads, ferrite has now been developed to such a degree that we find it defensible to adopt it for the playback head on the 10X. We make these heads ourselves and we are convinced that ferrite gives very low intrinsic noise and very high wear resistance.



The function diagram and sophisticated servo systems



Electronic servo-controlled speed regulation. The servo-control system for regulating the tape speed during record and playback is one of the many professional features on the 10X. It is responsible for a remarkably low speed tolerance: better than $\pm 0.3\%$! The servo-control system operates as follows: a light-emitting diode is located on one side of the toothed wheel attached to the flywheel. The teeth break the light

beam and the resulting light pulses are transferred to electronic circuits via a photo-transistor located on the other side of the toothed wheel. Each speed (15", 7 1/2" and 3 3/4" per second) corresponds to a particular pulse frequency. If the comparison reveals a deviation, the capstan motor either increases or decreases its speed accordingly. The system operates instantaneously.

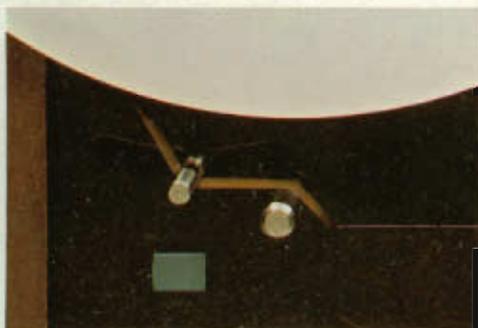
Servo-controlled tape tensioning.

It is important that the tape tension is correct so that the tape makes good contact with the heads.

Tape recorders with a 3-motor transport usually have a constant voltage applied to the left reel motor during record or playback. The voltage produces braking which results in tape tension. But the tension is not constant because it also depends on the amount of tape left on the reel. So the machine either has a tendency towards high head wear and tape deformation when the supply reel is almost empty or a tendency towards bad tape/head contact when the supply reel is full.

On the 10X this problem has been solved. The left tape tensioning arm acts as a sensor in a servo-controlled system.

The tape tension is to all intents and purposes constant - regardless of how much tape there is on the supply reel. Sophisticated, accurate and safe.



Refined audio frequency section



Unless the audio electronics are equal to the mechanical properties of the recording instrument, excellence cannot be attained. Tandberg machines have always been noted for their audio refinements, from our very first recorder in 1952, the world's first 1/4 inch tape stereo recorder (Tandberg Model 3 Stereo) in 1957 - right up until today.

Self-adjusting input circuits.

Noise contribution from the input amplifiers is a big problem in many tape recorders, often making it impossible to achieve top quality sound reproduction. If the signal from the microphone is weak so that the input levels on the recorder must be adjusted for maximum sensitivity, the results is often audible noise from the input amplifiers. Tandberg has developed a microphone amplifier which *automatically adjusts itself to the impedance of the microphone* giving a *minimum noise contribution with different microphone impedances*. The input stage in the 10X is of course transformer-less, but it is also equipped with this novel self-adjusting input amplifier which means that the noise contribution from this stage is very low indeed.

Mixing in stereo.

