EXPLANATION OF MRL CATALOG NUMBERS

MRL Catalog Numbers come in two flavors: 6-digit numbers and 12-digit numbers. The "Multifrequency" Calibration Tapes (see MRL Publication 101) all have 6-digit numbers.

Because 6 digits are not enough to uniquely identify all of the Calibration Tapes that MRL makes, everything else has a 12-digit number.

6-DIGIT CATALOG NUMBERS

The 6-digit numbers are of the form: "21J205".

The first 4 digits have specific meanings; the last two are arbitrary.

The meanings are assigned as follows: "MTSFXX"

where:

M designates the medium width and special characteristics (for instance, back-lubricated),

T designates the test signals on the tape (now always a "1", because we now use the 6-digit series only for the Multifrequency Calibration tapes; all other test signals are designated with 12-digit numbers),

S designates the tape speed.

F designates the tape reference fluxivity ("level") of the recording, and

XX is an arbitrary number that now only designates the equalization.

MTSFXX
MEDIUM TABLE

M	Medium Nominal Width		Special Requirements
2	6.3 mm	0.25 in	
3	12.5 mm	0.5 in	
4	25 mm	1 in	
5	50 mm	2 in	
6	6.3 mm	0.25 in	Cart. tape (lubricated)

NOTE: "Nominal width" is the *name* by which the width is designated; for the standard widths, see [1] or [2].

MT**S**FXX
SPEED TABLE

S	Tape Nominal Speed	
F	95 mm/s	3.75 in/s
T	190 mm/s	7.5 in/s
J	380 mm/s	15 in/s
L	760 mm/s	30 in/s

NOTE: "Nominal speed" is the *name* by which the speed is designated; for the standard speeds, see [1], [2], or [3].

M**T**SFXX
TEST SIGNALS TABLE

T	Test Signals Recorded
1	Multifrequency (Level set, Azimuth, Tones at octaves from 31.5 Hz to 8 kHz; 1/3 octaves to 20 kHz

MTS**F**XX
FLUXIVITY TABLE

F	Reference Fluxivity	Applications
0	160 nWb/m	NAB Broadcast Cart Standard (but many now use 250 nWb/m instead with modern tapes)
1	200 nWb/m	For use when recording on "General Purpose" (consumer) blank tape. Use in place of old "Ampex Operating Level" (185 nWb/m), which is 1 dB lower level
2	250 nWb/m	For use when recording on "Mastering" blank tape such as Quantegy 406
3	G320 nWb/m	Used mainly in Europe, to match level recorded on German (BASF and AGFA) Calibration Tapes
4	355 nWb/m	For use when recording on "Mastering" blank tape such as Quantegy 456 and Emtec 911
5	500 nWb/m	For use when recording on "Mastering" blank tape such as Quantegy 499 or GP9 and Emtec 900

MTSF**XX**

The last three digits ('FXX' above) were originally intended to be a *unique* number for each (of 1000) different Calibration Tapes, in order to act as a double-check on the catalog number. But since the 'F' was used for reference fluxivity, it left only 'XX' which would be 100 possible items.

This was adequate for the Multifrequency Calibration Tapes (our first product), and the Fast Sweep Calibration Tapes, and they were given unique values of 'FXX'. When, however, we introduced other test signals, we clearly didn't have enough digits, so we re-used the 'FXX' values. So the last two digits became *purely arbitrary*. Now that only the Multifrequency tapes use the 6-digit numbers, the last two digits only designate the equalization, but for historical reasons they don't follow any pattern.

At first Special Calibration Tapes were given 'S-NNN' catalog numbers, where 'NNN' was an arbitrary serial number. It eventually became apparent that this was ineffective, because there was neither any relationship between the 'S' number and the format (width, speed, and equalization) nor between the 'S' number and the test signals.

So we devised a 12-digit numbering system (described below) which could uniquely describe each Calibration Tape. It worked fine for Specials, but when we proposed using 12-digit numbers for everything, our dealers and customers said "Oh no! Not 12-digit part numbers!". So we have retained the original 6-digit catalog numbers for all of the Multifrequency Calibration Tapes that already had 6-digit numbers, and we have used the 12-digit numbers everything else.

12-DIGIT CATALOG NUMBERS

The 12-digit numbers are of the form: "233-101-460-114".

