Complying with the resource requirements of ISO/IEC 17025:2017 in Indonesian calibration and testing laboratories: current challenges and future directions

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Abstract
Compliance with all the requirements in the ISO/IEC 17025:2017 is crucial for testing and calibration laboratories in assuring the quality of measurement conducted in their laboratories. The latest version of the ISO/IEC 17025:2017 presents a different structure compared to the previous version, ISO/IEC 17025:2005. Therefore, amendments in the quality documents and the operational procedures in the laboratories are urgently required. However, not all laboratories’ personnel understand this new standard and know how to implement or incorporate this new version standard with their old version documents and operational procedures. It causes a problem for the testing and calibration laboratories, especially in Indonesia. This study is expected to provide enlightenment and hints for the laboratories struggling to comply with the ISO/IEC 17025:2017.

Keywords Resource requirements · ISO/IEC 17025:2017 · Testing laboratory · Calibration laboratory

Introduction
ISO/IEC 17025 is an international standard applied for testing and calibration laboratories. This standard contains all the requirements need to manage the laboratories and ensure the measurements conducted in the laboratories are valid, comparable and traceable. Complying with this standard is one of the requirements to get accreditation status from the National Accreditation Body. Considering the number of accredited laboratories in Indonesia, 1541 testing laboratories and 318 calibration laboratories [1], it is important to discuss one of the important clauses in the ISO/IEC 17025:2017 assisting the laboratories to comply with this standard.

History of the standard
The standard of ISO/IEC 17025 was firstly known as ISO/IEC Guide 25 and then changed into ISO/IEC 17025 in 1999. The first edition of ISO/IEC 17025 had a simple structure with five clauses; (1) scope, (2) normative references, (3) term and definition, (4) management requirements, and (5) technical requirements. This version was valid for six years until the second version of ISO/IEC 17025 was published in 2005.

The structure of the second edition was similar to the first edition but there were some changes in some subclauses. The subclause of 1.4 (the scope of the standard) emphasized that ISO/IEC 17025:2005 applied not only for the certification of laboratories but also for the competence of laboratories. The subclause of 1.6 was also changed underlining that the laboratories have been accredited for ISO/IEC 17025 cannot claim that they already meet all the requirements in ISO 9001. In the fourth clause, subclause 4.7 (service to the customer) was also changed and subclause 4.10 (improvement) was added. In the fifth clause, the subclause 5.2.2 and 5.9.2 were changed by adding some statements to ensure the quality of the testing and calibration results [2]. Furthermore, some terms and statements were revised in this second version to align with the ISO 9001:2000 as suggested by ISO/CASCO WG25 [2, 3]. In the ISO/IEC 17025:2005,
there were some new terms used in the standard, such as “customer” and “management system” which used to replace the term “client” and “quality management system”, respectively. The statement “test and calibration laboratories that are in compliance with this International Standard will also operate in accordance with ISO 9001” was also added in the version of ISO/IEC 17025:2005.

After twelve years, the ISO/IEC 17025:2005 was revised by issuing ISO/IEC 17025:2017 by the end of 2017. This newest version considers that the clause of management requirements (fourth clause) was already irrelevant to the current laboratories condition because this clause had not significantly been changed since 1999. The changed for the ISO/IEC 17025:2005 was initially proposed in October 2014 by surveying the member of International Laboratory Accreditation Cooperation [4] which was about 84 % of the respondent approving the changing proposal for the ISO/IEC 17025:2005 [5]. This was followed by continuing process to change and complement the new ISO/IEC 17025 for three years until finally the new version of ISO/IEC 17025 was published in 2017 [5].

The ISO/IEC 17025:2017 has eight clauses. The first three clauses were similar to the former version (scope, normative references, terms and conditions) while the fourth and fifth clauses of the previous version were transformed into five new clauses, i.e. (1) general requirements, (2) structure requirements, (3) resource requirements, (4) process requirements, and (5) management system requirements [6].

Resource management is one of important clauses in the ISO/IEC 17025:2017. It has six subclauses which most of them could be found in the ISO/IEC 17025:2005, except subclause 6.5 (metrological traceability). This subclause is adapted from the last version (the subclause of “measurement traceability”) with additional explanation in Annex A. In the resource requirement, the resources, such as personnel, equipment, environment and external provider, which are the vital part of conducting the reliable and traceable measurement in the calibration and testing laboratories are discussed. The changes in the standard challenge the testing and calibration laboratories to understand, adapt, and implement this version of the standard.

