Lubrication Certification Requirements for ICML Certifications including:

- MLE

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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 – MLE

MLE (Machinery Lubrication Engineer)

Education and/or Experience - Candidates must have at least 5 years' education (post-secondary) or on-the-job training in one or more of the following fields: engineering, mechanical maintenance, maintenance trades, lubrication, oil analysis and/or condition monitoring (mechanical machinery).

No engineering degree or ICML certifications are pre-requisites to candidacy for the MLE certification. However, the MLAs and MLTs would support a candidate's preparation for the MLE test.

Examination - Each candidate must successfully pass a 150 question multiple choice Machinery Lubrication Engineer (MLE) examination that tests the candidate's mastery of the ICML's Machinery Lubrication Engineer (MLE) body of knowledge. Candidates have four hours to complete the closed-book examination. A score of 70% is required to pass the examination and achieve certification. Please Note: Due to the four-hour length of this exam, it may impact exam sessions when administered alongside our other exams. Candidates should contact us well in advance to ensure sufficient arrangements can be made.

Body of Knowledge MLE

The MLE Body of Knowledge (BOK) is a structured delineation of the Major Subjects (numbered in bold) that one should master in order to pass the MLE certification exam. The bulleted listings under each Major Subject are examples of the subtopics that help define range and scope. However, the listed subtopics should not be assumed to be complete or comprehensive. Additionally, many subtopics relate to more than one Major Topic and are replicated accordingly.

The BOK is intended to relate to practical knowledge needed by lubrication and reliability engineers who work in user organizations with lubricated physical assets. It is not intended to be academic, scientific or theoretical. The MLE BOK was also constructed to align, at a higher level, to all major BOK subjects across MLA I, II & II and MLT I & II categories and levels. As such, training related to those certifications would support a candidate's preparation for MLE testing. Most significantly, the MLE BOK is specifically designed to align to the majority of the compliance elements of the new ICML 55 certification for asset management related to lubricated machines. ICML 55 is further aligned to all of the main and relevant subjects required for ISO 55000 certification.

The MLE Body of Knowledge is an outline of concepts that one should have in order to pass the exam. References from which exam questions were derived (Domain of Knowledge) can be found under each area of the BOK.

I. Asset Management, ISO 55000 & ICML 55; Basic Elements (3%)

- Definition of Asset Management in the context of the organization
- ISO 55001 Requirements (refer also to EN 16646 for physical assets)
- Physical asset hierarchy (ISO 14224:2016)
- ICML 55 Attributes and Requirements in the context of machinery lubrication

II. Machine Reliability; Basic Elements (5%)

- Reliability philosophies and strategies
- Condition-based maintenance (see also Major Subject 4.0)
- Reliability culture
- Financial analysis and economic justification
- Failure Modes Effects Analysis (FMEA), Failure Reporting, Analysis and Corrective Action System (FRACAS), and Root Cause Analysis (RCA) (see also Major Subject 16.0)
- Asset design change process and management of change
- Criticality analysis and risk management
- Metrics, KPIs, Scorecard, Overall Equipment Effectiveness (OEE)
- Asset life cycle engineering and management
- Design for reliability, operability and maintainability
- Managing Sources of vibration and wear, including fasteners, alignment and balance

III. Machine Maintenance; Basic Elements (5%)

- Procedure-based maintenance and standardized work
- PM optimization

- Work management, planning and scheduling
- Shutdown, turnaround and outage management
- Operator-driven maintenance, autonomous maintenance, Total Productive Maintenance
- Enterprise Asset Management (EAM) and Computerized Maintenance Management System
- Stores, parts and inventory management
- Workforce management, skills and training

IV. Condition-based Maintenance (CBM); Basic Elements (5%)

- Condition-based maintenance versus breakdown maintenance
- Predictive maintenance
- Proactive maintenance
- Inspection 2.0
- CBM technologies (lubricant analysis, vibration, thermography, acoustics, motor current, etc.)
- CBM for major machine categories: pumps, compressors, turbines, gearboxes
- CBM integration and program management
- CBM data management

