

Assessment Process

PR-007

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		Renee Byrne, ICS Consulting	Ken Keith, Executive Director	Matthew Holmes, National President
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		Ken Keith, Executive Director	Lloyd Appelt Director	Matthew Holmes, National President

Revision History

Revision Status	Revised Section (s)	Description of Revision	Reason for Revision
0	All	New Procedure	Original Document – Compliance with ISO 17024:2012
1	4.2 and 7.1	Add Approved Trainers Log, FM-007-4 in 4.2 and include log review in procedure.	To address NCR 3 from March 4,2021 external audit.

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1. Purpose

The proper assessment of an individual's experience, skills and knowledge are necessary to demonstrate the qualifications of that individual to carry out tasks in machinery condition monitoring and diagnosis. The purpose of this procedure is to describe CMVA / ACVM processes implemented for specific assessment methods and mechanisms to ensure that the certification scheme requirements are objectively and systematically verified, with documented evidence, prior to written attestation of the candidate's qualifications.

2. Scope

This procedure applies to all CMVA / ACVM Certification Categories as described in the Certification Schemes. This procedure includes conformity assessments related to both technical and administrative requirements in accordance with the International Standards ISO 18436-1, ISO 18436-2 and ISO 17024.

3. Definition

ACVM – L'Association Canadienne en Vibrations de Machines

CMVA – Canadian Machinery Vibration Association

Applicant – Person who has submitted an application to be admitted into the certification process.

Assessment – Process that evaluates a person's fulfillment of the requirements of the certification scheme.

4. References

4.1. International Standards

The following referenced international standards are indispensable for the application of this document. The latest edition of the referenced documents (including any amendments) applies.

- ISO 17024 Conformity assessment – General requirements for bodies operating certification of persons.
- ISO 7000 Conformity assessment – Vocabulary and general principles.
- ISO 18436-1 Condition monitoring and diagnostics of machines – Requirements for qualification and assessment of personnel, Part 1: Requirements for assessment bodies and the assessment process.
- ISO 18436-2 Condition monitoring and diagnostics of machines – Requirements for qualification and assessment of personnel, Part 2 – Vibration condition monitoring and diagnostics.
- ISO 18436-3 Condition monitoring and diagnostics of machines – Requirements for qualifications and assessment of personnel, Part 3 – Requirements for training bodies and the training process.
- ISO 13372 Condition monitoring and diagnostics of machines – Vocabulary
- ISO 9000 Quality Management Systems – Fundamentals and vocabulary.
- ISO 9001 Quality Management Systems - Requirements

4.2. CMVA / ACVM Documents

Certification Scheme, PR-004

Application Process, PR-006

Application for Examination and Certification of Vibration Analysts, FM-006-1

Appeals and Complaints Process, PR-011

Examination Process, PR-008

CMVA/ ACVM Trainer Agreement, FM-007-1

Course Registration Form, FM-007-2

Approved Trainers List, FM-007-3

Approved Trainers Log, FM-007-4

5. Responsibility

5.1. Executive Director

The Executive Director or designate is responsible for ensuring this procedure is written to meet the latest requirements for document control as stated in the ISO 17024 for Conformity Assessment.

The Executive Director is responsible for the assessment process and for communicating the requirements of this procedure to all staff, Board of Directors, volunteers and other interested parties, as applicable. This communication should be in a format where all affected personnel understand their roles and responsibilities as it relates to this procedure

The Executive Director is responsible for:

- The assessment of a candidate's eligibility to ensure the certification scheme requirements are objectively and systematically verified, with documented evidence (as required), to confirm the competence of the candidate.
- Ensuring that each assessment is fair and valid.
- The promotion and facilitation of this process with external entities.

5.2 National President

The CMVA / ACVM National President or designate is responsible for reviewing and approving this procedure for adequacy prior to release.

5.3 Board of Directors

The CMVA / ACVM National Board of Directors are responsible for reviewing assessment processes as part of the annual management review. This includes taking necessary action to improve processes as needed.