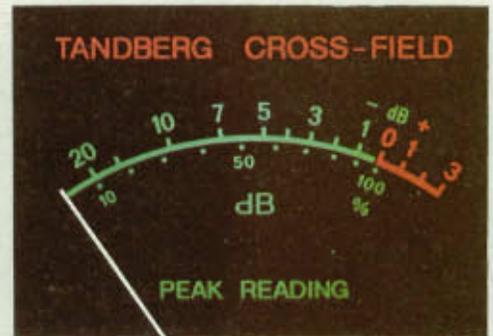
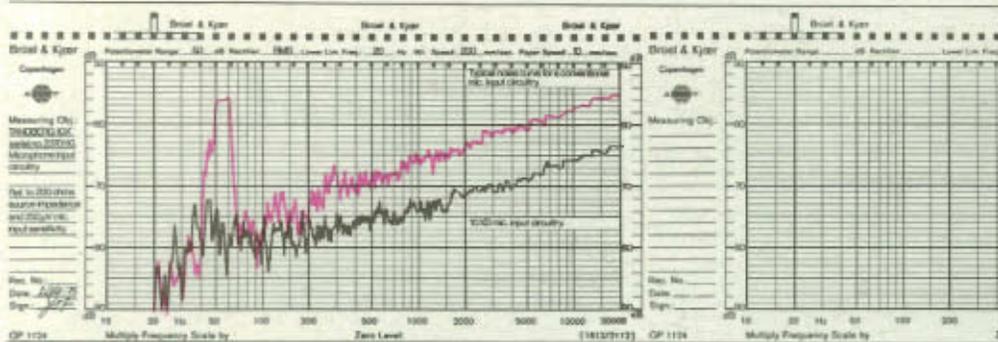
The Tandberg 10X has 4 input controls, 2 for microphones and two for line inputs (programs from radio receivers/amplifiers or another tape recorder). This provides opportunities for mixing stereo programs or mono programs. In common with the output controls, the input controls have slide potentiometers which are easy to use because of the large distance travelled by each control.

The 10X has equalized peak-indicating instruments.

Unless the meter system is foolproof, serious errors can be made. The input level instruments give us the only visual indication we have of the signal level going onto the tape. Therefore the way these instruments operate is of prime importance for every recording we make. The 10X has been designed to suit the characteristics of the best magnetic tape currently available. To exploit this combination of top design in tape and tape recorder, it is extremely important to have quality meters operating according to the best known measurement practices. The most common meter in use today is the so-called VU meter. When recording, the object is to have the strongest possible signal on the tape without audible distortion. But very many of the sound impulses that are recorded are of very short duration e.g. the peak intensity of a piano note or a kettledrum note. The problem here is to get an exact measure of these short duration sound impulses, because they are just the ones that distort first.

A VU meter only indicates the *average value* of the sound level which is somewhere between the weakest level and the strongest level during a given time interval. This type of meter will not reveal the peak intensity of short, powerful sound impulses and therein lies its disadvantage - exactly where there is the biggest danger of distortion. In practice it is impossible to avoid periodically overloading a tape on a recorder equipped with this type of level meter. Tandberg tape recorders have always been equipped with *peak-indicating*

instruments because we believe they give the truest indication of the sound level. On all Tandberg tape recorders the level instruments are connected *after* the frequency-corrected record amplifier. For this reason the instruments measure direct the current flowing in the record head. We call this an equalized meter. Tandbergs is one of the very few manufacturers in the world connecting peak-indicating instruments in this way! Peak-indicating instruments *always show the most powerful components in the sound signal regardless of the frequency of the sound*. Correct use of the large, precise peak-indicating level instruments on the 10X will result in: a correct indication of the level at all times and never any audible distortion! (In addition the 10X has some overload reserve which means that if despite careful use there is an unexpected loud signal there is that extra bit of "head room" to provide for it, for safe recording everytime.



The 10X is of course equipped with the recording features most demanded by knowledgeable users.

Source and tape tests.

The SOURCE/TAPE buttons enable you to monitor a recording in two ways: the source test (A test) tests the program *before* it is recorded on tape: the tape test (B test) tests the program *after* it has been recorded on tape (instantaneous playback via the separate playback head). It speaks for itself that the tape test is the more important of these tests since it is really a critical listening test of the quality of the recording as it takes place.

Flying start.

This is a facility that enables you to carry out a so-called "flying start" which is a direct transfer from playback to record. This facility is particularly useful for editing work and when one recording must follow immediately after another recording. Great emphasis has been placed on avoiding clicks and other electrical noise being recorded on the tape as the circuits switch over from playback to record.

Easy editing.

The EDIT/CUE facility allows you to listen to a program on the tape during fast winding. This means that you can locate a particular part of a program and makes the job of editing easier. In addition the 10X has a four number counter which is a reliable device for locating parts of a program and is useful for compiling a list of tape contents.