**Transition from ISO/IEC 17025:2005 to ISO/IEC 17025:2017**

The testing and calibration laboratories accredited for ISO/IEC 17025:2005 have to apply for the new standard and align to the requirements of ISO/IEC 17025:2017 during certain transition period. In Indonesia, the transition period followed the timeline set by ILAC (Fig. 1), which is from November 2017 until November 2020. However, due to the global coronavirus disease 2019 (COVID-19) outbreak, the transition period has been extended from November 2020 to 1 June 2021. This extension has been granted to ensure all accreditation bodies and accreditation laboratories were able to achieve the remaining transitions. In Indonesia, the transition period is over. Some laboratories have successfully implemented the new version of ISO/IEC 17025 but there are some laboratories still struggle with this standard,
especially for the new laboratory. The laboratory of SNSU-BSN as National Metrology Institute in Indonesia is one example of the laboratories has successfully implemented the ISO/IEC 17025:2017 during the transition period [7]. Another testing laboratories reported their transition progress is Testing Laboratory of The Department Environmental Engineering at Andalas University, Indonesia. They reported their progress in preparing the Laboratory Quality Manual based on ISO/IEC 17025:2017, which was conducted by PDCA (plan, do, check, action) approach. The result shows that their quality manual still need improvement, especially in resource requirements and process requirements because there were still found the weaknesses and some non-fulfilment of some clauses in those requirements [8].

In Pakistan, the transition process to adapt to the ISO/IEC 17025:2017 was not an easy process. By the end of the transition period, PNAC (Pakistan National Accreditation Council), the accreditation body in Pakistan, reported that out of 26 laboratories, 18 of them have problems complying with the ISO/IEC 17025:2017. The non-conformities found in those 18 laboratories were mostly due to the finding does not meet the requirement of the subsequent clause, neither in form of implementation nor in documentation which effects the validity of test results. From the results of their study, it can be seen that the compliance with the resource, process and management requirements are still being issues for testing or calibration laboratory even though the transition period is already over [9].

Considering the importance of ISO/IEC 17025:2017 and its compliance for testing and calibration laboratories and also the problem facing by some laboratories in complying this standard, it is still important to discuss this standard even though the transition period is already over. This paper specifically discusses the compliance with the clause of resource management ISO/IEC 17025:2017 in testing and calibration laboratories, including the challenges and the future directions.

**Understanding the resource requirements of the ISO/IEC 17025:2017**

**Personnel**

Personnel is the first resource requirement mentioned in the ISO/IEC 17025:2017. All personnel involved in the management system of laboratory, internal or external, have to work and act impartiality. Impartiality means the presence of objectivity [6], no conflict of interest. If there is a conflict, it has to be resolved by the personnel involved to prevent the negative influences on all the activities in the laboratory. The decision related to the laboratory work has to be taken without any personal objectives and according to the real condition.

Considering the importance role of the personnel in the laboratory activities, the laboratory shall document the competence requirements for each laboratory personnel, such as requirements for education, qualification, training, technical knowledge, skills and experience. The laboratory management also has to communicate and assign the personnel started from the top manager, calibration supervisor, technician, administration staff and document control staff thus they can work effectively along with the laboratory’s services. All the activities performed related to the determination and monitoring competence of personnel shall have procedures and the records shall be retained as part of the document information from the laboratory management.

**Facilities and environmental conditions**

In conducting the calibration and testing activities, the facilities and environmental conditions shall be suitable. The laboratory is required to monitor, control and record the conditions of the laboratory facilities and environment, which is stated in the subclause 6.3 of the ISO/IEC 17025:2017. The calibration and testing laboratories need to document the requirements related to facility and environmental conditions in accordance with certain specifications, methods or procedures. These requirements may refer to international standards, national standards, consensus results, technical meetings, scientific journals. In this case, it is recommended to refer the requirements of the facility and environmental conditions of international standards published by standards bodies having good credibility.

**Equipment**

Equipment is one of the vital resources to carry out calibration and testing activities. The laboratory equipment consists of the instrument used to measure the samples, calibrate the standards, or monitor the environmental condition. All of these instruments can affect the calibration and testing results with a certain level of accuracy. According to ISO/IEC 17025:2017, the laboratory personnel, such as technician, supervisors, and managers, shall have access to the equipment used for calibration and testing activities. The procedure regarding laboratory equipment used for calibration and testing service activities is required, which includes the process of handling, transporting, storing, using and maintaining. Procedures related to the equipment can be part of the parent procedure [9] or can be a stand-alone procedure.

