



WORKING PROCEDURE MANUAL SPEAKER IDENTIFICATION & AUDIO-VIDEO ANALYSIS



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2022

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PREFACE

The analytical procedures for examination of forensic physical clue materials in forensic science laboratories involve a high degree of skill and expertise and play a significant role in a wide range of legal proceedings. The occurrence of errors in any of the forensic analytical activities is a serious matter for both the laboratories as well as for the end users. For the laboratory, it can lead to re-testing of samples, if available, and loss of the credibility of laboratory. The analytical techniques adopted by the scientist (s) for the forensic analysis may be one of the causes for this serious error.

The risk of committing error can be eliminated if the scientists undertake two or more independent validated techniques while undertaking forensic analysis of crime case exhibits in the laboratory. Essentially, the procedures adopted must conform to the quality, sensitivity, repeatability and reproducibility of the examination so that the chances of error are absolutely avoided. It is, therefore, one of the essential requirements of good laboratory practices to introduce a Laboratory Procedure Manual, which contains validated laboratory methods/techniques for forensic analysis of the exhibits. It is also necessary that all the Central/State Forensic Science Laboratories uniformly follow these manuals in the country.

Keeping in view the advancement in science & technology and use of various protocols & procedures in the international arena of forensic science, Directorate of Forensic Science Services (DFSS) has taken the initiative for preparing a systematic and comprehensive working procedure manual for the 'Forensic Ballistics' to bring uniformity and standardization in the examination methods. In this regard, this Directorate formed Scientific Working Groups, comprising eminent forensic scientists of the CFSs and FSLs for each forensic discipline to compile forensic analytical techniques in the form of Laboratory Procedure Manuals. Several meetings were conducted with detailed deliberations among the scientists at National level and finally the manual has been prepared /updated in the present form.

I am sure that this Laboratory Procedure Manual, which pertains to the discipline of Digital Forensics - 'Speaker Identification and Audio-Video Analysis' will help the Forensic laboratories to continue to follow standard and latest updated procedures in the examination of clue materials as well as to adopt quality control/ quality assurance in the forensic practices and also for obtaining accreditation from NABL.

I understand that there is always a scope of improvement and perfection can be achieved with collective efforts, therefore, stakeholders are welcome to give their feedback and suggestion, if any, in this regard.

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Index

Sr. No.	Chapter	Pages
1	Chapter 1	
	Guidelines for Forensic Voice Analysis for Speaker Identification	2
1.1	Significance and Scope	2
1.2	Procedure	2
	1.2.1: Handling of audio recording evidences	2
	1.2.1.1 Checking of parcel (s)	2
	1.2.1.2 Checking of seals	2
	1.2.2 physical examination of evidences	2
	1.2.2.1 Integrity checking of evidences	2
	1.2.2.2 Medium and mode of recording	3
	1.2.3 Nature of criminal offence	3
	1.2.4 Marking of speaker	3
	1.2.5 Checking for sufficiency of speech data	3
	1.2.6 Preparation of copies of recorded audio evidences	4
	1.2.6.1 Making of direct copy	4
	1.2.6.2 Making of enhanced copy	4
	1.2.6.3 Making of accuracy of copies	4
	1.2.7 Converting to digital format	4
	1.2.8 Signal enhancement	4
	1.2.9 Analysis	5
	1.2.9.1 Auditory analysis	5
	1.2.9.2 Instrumental analysis	6
	1.2.10 Report writing	7
	1.2.10.1 Positive identification	7
	1.2.10.2 Identification with high probability	7
	1.2.10.3 Probable identification	7
	1.2.10.4 Possible identification	7
	1.2.10.5 No opinion	7
	1.2.10.6 Possible elimination	7
	1.2.10.7 Probable elimination	8
	1.2.10.8 Elimination with high probability	8
	1.2.10.9 Positive elimination	8
	1.2.11 Limitations voice identification and elimination	8
	1.2.12 Precautions	8
	ANNEXURE – I	9
	ANNEXURE – II	9
	ANNEXURE – III	9
2	Chapter -2	11
	Guidelines for Forensic Audio Analysis	
2.1	Introduction	11
2.2	Scope	11
2.3	Procedure	11
	Exhibit handling	11
	Physical examination of Audio recording media	11
	Examination of Recorder & Peripherals	12
2.4	Examination for Authentication of audio recording	12
	2.4.1 Critical listening	12-13
	2.4.2 Waveform analysis	13
	2.4.3 Spectrographic analysis	13
	2.4.4 Examination of questioned Recorder	13
	2.4.5 Photo microscopic examination in case of analogue exhibits/ speech signals	13
	2.4.6 comparisons of audio recordings in terms of their contents	13
2.5	Interpretation of results	14
3	Chapter -3	15
	Guidelines for Forensic Video analysis	
3.1	Scope	17
3.2	Description of recording media	15
3.3	Procedure	15
	Physical examination of Camcorder/VCR/Mobile phones	15
	Physical examination of storage media	15
	Critical observation	15-16
	Instrumental analysis	16
	Last page	17-18