V. Tribology, Friction, Wear, and Lubrication Fundamentals; Basic Elements (5%)

- Mechanical friction, fluid friction, dry friction
- Lubrication fundamentals
- Lubrication regimes, thick film, hydrodynamic, elastohydrodynamic, boundary
- Film thickness, specific film thickness, mixed film
- Film strength, additive and chemical-induced films
- Corrosive, cavitation and erosive wear
- Mechanical wear, abrasion, adhesion, surface fatigue

VI. Lubricant Formulation for Machine Types to achieve Optimum Reliability, Energy Consumption, Safety and Environmental Protection; Basic Elements (5%)

- Liquid and grease lubricants, formulation science, base oils, common thickeners, common additives
- Solid-film lubrication and types
- Physical and chemical properties of lubricating oils and grease.
- Common lubricant laboratory test methods such as oxidation stability, viscosity index, film strength, rust suppression, air release, demulsibility, penetration number, dropping point, water washout resistance, biodegradability, etc.
- Differences and unique physical and chemical properties of major lubricant formulation categories including: engine oil, automatic transmission fluid, brake fluid, hydraulic fluid, turbine oil, gear oil, compressor lubricant, chain lubricant, wheel bearing grease, chassis

grease, electric motor bearing grease, coupling grease, multipurpose grease, foodgrade lubricants

VII. Job- and Task-based Skills/Training related to Lubrication and Reliability by User Organizations (4%)

- Skills possibly required for common tasks performed by lubrication technicians
- Skills possibly required for common tasks performed by operators and inspectors
- Skills possibly required for common tasks performed by mechanics and millwrights
- Training and knowledge required by reliability engineers and maintenance supervision
- Training and knowledge required by plant management
- Standardized training, tasked-based training and competency testing for practitioners in the lubrication field, ISO 18436

VIII. Lubrication Support Facilities needed in Plants and Work Sites (3%)

- Design and use of a lube room facility that meets reliability, safely and environment requirements
- Design and use of lubricant storage facilities including bulk tanks, tank farms, totes, etc. that meet reliability, safety, environment and regulatory requirements
- Standardized lubricant labeling for packaged and bulk vessels
- Proper selection, use and care of tools for inspection and reconditioning of tank, vessel and containers related to cleanliness, cross contamination, bottom sediment and water, and leakage
- Spill containment and leak protection practices for environmental protection and basic regulatory compliance
- Transfer, handling, dispensing, filtration from drums, totes and day tanks.
- Transfer, handling, dispensing, filtration from bottles, jugs, and small grease packages
- Selection and use of workplace and lube room tools and accessories (tools, benches, rooms, lockers/cabinets, etc.) and basic care and storage
- Safety practices related to the storage and handling of lubricants

IX. Risk Management for Lubricated Machines; Basic Elements (4%)

- Basic elements of Reliability-centered Maintenance (RCM)
- The Pareto Principle and its application to establish maintenance strategy and focus of resources
- Failure patterns and Weibull Distributions basic elements
- Ranking of lubrication-specific failure modes and causes and the use of Failure Modes Effects Analysis (FMEA)
- Assessment of equipment to determine failure probability along with the severity/consequence of failure
- Basic elements in use of Hazard Analysis Critical Control Point (HACCP) (ISO 22000) to localize and control risk in lubricant-dependent machines and systems

X. Optimum Machine Modifications and Features Needed to Achieve and Sustain Reliability Goals (5%)

- Optimum selection, set-up and use of lubricant application devices and hardware (single-point autolubers, circulating lubrication, constant-level oilers, centralized lubrication systems, mist systems, spray, etc.)
- Optimum selection, installation and use of contamination control devices/hardware (filters, breathers, filter cart connects, headspace management, seals, dehydrators, de-aeration devices, etc.)
- Instrumentation requirements including selection and location of online oil analysis sensors
- Optimum selection, location and use of sight glasses and level gauges
- Optimum selection and use of relubrication and oil change hardware & tools
- Optimum selection and location of sampling valves and hardware
- Purpose and use of drip pans, grease traps, berms, purge ports, etc.
- Optimum selection and use of tags, labels and plates for lubricant type and lubrication practices on the machine

XI. Lubricant Selection for Optimum Reliability, Safety, Energy Consumption and Environmental Protection based on Machine Type and Application (4%)