Generally, the equipment used for calibration and measurement activities need to be calibrated. There are three conditions where the calibrated instruments have to be urgently...
required. First, if the value of its accuracy or uncertainty affects the validity of the calibration or test results. Second is if the calibration process is used to establish metrological traceability, and the last one is if the instruments are used to establish a calibration program for other equipment. In this case, the laboratory also has to review the calibration period of the equipment, which is important to maintain confidence in the calibration status of the equipment.

The equipment that requires calibration has to be uniquely identified and marked by being labelled with the information containing the last calibration date and the next calibration due date. This label helps to identify the equipment and control its calibration status.

**Metrological traceability**

Metrological traceability is an indispensable part of the measurement result widely used when assessing the compliance with regulatory and specification requirements. The traceability concept in the new ISO/IEC 17025 has a similar concept to the measurement traceability which was described in subclause 5.6 of the ISO/IEC 17025:2005. According to the International Vocabulary for Metrology (VIM), metrological traceability is defined as a property of measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty [10]. In the ISO/IEC 17025:2017, the metrological traceability is discussed concisely with three important points [6]. First, the measurement results shall metrological traceable through a documented unbroken chain of calibration. Second, metrological traceability to International System of Units (SI) shall be achieved by calibration provided by a competent laboratory, certified value of CRM provided by competent producer stating metrological traceability to the SI, or direct realization of the SI units ensured by comparison with national or international standards. Third, the traceability can be achieved through an appropriate reference, such as certified value of certified reference material (CRM) produced by competent producer or results of a reference measurement, a specified method or a clearly described consensus standard if the metrological traceability to SI is not possible [11, 12]. In Annex A, the concept of metrological traceability is explained in more detail including how to establish and demonstrate metrological traceability. The purpose of this additional detail is to ensure comparability of measurement results both nationally and internationally.

**Externally provided products and services**

The clause regarding externally provided products and services is the last subclause in the resource requirements according to ISO/IEC 17025:2017. The external suppliers mentioned in this clause include the external calibration services, reference materials (RMs) producers, and proficiency testing (PT) providers. This clause ensures that the products and services supplied from the external resources are suitable for the laboratory activities.

The testing and calibration laboratories have to select the vendors or suppliers supplying the services and products for the laboratory activities to ensure the criteria and competency of the suppliers matching to the laboratory needs. There are some criteria that can be used to select the suppliers such as the competence of the suppliers, the accreditation status of the suppliers, the accreditation standards applying to its suppliers and the documentation of the standard and its appropriate control done by the suppliers [13]. Furthermore, it also covers the procedure on how to evaluate and monitor the performance of external suppliers including retaining its records.

**Compliance, challenges and future directions**

Following the discussion about the resource requirements according to ISO/IEC 17025:2017, in this section, the compliance and challenges in complying with those resource requirements are discussed including the future direction.

**Personnel**

As discussed before, the clause 6.2 emphasizes that all laboratory personnel involved in the calibration and testing activities must be impartial and competent in order to provide excellent service to customers leading to customer satisfaction. It is not always easy to raise awareness of the personnel to implement the principle of impartiality in their daily activities in laboratory. Therefore, it is necessary to have a laboratory management system and work environment which supporting a culture of impartiality in carrying out calibration and testing work. Placing impartiality as a risk factor for laboratory and be proactive to communicate the importance of upholding the impartiality principle to all personnel on a regular basis are very crucial. These examples are the concrete action that can be done by laboratory management to prevent or overcome problem due to impartiality in laboratory.

Regarding the competence of personnel, the laboratory needs to have competence development programs for all personnel, such as attending training (formal or informal), participating in relevant conferences or seminars, participating in internship programs, and continuing in higher degree education. All of these programs must be linked to and in line with the personnel competency development in the laboratory. As an example, the personnel who has a potential
to be a supervisor of weighing calibration work is strongly encourage to participate in training of calibration and testing of the weighing scales.