CHAPTER-1

Guidelines for Forensic Voice Analysis for Speaker Identification

1.1 SIGNIFICANCE AND SCOPE

Voice is encountered as evidence in offences like bribery/ intimidation/ kidnapping/ threat call/ hostile witness and tampered audio-recorded conversation. This procedure manual describes the recommended practices for handling, preparation and analysis of recorded evidence to be followed by forensic practitioners for speaker identification. The document also covers making direct and enhanced copy of the original evidence, preparation of speech exemplars, preliminary aural examination for determining sufficiency and quality of the speech exemplars and selection of clue words from verbatim/ non-verbatim.

1.2 PROCEDURE

1.2.1 Handling of audio recording evidences

1.2.1.1 Checking of parcel (s)

The parcels should be intact and should not have any sign of intentional mishandling. Number of parcels and contents must be verified whether they are in accordance with the forwarding memo or not.

1.2.1.2 Checking of seals

Seals on the parcels should be intact and must be similar to the attested specimen seals provided by the forwarding authority.

1.2.2 Physical examination of evidences

1.2.2.1 Integrity checking of evidences

In case the investigator has raised query on this issue, critical listening and waveform analysis must be followed by spectrographic analysis. All suspected altered points should be noted.

1.2.2.1.1 Physical damage to (or condition of) the reel/cassette

It is to be examined by checking for pry marks or damage to the screws that hold them together and shall be noted if it is found present.

1.2.2.1.2 Splices

It is to be checked either by naked eye or by magnifying glass and further each noise and period of silence, each click and bang are to be noted by listening to the recorded tape.

1.2.2.1.3 Length of the tape on reel

It is to be checked by playing at normal speed and checking the time as per specification, if required and any abnormality observed should be noted. Duration of the recording is to be fixed by playing at normal speed. For recording at speed other than the normal speed of recording, either it should be played on the playback system having same speed as the recording speed after determining speed of the original recording or should time wrapped to normal length of the recording.

1.2.2.1.4 Optical media

In case the recording media is an optical media (CD/DVD), care should be taken for not to expose the media under direct sunlight or a heat source. Any scratch or crack on the media should be photographed and further to be checked whether the media is useable.

1.2.2.1.5 Semiconductor Memory Chip

Now-a-days mobile phones, digital recorders and spy camera/recorders etc. are equipped with either internal or removable semiconductor memory (MMC, SD, Micro SD etc. cards) and can contain a voice recording. In such cases, its specifications are to be noted down. Any physical damage is to be photographed.

1.2.2.2 Medium and mode of recording

The medium like audiocassette (normal or micro), videocassette, CD or any other digital recording media is to be specified. Mode of the recordings, whether it is direct recording or it has been recorded through mobile and telephonic channel, hidden microphone/transmitter/ pocket recorder or from public loud speaking system should be noted.

1.2.3 Nature of the criminal offence

The nature of the criminal offence, whether it is bribery /intimidation /kidnapping/threat call/ bomb hoax / false alarm or any other kind of offence should be noted.

1.2.4 Marking of speaker

For marking of the speaker in the questioned recording, the starting words for each relevant speaker to be compared should be noted down in order to mark the speaker. If the starting word(s) or phrase(s) is/are intelligible, then the portions with clarity should only be noted. If the questioned recorded conversation is between a male speaker and a female speaker, either the male or the female speaker, whichever is the relevant speaker, can be marked. The speakers in specimen speech sample, is marked in the same way as questioned recording. The marking of speaker is solely dependent on the practitioner's convenience.

