BBC

Radio Engineering Services

SECTION : TEST ROOM

REPORT: R 440/1

WRF: 7177A

SUBJECT TEST CASSETTES

OBJECT Two of the line-up cassettes currently in use by R.E.S. are no longer available. An evaluation was made to determine suitable replacements. A kit of 7 cassettes was supplied by TDK and further cassettes were purchased from BASF and TEAC, these were compared with the BASF, TDK and Philips cassettes currently in use.

SUMMARY

On an overall assessment, it was observed that BASF cassettes produced the best and most consistent results of the samples tested.

Subject to further tests to ensure batch consistency, the BASF test cassettes perform to our satisfaction and with this proviso it is recommended that BASF test cassettes be used by R.E.S. in future.

A second report in this series will cover the results of these further tests.

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1. INTRODUCTION

The currently used test cassettes are:-

BASF HI-FI Calibration Cassette (Fe) for level and replay response.
TDK AC323 for replay azimuth at 6.3KHz.
Philips TC-FL 3 for wow and flutter at 3KHz.

Of these only the first is still available, the others being now discontinued by their manufacturers. This necessitated the finding of a new set of test cassettes to replace them.

The cassettes submitted for test were:-

TDK TT107, a kit containing seven cassettes:-

TT101 Level I
TT102 Level II
TT103 Dolby Level
TT201 Azimuth 8KHz
TT301 Frequency I Type I
TT302 Frequency II Type II
TT401 Flutter 3KHz

TEAC MTT211 Wow and Flutter (3KHz)
TEAC MTT114 Azimuth (10KHz)
TEAC MTT113C Azimuth (8KHz)
TEAC MTT256 Frequency Response
BASF Azimuth (6.3KHz)
BASF Wow and Flutter (3150Hz)
Philips TCA 6.3 Azimuth (6.3KHz)
Philips TCA 10 Azimuth (10KHz)
Philips TC-FL 3 Wow and Flutter (3KHz)
TDK AC323 Azimuth (6.3KHz)

The TEAC MTT256 Frequency Response cassette was compared with the BASF Hi-Fi currently in use. The latter is still readily available and the TEAC sample was examined for any advantages it may offer over the BASF.

The TDK TT107 kit was supplied by TDK on a trial basis free of charge. It is not actually commercially available. The individual test cassettes were produced by another Japanese company, A-Bex Laboratories Inc. of Tokyo. It is felt that it would probably be impractical to attempt to set up a supply agreement on such a basis and therefore these cassettes cannot be considered as possible replacements for our current range of test cassettes. They were however included in this survey out of interest.

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2. TEST EQUIPMENT

Two REVOX B710 cassette recorders, serial nos 3714 and 3724
BBC Propack II serial no 1014
EP14/1 Audio Test Set
B and K 2305 Chart Recorder
Woelke ME106 Wow and Flutter Meter
Amber 4400A Audio Test Set
Bryans 25000 A4 XY Plotter
B and K 2971 Phase Meter
Hewlett Packard 3580A Audio Spectrum Analyser
Tektronix 454A Oscilloscope

3. TEST RESULTS - COMMENTARY

All measurements were carried out using both Revox B710s and were repeated several times. Results were averaged in the event of variations. The outputs of the B710s were fed to a BBC Propack II and then to the appropriate measuring equipment for each tape.

For the frequency response and level cassettes, a B and K level recorder was used with 50mm wide paper and a 10dB potentiometer.

Azimuth was measured both with the oscilloscope and the B and K Phase Meter and Level Recorder, the recorder was used with a linear potentiometer and 100mm wide paper. To simplify the display of the results, the "B" leg was phase reversed. Therefore, the correct azimuth corresponds to a chart recording of 180°.

Both cassette machines were fully lined up before the tests and adjustments made where necessary for each type of cassette. The frequency response cassettes were individually adjusted for azimuth, each having an azimuth band at the beginning to enable this. If this is not done, frequency response varies between channels. N.B. These azimuth bands are only for use with their respective cassettes and are not necessarily correct for any other uses.

Azimuth Cassettes

The current Test Room reference cassette TDK AC324 (8KHz) was plotted, and after the tape had "bedded in" for the first few seconds, the tape's azimuth jitter was approx. $+/-36^{\circ}$ (worst case).

