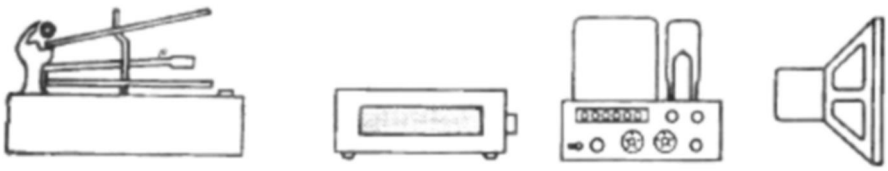
EQUIPMENT PROFILE



- TANDBERG MODEL 6 TAPE RECORDER
- SHURE M232 AND M236 PROFESSIONAL PICKUP ARMS
- GARRARD SPG3 STYLUS FORCE GAUGE

TANDBERG MODEL 6 TAPE RECORDER

The Tandberg Model 6 is a light, compact, handsome, versatile, three-speed tape machine with separate record and playback heads for four-track stereo and mono operation. There is no head-shift device for playing two-track stereo tapes, now becoming semi-obsolete; such tapes may be played nevertheless, although at some loss in signal-to-noise ratio on the right channel. In the main, design and construction are of professional caliber and so is performance at 7½ ips. In the machine tested there was some question as to frequency response and equalization at the low end. The price is approximately $500.

Features and Functions

The Model 6, shown in *Fig.* 1, operates at 7½, 3¾, and 1⅞ ips. It permits sound-on-sound recording without the necessity for an external mixer, echo effects, A-B monitoring, and mixing of input sources. For each channel there are separate gain controls for recording and playback—four in all. Each channel has a microphone input and two inputs for medium and high level sources. However, insertion of a microphone plug disconnects the other two sources from the recording amplifier.

Other features include: separate "magic eye" record-level indicators for each channel, with a "floating action" circuit to facilitate reading transient peaks; automatic demagnetizing circuit for the record and erase heads which operates whenever the record buttons are released; provision for automatic shutoff at the end of a reel, requiring attachment of a metallic leader to each tape; a four-digit tape counter with reset knob; a jack for attaching a remote on-off foot-pedal control; cathode follower outputs in playback; d.c. on all tube heaters except the oscillator; easy removal of head covers for cleaning and demagnetizing heads and other parts; azimuth adjustment screws; head-height adjustment screws.

A "tape motion lever," operating in a T slot, puts the machine into the rewind mode, fast-forward mode, or else in a preset position for normal forward operation. A stop-start pushbutton actually starts or stops the tape when the lever is in the normal forward mode. The lever moves the pressure roller within about ⅛-in. of the capstan and allows the motor to come up to full speed. Then the start-stop button moves the pressure roller the rest of the way, so that rapid starts and stops are possible without noticeable slurring.

Four additional pushbuttons plus the start-stop button control electrical operation. Two buttons, one for each channel, are for recording, and the other two for playback. The record buttons are linked with the tape motion lever so that they can be locked down only when the lever is moved into normal forward position. Putting the lever into neutral causes the record buttons to pop up.

The pushbuttons provide a fascinating example of switching logic. With only the left record button down, all input signals, whether fed to the left or right input jacks, are routed to the left tape track, and similarly for the right record button. But with both record buttons down, left and right input signals are routed to their respective tracks. The playback buttons work in an equally logical manner. With only the left button down, the left playback signal goes to both output jacks, and similarly for the right button. But with both playback buttons down, each playback signal goes to its respective ouput jack. When the playback button for a given channel is up, the input signal for that channel is routed to the output jack. Thus an A-B comparison can be made during recording by alternately releasing and depressing the playback button for the desired channel.

Signal routing operates as just described when the start-stop button is down and the tape is in motion. But with the button up and the tape at rest, the incoming signal is directed to the output jacks.

The high level input jack provides about 18 db attenuation compared with the medium-level input jack, to prevent overloading the first two recording stages. The medium-level jack presents an impedance of about 100,000 ohms, which may be too low for certain signal sources, such as a piezoelectric cartridge. The high-level input impedance is about one megohm.