5.4 Technical Training Committee

The CMVA / ACVM Technical Training Committee are responsible for the development and rework of examination questions. This Committee is also responsible for adhering to the technical areas of

proficiency, as defined in the relevant parts of ISO 18436 which relate directly to the specific technologies for each certification category assessment.

5.5 Administrative Assistant

The CMVA /ACVM administrative assistant is responsible to maintain official records, including the application forms, non-conformance communications and certificates.

5.6 Staff/ Volunteers/ Document Users

As applicable to their role within the CMVA/ ACVM, all Staff, Volunteers and Document Users are responsible for following the processes required by this procedure and for reporting any nonconformity or opportunity to improve this procedure or the processes described within it.

6. Application Assessment Process Requirements

6.1. Application for Examination and Certification of Vibration Analyst

Individuals interested in becoming certified to one of the four certification categories, as described in the Certification Scheme, PR-004, shall complete and submit to the CMVA / ACVM Executive Director the Application for Examination and Certification of Vibration Analysts FM-006-1. Due to examination time constraints, it is preferred that the application is completed on the CMVA / ACVM website and submitted electronically.

Upon receipt of the completed application form, the CMVA / ACVM Executive Director will assess the individual's application for certification to ensure all criteria are met.

The application assessment criterion consists of:

1. All required fields of the application have been completed.
2. Attestation of successful completion of formal vibration training expressed by topic and in hours, in accordance with Table 1.
3. Attestation of field experience in the application of vibration condition monitoring practises, in accordance with Table 2.
4. Verify the applicant's Supervisor has signed the application to attest to the applicant's field experience.
5. Any additional training on machine knowledge, as recommended in the Certification Schemes, PR-004, should be validated by verifiable records.
6. Attestation of CMVA / ACVM Code of Ethics is required by each applicant, regardless of their current certification category (Verify the applicant has signed the appropriate page of the application as an attestation of agreement to follow the terms and conditions and the CMVA/ACVM Code of Ethics.)
7. Qualification to a particular certification category is subject to attainment of certification to the previous category, with the exception of Direct Entry to Category II. See note in Table 2 below.
8. The individual's application must be completed at least two weeks prior the proposed examination date.

Subject		Category			
		I	II	III	IV
1.	Principles of Vibration	6	3	1	4
2.	Data Acquisition	6	4	2	2
3.	Signal Processing	2	4	4	8
4.	Condition Monitoring	2	4	3	1
5.	Fault Analysis	4	5	6	6
6.	Corrective Action	2	4	6	16
7.	Equipment Knowledge	6	4	4	-
8.	Acceptance Testing	2	2	2	-
9.	Equipment Testing and Diagnostics	-	2	4	4
10.	Reference Standards	-	2	2	2
11.	Reporting and Documentation	-	2	2	4
12.	Fault Severity Determination	-	2	2	3
13.	Rotor and Bearing Dynamics	-	-	-	14
Total hours per category of training		30	38	38	64

NOTE: The hours per subject are approximations to allow training bodies and assessment bodies to assess the relative importance of subjects, and it is recognized that subject contents may overlap.

Table 1: Minimum Required Training Topics and Durations

Minimum Required Training & Experience		
Category	Training (Hours)	Experience (Months)
Category I	30	6 + Data Collection Practicum
Category II	Cat I + 38	18*
Category III	Cat II + 38	36
Category IV	Cat III + 64	60

*NOTE: Candidates can apply for Direct Entry into Category II, provided they have met the requirements in section 6.2 below.

Table 2: Minimum Required Training & Experience

6.2. Direct Entry to Category II

A candidate may skip certification to Category I and apply directly to Category II if they meet any one of the following criteria. Documented proof is required to verify one of these criteria is met.

