SPECIFIC REQUIREMENTS FOR QUALIFICATION AND MIBOC CERTIFICATION OF

FIELD LUBRICANT ANALYSIS

ED183 Version 4

Accreditation Manager
miboc-accreditation@mobiusinstitute.com

MOBIUS INSTITUTE
BOARD of CERTIFICATION
1525 Frankston-Flinders Road
Tyabb, Victoria, AUSTRALIA
e-mail: miboc-accreditation@mobiusinstitute.com

Contents

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1525 Frankston-Flinders Road
Tyabb, Victoria, AUSTRALIA
e-mail: miboc-accreditation@mobiusinstitute.com

Introduction

Using lubricant analysis to monitor the condition and diagnose faults in machinery is a key activity in predictive maintenance programmes. The effectiveness of these programmes depends on the the experience of the person collecting the oil sample, and the competence of the technician analysing the samples.

This document follows on from document ED002 - General Scheme Requirements and is designed to provide comprehensive information for users of the MIBoC Scheme, specifically for the technology of field lubricant analysis. The complete list of published MIBoC documents is posted on the Mobius Institute website at www.mobiuscertification.org where all applicable documents are available for download free of charge.

It is intended, through publication of these documents, to provide industry, MIBoC candidates and certificate holders with all relevant information. However, if further information or advice is required on any certification matter, please contact the Certification Manager of the Mobius Institute Board of Certification on Tel +61 3 5977 4606, or email certification.manager@mobiuscertification.org

Scope

This document sets out the specific requirements for qualification and MIBoC certification of Field Lubrication Analysis. In the event of a conflict between the requirements of ED002 - General Scheme Requirements and this document, the requirements specified in ED002 - General Scheme Requirements shall prevail.

This document is based on ISO 18436-4: Condition monitoring and diagnostics of machines – Requirements for qualification and assessment of personnel – Field lubricant analysis.

Certification to this specification will provide evidence of the qualification and competence of individuals to perform field lubricant analysis for machinery condition monitoring. The certification scheme is not applicable to specialised equipment or other specific situations.

> Wherever there is a conflict between the requirements of standards concerning lubricant analysis personnel qualification and certification, the MIBoC scheme will comply with ISO 18436 criteria unless otherwise indicated by text placed within a frame similar to that in which this text is displayed, as authorised by invocation of ISO21-1.

Terms and Definitions

For purposes of this document, the terms and definitions in ISO 13372 and the following apply.

Lubricant – any substance interposed between two surfaces in relative motion for the purpose of modifying the friction and reducing the wear between them (note: hydraulic and heat transfer fluids are considered lubricants)

Lubricant analysis – process of monitoring and performing investigative testing of lubricants, with subsequent interpretation, reporting, and response to obtained results.

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Tyabb, Victoria, AUSTRALIA
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Classification of Personnel

3.1 General

Individuals certified in accordance with this specification are classified are classified as Category I, Category II, or Category III, depending on their qualification. They shall have demonstrated the necessary skills in field lubricant analysis for their category as indicated in Annex A.

Personnel classified as Category II need to have all the knowledge and skills expected of personnel classified as Category I, while personnel classified as Category III need to have all the knowledge and skills expected of personnel classified as Category II.

3.2 Field Lubricant Analyst Category I

Individuals classified as Category I are qualified to perform field lubricant analysis according to established and recognized procedures. Personnel classified as Category I shall be able to:

a) understand maintenance strategies, fundamentals of lubrication and lubricant selection.
b) dispense lubricants, re-lubricate, and/or inspect lubricants on a pre-programmed route, as appropriate, in accordance with established procedures.
c) properly store lubricants and manage inventory.
d) properly maintain lubrication devices and equipment.
e) use sampling hardware deemed appropriate, safe, and non-intrusive by Category II or higher personnel (any intrusive sampling hardware installation shall be undertaken by a suitably qualified person authorized by the customer).
f) acquire lubricant samples from machine systems, equipment, and/or storage containers in accordance with established procedures.
g) prepare samples for transport and/or testing in accordance with established procedures.
h) understand and apply onsite lubrication testing methodologies.
i) understand effective filtration techniques.