All activities related to personnel in the laboratory need to be supported by appropriate documented information such as documents, records, and procedures. It is necessary to document the track record of all laboratory personnel so that they can make appropriate planning, action, monitoring, and evaluation. The laboratory needs to establish a unit that controls and updates the documented information. Documented information from all laboratory personnel can be stored in hardcopy or softcopy versions according to the policies of the laboratory.

The laboratory management has the responsibility to ensure that all authorities, duties or responsibilities granted to laboratory personnel have been done properly. One of the methods to ensure and monitor all the personnel have exercised their authority in accordance with their duties and responsibilities is through the regular internal audit. Internal auditors can see the synchronization between job descriptions and its job records from laboratory personnel. Therefore, laboratory management needs to provide direction to the auditor related to this assurance, thus the checks can be made during the internal audit.

**Facilities and environmental conditions**

The condition of the facility and the environment in the calibration and testing laboratory is one of the crucial factors affecting the calibration and testing results. Special conditions of the facility are sometimes required to support calibration and testing activities, such as the need for a room with vibration resistant facility to reduce vibrations from the surrounding environment. This is urgently required for a scale measurement system or an interferometer measurement system that reads fringe pattern using the human eye.

In the dimensional metrology, for example, the calibration of gauge block has to be carried out in a laboratory with a controlled temperature and humidity. Those are two vital parameters because the changes in both parameters during the calibration process affect the validity of calibration results. Therefore, monitoring, controlling and recording the environmental conditions, especially temperature and humidity, are strongly required in the calibration laboratory.

Environmental conditions also need to be controlled for the laboratory in semi-permanent or non-permanent facilities according to the required specifications, procedures or methods. Therefore, the laboratory needs to determine and document the requirements related to the condition of the facility and the environment to carry out calibration and testing activities. In this case, the laboratory can refer to the facility and environmental conditions of the standards issued by international standards institutions, such as ISO, IEC, JCGM, OIML, or from other international scientific references.

For example, calibration of the gauge block (measurement of central length and variation in length) refers to the ISO 3650:1998 with a comparison method. In this standard, it is stated that the nominal length and the measured lengths of a gauge block apply at the reference temperature of 20°C and the standard pressure of 101325 Pa [14]. This means that for calibrating a gauge block, the environment condition is required with room temperature and pressure requirements in accordance with the standard of ISO 3650:1998.

Monitoring and recording the environmental conditions in the laboratory can be done by using special measuring instruments such as data loggers to monitor and record environmental conditions. This instrument can minimize the risk of forgetting to record or other human error because recording data loggers is conducted in real-time. Controlling the laboratory environmental conditions can be done by looking at the actual conditions of the laboratory environment such as temperature, humidity, air pressure, etc. recorded by the data loggers. These actual data are then compared with laboratory requirements to see their suitability. If the observation results show that the actual environmental conditions are beyond the requirements, it means that calibration and testing activities cannot be carried out under these conditions.

The ISO/IEC 17025:2017 also provides guidance when calibration activities are carried out outside the permanent facilities of the laboratory. As mentioned in the clause 6.2, if calibration and testing activities are carried out outside the laboratory facilities, it is necessary to ensure that all requirements related to the condition of the facility and the environment can be met. The laboratory shall ensure the ability of the customer to meet the requirements related to the facility and environmental conditions prior to commencement of work. This is important to maintain the quality of the calibration and testing results from the laboratory. Generally, pre-calibration and testing work are conducted to check the readiness of the facilities and environmental conditions at the location where calibration and testing activities are carried out. If the condition of the facility and the in-site environment is appropriate, then calibration and testing activities can be conducted, but if it is not appropriate then it needs to take action (if possible) in compliance with the ISO/IEC 17025:2017. Setting the temperature of the air conditioner and using the dehumidifier are examples of the action that can be done to control the environmental conditions in the in-site environment to meet the specific requirements.

**Equipment**

Principally, equipment is the basic thing that a calibration and testing laboratory needs to have in conducting its activities. Without having the proper equipment, the laboratory
will have many limitations in providing services to customers. The laboratory not only needs to have equipment with a certain accuracy, but the equipment also needs to be traceable metrologically. This metrological traceability is obtained by calibrating the equipment to a calibration laboratory which is also traceable. The equipment calibration program contains the identity of the equipment, the specifications of the equipment, the latest calibration schedule, the schedule for further calibration, the calibration interval of the equipment, and the name of the calibration laboratory for which the calibration is intended.