- Vendor selection based on product range, product quality, product performance, support & services
- Elements in generic lubricant specifications for common machine types, application types, operating conditions, workplace exposures, desired machine reliability, safety requirements, energy conservation, environmental protection and price. Common machine or application types include engines, driveline components, rolling-element bearings, journal bearings, enclosed & open gears, mechanical couplings, process pumps, hydraulic systems, compressors, gearboxes, turbines, chain and wire rope, and pneumatic systems. Lubricant specification elements include base oil, additives, thickeners, performance properties, physical properties, chemical properties, and health and safety properties.
- Food grade lubricant selection, application and regulations related to National Sanitation Foundation (NSF), Food Safety Modernization Act (FSMA), ISO 22000 (HACCP), ISO 21469 and similar guidelines
- Rationalized lubricant consolidation to optimize the number of lubricant grades and brands
- Lubricant cross-contamination risks, compatibility testing, and risk-management practices
- Proper labeling methods using standardized classifications and visual identification system for display on machines, containers, grease guns, lubricant transfer system, etc. Standardized classifications relate to internal and industrial standards including ISO

15380, ISO 12924/6743/12925 and many others related to engine oils, transmission fluids, axle lubricants, and brake fluids. These also include ILSAC, ACEA, API and SAE.

XII. Lubrication-related Planning, Scheduling and Work Processing (4%)

- Routine scheduled work and PMs
- Unplanned and condition-based work request processing
- Work prioritization and planning
- Work kitting, matching skill competencies to tasks, assembly of work crews
- Work scheduling
- Unplanned and planned work backlog management
- Process for troubleshooting faults and anomalies (see also Major Subject 16)
- Record keeping, documentation, CMMS

XIII. Periodic Lubrication Maintenance Tasks (4%)

- Control of correct lubricant supply: oil level, flow rate, drip rate, mist rate or grease volume
- Regrease, oil top-up and oil change frequency and lubricant volume (amount) criteria
- Proper oil top-up procedures for common machine types, sumps and reservoirs
- Proper grease relubrication procedures for common machine types and grease dispensing hardware
- Lubricant drain or purge criteria and methods for major machine types
- Contamination control tasks including general machine cleanliness, control of contaminant ingression, filtration, dehydration and other decontamination methods
- Machine flushing requirements, risks and benefits. Selection of flushing protocol, hardware and methodology
- Oil reclamation need and methods (see Major Subject No. 21 below)
- Lubricant waste handling, disposal and cleanup
- Leak detection, management and leak cleanup
- Safety in lubrication maintenance tasks

XIV. Inspection of Lubricated Machines for Optimum Reliability, Safety, Environmental Protection and Condition Monitoring (5%)

- Inspection personnel and responsibility (recognizing this vary between operators, lube technicians, mechanics, and reliability engineers)
- Inspection intervals, routes, autonomous inspection
- Selection and installation of machine inspection windows
- Selection, use and care of inspection tools and aids
- Inspection protocol for common machine types related to start-up, machine-run conditions, machine-stop conditions, repair inspection
- Inspection protocol for spare parts, stored new machines and standby machines
- Inspection personnel skill sets and training
- Inspection checklists, findings reports and documentation

- Integration of inspection with other condition monitoring practices

XV. Lubricant Analysis and Condition Monitoring for Optimum Reliability Objectives (8%)

- Selection of optimum sampling tools/devices, sample point location(s), sampling frequency, and procedure for common machines, operating conditions and reliability objectives
- Selection of off-site laboratory requirements based on instrument/sample prep capabilities, industry orientation, quality, turnaround time, data reporting format and data interpretation capabilities
- Selection of onsite testing tools/laboratory requirements
- General in-service lubricant sampling and analysis program design
- New lubricant receiving requirements: testing, inspection and quality control
- Stored lubricant (package & bulk) sampling and analysis
- Selection of routine lubricant test slate and standardized methods
- Selection of exception tests, condition for use and standardized methods
- Selection of data alarms and limits
- General strategy for data interpretation
- Data management and overall program management
- Reporting and responding to non-conforming data
- Integration with other inspection and condition monitoring methods
- Accuracy and quality verification and accreditation (e.g., ISO 17025)