1.2.5 Checking for sufficiency of speech data

The first step is to evaluate the recording of the unknown voice in order to ensure that the recording has sufficient amount of speech and clarity in the required frequency range for analysis. The relative intensity of the recorded speech signal must be significantly higher than that of the environmental noise. The greater the number of obscuring events such as

noise, music, and other speakers, the longer the sample of speech must be. The sufficiency of the recorded speech should also be checked as compared to the specimen speech samples whether it is possible to obtain sufficient number of clue words that can be used for extraction of feature parameters.

1.2.6 Preparation of copies of recorded audio evidences

1.2.6.1 Making of direct copy

Duplicate copies are to be prepared on good quality cassettes using connectors and a tape recorder of higher range of frequency response, preferably of 20 Hz to 20 KHz. at suitable volume level and the playback speed. The copies are to be marked properly with exhibit number and cases numbers.

1.2.6.2 Making of enhanced copy

The recorded speech material is to be subjected to enhancement processes by following the enhancement procedure (refer section 2.8). Copy of the enhanced speech material is to be made on audiocassette by using connector or on CD whichever is convenient to the concern authority at the user's end of the enhanced copy. The enhanced copies are to be marked properly with exhibit number and cases numbers.

1.2.6.3 Checking for accuracy of copies

The working copies (direct/enhanced) should be checked for accuracy of its recordings, whether the copy is exact replica of original or not by auditory and spectrographic method. The auditory quality is to be checked by playing at normal speed. Total duration of the recording is to be compared with the original recording.

1.2.7 Converting to digital format

This is to be performed by using a suitable software package such as Gold Wave software or CSL (In case Gold Wave software to be used, the frequency response is to be checked). The sampling rate for digitization is to be at least 16 KHz and 16 bits quantization. High quality connectors should be used. During the digitization, desired volume level (below over saturation limit) and speed of the playback system should be maintained throughout the process. The complete recording on each side of the cassette should always be digitized in one run maintaining the same level throughout the recording duration.

1.2.8 Signal enhancement

If the practitioners feel necessary that the signal is to be subjected to the process of enhancement/noise cancellation for the purpose of either speaker identification or speech recognition, this is to be performed considering two different necessities.

If the speech signal is to be used for speaker identification, it should be limited to band pass filtering of desired frequency range followed by blowing up of speech signal by 5dB in each attempt. The desired frequency range is to be decided by the practitioner by examining both the questioned and specimen sample.

On the other hand, the process for noise cancellation should not be restricted only to band pass filtering alone. Other methods are to be applied for such circumstances and should be

decided by the practitioner himself on the basis of the analysis of noise embedded in speech signal.

1.2.9 Analysis

1.2.9.1 Auditory analysis

This analysis is based on short-term memory process and depends on the practitioner's capability of auditory perception and understanding of articulatory and acoustic phonetics. The approach involves following processes-

1.2.9.1.1 Segregation of speech samples

This is to be carried out by using a suitable software package like the Gold Wave software or CSL. In case, only one person in the conversation is the relevant speaker to be identified, then the speech samples for the relevant speaker is to be segregated from the recorded conversation and saved in a wave file. If two or more speakers in the conversation are relevant speakers, then speech samples of the each speaker should be segregated and saved on separate wave files. The practitioner should discard the portions of the speech signal spoken simultaneously by both the speakers and the portions having high level of distortion/background noise. The position of the speech signals in source as well as in target file should be noted in the format attached in Annexure-I. After complete segregation of the conversation, segregated wave file is to be stored in the computer with appropriate file name for further reference.

1.2.9.1.2 Phonetic transcription

Phonetic transcription is to be carried out, if required, for an unknown language. Linguistic transcription is to be carried out, if required, for a known language.

1.2.9.1.3 Linguistic and phonetic analysis

The linguistic features of the speaker like stylistic impression, delivery of speech, phonation, physiological pitch level and articulatory speech (qualitative flow of speech, quantitative flow of speech, plosive formation and nasality) are to be noted. The prosodic features like intonation, dynamics of loudness, speech rate, speech variation, striking time features and pause are also to be noted by taking care of the variability on the questioned/specimen speech sample. After listening the segregated wave files of each of the marked speakers, repeatedly, to identify similar and dissimilar linguistics and phonetic features, the linguistic and phonetic features are to be noted in the observation sheet attached in Annexure-III.