There is a risk related to a decreasing the degree of confidence in the calibration status of the equipment which come from the calibration program planned in the laboratory. Therefore, it is important to regularly monitor the interval calibration for each instrument which can be done by conducting an intermediate check for the instruments to know the validity of the calibration or testing results which is related to the calibration status of the instruments.

The determination of this calibration interval is generally carried out by the laboratory that owns the equipment unless required by higher rules or standards or regulated by documents that have legal or legal force. Regarding this calibration interval, according to the ILAC-G24:2017 [15] document, the initial calibration interval of the equipment can be determined based on the instrument manufacturer’s recommendation, expected extent and severity of use, the influence of the measured quantity, and pooled or published data about the same or similar device. To determine the next calibration interval, according to ILAC-G24, several methods can be used, including automatic adjustment or staircase method, control chart method, in-use time method and in-service checking method. The calibration and testing laboratory can choose that most appropriate method approach in conducting a review of the calibration intervals of its equipment.

In the automatic adjustment/staircase method, the calibration interval is determined based on the last calibration result of the equipment. If the calibration results show a shift since the previous calibration within 80% of the specified Maximum Permissible Error (MPE), the new calibration interval (In), the initial calibration interval (Io), and vice versa. Using this method requires a larger investment to provide the standard check that will be used. In the other method, namely the in-use time method, the calibration interval is stated based on the time of use of the equipment. Equipment is assigned a usage time indicator and is calibrated when the indicator has reached the set usage time. Generally, this method is used in equipment conditions that are overloaded or in extreme conditions which are likely to deteriorate over time due to use. The last method is in-service checking method, which is a variation of the automatic adjustment/staircase method with the control chart method. Critical parameters are checked at fairly close intervals by portable systems or specially made black boxes for critical parameters. If the test results on the black box give a value outside the specified MPE, the equipment needs to be calibrated immediately. When using this method, the laboratory needs to invest in providing a “black box” that has characterization according to the equipment.

**Metrological traceability**

Metrological traceability concept in testing and calibration laboratory is important to be complied to guarantee the measurement results conducted in laboratory is accurate, traceable, comparable, reliable, repeatable, reproducible, and accepted everywhere [16]. There are two measurement properties in making the valuable measurement results; stable and comparable. Stable means that the measurement results are still the same even the measurement is conducted or repeated in the next few months after doing the first measurement. Comparable means that the measurement results can be compared with other laboratories doing the similar measurement and other measurement conducted with different methods [17].

Establishing metrological traceability is close related to utilization of measurement standard. In conducting measurement, there are some standards that can be applied, such as primary, secondary, reference and working measurement standard. These can be achieved by using external services, such as National Metrology Institute [18], accredited calibration laboratory and certified reference materials. NMI works in national level. NMI has responsibility to maintain national primary standards and inter-compare them periodically, issue quantitative equivalent statements published in the Key Comparisons database of the Bureau International des Poids et Measures [19], who is responsible for developing technical and organizational infrastructure. Accredited calibration laboratory has to guarantee that the method employing in the laboratory is only the appropriate and worldwide recognized method together with well-documented unbroken chain calibrations (Fig. 2).

In calibration laboratories, meeting the metrological traceability requirements of ISO/IEC 17025:2017 can be
done by following some important steps, such as linking the measurement standards to primary standards of the SI unit of measure, calibrating the equipment that has significant effect on measurement results, creating a procedure to calibrate the equipment, and choosing competent, capable and traceable calibration services.

In the chemical measurements, the metrological traceability is typically conducted by indirect methods, such as measuring the quantity of the substance (sample mass, sample volume or relative signal response) and calculating the measurement results using an appropriate equation [20]. These results are stated in form of the value including its measurement uncertainty and a statement of metrological traceability. Therefore, in chemical metrology, the compliance with the metrological traceability requirements of ISO/IEC 17025:2017 is not easy and simple because the measurement is usually conducted for species with many variation of matrices [17].

In practical, the metrological traceability based on ISO/IEC 17025:2017 in chemical metrology can be achieved by following these steps [21, 22]; specify the measurand, scope of measurement and acceptable uncertainty; choose a suitable measurement method (a measurement procedure and condition); validate the method of measurement (measurement conditions, calculations and standard assigned value); identify all influences that will affect the result; choose appropriate reference standards or CRMs from competent procedures; calibrate crucial instruments; and estimate the uncertainty components associated with all influences and references. For example in the measurement of electrolytic conductivity, the method that use to measure the electrolytic conductivity has to be validated and the instrument (conductivity meter) has to be calibrated with the standard solution (CRM) traceable to SI through a primary or secondary CRM before measuring the sample. The use of CRM assures the validity and traceability of the sample measurement.