XVI. Fault/Failure Troubleshooting, Root Cause Analysis (RCA) and Remediation (5%)

- Basic problem troubleshooting procedures and guidelines
- Application of failure management and processes, e.g., the use of FRACAS policies (Failure Reporting, Analysis and Corrective Action System)
- General RCA policies and guidelines
- RCA phases: data collection, assessment, corrective action, inform and follow-up
- Data collection and evidence preservation policies
- Root cause assessment methods: fault trees, cause-and-effect, sequence of events, etc.
- Guidelines for responding to root cause conditions
- Guidelines for responding to incipient failure/faults
- Guidelines for responding to Impending/precipitous failure
- Sudden-death or catastrophic failure guidelines
- Guidelines for fault/failure findings from rebuild shops

XVII. Supplier Compliance/Alignment and Procurement of Services and Products (3%)

- Supplier and service-provider alignment/commitment to reliability, safety, energy consumption, quality and environmental protection goals
- Incoming lubricants, parts, and machine product acceptance testing/inspection
- Certificate-of-analysis of lubricant supplies

- Internal/external cleanliness and packaging of new or rebuilt components/parts. Roll-off cleanliness of final machine assemblies.
- Lubricant supply agreement terms and conditions related to quality and services provided
- Supplier safety and lubricant quality communications and documentation
- Services of off-site service providers and rebuild shops (quality, part cleanliness, roll-off cleanliness, documentation, findings reports, etc.)

XVIII. Waste and Used Lubricant Management and Environmental Compliance (3%)

- Disposal of lubricants, filters, rags, containers
- Cleaning of containers, parts, hoses, components and devices
- Labeling and documentation of hazardous waste and non-hazardous materials
- Disposal of hazardous and non-hazardous materials
- Alignment to ISO 14000

XIX. Energy Conservation and Environmental Protection (3%)

- Influence of lubricants and lubrication on energy conservation
- Influence of lubricants on atmospheric contamination
- Environmental-friendly lubricants (e.g., biodegradability)
- Lubricant aqueous toxicity, risk and assessment
- Organizational goals and policies related conservation and protection of the environment
- Optimized and practical use of lubricants and lubrication conservation and environment protection

XX. Health and Safety (3%)

- Disposal & waste management
- Safety training, policies and guidelines
- Hazardous lubricants and toxicity
- Microbial safety risks and control of transmission (to other machines)
- Fluid pressure and fluid injection risks (blood stream injection)
- Lubricant mists in the work environment
- Confined space risks
- Fire and combustion risks
- Electrocution risks
- Other mechanical risks

XXI. Oil Reclamation, Decontamination, De-varnishing & Additive Reconstruction (3%)

- Lubricant conservation strategy and practices related to extended lubricant service life
- Selection of dehydration methods and practices
- Additive reconstruction of aged or damaged lubricants
- De-varnishing of fluids and machine surfaces
- Acid scavenging methods, best applications and risks

XXII. Lubrication during Standby, Storage and Commissioning (2%)

- Special lubrication requirements related to machine commissioning and running-in conditions
- Special lubrication-related practices to protect machines and parts in storage or standby

XXIII. Program Metrics (5%)

- Fundamental elements in metrics and performance measures
- Micro metrics of machines and lubricant conditions
- Macro and big-picture metrics for overall fleet or plant machine health
- Mapping and aligning metrics to Return on Net Assets (RONA)
- Overall Equipment Effectiveness (OEE) (related to asset utilization)
- Leading metrics that predict future conditions or events (what's going to happen)
- Lagging metrics that report or summarize past conditions or events (what just happened)
- Overall lubrication performance and compliance metrics related to cleanliness compliance, lubricant health and PM compliance
- Lubricant consumption ratios/metrics
- MTBF and general machine reliability metrics
- Route compliance measurement
- Percent planned maintenance, workforce efficiency, wrench time
- Metric communication
- Performance control and remediation

XXIV. Continuous Improvement (4%)

- Culture of continuous improvement
- Improved Data Analytics (to Industry 4.0)
- Improved CBM sensor application and scope
- Improved cost reductions
- Improved production output
- Improved energy consumption
- Improved environmental protection
- Improved safety
- Improved product quality and timely delivery
- Improve profitability