Two TDK AC323 (6.3KHz) cassettes gave the same azimuth readings. These are the azimuth test cassettes currently used by maintenance engineers.

The azimuth cassettes were first plotted out with the azimuth adjusted to the current TDK AC324 reference cassette, and then with the azimuth adjusted for the cassette under test. With the azimuth adjusted to the TDK AC324 reference, wide variations in azimuth readings were observed on other cassettes, with phase errors of up to 180°.

The BASF azimuth cassette was found to be the same as the TDK AC324 with a low jitter.

Both the TEAC MTT113C and MTT114 cassettes showed an azimuth error of almost 180° with the TDK AC324 reference.

The azimuth adjustment section of the TEAC MTT256 Frequency Response cassette showed an error of approx. 120° when compared with the TDK AC324 reference.

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Three samples of the BASF Hi-Fi Calibration Cassette were compared for azimuth with the TDK AC324 reference. Two of these produced a correctly phased output under these conditions, whilst the third produced a phase error of approx. 60°.

The Philips Azimuth cassettes proved to be unreliable, as the plots show, with large variations in azimuth over the length of the cassette.

The manufacturers' specifications are:

BASF: Recording angle is $90^{\circ} \pm 2$ minutes. (At 6.3KHz this is equivalent to a phase error between the two adjacent stereo tracks of $\pm 26^{\circ}$.)

TEAC: Recording angle is $90^{\circ} \pm 2$ minutes. (At 8KHz this is equivalent to a phase error between the two adjacent stereo tracks of $\pm 32^{\circ}$.)

On the above basis, the greatest phase difference one should expect between the BASF and TEAC cassettes is about 60°. This was clearly not the case.

If Test Room's TDK AC324 reference azimuth cassette (which has an azimuth similar to the AC323 cassettes in use) is taken as an absolute azimuth reference, then the only suitable replacement for the AC323 cassette is the BASF Azimuth Cassette (6.3KHz). This would obviously depend on the production spread on these which would have to be investigated.

The question of what is the correct absolute azimuth is a difficult one: there is no easy method of determining it accurately. Ultimately the replay head azimuth is directly related to the angle of the head gap in relation to the reference plane of the cassette deck. Measuring angles to an accuracy of 2 minutes of arc or thereabouts is not within the scope of Test Room.

Frequency Response Cassettes

All the frequency response cassettes tested produced similar results as can be seen from the charts. The corresponding levels on the various cassettes were within a spread of about 1dB. The production spread on the BASF cassettes was about 0.5dB. (4 samples were tested). The manufacturers' specifications are:

BASF:	31.5 Hz	- 6.3KHz	$\pm$ 0.5 dB
(Latest samples)	8	- 18 KHz	$\pm$ 1.0 dB
TEAC:	40 Hz	- 4 KHz	$\pm$ 0.5 dB
	6.3	- 14 KHz	$\pm$ 1.0 dB

The Revox B710 has a quoted replay frequency response (40Hz-16KHz) of $\pm$ 2dB w.r.t. 315 Hz and there are no replay equalisation controls. The charts indicate a difference in the response of the two machines. B710/3724 gives the closest agreement between tracks in terms of response.

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The TDK TT302 cassette (chrome equalisation 70us) is shown with both chrome and ferric equalisation to allow comparison with the table of correction values available.

The BASF Hi-Fi Calibration Cassette carries an initial "line-up" 315Hz tone recorded at 250nWb/m. Subsequent tones are recorded at -10dB for azimuth and -20dB wrt 250nWb/m for frequency response.

The TDK 301 and TEAC MTT256 cassettes' initial "line-up" tones are recorded at a quoted -4dB wrt 250nWb/m. This level is then referred to as "peak level" in the commentary on the TEAC MTT256 cassette, and azimuth and frequency response tones are quoted as recorded at -10dB or -20dB wrt this "peak level". The result of this is that all tones are recorded 4dB lower than on the BASF cassette, with a subsequent degradation of signal to noise ratio of 4dB.

Commentaries on the TEAC and BASF cassettes are now in English. On the earlier BASF cassettes the commentary was in German, introducing possible translation difficulties. The TDK 301 has no commentary and hence identification of frequencies is left to the user.