1. Holds a 4-year degree from a college or university;
2. Holds a 2-year technical degree from a college or university;
3. Has 3 or more years of experience in vibration analysis; or
4. Holds active vibration analyst recognition (certificate) at any category from a recognized training organization.

If the applicant meets any one of the above criteria, a minimum of 12 months experience is acceptable as opposed to the 18 months required in Table 2 above.

6.3. Special Needs Accommodation

It is the policy of CMVA / ACVM to make reasonable accommodations for candidates with special needs. The Candidate must first identify the special need on the application form. The special need could be needs such as English translation dictionary, visual impairment, dyslexia, handicapped facilities, etc.

When a special need is identified, the Executive Director will verify and accommodate the special need, within reason and where the integrity of the assessment is not violated, taking into account national regulations. The Executive Director may consult with the Technical Training Committee and/or the National President to determine how to accommodate the special need.

Any accommodation for special needs will be documented in the applicants file and communicated to the Examination Proctor. Depending on the nature of the special needs request, verification from an authorized medical professional or other professional may be required prior to accommodating the need.

6.4. Approving the Eligibility of Candidates

After thoroughly assessing the candidate's application, the Executive Director will notify the candidate, typically by email, of the candidate's acceptance or denial of their application.

If denied, the Executive Director will explain why the application was denied. The candidate then has the option to re-submit the application with the required information or may evoke his/her rights to appeal, see Appeals and Complaints Process, PR-011.

If the candidate meets all the criteria, as described above, the Executive Director will notify the candidate, by email that he/she qualifies to write the examination and requests exam payment. The Trainer will also be notified by email if the exam will be completed through them. The Executive Director then notes the date that the application was approved on the CMVA/ ACVM Planned exam sessions file. Payment must be received before the proposed examination date and is preferred by the credit card payment option using the STORE tab on the CMVA / ACVM Web site.

The Executive Director then prepares and schedules the examination; see Examination Process, PR-008. A file in the Candidate's name is created and maintained in the Executive Director's office. This file will contain the Candidate's application and any associated records used to assess and confirm the eligibility of the Candidate.

7. Adherence to Training Curricula Process Requirements

7.1. Assessing Training Providers and Curricula

Training organizations who wish to provide training to meet the requirements of CMVA / ACVM certification schemes are required to complete and to comply with the CMVA/ ACVM Trainer

Agreement, FM-007-1. On this form, trainers are attesting that their training is compliant with 18436-2. Training providers cannot be part of the legal entity of CMVA / ACVM to ensure impartiality is not compromised.

The Executive Director and the Technical Training Committee assesses each application and determines if the Training Provider has met the requirements. Only qualified Training Providers courses are promoted on the certified course calendar on the CMVA website. CMVA / ACVM do not endorse or recommend any particular training provider. Training providers wishing to have their courses promoted on the CMVA/ ACVM website are required to complete the Course Registration Form, FM-007-2.

Approved trainers are documented on the Approved Trainers List, FM-007-3. Trainer approval is valid for one year, after which trainers must successfully reapply with the CMVA/ ACVM Trainer Agreement, FM-007-1 to remain on the approved trainers list. Trainer agreement expiries will be tracked using the Approved Trainers Log, FM-007-4

Candidates are provided with a course and exam survey upon completion of an online exam to evaluate conformance with 18436-2 as well as satisfaction with course, trainer, venue, and exam.

8. Assessment of Examination Process Requirements

8.1. Development, Approval and Rework of Examination Questions

8.1.1 The Basis of Examination

The International Standard ISO 18436-2 is a standard concerning the training and certification of vibration personnel in the field of Vibration Condition Monitoring and Diagnostics. The Technical Training Committee of CMVA / ACVM use the latest edition of this standard as the basis for developing examination questions. These examinations are used to assess candidates competence based on and consistent with the Certification Schemes. During the development of examinations the Technical Training Committee identified that this standard does lack detail. As a result, the committee took the approach of developing Performance Objectives, which start from this ISO standard and amplify its provisions so as to define the requirements for each certification category in great detail. These “Performance Objectives”, as listed in the controlled documents log, provide a very detailed basis for creating training courses, enabling self-study and developing exam questions.