1.2.9.1.4 Temporal measurement

Speaking rate, phonation-time (P/T) ratio or speech-time (S/T) ratio is to be measured at appropriate places. Number, length and pattern of pause could be measured if felt necessary. Likewise, number length and patterns of speech burst if felt necessary could be measured.

1.2.9.2 Instrumental analysis

1.2.9.2.1 Selection of verbatim/non-verbatim words

Verbatim words available in segregated questioned and specimen samples are to be selected and as many as possible verbatim words are to be collected in separate wave files, i.e. one for questioned and other for specimen but at least there should be minimum of three repetitions for each verbatim word. There may be a situation where only one word in the sample is available, no repetition of the word is there and in such a case, a single word can be used as a non-verbatim word considering the intra-speaker variability. These non-verbatim words can be used as clue words. Care should be taken while selecting clue words from non-verbatim words. Only those non-verbatim words carrying comparable value should be used. The position of the speech signals of the verbatim/Non-verbatim words should be noted in the format attached in Annexure-II.

1.2.9.2.2 Selection of clue words

Similarly spoken words are to be identified from the verbatim words chosen and selected on separate file for questioned and specimen samples. There should be sufficient number of clue words/words segments between two voice samples to reach decision criteria. The selection of clue words from the non-verbatim words is solely dependent on the degree of similarity on pronunciation of the words under consideration based on auditory comparison. Those non-verbatim words or partially verbatim words showing dissimilarity in manner of pronunciation should not be made as clue-words. Clue words selected should be having different vowels at least five or six vowels. This process is solely dependent of the expertise and experience.

1.2.9.2.3 IPA marking

The clue words selected for analysis are to be transcribed by inserting the International Phonetic Alphabets (IPA) using CSL or any other suitable equipment, if felt necessary.

1.2.9.2.4 Spectrographic analysis

The selected clue words from questioned and specimen are to be analyzed using CSL or any other suitable equipment for extraction of feature parameters, which are solely dependent on clue words selected. Spectrographic pattern analysis using analytical wide-band and narrow band filters is to be performed for the clue-words. Formant marking technique can be used for low SNR samples. Linear predictive coding techniques should be used at a particular location of the vowel formant. In addition to this pitch contour, pitch (F_0) at a particular location should be used. Examination and comparison of formant frequencies and their band widths (shaping), formant transition, plosive gaps, plosive formation, gradient/slope, high frequency spectrum envelope characteristics, articulatory errors, onset time if measurable, duration of filtered vowel are to be considered and availability of features is based on the individual clue words selected.

1.2.9.2.5 Automatic approach

The selected clue words from questioned and specimen voice samples or the suitable portion of the segregated samples are to be subjected to measurement of acoustic features

using customized soft wares like, indigenously developed 'SpId' or 'LISIS'. The specimen sample is to be used for training the system and the questioned sample is to be used for identification as per system requirement.

The automatic approach is useful when there is involvement of large number of suspects (more than one) and text and language of questioned and controlled sample is different.

1.2.10 Report Writing

On the basis of auditory and spectrographic analysis, the conclusions are drawn in respect of speaker recognition as:

1.2.10.1 Positive identification

If 90% of all the comparable words are very similar aurally as well as spectrally, producing sufficient matching words (having more than 20 words segments) and each word must have three or more usable formants to the satisfaction of the expert (with explainable degree of similarity).

1.2.10.2 Identification with high probability

At least 80% of the comparable words (clue words) must be very similar aurally and spectrally, producing more than 10 matching words (having more than 15 word segments) and each word must have two or more usable formants.

1.2.10.3 Probable identification

At least 80% of the clue words must be very similar aurally and spectrally, producing limited number of matching words (having more than 15 word segments) and each word must have 2 or more usable formants.

1.2.10.4 Possible identification

At least 80% of the comparable words must be very similar aurally and spectrally, producing limited number of matching words (having more than 10 word segments) and each word must have 3 or more usable formants.

