Lubrication Certification Requirements for ICML Certifications including:

- LLA I, II

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ICML

The International Council for Machinery Lubrication (ICML) is a vendor-neutral, not-for-profit organization founded to serve global industry as the world-class authority on machinery lubrication that advances the optimization of asset reliability, utilization and costs.

Scope

ICML was originally established to be a vehicle for the exchange of ideas and best practices, to assure the skills of those who work in our field, to recognize excellence and accomplishments, and to invite new participants to join our industry.

Today they support individuals and organizations through programs that strengthen machinery lubrication and oil analysis as technical fields of endeavor. They are a certification body, a standards body, a membership body, and an awards body.

Skills-based Testing and Certification

Certification is the mark of a professional. It helps to ensure that individuals who practice a craft, be it lubricant analysis or medicine, have a defined measure of skills. For the field of machine lubrication, formal certification serves these three vital purposes:

- Creates a formal framework of knowledge
- Raises the profiles of those working in the field
- Provides managers with assurance of skills

ICML – LLA I

Level I, LLA (Laboratory Lubricant Analyst, ISO 18436-5)

Education and/or Experience - Candidates must have at least 12 months of experience in the field of laboratory-based lubricant testing and analysis for machinery condition monitoring, with a minimum of 1,200 hours of actual testing and analysis experience.

Training - Candidate must have received 24 hours of documented formal training as outlined in the Body of Knowledge of the LLA I. For online or recorded training, exercises, lab tasks, practice exams, and review exercises may be included in the training time total but shall not exceed four hours of the required course time. Candidate shall be able to provide a record of this training to ICML that shall include the candidate's name, the name and signature of the instructor, the dates of the training, and the number of hours spent in the training.

Note: ICML does not require, recommend, endorse or authorize any specific training course as official or approved. It is the responsibility of each candidate to research the training options available in his/her area and make a decision as to the training provider of his/her choice. ICML recommends the outline of the course of choice be compared to the exam's Body of Knowledge. It is in the person's best interest and their responsibility as an ICML candidate to ensure they are being trained in the same subject areas in which they will be tested. ICML's Bodies of Knowledge are of public domain and can be utilized by companies in the development of courses, as well as by any prospective candidate for evaluating the appropriateness of chosen training.

Examination - Each candidate must successfully pass a 70 question, multiple-choice examination that evaluates the candidate's knowledge of the topic. Candidates have two hours to complete the closed-book examination. A score of 70% is required to pass the examination and achieve certification.

Body of Knowledge LLA I

The Level I LLA Body of Knowledge is an outline of concepts that one should have in order to pass the exam, in accordance with ISO 18436-5, Category I, Annex A.

References from which exam questions were derived can be found in the Domain of Knowledge.

I. Sample handling and preparation (30%)

A. Sample cleanliness
1. Sample diluting
2. Cross-contamination

B. Contaminant re-suspension
1. Bottle Ullage
2. Sample Agitation

II. Lubricant health monitoring (30%)

1. Kinematic viscosity ((ASTM D445/ISO 3104)
2. Absolute (dynamic) viscosity (ASTM D2983/ISO 3104)
3. Viscosity Index (ASTM D2270/(ISO 2909)
4. Acid Number (ASTM D664, D974/ISO 6618, ISO 6619)
5. Base Number (ASTM D4739, D974/ISO 6618, ISO 3771)
6. Fourier Transform Infrared (FTIR) analysis (ASTM E169, ASTM D7418)
7. Atomic Emission Spectroscopy (ASTM D5185, 6595)
8. Flash point test (ASTM D92, ASTM D93/ISO 2592, ISO 2719, ISO 1523 + ISO 3679 + ISO 13736)
9. Thermogravimetric analysis (TGA) (ASTM D5967)
10. Schiff's reagent (ASTM D2982)
11. Crackle test
12. Co-distillation (ASTM D95/ISO 3733)
13. Karl Fischer titration (ASTM D6304/ISO 10337 +ISO 12937)
14. Cyclic voltammetry (ASTM 6971)
15. Insolubles (ASTM D893)
16. Gas chromatography (ASTM D3524, ASTM D3525)