Front jack for stereo headphones.

The 10X has a push-pull output for stereo headphones. The output has been designed to match any headphones with a 1/4" jack plug and an impedance of 8 ohms or more. The output level can be adjusted by means of the output slide potentiometers. The output reproduces the full frequency range (see «Frequency range» in the technical data) and the distortion is less than 0.2%!

Adjustable output level.

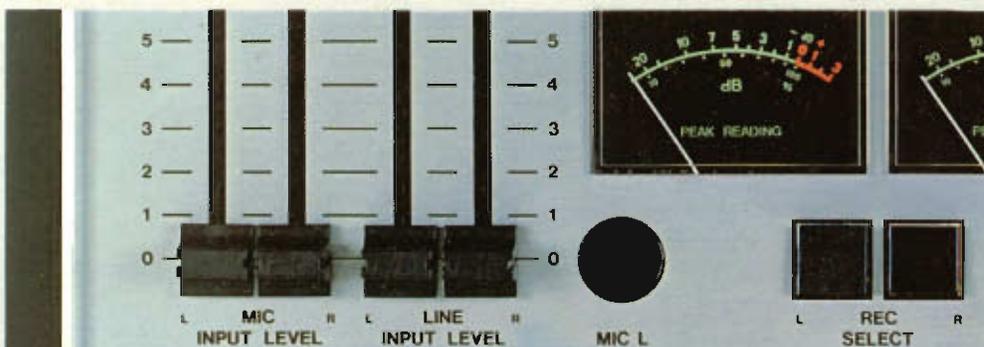
The Tandberg 10X has no built-in power amplifiers since it is designed for connection to a power amplifier of top quality. The output level can be easily and precisely controlled by means of the large slide

potentiometers. The peak-indicating level meters can also be used to show the output level.

Photo-electric stop.

The 10X is equipped with a photo-electric stop. The tape passes between a lamp and a photo-transistor. At the end of the tape or when a section of transparent tape arrives, the tape drive stops automatically and the pinch roller is retracted from the tape. This means that the machine has no unnecessary mechanical stresses during idle periods!

In short, the Tandberg 10X is a fully equipped recording instrument, flexible enough for any situation.



Complete integrated electronic controls

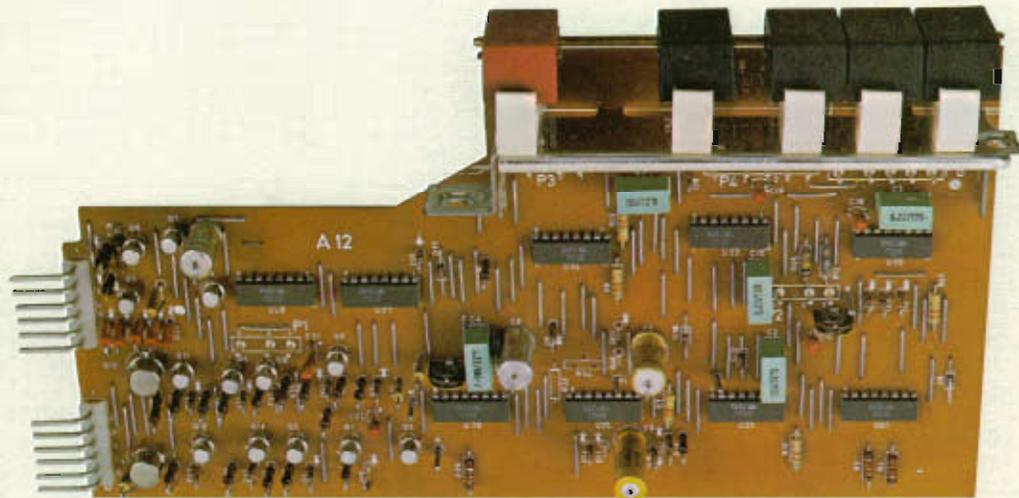
10X is equipped with high-level logic, integrated circuits to control the 3 motors.