Over several years, the Technical Training Committee ran workshops in which qualified people in the field of vibration analysis sat down in groups, face to face, and for each topic in the standard, answered these questions:

- a) If people are essentially just collecting data, and not analyzing it, (Category I) what do they need to be able to **do**, in regard to this topic (e.g. basic motion) that will make them better at that job?
- b) If they are actually going to analyze the data and make decision about the condition of the machinery (Category II), what extra things to they need to **do** with regard to this topic to enable them to make better decision?
- c) If their job is Program Development and Diagnostics (Category III), what else to they need to **do** with regard to this topic to improve their capability there?

Notice the word “**do**”. The Technical Training Committee is not interested in “having a general understanding”. They want to certify people to actually perform the work. The focus is on providing benefits to end users, since ultimately, end users drive the whole business.

As these detailed Principle Objectives were completed, they were made available to all CMVA / ACVM members through the website.

8.1.2 Developing Exam Questions

Initial suggestions for exam questions came from many individuals. Those who contributed were asked to follow the guidelines below, for the question and also for each of the answers:

- a) The writing must be clear and literate and the sentence structure and grammar must be straightforward and fair.
- b) Avoid trick questions entirely.
- c) Base every question you offer on a specific Performance Objective, and identify that objective with the question.
- d) If an illustration is needed, it must be clear, readable in grey scale, and submitted as a separate file in bitmap format such as jpg.
- e) There must be a reasonable number of answers for each question (i.e. four or five).
- f) The wrong answers must be sufficiently wrong, although not outlandish.
- g) Every answer (not just the right one) must fit the grammar and structure of the question.

8.1.3 Approval of Exam Questions

Once a body of questions was established, workshops were convened to review them in detail. At least three qualified people studied each question and considered the following issues:

- a) The Level/ Point of View of the Question
 - Is it appropriate to the category of the exam?
 - Does it take into account the expected training and experience of the candidate?
- b) Question Content
 - Does the question measure one or more of the performance objective for the category?
 - Is the question categorized into the correct section (e.g. Principles of Vibration, Corrective Action)?
 - Is it sufficiently different from the other questions in that section as to justify being included, or is it sufficiently better than other questions on the same topic as to justify replacing them?
- c) The Question/ Statement
 - Is it clearly worded?
 - Does it give sufficient information, without providing so much information that the candidate bogs down?
 - Is it positive rather than negative in format?
 - Where appropriate, does it use both Imperial and Metric system terms?
 - Are there implicit assumptions made in asking the question? If so, make the assumptions explicit.
 - Is the technical terminology correct and rigorous?
 - Is jargon used? If so, “translate” to standard English or make sure the jargon is universally known.
 - Is the scenario presented a reasonable one?

- d) The Possible Answers
- Does each answer fit grammatically with the question (so that answers cannot be discarded because they don't "read right")?
 - Is each answer clearly worded and unambiguous?
 - Is the stated correct answer clearly the best one – given the exam category?
 - Are the unselected answers sufficiently wrong so that a person we would want to be certified at this category has a very good chance of discarding them?
- e) The Illustration (if any)
- Is it clearly legible?
 - Is the vertical scale (if any) reasonable?
 - Is the horizontal scale (if any) reasonable?
 - If appropriate, are there both Imperial and Metric units?
 - Have references to specific companies been removed?
 - Does the illustration use notation or parameters specific to one company or industry? If so, standardize it.

Analyzing questions in a group setting is very time-consuming and very instructive. It becomes obvious that there is no such thing as a perfect question. Well-respected and knowledgeable people often disagree on aspects of a question. People frequently interpret a question somewhat differently depending on their background, industry, level of training, or even the area of residence in the country. The review and acceptance of questions was a demanding process, and it produced an excellent bank of 500+ questions.

