MAGNETIC REFERENCE LABORATORY, INC.
165 Wyandotte Dr ♦ San Jose, CA 95123 ♦ Phone&FAX +1.408.227.8631 ♦ www.mrltapes.com

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3150-Hz Flutter and Speed Test Tapes

0 INTRODUCTION

These tapes contain a recording of a 3150-Hz sine wave, for use in measuring weighted peak flutter and tape speed according to current national and international standards.

See "Choosing and Using MRL Calibration Tapes for Audio Tape Recorder Standardization", MRL Publication Choo&U, for more information on choosing and converting between different equalizations and levels, as well as descriptions of other test signals that are available from MRL, notes on using Calibration Tapes, and MRL's specifications.

1 FLUTTER MEASUREMENTS

According to IEC Standard 368 and other standards [1],[2], the measurement of the weighted peak flutter of normal recording and reproducing systems should be made on one element only of the system—either the recorder or the reproducer, but not on both at the same time. This is for two reasons: First, it is desirable to separate the flutter due to the recording system from that due to the reproducing system because professional recordings are usually played on a different system from the one that they were recorded on. Second, the recording system flutter adds vectorially to that of the reproducing system, and under some practical (but not too common) conditions, the flutter measured while simultaneously recording and reproducing may be anywhere from nearly zero to twice the true flutter for one element.

One convenient way to separate the recording flutter from the reproducing flutter is to reproduce a flutter test tape whose flutter is less than the value specified for the reproducer to be tested. The weighted peak flutter inherent in MRL Flutter and Speed Test Tapes [3] is listed in the table below. This value is adequate for routine measurements of most professional audio transports, to determine that the weighted peak flutter meets the specifications given by the manufacturer and those given by the IEC Standard 94-1 [4]. For professional applications, this Standard calls for the weighted peak flutter of the recorder or reproducer at 190 mm/s (7.5 in/s) to be less than ±0.15 %, and at 380 and 760 mm/s (15 and 30 in/s) to be less than ±0.10 %.

In case you need to measure the flutter of a transport that has extraordinarily low flutter, you will not be able to use the MRL Flutter and Speed Test Tape. Instead use the alternate method given in the standards, namely to measure a recorder/reproducer by recording a 3150 Hz test frequency and subsequently reproducing this record several times, measuring in each case the total weighted peak flutter and calculating the arithmetic average value of these measurements.

In general you should not measure flutter while simultaneously recording and reproducing, for the reasons given above.

Descriptions and Specifications of Flutter and Speed Test Tapes

Tape Width	Tape Speed	Wtd. Pk. Flutter	Duration	Catalog Number	Price
6.3 mm **¼ inch**	95 mm/s **3.75 in/s**	±0.10 %	4 min	221-570-480-100	100 $
	190 mm/s **7.5 in/s**	±0.05 %	4 min	231-570-480-107	
	380 mm/s **15 in/s**	±0.03 %	4 min	241-570-480-104	
	760 mm/s **30 in/s**	±0.02 %	4 min	251-570-480-101	105 $
12.5 mm **½ inch**	95 mm/s **3.75 in/s**	±0.10 %	4 min	321-570-480-109	145 $
	190 mm/s **7.5 in/s**	±0.05 %	4 min	331-570-480-106	
	380 mm/s **15 in/s**	±0.03 %	4 min	341-570-480-103	
	760 mm/s **30 in/s**	±0.02 %	4 min	351-570-480-100	170 $
25 mm **1 inch**	95 mm/s **3.75 in/s**	±0.10 %	4 min	421-570-480-108	265 $
	190 mm/s **7.5 in/s**	±0.05 %	4 min	431-570-480-105	
	380 mm/s **15 in/s**	±0.03 %	4 min	441-570-480-102	
	760 mm/s **30 in/s**	±0.02 %	4 min	451-570-480-109	305 $
50 mm **2 inch**	190 mm/s **7.5 in/s**	±0.05 %	4 min	531-570-480-104	375 $
	380 mm/s **15 in/s**	±0.03 %	4 min	541-570-480-101	
	760 mm/s **30 in/s**	±0.02 %	4 min	551-570-480-108	420 $

Prices are in US $, and do not include shipping or applicable taxes. Prices may be changed without notice.

2 SPEED MEASUREMENT

The IEC Standard 60 094-3 [5] recommends measuring the "tape speed" by reproducing a recording of an accurately recorded wavelength. When we record the MRL Flutter and Speed Test Tape, the recorded wavelength is ±0.1 % of the true value with a tape tension into the head assembly of 0.8 newtons (N) for 6.3 mm tape width (1 newton = 3.6 ounces = 100 grams-force); 1.3 N for 12.5 mm width; 2 N for 25 mm width; or 3 N for 50 mm width; and a tension increase at the reproducing head of about 25 % due to the friction of the tape over the other heads and guides.