Electronic controls add speed, flexibility and reliability to a recording instrument. The operation of the tape transport mechanism in a recording instrument can be controlled mechanically or electronically. Mechanical systems have certain disadvantages when compared with electrical systems. Small mechanical inaccuracies or bad adjustments can easily result in poor tape travel.

The total number of moving parts has been reduced to a minimum. This adds reliability because all mechanical systems sooner or later wear out or require adjustments or replacements. The change-over times from one mode to another mode are all very short. You can go direct from fast wind to fast rewind and, not least, direct from fast wind or fast rewind to playback.

The logic control.

The control system in the 10X is an "electronic brain" with integrated circuits mounted on one printed board. This gives flexibility which cannot be achieved with mechanical solutions. The push buttons are mounted on the same printed board as the integrated circuits and control all the modes of operation, record, playback, fast wind and rewind, and stop. Operating the 10X is therefore extremely simple and precise. Regardless of how the mode buttons are pressed the "self-thinking" electronic control system and the servo-controlled tape tensioning system ensure that the tape travel is always correct and the tape is never damaged.



The flexibility of the 10X can be extended by the electronic remote control unit (accessory). All the operational modes can be remotely controlled from a separate plug-in unit with 16 ft (5 m) of cable. The remote control unit contains the same keyboard as the tape recorder. Even when the remote control unit is connected, the mode buttons on the tape recorder are still operational. The buttons light to show you which mode the machine is in at any particular moment. If the 10X is connected to a timer, the remote control unit can be used to give you automatic record, playback, or stop at any chosen time of the day.

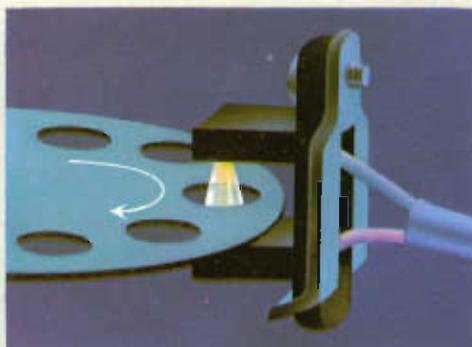
Controlled braking sequence.

Most tape recorders have a fairly long delay between the fast wind/rewind mode and the playback mode to make absolutely sure that nothing goes wrong during the change-over. This delay can be as much as

several seconds and is often inconvenient. This problem has been eliminated on the 10X. A light-emitting diode and a photo-transistor sense whether the right reel motor is rotating or not and sends the information to the logic control. At the instant when the reel motor stops the logic control sends out the information that the tape recorder can go over to playback - no delay!

Pitch control (manual speed control, accessory).

For professional use the 10X can be fitted with a PITCH CONTROL unit, which is an external manual control for adjusting the record and playback speed to within $\pm 10\%$ of the nominal speed. This facility is particularly useful for adjusting the pitch of one program exactly to the pitch of another program. Musicians will find it useful and it can also be an aid to tape editing.



