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OSAC 2024-N-0005

Standard Guide for Minimum

Training Recommendations of

Iris Image Examiners

Facial & Iris Identification Subcommittee
Digital/Multimedia Scientific Area Committee (SAC)
Organization of Scientific Area Committees (OSAC) for Forensic Science



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OSAC Proposed Standard

OSAC 2024-N-0005 Standard Guide for Minimum Training Recommendations of Iris Image Examiners

Prepared by
Facial & Iris Identification Subcommittee
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Disclaimer:

This OSAC Proposed Standard was written by the Facial & Iris Identification Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science following a process that includes an [open comment period](#). This Proposed Standard will be submitted to a standard developing organization and is subject to change.

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56 **Standard Guide for Minimum Training Recommendations of Iris Image Examiners**

57 **1. Scope**

58 1.1 This guide defines a minimum set of topics for training of personnel who will conduct iris
59 image comparisons.

60 1.2 This standard does not purport to address all the safety concerns, if any, associated with
61 its use. It is the responsibility of the user of this standard to establish appropriate safety and
62 health practices and determine the applicability of regulatory limitations prior to use.

63

64 **2. Referenced Documents**

65 2.1 ISO/IEC 2382-37:2022 (en) Information technology – Vocabulary – Part 37: Biometrics

66 2.2 ASTM E2917-19a Standard Practice for Forensic Science Practitioner Training, Continuing
67 Education, and Professional Development Programs

68 2.3 **[placeholder]** ASTM WK72441 New Guide for Standard Guide for Developing Discipline
69 Specific Methodology for ACE-V

70

71 **3. Terminology**

72 3.1 Definitions:

73 3.1.1 Analysis, *n*: the first step of the ACE-V method. The assessment of an image to
74 determine suitability for comparison.

75 3.1.2 Comparison, *n*: the second step of the ACE-V method; the examination of two or
76 more samples to establish similarities and dissimilarities.

77 3.1.3 Evaluation, *n*: the third step of the ACE-V method; where an examiner assesses
78 the value of the details observed during the analysis and comparison steps and reaches a
79 conclusion. Ascertaining the value of dissimilarities and similarities between two images.

80 3.1.4 Iris Image, *n*: an image of a human eye that contains the iris which constitutes a
81 biometric sample of the human eye.

82 3.1.4.1 Discussion - Iris images will typically include features of the periocular region such
83 as eyelids, eyebrows, eyelashes, and canthi.

84 3.1.5 Iris Recognition System, *n*: an automated machine-based system used to
85 compare images based on iris characteristics and quantitatively assess their similarity.

86 3.1.6 Iris Image Comparison, *n*: an assessment of the similarities/dissimilarities of a
87 pair of iris images.

88 3.1.7 Iris Image Examiner, *n*: a person who conducts iris image comparisons.

89 3.1.8 Verification, *n*: (1) the final step of the ACE-V method; the review and independent
90 analysis of the conclusion of another examiner. (2) In a biometric system, determining the
91 validity of a biometric claim.

92 3.1.8.1 Discussion - Verification may be followed by some level of review as specified by
93 agency policy.

94

95 **4. Acronyms**

96 4.1 ACE-V: Analysis, Comparison, Evaluation, and Verification

97 4.1.1 Discussion - Methodology used by forensic practitioners primarily when
98 conducting feature comparisons.

99

100 **5. Significance and Use**

101 5.1 Achieving proficiency in iris comparison requires training. Training must cover the
102 topics necessary to establish competency for an iris image examiner. This document provides
103 minimum training topics for an iris image examiner curriculum.

104 5.2 The intended audience for this document includes all personnel involved in iris
105 image comparisons.

106 5.3 This document includes, as appendices, an example Recommended Reading list
107 and an example Training Program.

108

109 **6. Minimum Training for Iris Image Comparisons**

110 6.1 **History**

111 6.1.1 Beliefs about the iris throughout history

112 6.1.2 Contributions made by individuals to iris recognition

113 6.1.3 Landmark events and major deployments

114

115 6.2 **Biology**

116 6.2.1 Embryological and postnatal development

117 6.2.2 Iris and periocular structure

118 6.2.3 Stability of iris patterns

119 6.2.4 Differences between irises; variations in iris texture intra (same person) and inter
120 (different people)

121 6.2.5 Biological distortions

122

123 6.3 **Iris Image Recognition Systems**

124 6.3.1 Iris image acquisition

125 6.3.2 Image science basics

126 6.3.3 Iris image science basics

127 6.3.4 Function and use of iris algorithms

128 6.3.5 Performance assessments of iris recognition systems

129

130 6.4 **Human Iris Comparison**

131 6.4.1 The relationship between human iris image comparison and iris recognition
132 systems