1.2.10.5 No opinion

Falls below, the probable identification or probable elimination confidence level and/or the examiner does not believe a meaningful decision is obtainable due to various limitations. Comparison that reveals aural similarities and spectral difference or vice versa must produce a no opinion decision.

1.2.10.6 Possible elimination

At least 80% of the comparable words must be very similar aurally and spectrally, producing limited number of matching words (more than 10 word segments), which do not match, and each word must have 3 or more usable formants.

1.2.10.7 Probable elimination

At least 80% of the comparable words (clue words) must be very similar aurally and spectrally, limited number of words (having more than 15 word segments), which do not match, and each word must have two or more usable formants.

1.2.10.8 Elimination with high probability

At least 90% of the comparable words (clue words) must be very dissimilar aurally and spectrally, producing more than 10 words (having more than 15 word segments), which do not match, and each word must have two or more usable formants.

1.2.10.9 Positive elimination

At least 90% of all the clue words must be very dissimilar aurally and spectrally, producing sufficient number of words (having more than 20 word segments), which do not match, and each word must have three or more usable formants.

i. [N.B. The opinion to be drawn is highly dependent on the practitioner's observation in collaboration with the linguistic, phonetic, acoustic features and also on some specific feature found on the recorded speech samples provided to the practitioner]

1.2.11 Limitations voice identification and elimination

- i. Disguise in speech samples poses a problem in speaker recognition process and the degree of disguise is decided by the practitioner and experts are trained to discard/disregard the disguised portions of speech sample.
- ii. The dissimilar text and language in the questioned and specimen are difficult to analyze.
- iii. Poorly recorded and too noisy samples are difficult to analyze.
- iv. Different channels/source of recording of questioned and controlled sample.

1.2.12 Precautions

- i. A copy of the questioned and controlled speech samples (whether analog or digital) should be made as a first step as soon as the parcel containing the exhibit is open and marked properly.
- ii. The audiocassettes/digital media containing the recorded questioned and specimen speech samples should be made safe from accidental pressing the recording button.
- iii. The audiocassettes/digital media should be played preferably on a high quality playback deck without recording option.
- iv. The audiocassettes/digital media should always be kept away from magnetic field.
- v. In case of analog speech sample, at the time of digitization, any change in the recording level or distortion in the sound quality may be due to misalignment of the recording head. It should be checked by adjusting the alignment of the recording head.

- vi. Suspected disguised speech should be dealt with care before drawing conclusion like elimination.

ANNEXURE-I

Segregation Format

Original File name:

Segregated Filename			Segregated Filename		
Original		Segregated	Original		Segregated
From	to		From	to	

ANNEXURE-II

Clue Word Selection Format

Clue words	Wavefile/exh:			Wavefile/exh:		
	Sampling file:			Sampling file:		
	From	To	Position on sampled file	From	To	Position on sampled file

ANNEXURE-III

Observation Sheet Format

1. The relevant speaker begins with the following words

Questioned Sample	Specimen Sample

2. Medium of recording

Questioned Sample	Specimen Sample

3. Recording mode

Questioned Sample	Specimen Sample

4. Nature of criminal offence

- Bribery/ intimidation/kidnapping/threat call/bomb hoax/ false alarm/others

5. Quality of speech sample

6. Linguistic features

- Stylistic Impression
- Delivery of speech
- Phonation
- Physiological pitch level
- Articulatory speech
 - Flow of speech (qualitative)
 - Flow of speech (quantitative)
 - Plosive formation
 - Nasality
- Prosodic analysis
 - Intonation pattern
 - Dynamic of loudness
 - Speech rate
 - Speech variation
 - Striking time features
 - Pauses

7. Voice impairment

(If Any) if Yes for a Positive Identification

8. Temporal measurement

- Sample duration

Questioned sample	Specimen sample

- Speaking rate

Questioned sample	Specimen sample

- Phonation – time P/T ratio and speech time S/T rate

Questioned sample	Specimen sample

- Pauses - number/length/patterns (if felt measurable)
- Speech bursts - number/length/patterns (if felt measurable)

- Spectrographic analysis

Questioned sample	Specimen sample

CHAPTER-2

Guidelines for Forensic Audio Analysis

2.1 Introduction

The audio recording required for checking integrity needs to maintain chain of custody. The guidelines for examination of integrity/ authenticity starting from receive of parcel(s) is crucial for laboratory examination procedure. Improperly packed or slightly suspicious parcels should not be accepted for examination. The parcel(s) containing recorded media having proper description of the exhibits and information about manner of obtaining the audio recordings should only be accepted. For referring to this laboratory for verification of integrity, the laid down criteria should be followed strictly. The analog audio recording(s) on standard/micro cassette and digital audio recording(s) in all formats are covered in this guideline.