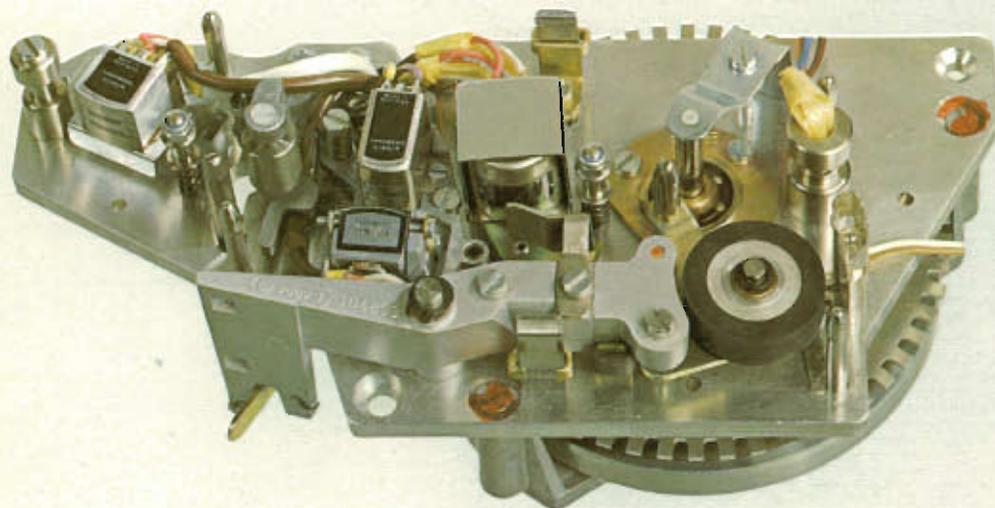
Studio-type mechanism

The tape path and the location of the magnetic heads is the "heart" of any tape recorder and the most critical part for good sound reproduction. All the parts in the tape path contribute to the transfer of the audio signals between the magnetic heads and the magnetic tape. If there is the slightest weakness in one of the parts in this complicated system, or if one of the parts goes out of adjustment, it will change the contact between the heads and the tape and result in reduced sound quality.

The 10X tape path.

In a recording instrument with a studio-type mechanism such as the 10X extraordinary care is taken to achieve quality and precision in the complete tape path. All the parts are made to very close tolerances and operate with minimum play when the tape is being transported. At the same time all the parts in contact with the tape must be adjustable for optimum tape contact to achieve exactly the same reproduction from one occasion to another. In the 10X we have solved all the above mentioned problems by mounting the entire tape path on an extremely solid $3/16''$ (5 mm) thick aluminium plate providing great stability. Therefore none of the parts mounted on this plate can go out of adjustment - regardless of the operational mode of the tape recorder. The capstan is made from special stainless steel and manufactured by a process that guarantees complete control over the dimensions and surface treatment.

The capstan is attached to a flywheel which is precision balanced and runs in special self-lubricating, hermetically sealed ball-races. In addition the *studio-type flutter filter* guarantees minimum speed variations and prevents modulation noise that can arise as the tape travels over the various polished surfaces. All the magnetic heads, which have been developed and manufactured at Tandbergs Radiofabrikk in Oslo, are subjected to special tests and hand-picked for each machine to have as far as possible the same performance. The heads and the motor pulley can be micro-adjusted in three dimensions! This guarantees the best possible contact between the heads and the tape. Reliability, of course.



Belt-driven transfer system.

If the capstan motor is located too near the heads, currents can be induced in the heads from the motor and these currents can disturb the sound reproduction. It is therefore highly desirable that the capstan motor be located as far from the heads as possible. At the same time it is also highly desirable that the system for transferring the power from the motor to the capstan is as simple and direct as possible. The capstan motor could drive the flywheel spindle directly, but this gives rise to hunting and vibration problems. The slightest eccentricity in the capstan would bias the flywheel and cause uneven tape drive. In the 10X the power from the capstan motor is transferred by a belt to the flywheel. This means that the motor is sufficiently far from the heads to avoid electrical interference and at the same time it provides a very simple stable power transfer system.

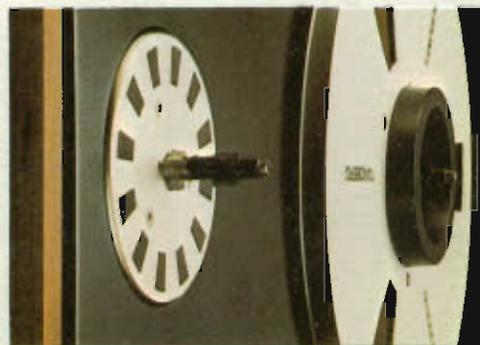
The 3 special motors.

Two reel motors are connected direct to their respective reel hubs to provide fast winding and rewinding. With the aid of the "electronic brain" in the 10X this arrangement allows you to switch from fast winding to rewinding, or vice versa, without going through the stop mode. The capstan motor which is used in the record and playback modes is an extremely reliable, servo-controlled d.c. motor. This

motor is brushless and consequently does not generate electrical noise. The 10X has an electronic servo-controlled speed regulating system and the d.c. capstan motor is operated by built-in HALL EFFECT devices.