3.3 Field Lubricant Analyst Category II

Individuals classified as Category II are qualified to perform basic field lubricant testing and analysis according to established and recognized procedures. Personnel classified as Category II shall be able to:

a) identify and select the appropriate lubricant, based on operating and environmental conditions.
b) set up instruments for basic on-site testing.
c) perform calibration checks on instruments used for on-site testing.
d) establish procedures for sample acquisition, preparation, and transport, select sample point locations, methods, and hardware and oversee installation of sampling hardware.
e) apply selected test methods for on-site testing and wear debris analysis.
f) liaise with an off-site laboratory.
g) classify, interpret, and evaluate basic test results (including acceptance tests) in accordance with applicable specifications and standards.
h) employ basic lubricant analysis techniques to troubleshoot lubricant, machinery, and components.
i) maintain a database of analysis schedules, results, and diagnoses.
j) prepare reports for appropriate personnel on basic lubricant and machine condition, recommend corrective action (non-intrusive maintenance), and report on effectiveness of repairs/changes.
k) be aware of the use of alternative or supplementary condition monitoring technologies.
l) provide guidance and supervision to Category I personnel.

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Tyabb, Victoria, AUSTRALIA
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3.4 Field Lubricant Analyst Category III

Individuals classified as Category III are qualified to perform and/or direct all types of field lubricant testing and analysis. Personnel classified as Category III shall be able to:

a) design and develop an appropriate lubricant analysis programme.
b) interpret and evaluate test methods, standards, codes, specifications, and procedures.
c) select the appropriate machinery lubricant analysis technique.
d) specify the appropriate instrumentation hardware and software for both portable and permanently installed systems.
e) design and manage calibration programmes.
f) establish lubricant monitoring programmes, including determination of machines for periodic/continuous monitoring, frequency and type of testing, route plans, etc., and quality assurance testing.
g) establish programmes for the specification of targets, alarms, and limits for machinery.
h) perform advanced on-site tests and wear debris analysis.
i) classify, interpret, and evaluate advanced test results and wear debris analysis (including acceptance tests) in accordance with applicable specifications and standards.
j) manage and perform administrative tasks for lubricant analysis software and databases.
k) perform Failure Mode, Effect, and Criticality Analysis (FMECA).
l) perform prognostics for fault conditions.
m) evaluate the performance of outside lubricant analysis services and recommend necessary corrective changes.
n) prepare reports for appropriate personnel based on advanced lubricant testing and wear debris analysis on lubricant and machine condition.
o) make major maintenance corrective action recommendations (normally intrusive maintenance) and report on effectiveness of repairs/changes.
p) be able to manage condition monitoring programmes, evaluate alarm sets, write working procedures, and specify acceptance testing procedures.
q) recommend the use of alternative condition monitoring (CM) technologies.
r) based on the accrued data, review the lubricants currently in use and make recommendations, inclusive of required lubrication specification changes, with a view to enhancing performance.
s) assess the influence of physical/chemical properties on the stability of rotating bearings, stability of turbine control systems, wear of gears, and hydrodynamic seals.
t) provide guidance and supervision to Category I and II personnel.

NOTE: It is the employer's responsibility to ensure that Category III personnel have the necessary competency in the required management skills, for example creating budgets preparing cost justifications and managing personnel development.

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Eligibility for Examination and Certification

4.1 General

In order to be eligible for MIBoC certification, candidates should have a combination of training, skills and experience to ensure that they understand the principles and procedures applicable to machinery lubrication and lubricant analysis.

4.2 Education

Candidates seeking classification do not need to provide evidence of formal education to establish eligibility. However, it is recommended that candidates for Category I and Category II have at least a secondary school graduate qualification or its equivalent. Category II and III candidates shall be able to manipulate simple algebraic equations, use a basic scientific calculator, and be familiar with the operation of personal computers. Successful completion of two or more years of mechanical technology or mechanical engineering at an accredited college, university, or technical school is highly recommended for candidates seeking classification to Category III.

4.3 Training

4.3.1 General

To be eligible for the MIBoC field lubricant analysis certification examination, candidates shall provide evidence of successful completion of approved training based on the requirements of Annex A and which follows the requirements of ISO 18436-3, or which is otherwise recognised by the MIBoC FLA Technical Committee. A list of approved/recognised training courses can be found in ED182 – Approved FLA Training Courses. The minimum duration of training is shown in Table 1. Training should be in the form of lectures, demonstrations, practical exercises, or formal training courses. Training time devoted to each subject shall be in accordance with Annex A and Table 1.

Table 1 – Minimum duration of training course (hours)

Category I	Category II	Category III
24	24	32

2.3.2 Additional training on tribology and lubrication management

In addition to the training hours shown in Table 1, candidates have the option to attend tribology and lubrication management training of at least a similar duration to that specified in Table 1.