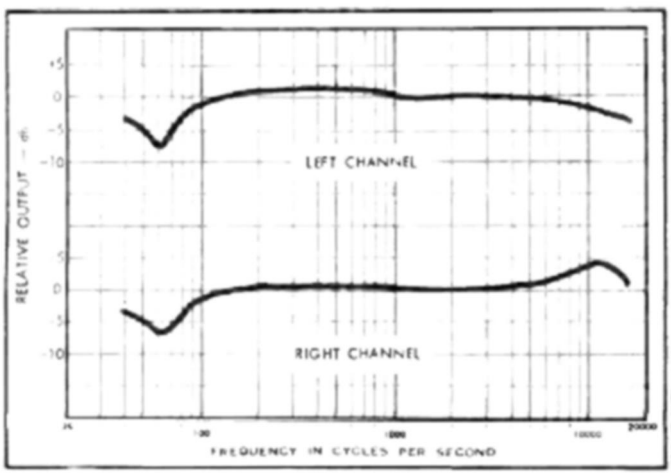
Fig. 1. The new Tandberg Model 6 stereo tape recorder.

Performance

The measured signal-to-noise ratio was 52 db on the left channel and 51 db on the right at 7½ ips while recording a 400-cps tone at 3 per cent harmonic distortion. This is excellent for quarter-track operation. Tape hiss was much more predominant than machine noise.

On each channel, the "magic eye" closed exactly at the 3 per cent harmonic distortion level, which is as should be.

The wow and flutter characteristics are excellent at 7½ ips. A professional tape editor, musically trained, lent an ear to this test and observed on listening to a 3000-cps tone being recorded and played back that the Tandberg's steadiness of motion equalled or possibly surpassed some of



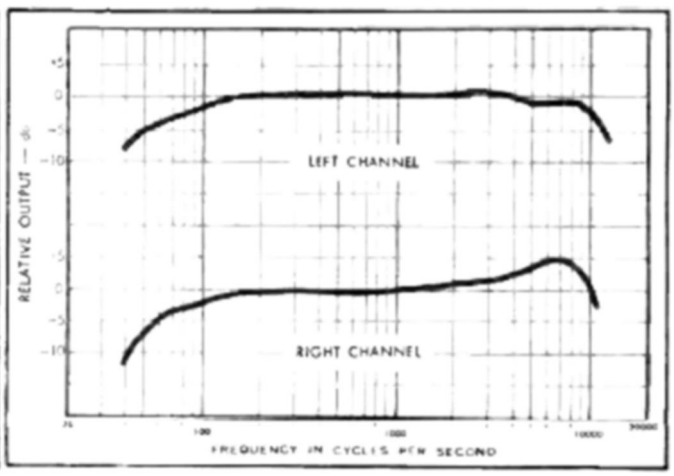


Fig. 2 (left). Frequency response curves for the Tandberg Model 6 at 7½ ips. Fig. 3 (right). Response curves for 3¾ ips.

the professional machines he works with. At 3¾ ips, wow was barely discernible on a sustained tone—still very good. But at 1⅞ ips wow became definitely apparent.

Speed measured 0.6 per cent fast; professional machines usually claim 0.2 per cent accuracy. Under 1 per cent is very good.

Figures 2, 3, and 4 show the frequency response measured at each speed while recording at a level 25 db below "magic eye" closure on a 1000 cps tone. At 7½ ips, response was within 3 db of flat from 80 to nearly 15,000 cps on the left channel; on the right channel, treble response was greater, with a slight tendency to "peakiness" in the 10,000 to 14,000 cps range. Perhaps there was somewhat less bias current in the right channel section of the record head.

The major difference in frequency response at 7½ ips occurred at the low end, with a dip in response between 50 and 70 cps. On A-B testing through a fine audio system, this made a significant change in the "color" of both voices and music. Moreover, it seems, the lack of bass caused the apparent signal-to-noise ratio to sound less than the measured ratio. That is, fuller bass would have masked tape hiss to a greater extent.

At 3¾ ips, high-frequency response held up very well to 10,000 cps. Bass response held up reasonably well to about 50 cps on one channel and 60 cps on the other. At 1⅞ ips, response was good from about 60 to 4000 cycles.

It must be stated that the measurements are definitely better than the listening at 3¾ ips. This appears substantially due to an increase in tape hiss, partly as the result of treble boost in playback (obtained by resonating the playback head with a capacitor) and partly to smaller playback bass boost (which is equivalent to smaller treble cut). Here is a machine that is very well designed and constructed, yet gives scant support to the thought that 3¾ ips is suitable for high fidelity.