8.1.4 Rework of Exam Questions

Continuous improvement is essential. It is important to make sure that the exam questions are as good as we can make them, since they are the measure of who passes and who fails, and ultimately, the measure of whether certification is worthwhile to the end user.

If thousands of people write an exam, statistical analysis is an excellent means of validating questions. However, in the case of CMVA / ACVM's questions, not nearly enough people write each question to make statistical analysis viable.

An alternative method, more time-consuming but no less effective, is to track all wrong answers, as shown in Figure 1 below, and then analyze the results. This method still requires that several people write the exam, and that is often achievable.

Look for patterns, mine the data; it may provide surprising insights, such as:

- a) Everyone who got it wrong got the same wrong answer.
- b) Too many people got the question wrong.
- c) The candidates who did very well on the exam got this question wrong.
- d) The candidates who did quite poorly overall got this question right.
- e) The wrong answers are all over the map.
- f) Almost everyone erred on all the questions in a particular major topic (e.g. acceptance testing).

Evaluate the patterns. Study the questions which "pop out" from this analysis. Some comments might be:

- a) The questions and answers are fine, and qualified candidates should have been able to answer it.
- b) The question is worded badly.
- c) The answers are insufficiently differentiated or badly worded.

d) The question should be in a different category.

For each situation above, make any necessary changes, and re-evaluate the question.

- a) No change. Could decide to reinforce the related Performance Objective.
- b) Fix the wording to make it straightforward and clear.
- c) Fix the wording of the answers, or change the “wrong” ones so they are more clearly wrong, or the right one so it is more clearly right.
- d) Redo the illustration.

In addition to this formal analysis, CMVA / ACVM suggest to all candidates that they note on the exam any issues they find with the questions. Occasionally, knowledgeable people identify important points which simply were not noticed by reviewers. These comments are also taken into account. Advances in technology have also necessitated a few modifications.

For the purposes of pass/fail results for a particular exam, questions which fail the above analysis are discarded for the calculation. For example, there might be two questions which require change. Those two questions are simply deleted for the 100, and the percentages are recalculated out of 98. Thus, if you got 74 questions right, and two of the ones you got wrong were in the deleted set, your new percentage would be $74/98 \times 100 = 75.5\%$. Thus you are not penalized for a “bad” question.

Before another exam is generated, the revised question replaces the original one. Notes are added which indicate the changes made, and who verified them, and when that was done.

Question number	Major Topic	CMVA's answer	Candidates' answer if it does not match CMVA's answer.				
1	acc	c					
2	test	c					e
3	eqt kno	d					
4	eqt kno	b			d		d
5	test	a					
6	doc	d					
7	con	e	b		b		b
8	data	c					
9	cor	b	a			a	a
10	acc	b				a	
11	fault	c					
12	vib	b					
13	cor	c					
14	data	c					d
15	data	d					
16	ref	b			a		
17	ref	c			d	a	
18	con	b	a		a		a
19	eqt know	d			a		
20	eqt know	a					
21	cor	c					
22	doc	b					
23	cor	c				a	
24	cor	b					
25	con	c			b		
26	cor	c					
27	sig	d					e
28	vib	b					
29	cor	b			d		d
30	fault	c		d			d
31					

Continued for entire exam

Figure 1: Analysis of exam shows which questions are problematic.

8.2. Design of Examinations

Examinations are design based on the International Standard 18436-2 where the standard recommends the number and type of exam questions and requires the examination content to be consistent with the training syllabus contained in the standard.

In addition to the requirements of ISO 18436-2, CMVA / ACVM examinations are established based on the Principle Objectives and Certification Schemes for each certification category. Refer to Table 3 below.

Category	I	II	III	IV
Number of questions	50	100	100	60
Number of hours allowed	2	3	4	5
Pass Grade	70%	70%	70%	70%

Table 3: Examination Content, Duration and Pass Grade

END OF PROCEDURE