III. Reagent Management (20%)

A. Equipment and glassware (Cleaning and preparation)

B. Chemicals
1. Preparation
2. Labeling
3. Storage
4. Safety
5. Disposal
6. Material safety data sheets

IV. Instrument Calibration (20%)

A. Reference materials
1. Primary and secondary standards

B. Record keeping
1. Routine control charts

ICML – LLA II

Level II, LLA (Laboratory Lubricant Analyst, ISO 18436-5)

Education and/or Experience - Candidates must have at least 24 months experience in the field of laboratory-based lubricant testing and analysis for machinery condition monitoring, with a minimum of 2,400 hours of actual testing and analysis experience. Complete one of these requirements:

- Hold Level I Laboratory Lubricant Analyst (LLA) certification.
- Qualify as a Mature Entry Candidate (without Level I LLA certification) by submitting documentation of: At least 12 months additional work experience in the field of laboratory-based lubricant testing and analysis for machinery condition monitoring, including a minimum of 1,200 additional hours of actual testing and analysis. This brings total work experience to 36 months (and 3,600 hours) when combined with the 24 months (and 2,400 hours) already listed above.

  Minimum 24 hours training relevant to the LLA I Body of Knowledge, accumulated through any combination of instructor-led events (such as workshops, seminars, or classes) and/or specific hands-on practice or observation.

Training - Candidate must have received 24 hours of documented formal training as outlined in the Body of Knowledge of the LLA II. For online or recorded training, exercises, lab tasks, practice exams, and review exercises may be included in the training time total but shall not exceed four hours of the required course time. These 24 hours are in addition to the previous 24 hours of training required for LLA I or Mature Candidate Entry, for a total cumulative training of 48 hours. Candidate shall be able to provide a record of this training to ICML that shall include the candidate's name, the name and signature of the instructor, the dates of the training, and the number of hours spent in the training.

Note: ICML does not require, recommend, endorse or authorize any specific training course as official or approved. It is the responsibility of each candidate to research the training options available in his/her area and make a decision as to the training provider of his/her choice. ICML recommends the outline of the course of choice be compared to the exam's Body of Knowledge. It is in the person's best interest and their responsibility as an ICML candidate to ensure they are being trained in the same subject areas in which they will be tested. ICML's Bodies of Knowledge are of public domain and can be utilized by companies in the development of courses, as well as by any prospective candidate for evaluating the appropriateness of chosen training.

Examination - Each candidate must successfully pass a 100 question, multiple-choice examination that evaluates the candidate's knowledge of the topic. Candidates have three hours to complete the closed-book examination. A score of 70% is required to pass the examination and achieve certification. Contact ICML about the availability of the exam in other languages.

Body of Knowledge LLA II

The Level II LLA Body of Knowledge is an outline of concepts that one should have in order to pass the exam, in accordance with ISO 18436-5, Category II, Annex A.

References from which exam questions were derived can be found in the Domain of Knowledge.

I. Lubricant health monitoring (21%)

1. Kinematic viscosity
2. Absolute (dynamic) viscosity
3. Viscosity Index
4. Total Acid Number
5. Total Base Number
6. Fourier Transform Infrared (FTIR) analysis
7. Atomic Emission Spectroscopy
8. Flash point test
9. Thermogravimetric analysis (TGA)
10. Schiff's reagent
11. Crackle test
12. Co-distillation
13. Karl Fischer titration
14. Cyclic voltammetry
15. Insolubles
16. Rotating pressure vessel oxidation test
17. Air release characteristics
18. Foam stability characteristics
19. Gas chromatography
20. Water demulsibility
21. Data correlation
22. Exception testing

II. Testing for wrong or mixed lubricants (4%)

1. Kinematic viscosity
2. Fourier Transform Infrared (FTIR) analysis
3. Atomic Emission Spectroscopy

III. Water contamination (11%)

1. Scope and significance of commonly accepted water oil analysis test methods. When to perform these and use of multiple test data to determine if results are reasonable
2. Causes of poor water demulsibility
3. States of coexistence of water in oil
4. Methods for assessing water contamination
   a) Crackle test
   b) FTIR analysis
   c) Co-distillation
   d) Karl Fischer titration
5. Effects of water contamination on the lubricant
6. Effects of water contamination on the machine