Note that the reproduced frequency, and therefore the apparent speed, depend on the *tape tension*. For instance, if a ¼ inch MRL Flutter and Speed test tape is reproduced on a constant-torque reproducer such as an Ampex 350, set on the "Large Reel" position, the tape tension will normally be 2.5 newtons instead of 0.8 newtons. Because of this high tension, even tho the tape is travelling exactly at the correct speed, the reproduced frequency will be about 3145 Hz, so the tape speed will appear to be 0.17% slow.

The IEC Standard 60 094-1 [4] calls for the speed to be its standard value ±0.2 % for professional systems, and ±2 % for home systems. Because the tape is a plastic medium which changes length during storage under tension, we can not guarantee that the recording that you receive from MRL after storage and temperature cycling will be better than ±0.5 % of true wavelength ("speed"). Other factors which limit measurement accuracy are discussed in [6].

For very accurate tape speed measurements, we recommend using a large pulley having an accurately-known diameter. This method is not mentioned by the IEC Standard 60 094-3, but is standardized by the NAB [7], and described in [6].

Some transports use such a pulley for tape playing- time measurements. For example, the Studer A-80, which we use to record these Flutter and Speed Tapes, uses a pulley whose circumference is exactly 190.5 mm (7.50 inches). The output of the sensor on that pulley is brought out to the back-panel Remote Control Connector (pin 36 = Return, pin 34 = "Clock"), as a 1 Hz square wave, 0 or 12 volts. We connect this through a 10:1 frequency divider to a period counter. Thus we can make a very accurate tape-speed measurement—one count in a 10.000 s period measurement is 0.01%.

3 RECORDED LEVEL AND EQUALIZATION

Since the recorded level and equalization on the tape are not important for flutter and speed measurements, only one recording is available for each tape width and speed; we have chosen to use 250 nWb/m relative to the IEC1 equalization.

REFERENCES

NOTE: The papers by J. G. McKnight are available from MRL on request, without charge. The national and international standards are available for purchase from your national standards organization—for instance, in the USA, the American National Standards Institute (ANSI) in New York City; in Britain, the British Standards Institute (BSI); etc.

[1] Flutter measuring methods and the technical requirements for flutter meters are given in the following standards: IEC 368, AES6-1982 (originally IEEE Std 193-1971), CCIR Recommendation 409-2, and DIN 45 507. (Altho the texts are different, the methods and technical requirements are essentially identical.) A complimentary copy of AES6 is available at

http://www.aes.org/publications/standards/courtesy.cfm?ID=15

[2] For a summary of the flutter measurement standards, see John G. McKnight, "The New Standard for Weighted Peak Flutter Measurements", *db, The Sound Engineering Magazine* (1974 January), p 28...30 [this paper is a revised version of the same author's "Weighted Peak Flutter Measurement...", *Jour. Audio Eng. Soc.* Vol. 19, p 859...861 (1971 November)]. These papers cite other papers which give the technical basis for the standards.

[3] The recording and reproducing flutters on MRL's equipment are approximately equal and random. Therefore the amount due to each process is approximately 70 % of the combined value, and this "70 % of the combined value" is reported in our table.

[4] IEC Standard 60 094-1 (formerly called 94-1), "Magnetic Tape Sound Recording and Reproducing Systems, Part 1: General conditions and requirements", Fourth Ed. (1981). Section 10 gives specifications for flutter and for speed.

[5] IEC Standard 60 094-3 (formerly called 94-3), "Magnetic Tape Sound Recording and Reproducing Systems, Part 3: Methods of measuring the characteristics of recording and reproducing equipment for sound on magnetic tape", First Ed., (1979). Section 11 gives speed-measurement methods; Sec. 11.1.1, Method B, specifies using a signal recorded on a tape.

[6] John G. McKnight "Speed, Pitch, and Timing Errors in Tape Recording and Reproducing", *Jour. Audio Eng. Soc.* Vol. 16, p 266...274 (1968 July), is available at http://www.flash.net/~mrltapes/mcknight_speed.pdf

[7] NAB Standard "Magnetic Tape Recording and Reproducing (Reel-to-Reel)" (1965 April), Washington DC, USA, *National Association of Broadcasters, Engineering Department.* See Annex A, "Methods of Speed Measurement".