2.2 Scope

The guidelines of forensic audio analysis covers: handling of audio recording media, physical examination, safety aspects, digitization, waveform analysis, spectrographic analysis and reporting.

2.3 Procedure

Exhibit Handling

Checking of parcel(s)

The parcels should be intact and should not have any sign of intentional mishandling. Number of parcels and contents must be verified whether they are in accordance with the forwarding memo or not.

Checking of seals

Seals on the parcels should be intact and must be matched with the attested specimen seals provided by the forwarding authority.

Chain of custody

Proper documentation of the chain of custody should be maintained.

Physical Examination of Audio Recording Media

The media of recording should be noted.

- a. **Audiocassette:** The condition of the record safety tab should be noted down. Colour and housing of the tape, winding position of the tape should also be noted down. Information related to the Make/Model of the cassette including the tape leader. The full length of the tape should be checked as per its specification and also for physical continuity.
- b. **CD:** In case the recording media is on CD, then the format and file size etc. should be noted down. Information related to type (CD-R or CD-RW), Make Brand with

serial number/batch number (if present), speed compatibility (1X-52X), capacity etc. to be noted down.

- c. **Mobile Phone:** In case the recording media is in mobile phone or SD Card, then the path, format and meta-data properties of the relevant file should be noted down. Call records of the relevant files, if telephonic.
- d. **Other Media:** Approximate safety measures have to be maintained for any other media like audio recording from videocassette/VCD/DVD/Chip/Hard drive. Physical observations related to safety aspects of the recording media is to be recorded. Physical examination of tape holder to be done in case of spool type recorder and whether recording tape was found in properly packed winding condition, should also be checked. In case of any media other than audiocassette or full track spool, physical pattern of media like videocassette, chip, hard drive etc. should be handled appropriately.

Examination of Recorder & Peripherals

Working condition of the recorder sent along with the media should carefully be checked with proper AC/DC source (as applicable). It is to be noted down whether any attempt of tampering/damage to the recording/erasing head and peripherals have been made. In case the recorder is not in playable/usable condition, its defective component(s) may be replaced with permission from the appropriate authority.

2.4 Examination for Authentication of Audio Recordings

2.4.1 Critical Listening

a. Direct playback of the tape

An analogue copy of the whole recording should first be made and kept under safe custody with proper labeling. The tape should be played back in the system in which it is actually recorded, if sent to the laboratory for examination otherwise it can be played back in a professional/semi-professional type playback system for exact reproduction of the recording. Importance is to be given for correct alignment of the reproducing head while playback. The recorded bands should be exactly perpendicular to the edge of the tape. Any deviation in perpendicularity of the record or reproduce head relative to the edge of the tape can result in a selected loss of output levels at different frequencies (6).

The change in the signal caused by the misalignment is given by the following ratio

$$R = [\sin (\pi W \tan a) / \lambda] / [(\pi W \tan a) / \lambda]$$

Where, W = width of record tract (inches)

A = misalignment angle (degrees or radian)

λ = Wave length of recorded signal (inches)

= V (tape speed in inches per second)/F (frequency in Hz)

The corresponding amplitude loss in dB is given by

$$A = 20 \log_{10} |R|$$

A good quality headphone should be used to listen to the contents. Any anomalies or artifacts or discontinuity in the recording are to be noted down and subjected to further study, as applicable the case may be.

b. Playback on digitalization

The analogue speech signal recorded on the cassette tape is to be digitized at the sampling rate of at least 22050 Hz and 16-bit quantization using suitable software like Audition/GoldWave/CSL/Multi Speech. The process of critical listening should also be performed on the digital form. In case of speaker identification to be carried out for speech contained in the audio tract of a video recording, the complete audio track has to be extracted and subjected to procedure as mentioned under *Procedure for Voice Analysis for Speaker Identification*.