Such training should be in addition to any formal education compliant with 5.2, inclusive of any college or university education. If undertaken, the additional training shall cover the design, implementation and operation of lubrication and lubricant analysis systems and programmes, maintenance principles of machines and components, the failure modes and mechanisms associated with each principle, and the typical tribological aspects associated with each mechanism. Such training shall be validated by verifiable records.

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4.3.3 Mature candidate entry

Mature candidate entry may be allowed at MIBoC's discretion.

Such candidates may apply for direct entry to Category II, without the need to have previously held classification at Category I.

Mature candidates shall have at least 36 months of documented experience without significant interruption in field lubricant analysis condition monitoring of machines. Such candidates should apply to the assessment body under the mature candidate route. If a significant interruption exists, the candidate may be required to undertake further training as determined by the assessment body.

4.4 Experience

To be eligible to apply for MIBoC Field Lubricant Analysis certification the candidate shall provide evidence of experience in one or more of the following activities, in accordance with the duration stated in Table 2:

- lubrication activities
- oil sampling and analysis
- lubrication management & monitoring

Table 2 – Minimum cumulative experience requirements (months)

Category I	Category II	Category III
12	24	36

Note: the experience months are based on 16 hours minimum per month of lubricant-analysis-based machinery condition monitoring experience.

Classification to Category II and Category III requires previous classification at the lower category, except for mature candidates (as per 4.3.3 above*)* applicable to Category II only.

Candidates must provide verifiable documentary evidence of the hours and nature of work for their field lubrication experience. Candidates for Categories I and II shall have this evidence validated by a Category II or III person, or in the absence of such a person, by the candidate's technical supervisor.

Candidates for Category III shall have this evidence validated by a Category III person, or in the absence of such a person, by the candidate's technical supervisor.

The validation process for all categories requires the signature (or electronic sign-off) of the candidate's supervisor on the documentary evidence.

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Qualification Examination

5.1 Examination content

For each category, the candidates shall be required to answer a fixed number of multiple-choice questions in a specified time duration as indicated in Table 3.

Table 3 – Examination details

Category	Number of questions	Time (hours)	Passing grade (%)
Category I	70	2	70
Category II	100	3	70
Category III	100	3	70

Questions will be of a practical nature and test the candidate's knowledge of the principles and procedures required to conduct machinery lubrication and lubricant analysis for condition monitoring of machines.

Some questions can involve the interpretation of charts and plots. Simple mathematical calculations using a basic scientific calculator can be required. A summary of common formulae can be provided along with the examination questions.

The examination content shall be proportionate with the training syllabus contained in Annex A.

MIBoC may, at its discretion, make accommodations to assist candidates who have a disability in accordance with ED002 - General Scheme Requirements, clause 9.3, or for whom the language of the examination is a second language.

5.2 Conduct of Examinations

All examinations shall be conducted in accordance with ED002 – General Scheme Requirements Clause 11.

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Annex A (normative)

Training course requirements and minimum training hours for Field Lubricant Analysis personnel

Table A.1 – Training Syllabus

SUBJECT	Hours of training		
	Category I	**Category II**	**Category III**
1. Maintenance strategies	2.5	1	-
2. Lubrication theory/fundamentals	4	1	6.5
3. Lubricant selection	2.5	-	-
4. Principles of lubricant application	4	-	-
5. Lubricant storage and management	2.5	-	-
6. Lubricant contamination measurement and control	2.5	6	-
7. Oil sampling	2.5	7	-
8. Lubricant health monitoring, diagnostics, prognostics, and generic maintenance recommendations	2.5	5	8
9. Wear debris monitoring and analysis	1	4	11.5
10. Lubricant analysis programme development and management	-	-	6
Total hours for each category	**24**	**24**	**32**

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Table A.2 – Detailed list of topics and hours of instruction

Note 1: Category II includes the knowledge of Category I; Category III includes the knowledge of Category I and II.

Note 2: * indicates topics to be taught at indicated category.