Each of the first eleven digits specifies some particular characteristic of the calibration tape; the twelfth is a "check digit" so we can detect errors of transmission or transcription of the numbers.

The meanings are assigned as follows: "MSE-CVV-FFT-PDX", where:

M designates the medium width and special characteristics (for instance, back-lubricated),

S designates the tape speed,

E (in conjunction with S) designates the equalization standard followed,

C designates the contents of the tape [multifrequencies (also known as spot frequencies), fast- or slow-swept frequency, single standard signal, white or pink noise, etc.],

VV (in conjunction with C) designates the particular version of those contents (for instance, the frequency of single standard signal etc.),

FF designates the reference fluxivity ("level") of the tape,

T designates whether any fringing compensation has been applied in recording, and, if compensated, the intended reproducer track width,

P designates the package (reel, hub, cartridge, etc),

D designates the approximate duration (playing time) of the tape, and

X is the check digit.

MRL Calibration Tapes are designed and manufactured to conform to the requirements of US and International Standards; see the References at the end of this catalog.

MSE-CVV-FFT-PDX
MEDIUM TABLE

M	Medium Nominal Width		Special Requirements
0	3.8 mm	0.15 in	(Not available from MRL)
1	6.3 mm	0.25 in	Cart. tape (lubricated)
2	6.3 mm	0.25 in	
3	12.5 mm	0.5 in	
4	25 mm	1 in	
5	50 mm	2 in	

NOTE: "Nominal width" is the *name* by which the width is designated; for the standard widths, see [1] or [2].

M**S**E-CVV-FFT-PDX
SPEED TABLE

S	Tape Nominal Speed	
0	24 mm/s	0.94 in/s
1	48 mm/s	1.88 in/s
2	95 mm/s	3.75 in/s
3	190 mm/s	7.5 in/s
4	380 mm/s	15 in/s
5	760 mm/s	30 in/s
9	Not Specified or Multi-speed	
C	244 mm/s (Video "C")	9.6 in/s

M**SE**-CVV-FFT-PDX
EQUALIZATION TABLE

	SE	Transition Frequencies F_t	Transition Time Constants t_t	Transition Wave Number k_t
FOR SPEED 2 (95 mm/s, **3.75 in/s**)				
21	IEC and NAB	50 Hz 1800 Hz	3180 µs 90 µs	3.3 km^{-1} 117 km^{-1}
22	Teac EE	50 Hz 3150 Hz	3180 µs 50 µs	3.3 km^{-1} 210 km^{-1}
FOR SPEED 3 (190 mm/s, **7.5 in/s**)				
30	Constant Flux			
31	IEC1 (= IEC, CCIR, DIN)	0 Hz 2240 Hz	∞ µs 70 µs	0 km^{-1} 75 km^{-1}
32	NAB Cart and IEC Cart	0 Hz 3150 Hz	∞ µs 50 µs	0 km^{-1} 105 km^{-1}
33	NAB and IEC2	50 Hz 3150 Hz	3180 µs 50 µs	1.67 km^{-1} 105 km^{-1}
34	CCIR-1953 (also IEC & DIN)	0 Hz 1600 Hz	∞ µs 100 µs	0 km^{-1} 52.5 km^{-1}
35	Teac EE	50 Hz 4500 Hz	3180 µs 35 µs	1.67 km^{-1} 150 km^{-1}
FOR SPEED 4 (380 mm/s, **15 in/s**)				
40	Constant Flux			
41	IEC1 (= IEC, CCIR, DIN)	0 Hz 4500 Hz	∞ µs 35 µs	0 km^{-1} 75 km^{-1}
42	(not standardized)	0 Hz 3150 Hz	∞ µs 50 µs	0 km^{-1} 52.5 km^{-1}
43	NAB and IEC2	50 Hz 3150 Hz	3180 µs 50 µs	0.83 km^{-1} 52.5 km^{-1}
44	Proposed Studio Master, & Pacific Rec & Eng Cart	0 Hz 6300 Hz	∞ µs 25 µs	0 km^{-1} 105 km^{-1}
45	Nagra Master	50 Hz 11800 Hz	3180 µs 13.5 µs	0.83 km^{-1} 195 km^{-1}
FOR SPEED 5 (760 mm/s, **30 in/s**)				
50	Constant Flux (Ampex 201 & 301)			
51	AES and IEC2	0 Hz 9000 Hz	∞ µs 17.5 µs	0 km^{-1} 75 km^{-1}
52	Historical IEC1 (= DIN)	0 Hz 4500 Hz	∞ µs 35 µs	0 km^{-1} 37.5 km^{-1}
53	Historical DGG	0 Hz 6300 Hz (approx*)	∞ µs 25 µs (approx*)	0 km^{-1} 52.5 km^{-1}
FOR "SPEED 9"				
90	Special (or no) equalization; playable at any speed			
99	Multiple speeds, equalizations, or both; determined by Program Number ("CVV")			