2.4.2 Waveform analysis

Attention is to be made for uninterrupted and consistent content. Presence of gaps, dropouts, abrupt change in volume level, change in background/foreground noise/content, over recordings or any other perceptible aural/visual anomaly should be noted down pointing its exact time frame location. Consistency in record function signature should also be verified.

2.4.3 Spectrographic Analysis

Spectrographic study is to be carried out, if felt necessary for those portions where information regarding formant frequency & bandwidth of the part of speech or noise or record function signature are to be obtained. Wideband and narrowband spectrographs should be taken under spectrographic analysis.

2.4.4 Examination of the Questioned Recorder

The recorder start, stop and pause signature are to be produced on a fresh tape. Also a set of speech sample(s) is to be recorded using in-built/external microphone. The signatures so produced are to be compared with the questioned recording for ascertaining whether the questioned recording was done in the recorder.

2.4.5 Photo-microscopic Examination in case of analogue exhibits/ speech signal

Photo microscopic examination of the questioned tape may be carried out, if felt necessary. Test record function signatures should be produced in a fresh tape, in case the recording device is available and further subjected for examination under microscope. The better patterns of the record function signatures should be photographed or video graphed for later comparison with those record function signatures obtained from the questioned tape under examination.

2.4.6 Comparison of Audio Recordings in Terms of their Contents

The contents of two recordings can be compared provided the transcription is supplied. About 10 seconds of waveform from each of the recording should be tabulated with time stamp. The record signatures are also to be compared for whether the same or different

recorder is used for recording both. Information related to the saturation level, built-in or external microphone used during recording should be noted down.

1. Interpretation of results

While drawing opinion regarding the authentication of the recording, the Forensic Audio Analyst (FAA) should be free from any form of ambiguity. The FAA should not opine like certification that the recording is free from any form of intentional alteration and the recording is authentic. Instead, if it is free from any form of alteration, it is rather convenient to say that there is no indication of intentional alteration.

In case of originality to be decided in two situations: i) if the recording device is provided, FAA should not conclude that the recording device has been used to produce the audio rather FAA should opine that the recording device could have been used to record the audio. This can be done by comparing the test signatures and metadata properties available in the questioned recording to the test recording sample prepared by FAA. 2) If the recording device is not provided, the originality can only be decided if same start, stop signature are present throughout the recording and the audio is free of any form of suspected alteration.

CHAPER-3

Guidelines for Forensic Video Analysis

3.1 Scope

The guideline for forensic video analysis covers handling of video recording media, physical examination, safety aspects, digitization, location of transition points, waveform analysis, measurement of parameters related to video signal and reporting case studies of events and description of dynamic parts during recording.

3.2 Description of the Recording Media

In addition to checking of parcels and seals as mentioned in audio tape examination, information on the media & format of recording such as micro SD Card, Pen Drive, Mobile Phone, optical media like CD, DVD, VHS/VHS-C format, S-VHS format. Hi-8/ 8mm format, Digital 8 format, DV/Mini DV format, DVC series format, U-matic format, BetaCam series format etc. on magnetic tape, on hard disk or the recording is on an, etc. should be described. Type of video cameras used in recording to get ideas of S/N ratio.

3.3 Procedure

Physical Examination of Camcorder/VCR/Mobile Phones

Recording device such as Mobile Phones /Camcorder/VCR/VTR should be checked for any attempt that might have been made to tamper with the connecting pins of mobile, recording control servo system, head and peripherals, change of neutral density filters in cameras, tracking level in VCRs, tape guide adjustment in VCR, angle adjustment in audio and CTL head, leveling in cassette platform, change of master oscillator frequency etc.

Physical Examination of Storage Media

Physical continuity, deformation/scratches (if any) and length of the questioned tape under examination should be verified. In case of CD or other optical media, presence of any scratches or damage that is likely to be the cause of loss of data during playback should be noted down. Observation should also be made for whether fungus is present in the tape; one side bending of tape, which can affect audio/CTL level.

Critical Observation

Identification of Shots

Critical observation on a high-resolution video monitor should be done by playing the tape in appropriate playback system. Video shots should be identified along with observable distortions/transition effects, if any in the video content. This helps in predicting the sequence of events. Wave shape in CRO/waveform monitor is to be observed for TBC correction i.e. conformation for original recording. Continuity of the recording is also to be monitored for the whole recording.