In practical, there are some risks that can be occurred related to the metrological traceability in the laboratory, such as the calibration status from the obsolete calibration provider laboratory, lack of confidence in the calibration status of the measuring standard at the calibration provider laboratory and untraceable measurement result to the top metrological traceability hierarchy as presented in Fig. 2. If this is the case, the laboratory needs to act proactively against the possible risk in metrological traceability because these risks are categorized as unacceptable risks thus the laboratory needs to preventive actions so that these risk do not occur.

**Externally provided products and services**

This subclause shall be considered and aware of when creating a quality document and selecting products and services providers hence only suitable and credible provided products and services are used by the laboratories. Some providers supported the calibration and testing laboratories in fulfilling these requirements are calibration services, RMs procedures and PT scheme providers [13, 23]. Those three are the types of conformity assessment bodies, which are very crucial because they affect the laboratory activities and the overall uncertainty budget [13].

Choosing the reliable supplier for calibration services is very crucial for the calibration and/or testing laboratories in establishing, assuring the quality and maintaining the metrological traceability of their measurement results. It is suggesting that the calibration services have to be conducted by the accredited calibration services supplier. The justification of the supplier selection is also part of the laboratory’s preventive action to anticipate risks related to the decrease in the quality of the measurement results produced. Besides assuring the accreditation status of the calibration services supplier, the calibration and/or testing laboratories need to ensure that the particular property is included in the supplier’s accreditation scope and whether the calibration and measurement capabilities (CMCs) declared by the supplier are fit for purpose of the laboratories. According to ISO/IEC 17025:2017, those accredited CMCs have to be under the International Committee for Weights Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA) [13]. In some cases, if the laboratories cannot find the reliable suppliers within the accreditation scope or the CMCs declared by supplier is not fit for purpose of the laboratories, the laboratories to be served shall asked to register that it has to estimate the case itself and suitable report it.
is important for the laboratory to establish its metrological traceability [9].

Calibration and testing laboratories use RMs in their everyday metrological activities, such as method validation, internal calibration, quality control process and inter-laboratory comparison [13, 23]. Considering the importance role of RMs in calibration and testing laboratories, the laboratories shall get the RMs from reliable RM producers, which are accredited for ISO 17034 (General requirements for the competence of reference material producers). According to ISO 17034, the RM producer shall establish uncertainty budgets, estimate uncertainties of certified values, and describe acceptance criteria for measurement levels including their uncertainties. Furthermore, if requested, recognize the uncertainty contributions to be included in the assigned uncertainty, and record factors affecting the uncertainty of the certified value [13]. It is important to mention that the testing and calibration laboratories have to find additional methods to demonstrate the quality of the RMs if they obtain the RMs from unaccredited RM producers [23].

According to ISO/IEC 17025:2017, the calibration and testing laboratories, participating in a PT scheme is a mandatory in order to assess the competence of the laboratory in conducting the measurements. However, the laboratories shall be selective in participating in a PT. Besides looking for the suitable PT scheme, the laboratories shall select the competence PT provider which has been accredited for ISO/IEC 17043 (Conformity assessment: General requirements for proficiency testing). The accredited PT providers shall have a proper documentation and information regarding the PT sample (the source, its homogeneity and stability), metrological traceability, and measurement uncertainty of the PT sample’s assigned value considering all parameters comprising issues inhomogeneity and stability. In some situation of no accreditation status of PT provider, the laboratory must take another action of evaluating the expertise of the provider. In spite of how the provider proves expertise, the laboratory must be capable of conveniently announce and profit from the information the provider gives [7].

Conclusion

The testing and calibration laboratories have responsibility to maintain their metrological traceability, produce reliable results for customers, and obtain accreditation status from National Accreditation Body. Therefore, complying with the standard and completing all the documents related to the standards are important in gaining the accreditation status from the national accreditation body. This study discusses the standard ISO/IEC 17025:2017, especially on the resource requirements and how to comply with these requirements in the laboratories. It is expected that this study could help the laboratories implement the ISO/IEC 17025:2017, maintain the documentation related to this standard and improve the quality of their testing or calibration services.

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