* Historical DGG is actually ∞ µs 27 µs

NOTES:

The designation E for equalization depends also on the speed S; therefore the number for S is repeated here.

The equalization standards of IEC [1], NAB [2], [3], and AES [4] specify the low-frequency point at which the standard tape flux has risen 3 dB, and the high-frequency point at which the standard tape flux has fallen 3 dB. This information is usually given either as the transition frequencies F_t, or as the transition "time constants" τ_t. The conversion formulas are given below.

The table also gives a "transition circular wavenumber", k_t, in thousands of reciprocal meters [km^{-1}]. (The circular wavenumber is simply 2π times the reciprocal wavelength.) Recordings at different speeds with the same transition wavenumber have the same fluxivity versus wavelength, and so — as far as "equalization" is concerned — can be played at any of those speeds.

Conversion formulas: (s is tape speed in meters per second)

$$F_t = 1/(2\pi\tau_t) = k_t s/(2\pi) \qquad \tau_t = 1/(2\pi F_t) = 1/(k_t s) \qquad k_t = 2\pi F_t/s = 1/(\tau_t s)$$

MSE-CVV-FFT-PDX

The detailed Contents and Version (Programs) Table is published as a separate document which is updated from time-to-time as we add new Programs.

CONTENTS AND VERSION (PROGRAMS) SUMMARY TABLE

CVV	Test Signals Recorded
100...199	Multifrequency (Level set, Azimuth, Tones at octaves from 31.5 Hz to 8 kHz; 1/3 octaves to 20 kHz
300...349	Fast-swept frequency, 500 Hz ... 20 kHz in 100 ms, repeated
400...419	Slow-swept frequency
700...799	Broadband random noise, "white" spectrum
800...899	Broadband random noise, "pink" spectrum

NOTES to the MSE-CVV-**FF**T-PDX

REFERENCE FLUXIVITY TABLE (table on the next page)

The de facto reference fluxivity in the US is the "Ampex Operating Level", which is 185 nWb/m at 700 Hz, corresponding to 180 nWb/m at 1000 Hz with the NAB equalization at 7.5 and 15 in/s. This column above has been shaded on the table for emphasis. When a tape fluxivity level is given without a specified reference fluxivity, it is almost certainly this value.

Different values of the flux per unit track width (called fluxivity, Φ/w in symbols) are used to set the program level meter to its "reference deflection" (0 dB) point. The optimum fluxivity for this purpose depends on the recording system subsequently to be used: the tape type (general purpose, high output, etc), tape speed, equalization standard used, recording application (desired compromise of distortion and noise), and type of program level meter ("vu" meter, peak program meter, etc).

The table below uses the R20 preferred numbers [5], which correspond to fluxivity levels in 1 dB steps.

Fluxivity $\Phi/w = 10^{(FF)/20}$ nWb/m, and Fluxivity Level FF = 20 log [(Φ/w)/(1 nWb/m)]; where FF is an integer, and Φ/w is conventionally rounded according to the R20 series of preferred numbers [5].

MRL fluxivity values are as measured according to the AES7-2000 Standard [6]. Recent research [7] has shown that the tape flux measurements made by the German Standard measurement method [8] agree with AES7, but that the original German measurements made in apprximately 1956 were 10 % in error. The fluxivity on the modern German Calibration Tapes continues this 10 % error – that is, the current German tapes are consistent with the older German tapes, and the MRL Calibration Tapes with fluxivity values of G250, G320, and G510 nWb/m are consistent with the old German measurements.

REFERENCE FLUXIVITY USAGES

NOTE: All recording level recommendations below assume the use of a "Standard Volume Indicator" ("vu meter") for monitoring the recording level.

A 160 nWb/m is standardized for broadcasting cartridge use by the NAB [3] and the IEC [1], but actually 250 nWb/m is now usually used with modern high-output cartridge tape.