Subject	Topics	Hours of training		
		CAT I	CAT II	CAT III
1. Maintenance strategies		**2.5**	**1**	**-**
1.1	Why machines fail	*		
1.2	The impact of poor maintenance on company profits	*		
1.3	The role of effective lubrication in failure avoidance	*		
1.4	Fundamental aspects of Reliability- Centred Maintenance (RCM)		*	
1.5	Aspects of Condition-Based Maintenance (CBM)		*	
1.5.a)	Predictive maintenance strategies		*	
1.5.b)	Proactive maintenance strategies		*	
1.5.c)	Lubrication routes and scheduling	*		
1.5.d)	Lubricant analysis and technologies to ensure lubrication effectiveness	*		
1.5.e)	Equipment tagging and identification	*		
2. Lubrication theory and fundamentals		**4**	**1**	**6.5**
2.1	Fundamentals of tribology	*		
2.2	Functions of a lubricant	*	*	
2.3	Lubrication regimes	*	*	*
2.3.a)	Hydrodynamic	*	*	*
2.3.b)	Elasto-hydrodynamic	*	*	*
2.3.c)	Boundary	*	*	*
2.4	Base Oils	*	*	*
2.4.a)	Functions	*	*	
2.4.b)	Properties	*	*	
2.4.c)	Characteristics, advantages, and disadvantages	*	*	*
2.5	Additive functions	*	*	*
2.5.a)	Antioxidants/oxidation inhibitors	*		*
2.5.b)	Rust inhibitors			*
2.5.c)	Corrosion inhibitors			*
2.5.d)	Demulsifying agents			*
2.5.e)	Viscosity index (VI) improvers	*	*	*
2.5.f)	Detergents	*	*	*

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Subject	Topics	Hours of training		
		CAT I	CAT II	CAT III
2.5.g)	Dispersants			*
2.5.h)	Pour-point depressants			*
2.5.i)	Foam inhibitors			*
2.5.j)	Anti-wear (AW) agents	*		*
2.5.k)	Extreme pressure (EP) agents	*		*
2.6	Oil lubricant physical, chemical, and performance properties and classifications	*		
2.7	Grease lubrication	*		
2.7.a)	How grease is made	*		
2.7.b)	Thickener types	*		
2.7.c)	Thickener compatibility	*		*
2.7.d)	Grease lubricant physical, chemical, and performance properties and classifications	*		*
2.8	Solid lubrication	*		
2.8.a)	Types of solid lubricant	*		
2.8.b)	Mechanisms of solid lubrication	*		
2.8.c)	Pressure-velocity (PV) factor equation	*		*
2.8.d)	Specific wear rate equation	*		*
2.9	Gas lubrication	*		
2.9.a)	Advantages of gas lubricated bearings	*		
2.9.b)	Properties of lubricating gases	*		
2.10	Classification systems	*		
2.10.a)	Viscosity (ISO/SAE)	*		
2.10.b)	Grease consistency (NLGI)	*		
2.10.c)	Engine (API/ILSAC)	*		
2.10.d)	API automotive gear oil classification	*		
2.10.e)	ATF classifications	*		
2.10.f)	Automatic brake fluid classifications	*		
2.10.g)	AGMA gear classifications	*		
2.10.h)	AGMA gear coupling classifications	*		
2.10.i)	Turbine oil classifications (BSI, DIN, GE, ABB)	*		
2.10.j)	Hydraulic fluids (ISO, Factory Mutual fire resistance grading system, ASTM, various components/system OEM performance specifications)	*		
2.10.k)	USDA/FSIS and NSF food-grade lubricant classification	*		
3. Lubricant selection		**2.5**	**-**	**-**
3.1	When to choose/advantages and disadvantages of: oil, grease	*		
3.2	When to choose/advantages and disadvantages of: solid, gas	*		

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Subject	Topics	Hours of training		
		CAT I	CAT II	CAT III
3.3	Viscosity selection	*		
3.4	Base-oil type selection	*		
3.5	Additive system selection	*		
3.6	Grease thickener selection	*		
3.7	Machine-specific lubricant requirements	*		
3.7.a)	Hydraulic systems	*		
3.7.b)	Plain bearings	*		
3.7.c)	Rolling element bearings	*		
3.7.d)	Journal bearings	*		
3.7.e)	Reciprocating engines	*		
3.7.f)	Gearing and gearboxes	*		
3.7.g)	Ropes	*		
3.7.h)	Chains	*		
3.7.i)	Steam turbines	*		
3.7.j)	Gas turbines	*		
3.7.k)	Internal combustion engines	*		
3.7.l)	Compressors	*		
3.8	Application and environment-related adjustments	*		
4. Principles of lubricant application		**2.5**	**-**	**-**
4.1	Effective use of manual delivery techniques	*		
4.2	Automatic delivery systems	*		
4.2.a)	Distributed delivery systems	*		
4.2.b)	Automated lubricators	*		
4.2.c)	Maintenance of automated lubrication systems	*		
5. Lubricant storage & management		**2.5**	**-**	**-**
5.1	Lubricant receiving procedures	*		
5.2	Proper storage and inventory management	*		
5.3	Lubricant storage containers	*		
5.4	Proper storage of grease guns and other lubricant application devices	*		
5.5	Maintenance of automatic grease systems	*		
5.6	Health and safety assurance	*		
6. Lubricant contamination measurement and control		**2.5**	**6**	**-**
6.1	Particle contamination		*	
6.1.a)	Effects on the machine		*	
6.1.b)	Effects on the lubricant		*	