Spark-free fast winding.

Many 10 1/2" reels are made from metal. When these reels rotate at high speed static electricity is generated which can easily jump over to the chassis as sparks. This can damage a recording on the tape. Therefore this static must be allowed to discharge itself. On the 10X the rubber pads on the turntables have been impregnated with an electrically conducting material and the static discharges itself through these pads. Therefore there is no danger of spark formation and any professional metal reel can be used.



Technical data

Adjusted for lowest noise, highest output tape.

Tracks: delivered as a 4-track model (2-track model to order).

Power requirements: 240, 230 or 115 V at 50 Hz (60 Hz to order).

Power consumption: 100 W maximum.

Tape speeds: 15" (38 cm), 7 1/2" (19 cm) and 3 3/4" (9.5 cm) per second.

Speed tolerance at normal operating temperature: not greater than $\pm 0.3\%$.

Wow and flutter, maximum:

	Peak DIN 45511	W.R.M.S.
15" (38 cm) per second	0.07%	0.04%
7 1/2" (19 cm) per second	0.09%	0.06%
3 3/4" (9.5 cm) per second	0.15%	0.11%

Frequency response:

	DIN 45511	± 3 dB
15" (38 cm) per s.	30 to 30 000 Hz	30 to 25 000 Hz
7 1/2" (19 cm) per s.	30 to 26 000 Hz	30 to 22 000 Hz
3 3/4" (9.5 cm) per s.	30 to 20 000 Hz	40 to 18 000 Hz

Signal-to-tape noise ratio at the highest tape speed with specified tape:
greater than 67 dB (2-track) and 65 dB (4-track) according to DIN 45 500, weighted and IEC, A curve.
greater than 58 dB (2-track and 4-track) according to DIN 45 500, unweighted and IEC unweighted.

Channel separation at 1000 Hz: mono greater than 60 dB, stereo greater than 50 dB.

Distortion: from the record amplifier maximum 0.2% at 0 dB. From the playback amplifier maximum 0.2%. From the magnetic tape maximum 3% with 0 dB recording level.

Inputs.

MIC: inputs matched to dynamic microphones. The sensitivity is self-adjusting according to the microphone impedance. Sensitivity range: 0.23 mV to 35 mV (1 mV to 130 mV, US version).

RADIO: input impedance 50 k ohms. The sensitivity is 8 mV (30 mV, US version) and the max. voltage is 1.2 V (3 V) at 400 Hz.

LINE: input impedance is 200 k ohms. The sensitivity is 30 mV and the max. voltage is 4.5 V at 400 Hz.

Outputs:

RADIO: output impedance 5 k ohms. The unloaded output voltage is 0.775 V.

LINE: output impedance 150 ohms. The unloaded output voltage is 1.5 V.

HEADPHONES: minimum load impedance 8 ohms. Output power 5 mW per channel.

Dimensions (without reels): width 17 1/4" (43.5 cm), height 7 3/8" (18.5 cm) and depth 17 3/4" (45 cm).

Weight: 36 lb (16.4 kg).

Standard equipment

The following standard accessories are packed with each tape recorder: 2 NAB adapters, 1 Tandberg 10 1/2" (26.5 cm) dia. reel and interconnecting cables. The 10X is equipped with reel locks.

Accessories

Microphone: Tandberg TM6. Dynamic microphone (moving coil), omnidirectional. Frequency response: 50 to 15 000 Hz (+ 3, - 6 dB).

Magnetic tape (not available in USA): Tandberg Tape in different lengths.

Empty spools: a range of sizes in plastic or aluminium.

Remote control unit and pitch control, see separate descriptions in text.

TANDBERG

Your Hi-Fi dealer:

TANDBERGS RADIOFABRIKK A/S
Oslo 8, Norway