B 180 nWb/m is the "Ampex Operating Level" at 1000 Hz, corresponding to 185 nWb/m at 700 Hz when the transition frequency is 3150 Hz. It is suitable for recording on tapes with a remanence fluxivity around 1000 nWb/m, such as consumer-type blank tapes.

C 200 nWb/m has been used by MRL. It is also suitable for consumer-type blank tapes (see B).

D 224 nWb/m according to the AES7 Standard measurement [6] corresponds to G250 nWb/m, as described above. It is seldom used.

E 250 nWb/m is also called "+3 dB elevated operating level re 180 nWb/m." It corresponds to 260 nWb/m at 700 Hz when the transition frequency is 3150 Hz. It us suitable for recording on tapes with a remanence fluxivity around 1400 nWb/m, such as Quantegy 406.

F 280 nWb/m according to the AES7 Standard measurement [6] corresponds to G320 nWb/m, as described above. This fluxivity is generally used as a reference for tape measurements in DIN and IEC standards. It is generally not used by sound recording studios (even in Europe) for setting actual sound recording references.

G 355 nWb/m is also called "+6 dB elevated operating level re 180 nWb/m." It corresponds to 370 nWb/m at 700 Hz when the transition frequency is 3150 Hz. It is suitable for recording on tapes with a remanence fluxivity around 2000 nWb/m, such as Quantegy 456 and Emtec 911.

H 450 nWb/m according to the AES7 Standard measurement [6] corresponds to G510 nWb/m, as described above. This fluxivity is used by German broadcasters when recording in the stereo format, to get level compatibility with mono recordings that use the G320 nWb/m reference fluxivity.

I 500 nWb/m is also called "+9 dB elevated operating level re 180 nWb/m." It is suitable for recording on tapes with a remanence fluxivity around 2800 nWb/m, such as Quantegy 499 and GP-9, and Emtec 900.

MSE-CVV-**FF**T-PDX
REFERENCE FLUXIVITY TABLE

FF	Reference Fluxivity/ [nWb/m]	Usage	Fluxivity Level/[dB] Referred to:							
			160 nWb/m	180 nWb/m	200 nWb/m	224 nWb/m G250	250 nWb/m	280 nWb/m G320	320 nWb/m	355 nWb/m
30	32		-14	-15	-16	-17	-18	-19	-20	-21
31	36		-13	-14	-15	-16	-17	-18	-19	-20
32	40		-12	-13	-14	-15	-16	-17	-18	-19
33	45		-11	-12	-13	-14	-15	-16	-17	-18
34	50		-10	-11	-12	-13	-14	-15	-16	-17
35	56		-9	-10	-11	-12	-13	-14	-15	-16
36	63		-8	-9	-10	-11	-12	-13	-14	-15
37	71		-7	-8	-9	-10	-11	-12	-13	-14
38	80		-6	-7	-8	-9	-10	-11	-12	-13
39	90		-5	-6	-7	-8	-9	-10	-11	-12
40	100		-4	-5	-6	-7	-8	-9	-10	-11
41	112		-3	-4	-5	-6	-7	-8	-9	-10
42	125		-2	-3	-4	-5	-6	-7	-8	-9
43	140		-1	-2	-3	-4	-5	-6	-7	-8
44	160	A	0	-1	-2	-3	-4	-5	-6	-7
45	180	B	+1	0	-1	-2	-3	-4	-5	-6
46	200	C	+2	+1	0	-1	-2	-3	-4	-5
47	224 G250	D	+3	+2	+1	0	-1	-2	-3	-4
48	250	E	+4	+3	+2	+1	0	-1	-2	-3
49	280 G320	F	+5	+4	+3	+2	+1	0	-1	-2
50	315		+6	+5	+4	+3	+2	+1	0	-1
51	355	G	+7	+6	+5	+4	+3	+2	+1	0
52	400		+8	+7	+6	+5	+4	+3	+2	+1
53	450 G510	H	+9	+8	+7	+6	+5	+4	+3	+2
54	500	I	+10	+9	+8	+7	+6	+5	+4	+3
55	560		+11	+10	+9	+8	+7	+6	+5	+4
56	630		+12	+11	+10	+9	+8	+7	+6	+5
57	710		+13	+12	+11	+10	+9	+8	+7	+6
58	800		+14	+13	+12	+11	+10	+9	+8	+7
59	900		+15	+14	+13	+12	+11	+10	+9	+8
60	1000		+16	+15	+14	+13	+12	+11	+10	+9