IV. Glycol coolant contamination (4%)

1. Scope and significance of commonly accepted oil analysis test methods for glycol contamination. When to perform these and use of multiple test data to determine if results are reasonable
2. Elemental spectroscopy
3. Fourier transform infrared (FTIR) analysis
4. Schiff's reagent
5. GC (Gas Chromatography)
6. Effects of glycol contamination on the lubricant
7. Effects of glycol contamination on the machine

V. Soot contamination (4%)

1. Scope and significance of commonly accepted oil analysis test methods for soot contamination. When to perform these and use of multiple test data to determine if results are reasonable
2. Thermogravimetric analysis (TGA)
3. Fourier Transform Infrared (FTIR) analysis
4. Pentane Insolubles
5. Blotter Test
6. Effects of soot contamination on the lubricant
7. Effects of soot contamination on the machine

VI. Fuel contamination (8%)

1. Scope and significance of commonly accepted oil analysis test methods for fuel contamination. When to perform these and use of multiple test data to determine if results are reasonable
2. Kinematic viscosity
3. Fourier transform infrared (FTIR) analysis
4. Flash point test
5. Gas chromatography
6. Effects of fuel contamination on the lubricant
7. Effects of fuel contamination on the machine

VII. Air contamination (4%)

1. Scope and significance of commonly accepted oil analysis test methods for air contamination. When to perform these and use of multiple test data to determine if results are reasonable
2. States of coexistence of air in oil
3. Methods for assessing air contamination
   a) Air release characteristics
   b) Foam stability characteristics
3. Effects of air contamination on the lubricant
4. Effects of air contamination on the machine

VIII. Particle contamination (6%)

1. Scope and significance of commonly accepted oil analysis test methods for particle contamination. When to perform these and use of multiple test data to determine if results are reasonable
2. ISO solid contamination code
3. Optical particle counting usage and calibration

4. Pore block particle counting
5. Effects on the lubricant
6. Effects on the machine

IX. Wear Particle Monitoring and Analysis (13%)

A. Detecting abnormal wear
1. Atomic emission spectroscopy methods
a) Inductively coupled plasma (ICP) spectroscopy
b) Arc-spark emission spectroscopy
2. XRF spectroscopy
3. Wear particle density measurements

B. Wear debris analysis
1. Ferrogram preparation
2. Filtergram preparation
3. Light effects
4. Magnetism effects
5. Heat treatment
6. Chemical microscopy
7. Basic morphological analysis

C. Common wear mechanisms
1. Abrasive wear
a) Two-body
b) Three-body
2. Surface fatigue (contact fatigue)
a) Two-body
b) Three-body
3. Adhesive wear
4. Corrosive wear
5. Cavitation wear

D. Size distribution of wear particles from common wear mechanisms

X. Data Interpretation (11%)

A. Limits
1. Understanding statistical limits (wear debris)
2. Understanding aging limits (acid number, viscosity)
3. Understanding targets (Water, ISO cleanliness)
4. Establishing statistical limits
5. Establishing aging limits
6. Establishing goal based limits

B. Graphical trend analysis
1. Rate of change analysis
2. Normalization of data
3. Reference/baseline data comparison
4. Effects of make-up oil
5. Lock-step trending

XI. Quality Control (6%)

A. Procedure writing

B. Record management
  1. Record generation
  2. Record storage
C. Quality control samples
  1. Types
  2. Control charts
D. Procedures editing
E. Audits
  1. Internal audit
  2. External audit

XII. Lubricant roles and functions (8%)

A. Base oil
  1. Functions
  2. Properties
B. Additive types and functions
  1. Surface active additives and their functions
  2. Bulk oil active additives and their functions
C. Synthetic lubricants
  1. Synthetic lubricant types
  2. Conditions dictating their use
D. Lubrication regimes
  1. Hydrodynamic
  2. Elasto-hydrodynamic
  3. Boundary
E. Baselining physical and chemical properties tests
F. Identifying additive discrepancies
G. Lubricant failure modes