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Subject	Topics	Hours of training		
		CAT I	CAT II	CAT III
6.1.c)	Methods and units for measuring particle contamination		*	
6.1.d)	Techniques for controlling particle contamination		*	
6.2	Moisture contamination		*	
6.2.a)	Effects on the machine		*	
6.2.b)	Effects on the lubricant		*	
6.2.c)	States of coexistence		*	
6.2.d)	Methods and units for measuring moisture contamination		*	
6.2.e)	Demulsibility measurement		*	
6.2.f)	Techniques for controlling moisture contamination		*	
6.3	Glycol coolant contamination		*	
6.3.a)	Effects on the machine		*	
6.3.b)	Effects on the lubricant		*	
6.3.c)	Methods and units for measuring glycol contamination		*	
6.3.d)	Techniques for controlling glycol contamination		*	
6.4	Soot contamination		*	
6.4.a)	Effects on the machine		*	
6.4.b)	Effects on the lubricant		*	
6.4.c)	Methods and units for measuring soot contamination		*	
6.4.d)	Techniques for controlling soot contamination		*	
6.5	Fuel contamination (fuel dilution in oil)		*	
6.5.a)	Effects on the machine		*	
6.5.b)	Effects on the lubricant		*	
6.5.c)	Methods and units for measuring fuel contamination		*	
6.5.d)	Techniques for controlling fuel contamination		*	
6.6	Air contamination (air in oil)		*	
6.6.a)	Effects on the machine		*	
6.6.b)	Effects on the lubricant		*	
6.6.c)	States of coexistence		*	
6.6.d)	Methods and units for measuring air contamination		*	
6.6.e)	Techniques for controlling air contamination		*	
6.7	Filtration and separation technologies	*		
6.8	Filter rating	*		
6.9	Filtration system design and filter selection	*		
7. Oil Sampling		**2.5**	**7**	**-**
7.1	Objectives for lubricant sampling	*		

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Subject	Topics	Hours of training		
		CAT I	CAT II	CAT III
7.2	Equipment-specific sampling		*	
7.2.a)	Gearboxes with circulating systems		*	
7.3	Sampling methods	*	*	
7.3.a)	Non-pressurized systems		*	
7.3.b)	Pressurized systems – low		*	
7.3.c)	Pressurized systems – high		*	
7.4	Managing interference	*	*	
7.4.a)	Bottle cleanliness and management	*	*	
7.4.b)	Flushing	*	*	
7.4.c)	Machine conditions appropriate for sampling	*	*	
7.5	Sampling process management	*	*	
7.5.a)	Sampling frequency	*	*	
7.5.b)	Sampling procedures (to include sampling point selection)	*		
7.5.c)	Sample processing	*		
8. Lubricant health monitoring, diagnostics, prognostics, and generic maintenance recommendations		**2.5**	**5**	**8**
8.1	Lubricant failure mechanisms	*	*	*
8.1.a)	Oxidative degradation – the process, causes, and effects	*	*	*
8.1.b)	Oxidative degradation – at-risk lubricants and applications; strategies for deterring it; strengths, limitations, and applicability of tests used to detect and troubleshoot oxidation (AN, viscosity, FTIR, RPVOT, sensory inspection)			*
8.1.c)	Thermal degradation – the process, causes, and effects	*	*	*
8.1.d)	Thermal degradation – strengths, limitations, and applicability of tests used to detect and troubleshoot thermal failure (AN, viscosity, FTIR, thermal stability test, ultracentrifuge detection of carbon insolubles, sensory inspection)			*
8.1.e)	Additive depletion/degradation – mechanisms; additives at risk	*	*	*
8.1.f)	Additive depletion/degradation – risk assessment for common mechanisms (neutralization, shear down, hydrolysis, oxidation, thermal degradation, water washing, particle scrubbing, surface adsorption, rubbing contact, condensation settling, filtration, aggregate adsorption, evaporation, centrifugations); strengths, limitations, and applicability of methods for measuring additive depletion/degradation (atomic emission spectroscopy, FTIR, AN, BN, VI, RPVOT, blotter spot test)			*
8.1.g)	Testing for wrong or mixed lubricants (base-lining physical and chemical properties test, additive discrepancies)	*	*	*
8.1.h)	Fluid properties test methods and measurement units – viscosity (kinematic and absolute, VI), AN/BN, elemental spectroscopy, FTIR, RPVOT, atomic emission spectroscopy, other tests	*	*	*
9. Wear debris monitoring and analysis		**1**	**4**	**11.5**
9.1	Common machine wear mechanisms	*	*	*
9.1.a)	Abrasive wear: two-body and three-body abrasive wear	*	*	*
9.1.b)	Surface fatigue: two-body and three-body	*	*	*