MSE-CVV-FF**T**-PDX
TRACKS TABLE

T	Number of Recorded Tracks, and Fringing Compensation Used
0	Full-track recording, no fringing compensation applied in recording.
1	Full-track recording, recorded with fringing compensation for reproduction with a 1- mm-wide reproducing head, as used for the following formats: 3 T and 4 T on 6.3 mm tape width; 8 T on 12.5 mm width; 16 T on 25 mm width; 24 T on 50 mm width.
2	Full-track recording, recorded with fringing compensation for reproduction with a 2- mm-wide reproducing head, as used for the following formats: 2 T on 6.3 mm width; 4 T on 12.5 mm width; 8 T on 25 mm width; 16 T on 50 mm width.
3	
4	
5	Full-track recording, recorded with fringing compensation for reproduction with a 0.5-mm-wide reproducing head, as used for the following formats: 4 T on 3.8 mm width; 8 T on 6.3 mm width.
6	
7	
8	For use with broadcasting cartridge systems: Full-track recording,“cue” track erased. No fringing compensation applied in recording (same as “0” above) .
9	For use with broadcasting cartridge systems: Full-track recording, “cue” track erased. Recorded with fringing compensation for reproduction with a 2-mm-wide reproducing head (same as “2” above), as used for “Mono” carts (2 T on 6.3 mm width). Less than 1 dB error when used with a 1-mm-wide reproducing head, as used for “Stereo” carts (3T on 6.3 mm width).

MSE-CVV-FFT-**P**DX
PACKAGE TABLE

P	Package
0	Special
1	Reel & box
2	Hub
3	Audiopak AA-4 NAB Broadcasting Audio Cart
4	3M ScotchCart2 NAB Broadcasting Audio Cart
5	Other types of NAB Broadcasting Audio Carts
6	
7	
8	Computer Reel
9	Reel and Box, with Special Tape Requirement

MSE-CVV-FFT-P**D**X
DURATION TABLE

D	Approx. Total Duration of Tape/[minutes]
D	1.5
E	2
F	3
0	4
1	5.7
2	8
3	11.3
4	16
5	22.6
6	32
7	45
8	64
9	90
A	128
B	181
C	256

NOTE: Duration in minutes = $4(2^{D/2})$, where D is the duration code in hexadecimal, and duration D is interpreted as -3, E as -2, and F as -1.

REFERENCES

[1] IEC Standard: Publication 60094-1 “Magnetic Tape Sound Recording and Reproducing Systems”, Part 1 “General Conditions and Requirements”, 4th edition, 1981.

[2] (US) National Association of Broadcasters: NAB Standard for Reel-to-Reel Recording and Reproducing, 1965.

[3] (US) National Association of Broadcasters: NAB Standard for Cartridge Tape Recording and Reproducing, 1985/1986.

[4] Audio Engineering Society “Proposed Recommended Practice” (for 760 mm/s = 30 in/s Recording Equalization), *Jour. Audio Engineering Society*, vol 19, nr 1, p 68, (1971 Jan).

[5] International Standards Organization: ISO 3, “Preferred Numbers: Series of Preferred Numbers”.
ISO 17 “Guide to the Use of Preferred Numbers and of Series of Preferred Numbers”.
ISO 497, “Guide to the Choice of Series of Preferred Numbers and of Series Containing More Rounded Values of Preferred Numbers.”
American National Standards Institute: ANSI Z17.1, “Preferred Numbers”.

[6] Audio Engineering Society Standard: AES7-2000, “Method of Measuring Recorded Fluxivity of Magnetic Sound Records at Medium Wavelengths”. Single copies available at no charge from http://www.aes.org/standards/b_pub/aes7-2000.pdf .

[7] McKnight, John G. (Jay); Cortez, Benito E.; McKnight, Jeffrey A.; “Tape Flux Measurement Revisited”, *Jour. Audio Eng. Soc*., vol. 46, nr 10, pp. 845·858 (1998 Sep).

[8] German Standard DIN 45 520 “Method for Measuring the Absolute Magnitude and Frequency Response of the Flux on Magnetic Tape” translation in AES Journal, vol 46 nr 10, pp. 865·867 (1998 Sep).