On the TEAC MTT256 sample examined it was observed that the commentary at one point was badly distorted and appeared to be "breaking up". No disturbance to the test tones was observed; however this cast doubts upon the quality and reliability of this cassette.

The BASF Hi-Fi Calibration Cassette carries frequency response tones of up to 18KHz.

The TEAC MTT256 cassette only carries tones of up to 14KHz. Other TEAC cassettes are available with higher frequencies.

The TDK 301 cassette carries tones of up to 16KHz with no commentary.

TDK Level cassettes

These cassettes are not normally required for line-up, since the frequency response cassettes are adequate for setting up the replay levels using the 250nWb/m band. The level is consistent over the whole length of the tape. The Dolby cassette is not required since an acceptable alternative method is currently used for adjusting the Dolby circuitry.

Wow and Flutter

From all the cassettes examined, the Philips TC FL-3 produced the highest weighted wow and flutter readings and hence the poorest results.

When first tested, the TEAC MTT211 cassette produced the lowest readings. However, after the cassettes had been spooled approximately 25 times the TEAC wow and flutter readings had increased whilst the BASF Wow and Flutter cassette remained constant. Both were within their respective manufacturers' specifications.

The TDK TT401 produced slightly higher readings than the BASF or TEAC cassettes. Spooling the cassette 25 times produced no appreciable degradation of wow and flutter.

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The frequency of the recorded tone was measured on each wow and flutter test cassette. This was found to be 0.4% high on the TEAC MTT211 and 0.5% high on the TDK TT401 and BASF Wow and Flutter cassette.

The manufacturers' specifications are:

BASF:	Speed accuracy	3150 Hz	± 0.2%
	Wow and Flutter - weighted		0.1%
	unweighted		0.3%
	(No other details are given for the method of measuring w & f.)		
TEAC:	Speed accuracy	3150 Hz	± 0.2%
	Wow and Flutter - weighted		0.05%
	unweighted		± 0.08%

4. CONCLUSIONS

Any of the wow and flutter cassettes tested offers a considerable improvement over the now obsolete Philips cassette. The BASF Wow and Flutter cassette appears to be the most consistent and reliable of the samples and it is recommended that this cassette be used as the replacement for BBC use in future - subject to further tests to determine the production tolerance spread.

Great variations were observed between the azimuth cassettes. No satisfactory method of determining which cassette was absolutely correct was found.

Since machines in service are at present set to the azimuth of the TDK AC323 cassette, it is recommended that the BASF azimuth 6.3 cassette is used as the replacement in order to maintain existing standards. This would be subject to further tests to determine the production tolerance spread.

The azimuth adjustment sections of the frequency response cassettes are only supplied in order to enable correct azimuth adjustment for that particular cassette before checking frequency response.

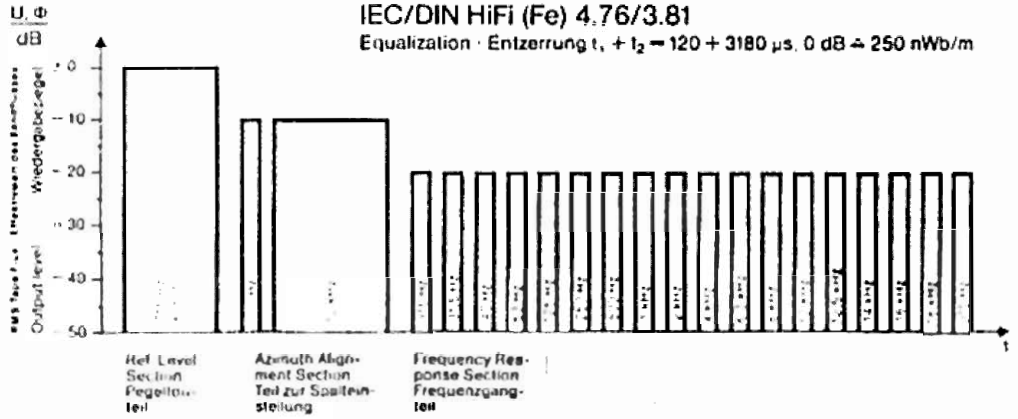
The BASF Hi-Fi Calibration Cassette (Fe) is still readily available. Neither the TEAC MTT256 nor the TDK TT101 cassettes offered any advantage over the BASF and it is recommended that the BASF Cassette is retained for BBC use.