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		CAT I	CAT II	CAT III
9.1.c)	Adhesive wear	*	*	*
9.1.d)	Corrosive wear	*	*	*
9.1.e)	Fretting wear	*	*	*
9.1.f)	Erosive wear	*	*	*
9.1.g)	Electrical wear		*	*
9.1.h)	Cavitation wear: gaseous and vaporous cavitation		*	*
9.2	Common machine-specific wear modes			*
9.2.a)	Gearing			*
9.2.b)	Plain bearings			*
9.2.c)	Rolling element bearings			*
9.2.d)	Hydraulics			*
9.3	Wear particle types, origins, and probable causes	*		*
9.3.a)	Cutting wear particles			*
9.3.b)	Spherical particles			*
9.3.c)	Chunky particles			*
9.3.d)	Laminar particles			*
9.3.e)	Red oxide particles			*
9.3.f)	Black oxide particles			*
9.3.g)	Corrosion particles			*
9.3.h)	Non-ferrous particles			*
9.3.i)	Friction polymers			*
9.4	Wear debris analysis techniques	*	*	*
9.4.a)	Ferrogram preparation		*	
9.4.b)	Filtergram preparation		*	
9.4.c)	Light effects		*	*
9.4.d)	Magnetism effects		*	*
9.4.e)	Heat treatment		*	*
9.4.f)	Chemical treatment		*	*
9.4.g)	Morphology		*	*
9.4.h)	Surface detail		*	*
9.5	Atomic emission elemental spectroscopy		*	*
9.5.a)	Basic determination of wear particle metallurgy from elemental composition			*
9.5.b)	Evaluating sequential trends			*
9.5.c)	Evaluating lock-step trends			*
9.5.d)	Particle size limitation of common atomic emission spectrometers			*

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		CAT I	CAT II	CAT III
9.5.e)	ICP spectroscopy		*	
9.5.f)	Arc-spark emission spectroscopy		*	
9.5.g)	Wear particle density measurement		*	
9.5.h)	Advanced techniques (acid/micro-wave digestion, rotrode filter spectroscopy)			*
9.5.i)	X-ray fluorescence (XRF) and other advanced elemental spectroscopy methods			*

10. Lubricant analysis programme development and programme management		**-**	**-**	**6**
10.1	Machine-specific test slate selection			*
10.2	Optimizing frequency of analysis			*
10.3	Setting alarms and limits			*
10.3.a)	Setting goal-based limits for contamination			*
10.3.b)	Statistically derived level limits: editing data, calculating averages and standard deviation, setting upper and lower limits using the mean and standard deviation, how changes in system operation or maintenance influence statistically derived inferences			*
10.3.c)	Rate-of-change limits: calculating rate of change, slope-based alarms, statistically derived rate-of-change limits			*
10.3.d)	Setting aging limits for fluid properties: physical, chemical, and additive properties			*
10.3.e)	Trend analysis			*
10.4	Managing lubricant analysis information			*
10.5	Creating and managing lubricant analysis procedures			*
10.6	Scoping lubricant analysis training and examination for reliability technicians, trades people, and management			*
10.7	Performing cost/benefit analysis for lubricant analysis and contamination control programmes			*
10.7.a)	Calculating programme costs			*
10.7.b)	Estimating programme benefits			*
10.7.c)	Calculating return on investment metrics			*
10.7.d)	Generating an effective business proposal			*
10.8	Quality assurance			*
10.8.a)	Of on-site lubricant analysis			*
10.8.b)	Of off-site lubricant analysis providers			*
TOTAL HOURS		**24**	**24**	**32**

Note 1: Category II includes the knowledge of Category I; Category III includes the knowledge of Category I and II.
Note 2: * indicates topics to be taught at indicated category.