133 6.4.2 Visible iris and periocular features

134 6.4.3 Analysis, Comparison, Evaluation, and Verification (ACE-V) methodology

135	6.4.4	Value determination for comparison
136	6.4.5	Comparison of two images
137	6.4.6	Source opinions
138	6.4.7	Quality assurance
139		
140	6.5	Iris Anomalies
141	6.5.1	Disease and temporary conditions
142	6.5.2	Traumatic injury
143	6.5.3	Drug and alcohol effects
144	6.5.4	Surgical effects
145	6.5.5	Patterned contacts/cosmetics enhancements
146	6.5.6	Iris Presentation Attack and Detection (PAD)
147	6.5.7	Generative Adversarial Network (GANs)/Deepfakes
148		
149	6.6	Human Factors
150	6.6.1	Validation methods
151	6.6.2	Performance assessments
152	6.6.3	Bias
153	6.6.4	Reporting and testimony
154	6.6.5	Psychological stressors
155		
156	6.7	Logic, Probability, and Statistics
157	6.7.1	Logic and Reasoning
158	6.7.2	Descriptive Statistics
159	6.7.3	Probability Theory
160	6.7.4	Inferential Statistics
161	6.7.5	Reporting results

162	6.8	Legal Considerations
163	6.8.1	Legal admissibility and landmark cases
164	6.8.2	Effective courtroom testimony
165	6.8.3	Comprehensive description of iris recognition and forensic comparison
166	concepts.	
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APPENDIX

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(Non Mandatory Information)

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X1. Example Recommended Readings

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190 **X.1 History**

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320 13.3,1, 13.5; Chapter 15

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APPENDIX

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(Non Mandatory Information)

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X2. EXAMPLE TRAINING PROGRAM

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These topics are intended as a suggested starting point for the development of a training

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program for iris image examiners.

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X.9 History

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X.9.1 Beliefs about the iris throughout history

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X.9.2 Iris divination

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X.9.2.1 Iridology

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X.9.3 Contributions made by individuals to iris recognition

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X.9.3.1 Alphonse Bertillion

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X.9.3.2 Frank Burch

334

X.9.3.3 J.H. Doggart

335

X.9.3.4 F.H Adler

336

X.9.3.5 Leonard Flom and Aran Safir

337

X.9.3.6 John Daugman

338

X.9.3.7 Richard P. Wildes

339

X.9.3.8 Mitsuji Matsushita

340

X.9.4 Landmark events and major deployments

341

X.9.4.1 Emirates ID

342

X.9.4.2 United Kingdom Project Iris Recognition Immigration System (IRIS)

343

X.9.4.3 Unique Identification Authority of India's (UIDAI) Aadhaar system

344

X.9.4.4 Canadian Passenger Accelerated Service System (CANPASS)

345

X.9.4.5 CLEAR

346

X.9.4.6 Identity for All in Africa (ID4Africa)

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X.9.4.7 The Afghan Girl

348 X.9.4.8 The Brown Sisters

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350 **X.10 Biology**

351 X.10.1 **Embryological and postnatal development**

352 X.10.1.1 Embryological development

353 X.10.1.2 Iris layer formation and timing

354 X.10.1.3 Changes that occur postnatal

355 X.10.2 **Iris and periocular structure**

356 X.10.2.1 Understand the mechanical structure of the iris and basis of the persistence of
357 the iris structure.

358

359 X.10.3 **Stability of iris patterns**

360 X.10.3.1 Changes due to aging

361 X.10.3.2 Changes due to disease and injury

362 X.10.3.3 Changes that occur postmortem

363 X.10.4 **Differences between iris patterns, for same and for different people**

364 X.10.4.1 Understand the genetic and epigenetic influences on the resulting appearance
365 of the iris, with specific emphasis on:

366 X.10.4.2 The biological origin and nature of iris variability

367 X.10.4.3 Similarities and differences between monozygotic twin iris structures

368 X.10.5 **Biological distortions**

369 X.10.5.1 Pupil dilation and contraction

370

371 **X.11 Iris Image Recognition Systems**

372 X.11.1 **Iris image acquisition**

373 X.11.1.1 Describe methods of iris image capture (e.g., near-IR)

374 X.11.1.2 Understand control measures needed to achieve quality iris images

- 375 X.11.1.3 Understand procedures for addressing missing eyes, injuries, and image
- 376 recapture
- 377 X.11.2 **Image science basics**
- 378 X.11.2.1 Photonics
- 379 X.11.2.2 Wavelengths
- 380 X.11.2.3 Spectral reflectance
- 381 X.11.2.4 Optics
- 382 X.11.2.5 Sensors
- 383 X.11.3 **Iris image science basics**
- 384 X.11.3.1 Iris albedo
- 385 X.11.3.2 Specularities
- 386 X.11.4 **Function and use of iris algorithms**
- 387 X.11.4.1 Phase structure algorithms (Iris2Pi)
- 388 X.11.4.2 Discrete features algorithms
- 389 X.11.4.3 Deep Neural Network algorithms (currently uninterpretable inferences)
- 390 X.11.4.4 Understand processes related to acquisition, searching, storage, retrieval,
- 391 identification, and reporting of iris image records
- 392 X.11.4.5 Understand system quality controls to ensure completeness, image quality, and
- 393 data integrity
- 394 X.11.5 **Performance assessments of iris recognition systems**
- 395 X.11.5.1.1 IREX-10
- 396 X.11.5.1.1.1 Black box studies of algorithms
- 397 X.11.5.1.2 Effect of pupil dilation on algorithm results
- 398 X.11.5.1.3 Differences that visible light images, near infrared images, and other
- 399 multispectral images have on results
- 400
- 401 **X.12 Human Iris Comparison**
- 402 X.12.1 **The relationship between human iris image comparison and iris recognition**
- 403 **systems**

- 404 X.12.2 **Visible iris and periocular features**
- 405 X.12.3 **Analysis, Comparison, Evaluation, and Verification (ACE-V) methodology**
- 406 X.12.4 **Value determination for comparison**
- 407 X.12.4.1 Understand the assessment of quality, quantity, and rarity of features
- 408 X.12.4.2 Understand the concept of sufficiency as it relates to drawing conclusions
- 409 X.12.4.3 Understand and demonstrate the ability to properly determine correct
- 410 orientation and difference between right and left irises
- 411 X.12.4.4 Understand and demonstrate how to document observations
- 412 X.12.5 **Comparison of two images**
- 413 X.12.5.1 Understand how to select an effective target group
- 414 X.12.5.2 Understand and demonstrate how to assess the discriminability of features
- 415 X.12.5.3 Understand and demonstrate the ability to distinguish between an apparent
- 416 dissimilarity and an actual difference in iris texture, for example:
- 417 X.12.5.3.1 Pupil dilation
- 418 X.12.5.3.2 Effect of aging, disease, surgery, post-mortem changes
- 419 X.12.5.3.3 Perceived differences caused by wavelength changes
- 420 X.12.6 **Source opinions**
- 421 X.12.6.1 Exclusion
- 422 X.12.6.2 Strong Support for exclusion
- 423 X.12.6.3 Support for exclusion
- 424 X.12.6.4 Inconclusive
- 425 X.12.6.5 Support for common source
- 426 X.12.6.6 Strong support for common source
- 427 X.12.7 **Quality assurance**
- 428 X.12.7.1 Understand the measures that should be taken to verify opinions
- 429 X.12.7.2 Understand the types of possible verifications: peer review, blind verification,

430 multiple verifiers, and group consensus

431 X.12.7.3 Understand the issues that may contribute to erroneous conclusions and
432 safeguards that can help minimize their occurrence