The Model 6 requires about 85 seconds to wind or rewind a 7-in. reel bearing 1200 feet of tape, which is about medium, which is to the good, preventing tape stretching and stresses leading to distortion. Professional machines usually take about 45 seconds; the average "hi-fi" machine is nearer two minutes.

Construction and Circuitry

Parts are of first quality, neatly laid out, and readily accessible on four printed circuit boards: record amplifiers, playback amplifiers, oscillator circuit, "magic eye" circuits. One motor is used, a hysteresis synchronous unit. Low-noise resistors and hermetically sealed capacitors are liberally employed. The power transformer has toroid windings to minimize its external hum field.

There are four separate amplifiers—two for recording and two for playback. Each amplifier has four triode stages, employing ECC83's, with the exception of ECC82's (12AU7's) for the last two stages of each playback amplifier. Feedback equalization is employed both in recording and in playback. For treble boost in playback at 3¾ and 1⅞ ips, resonating capacitors are switched across the playback head.

Some questions are raised by the equalization characteristics. In recording, a small coupling capacitor between the first and second stages produces a bass rolloff commencing (3 db down) at approximately 65 cps. Yet in the next stage, feedback equalization produces just enough bass boost to bring response up to or slightly above flat.

In playback, equalization is claimed to be NAB at 7½ ips, and a reading of the schematic indicates this is so. Measurement shows that equalization conforms to NAB above 1000 cps, except for about 3 db too much treble in the region of 10,000 to 14,000 cps, not a serious fault. But below 1000 cps there is substantially less bass boost than called for by NAB. Bass boost comes to a halt at about 100 cps, reaching a maximum of 14 db. The NAB curve calls for 19 db boost at this frequency, and 23 db at 50 cps.

The fact that response, nevertheless, is down only 3.5 db at 40 cps at 7½ ips makes it appear that the contour effect is employed to maintain low-frequency response. The contour effect refers to the fact that at low frequencies the whole playback head, particularly a small one, behaves in the same manner as the gap, augmenting response at some bass frequencies and decreasing response at others.

The Model 6 has a profusion of *internal* controls that permit the technically qualified individual to adjust performance to optimum. Each channel has the following five internal controls: recording level pot, providing the proper amount of signal to the record heads at a given distortion level; playback level pot, permitting the playback output signal to be equated to the input signal for A-B comparison; record-level indicator pot, causing the "magic eye" to just close at the 3 per cent harmonic distortion level; bias level pot; variable inductance, forming part of a resonant trap to keep bias current away from the "magic eye" tube and elsewhere. There are three more controls which affect both channels: bias frequency adjustment; variable capacitor to ground, to keep bias current out of the wrong places; balance control in the grid return of the push-pull oscillator, for obtaining the purest possible bias waveform and thereby minimizing noise in recording.

Accessories available for the Model 6 include microphones, a footpedal for remote start-stop control, a carrying case, and headphones. (*H.B.*) **L-21**

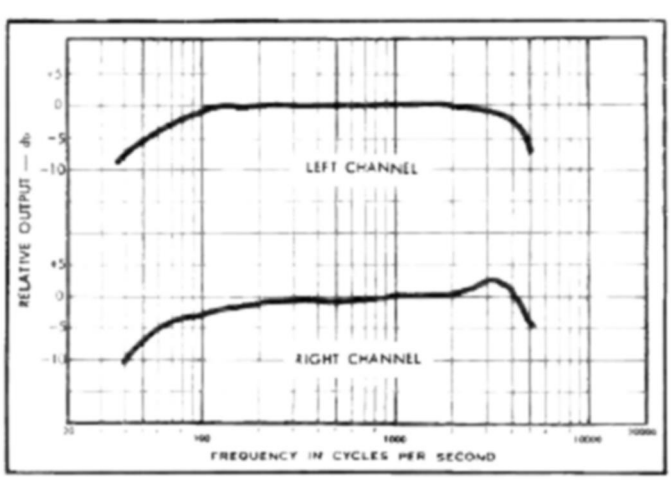


Fig. 4. Response curves for 1⅞ ips.

NOTE: *Recent shipments of the Model 6 have been corrected as to the low-frequency response at 7½ ips. Mr. Burstein will retest a later unit and the results will appear next month.* Ed.