The current prices are:

BASF:	Hi-Fi Calibration Cassette (Fe)		£83
	Azimuth (6.3KHz)		£32
	Wow and Flutter		£32
TEAC:	MTT-256	(Level & Freq. Response)	£69
	MTT-113C	(Azimuth)	£37
	MTT-211	(Wow and Flutter)	£41

BASF

HiFi Calibration Tape (Fe)
HiFi Bezugsband (Fe)



IEC/DIN HiFi Calibration Tape 4.76/3.81 (Fe)

Tape speed 1.7/8 i.p.s.; according to IEC 94*, part 1 and 2, and DIN 45 513, part 6, respectively; Equalization $t_1 + t_2 \triangleq 120 + 3180$ µs.

The BASF HiFi Calibration Tape 4.76/3.81 (Fe) will be used to adjust tape recorders at 4.76 cm/s (1.7/8 i.p.s.) tape speed and corresponds to IEC 94*, part 1 and 2, and DIN 45 513, part 6, respectively; the frequency response section however is extended up to 18 kHz. The vector of the magnetization is parallel to the tape edges and the deviation of this position is less than ± 2 min. This BASF HiFi Calibration Tape is full-track recorded and consists of three sections:

1. Reference Level Section: When playing back this section the reference level will be determined by adjusting the playback amplifier. The recorded wavelength corresponds to a frequency of 315 Hz ± 0.3 %. The RMS tape flux (ref. DIN 45 520, part 3) is 250 nWb/m ± 5 %. The harmonic distortion of the recorded signal is less than 3 %. The duration of the recorded signal is approximately 30 s. Using this reference level section, the playback amplifier is properly aligned when the voltages of playback and a certain voltage reference level are equal.

2. Azimuth Alignment Section: This section serves the purpose to align the azimuth of the playback and the record/playback head, respectively, as well as for a short test of the playback frequency response. Two different signals are recorded:

a) reference frequency 315 Hz ± 3 %, recording level about 10 dB below reference level, duration approx. 10 s.
b) a signal of 10 kHz ± 3 %, which gives the same output level as the 315 Hz signal when reproduced at correct equalization, duration approx. 60 s.

The playback head gap is vertically aligned by altering the position of the head during playback of the 10 kHz signal until reaching the maximum output voltage and simultaneously the least level variation.

When using the BASF HiFi Calibration Tape in a cassette, the reproducibility of the head azimuth position depends substantially on the mechanical guiding properties of the cassette. Therefore the above mentioned accuracy can not always be guaranteed.

3. Frequency Response Section: This section will be used to determine and align step by step the frequency response of the playback channel (ref. IEC 94, part 3, and DIN 45 511, respectively). The following frequencies are recorded: 315 Hz – 31.5 – 40 – 63 – 125 – 250 – 500 Hz – 1 kHz – 2 – 4 – 6.3 – 8 – 10 – 12.5 – 14 – 16 – 18 kHz – 315 Hz. Each signal will be announced and is recorded for approximately 10 s. The deviation of the nominal frequency is less than ± 3 %. The difference to the nominal level in the range from 31.5 Hz to 6.3 kHz is less than ± 0.5 dB and from 8 to 18 kHz less than ± 1 dB. The level of the 315 Hz signal is 20 dB less than the reference level. The flux "frequency response" corresponds to the impedance characteristic of a RC-parallel-network with a time constant of $t_1 \triangleq 120$ µs for the high frequencies and a RC-series-network with a time constant of $t_2 \triangleq 3180$ µs for the low frequencies. A physically incontestable method to determine the flux "frequency response" on calibration tapes is not known until now. For this reason the flux "frequency response" curves of calibration tapes are based on agreed substitute measurements by means of specified "calibration playback heads".

*according to the new IEC Standard, Prague 1981

IEC/DIN HiFi-Bezugsband 4,76/3,81 (Fe)

für Bandgeschwindigkeit 4,76 cm/s nach IEC 94* Teil 1 und 2 bzw. DIN 45 513 Blatt 6