433 X.12.8 Software tools supporting human examination of iris images

434 X.12.8.1 Inversion of geometric distortions caused by differences in pupil dilation

435 X.12.8.2 Rescaling

436 X.12.8.3 Rotation

437 X.12.8.4 Contrast Normalization

438

439 **X.13 Iris Anomalies**

440 X.13.1 **Disease and temporary conditions**

441 X.13.2 **Traumatic injury**

442 X.13.3 **Drug and alcohol effects**

443 X.13.4 **Surgical effects**

444 X.13.5 **Patterned contacts/cosmetic enhancements**

445 X.13.6 **Iris Presentation Attacks (IPAD)**

446 X.13.7 **Generative Adversarial Network (GAN) images/Deepfake**

447

- 448 **X.14 Human Factors for Iris Image Examiners**
- 449 X.14.1 **Validation methods**
- 450 X.14.1.1 Understand the role of human judgements in forensic science methods and
451 necessity for empirical testing of human accuracy.
- 452 X.14.1.2 Black Box Studies
- 453 X.14.1.3 White Box Studies
- 454 X.14.2 **Performance assessments**
- 455 X.14.2.1 Understand the importance of examiner training, proficiency testing, quality
456 assurance, and professional development.
- 457
- 458 X.14.3 **Bias**
- 459 X.14.3.1 Understanding and mitigating effects of bias in comparisons
- 460 X.14.3.1.1 Cognitive bias
- 461 X.14.3.1.2 Contextual bias
- 462 X.14.3.1.3 Confirmation bias
- 463 X.14.4 **Reporting and testimony**
- 464 X.14.4.1 Understand the importance of using justifiable, scientifically based statements
- 465 X.14.4.2 Understand the importance of transparency
- 466 X.14.4.3 Understand the importance of using common sense terminology
- 467 X.14.5 **Psychological stressors**
- 468 X.14.5.1 Understand the impact psychological well-being on examiners
- 469 X.14.5.2 Time pressure and fatigue
- 470 X.14.5.3 Exposure to traumatic events (e.g., violent crimes, disasters)
- 471 X.14.5.4 Adversarial environments
- 472
- 473 **X.15 Logic, Probability, and Statistics**
- 474 X.15.1 **Logic and reasoning**
- 475 X.15.1.1 Understand how inferences are formed using deductive, inductive, and

476 abductive logic.

477 X.15.1.2 Understand the different circumstances in which deductive, inductive, and
478 abductive logic are utilized as well as the strengths and limitations associated with these
479 resulting inferences.

480 X.15.2 **Descriptive statistics**

481 X.15.2.1 Understand the concepts of variables, data, frequency distributions, and
482 statistics

483 X.15.2.2 Understand the statistics and displays for describing the central tendency and
484 variability of data.

485 X.15.3 **Probability Theory**

486 X.15.3.1 Understand the axioms of mathematical probability and the definition of a
487 probability function, and it's cumulative.

488 X.15.3.2 Understand the definition of conditional probability and why transposing the
489 events or proposition in a conditional probability is not generally correct

490 X.15.3.3 Understand the difference between a likelihood and a probability

491 X.15.3.4 Understand the relationship between probabilities and odds

492 X.15.3.5 Understand the components of the odds form of Bayes' rule for binary
493 variables and their relationship

494 X.15.3.6 Understand the definition of combinatorics: how feature comparison
495 combinations generate probabilities.

496 X.15.4 **Inferential Statistics**

497 X.15.4.1 Understand the concept of a "probability distribution and its parameters"

498 X.15.4.2 Understand the difference between a sample statistic and a population
499 parameter, including the estimation of a population proportion from a sample proportion

500 X.15.4.3 Understand and be able to explain the differences between the following
501 terms and their use when describing the performance of an analytical technique:

502 X.15.4.3.1 Sensitivity (True positive rate, likelihood of correct detection of a match)

503 X.15.4.3.2 Specificity (True positive rate, Likelihood of correct rejection of a non-match)

- 504 X.15.4.3.3 False positive rate
- 505 X.15.4.3.4 False negative rate
- 506 X.15.4.3.5 Positive predictive value
- 507 X.15.4.3.6 Negative predictive value
- 508 X.15.4.3.7 False positive discovery rate
- 509 X.15.4.3.8 False negative discovery rate
- 510 X.15.5 **Reporting Results**
- 511 X.15.5.1 Understand the various methods of expressing the weight of evidence as they
- 512 relate to iris image evidence.
- 513 X.15.5.1.1 Posterior probability
- 514 X.15.5.1.2 Likelihood ratio
- 515 X.15.5.1.3 Bayes Factor

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- 516 **X.16 Legal Considerations**
- 517 X.16.1 **Legal admissibility and landmark cases**
- 518 X.16.1.1 U.S. vs. Frye (1923)
- 519 X.16.1.2 Daubert vs. Merrell Dow Pharmaceuticals (1993)
- 520 X.16.1.3 Kumho Tire vs. Carmichael (1999)
- 521 X.16.1.4 Brady vs. Maryland (1963)
- 522 X.16.2 **Effective courtroom testimony**
- 523 X.16.2.1 Understand the importance of verbal and non-verbal communication
- 524 X.16.2.2 Understand the importance of personal appearance
- 525 X.16.2.3 Understand the importance of vocal volume and inflection
- 526 X.16.2.4 Understand the jurisdiction’s rules about reference to notes or other materials
- 527 X.16.3 **Comprehensive description of iris recognition and forensic comparison**
- 528 **concepts**
- 529 X.16.3.1 Describe how iris algorithms function
- 530 X.16.3.2 Describe the comparison process of the evidence
- 531 X.16.3.2.1 Describe the strengths and weaknesses of ACE-V
- 532 X.16.3.2.2 Describe how tolerance is established for differences in appearance during
- 533 analysis
- 534 X.16.3.3 Describe the research that measures the rarity of iris features
- 535 X.16.3.4 Describe the research that studies the persistence of iris features
- 536 X.16.3.5 Describe how likelihood ratio research is used to support conclusions
- 537 X.16.3.6 Describe how human factors can affect decision-making