Frame-by-frame Playback

Contents should be digitized and played back frame-by-frame in a non-linear workstation using appropriate software. A frame each from beginning and end of a shot should be extracted and documented with time stamping. Observation should also be made for unexpected change in color temperature of the consecutive scenes to know whether any editing has been done (added/deleted scenes), surrounding objects, number of persons etc. within a shot luminance and chrominance level of a person entering twice in different scenes are to be checked to get idea of continuity and the level of black burst should be monitored, specially at the transition points to get an idea of editing.

Media Information/ Meta Data Properties

Media Information/Meta Data properties such as file type, format, frame rate, MAC dates, Device information etc. for the relevant video files should be checked and noted

Instrumental Analysis

Instrumental analysis should be carried out for detection of transition points including those which otherwise have not been detected during critical observation. Luminance and chrominance of the video signal should be compared at the transition points for any doubt about the color temperature changes in two successive scenes including color depth by using a precise video measurement set. Waveform should also be observed and peak-to-peak voltage and other related parameters such as phase, burst amplitude etc. should be measured at these points. A cross pulse monitor should be used for comparison of two scenes in the same monitor. Time-based errors, capstan jitter & drum jitter etc. should be observed when felt necessary. For doubtful scene an amplified color burst signal should be examined to get idea of different equipments used after recording. Output of original camcorder should be compared with contents available in tape for ascertaining duplication/editing.

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Last Page

Formation of committees at National Level for formulation of SOPs and Manuals:

Background: In view of technological advancements in the scientific arena, the Standard Operating Procedures (SOPs) and Working Procedure Manuals, around which the technical and analytical exercise takes place in the laboratory in the examination of crime exhibits, needs periodical review to keep the laboratory updated.

For uniform SOP/Manuals and reporting pattern in all the CFSLS / State FSLs following committees were formed by JS (PM), MHA by including members from Central and State FSLs in the following areas:

Discipline	CFSL Member	Member
Biology/DNA	Dr. A. K. Sharma, Director, CFSL, Kolkata/Guwahati	1. Sh. Arun Sharma, Director, FSL, HP 2. Sh. Srikumar, Director, Chemical Examiner Lab, Thiruvananthapuram.
Chemistry/ Narcotics	Sh. K. M. Varshney, Coordinator, CFSL, Pune	1. Dr. R. K. Gupta, Director, FSL, Chhattisgarh. 2. Sh. B Shanmukham, Director, FSL, Puducherry. 3. Dr. Harsh Sharma, Director, FSL, Sagar (MP)
Explosives	Dr. Sukhminder Kaur, Coordinator CFSL, Pune	1. One officer from FSL, Delhi 2. One officer from FSL, Maharashtra
Toxicology	Dr. Vimukti Chauhan, SSO, CFSL, Chandigarh	1. Dr. K. V. Kulkarni, Director, DFSL, Maharashtra 2. One officer from FSL, Karnataka.
Ballistics	Sh. S. S. Baisoya, CFSL Chandigarh	1. Dr. D. K. Kaushal, Director, FSL, Haryana 2. Sh. N. P. Waghmare, Director, FSL, Goa 3. Dr. S. S. Das, Director, FSL, Odisha
Documents	Sh. M. C. Joshi, Dy. Director, CFSL, Chandigarh (Shimla Unit) and Dr. S. Ahmad, DFSS HQs., New Delhi	1. Ms. Deepa Verma, Director, FSL, Delhi
Psychology, Computer, Audio-Video	Dr. S. K. Jain, Director, CFSL, Chandigarh and Sh. M. Krishna, AD, CFSL, Hyderabad	Officers from FSL: HP, Delhi, Gujarat and Maharashtra
Crime Scene	Dr. M. Baskar, Dy. Director (Physics), CFSL, Chandigarh	1. Dr. Harsh Sharma, Director, FSL (MP) 2. Sh. R. K. Gupta, Jt. Director, FSL, Chhattisgarh

The officers of CFSLS will coordinate with the experts of State FSLs for convening of meeting(s) in the state and Central FSLs and finalization of SOPs and manuals.