***Draft* TCTF Guidelines for Remote Calibration**

**Preamble**

"Remote calibration" is a technology which has been employed for a number of years in several areas of calibration technology, including time and frequency calibration using common-view GNSS GPS and other areas of technology, particularly in electromagnetics. Remote calibration is not peculiar to a specific calibration method but a broad technology to increase the efficiency of calibration processes by effective use of information technology. It includes, for example, automatic control of calibration processes, automatic acquisition and processing of data, and real time transmission of data through the Internet. Furthermore, the potential application of remote calibration technology is increasing in many fields, such as length (gauge blocks, coordinate measuring machines), ionizing radiation, and flow.

Consequently a demand for NMIs accreditation of calibration laboratories that perform remote calibration services arose. During such accreditation processes various issues were identified that required particular interpretation of the requirements of ISO/IEC 17025. These related mainly to technical aspects of remote calibration. Such issues included, for example, the fact that no staff of the remote calibration NMI laboratory may be present at the location where the calibration is conducted. Information technology plays a significant role in the conduct of the calibrations and in communication with customers. Hence the demand for a consistent interpretation of the ISO/IEC 17025 requirements relating to remote calibration is increasing. This document was prepared to assist in consistent interpretations of relevant requirements in ISO/IEC 17025 for remote calibration and focuses mainly on the technical aspects of such activities.

This document is for use by NMIs calibration laboratories in time and frequency metrology field that perform remote calibration services in developing their management systems for administrative and technical operations. Assessors and other stakeholders of remote calibration laboratories may also use it in confirming or recognising competence of remote calibration laboratories.

**1. Scope**

The general requirements that NMIs calibration laboratories have to meet if they wish to demonstrate that they operate to a quality system, are technically competent and are able to generate technically valid results are contained within ISO/IEC 17025. This international standard forms the basis for international laboratory accreditation and in cases of differences in interpretation remains the authoritative document at all times. The present document is not intended to be prescriptive and does not set out to introduce additional requirements to those in ISO/IEC 17025 but to provide amplification and guidance on the current requirements within the international standard.

**2. Terms and definitions**

For the purpose of this document, the relevant terms and definitions given in ISO/IEC 17000, VIM and the following apply.

**2.1 remote calibration**

calibration performed by an NMI accredited laboratory for devices installed at sites other than its permanent calibration facility, normally by the common-view method sending a transfer device associated with relevant instruments and exchanging information related to the calibration with its customers, without personnel of the accredited laboratory being present.

NOTE: “Exchanging information with its customers” mentioned above includes:

1. transmitting programs, instructions or data for remote control from the NMI accredited laboratory to its customers,
2. giving instructions and checking relevant issues in order to ensure security in collecting and transmitting calibration/measurement data etc.,
3. transmitting data relating to calibration/measurement and environmental conditions to the NMI, if necessary accredited laboratory,
4. monitoring support personnel and progress of calibration at on-site facility, and
5. exchanging other information and work instructions necessary for the calibration.

**2.2 remote calibration NMI laboratory**

an NMI laboratory which provides remote calibration service and is responsible for the entire process and the results of remote calibration including the issue of a calibration certificate.

**2.3 device under calibration (DUC)**

device, equipment, instrument or measurement standard subject to calibration.

**2.4 transfer device for remote calibration**

measuring instrument or other transfer device which is transported to the site where a customer’s DUC is installed and is used as an transfer standard when a remote calibration laboratory calibrates the customer’s DUC

NOTE: The above-mentioned “other transfer device” includes measurement standards and signals relating to the transfer process, such as the signals form GNSS.

**2.5 main premises (of a remote calibration laboratory)**

premises of a remote calibration NMI laboratory, in which a member of staff responsible for a remote calibration service is available to take responsibility for the conduct of the remote calibration, to verify the calibration results and to issue the calibration certificate.

**2.6 on-site facility (for a remote calibration)**

facility where a DUC subject to remote calibration is located.

**2.7 on-site equipment for remote calibration**

equipment and instruments for remote calibration provided by a customer and used at on-site facility. This may include peripheral devices, such as those used to measure environmental conditions at the site.

**2.8 calibration personnel**

technical staff of a remote calibration NMI laboratory who remotely control calibration processes being conducted at the on-site facility.

**2.9 support personnel**

technical personnel, provided by the customer or other external bodies based on a contract between a remote calibration laboratory and its customers, who handle and may operate a DUC, transfer device and on-site equipment for remote calibration at on-site facility to support the remote calibration.

**2.10 support service**

service, provided by support personnel based on the contract for the remote calibration.

NOTE if the work to be done by the customer for remote calibration does not require technical competence or experience in operation of equipment or instrument, such work is not considered as a support service.

**3. Guidelines for remote calibration**

Hereinafter, the number in the parentheses indicates relevant item number of ISO/IEC 17025.

**3.1 Organization (ISO/IEC 17025, 4.1)**

3.1.1 The remote calibration NMI laboratory should be responsible for ensuring that the entire remote calibration activities including support services comply with relevant requirements of ISO/IEC 17025 (ISO/IEC 17025, 4.1.2).

3.1.2 The remote calibration NMI laboratory should clearly define the scope of its own activities and details of support services necessary to perform remote calibration (ISO/IEC 17025, 4.1.3).

3.1.3 The remote calibration NMI laboratory should clearly specify the responsibility, authority and interrelationships of all personnel, including support personnel, involved in the remote calibration activities (ISO/IEC 17025, 4.1.4).

3.1.4 The remote calibration NMI laboratory should establish a management system to minimize the possibility of measurement data being influenced by its customers or support personnel (ISO/IEC 17025, 4.1.5 d)).

NOTE: Such measures may include transmitting the obtained data simultaneously to the remote calibration NMI laboratory whenever support personnel perform activities, or not disclosing assigned reference value of transfer device either to support personnel or customers.

**3.2 Management system and Document control**

3.2.1 Management system documentation should specify calibration activities and operations of equipment performed both at the main premises of a remote calibration NMI laboratory and at an on-site facility. The management system documentation should, where appropriate, include (ISO/IEC 17025, 4.2.5):

a) facilities, equipment and instruments used for remote calibration,

b) DUCs, transfer standards and calibration methods under accreditation;

c) means to enter, collect, store or transmit data at on-site facility (including measures to prevent amendment of data);

d) means to validate calibration methods and to verify the calibration results;

e) methods to check performance of the on-site equipment and the environmental conditions of the on-site facility;

f) responsibilities and authorities of personnel concerned with management of remote calibration;

g) contracts with its customers including appointment of support personnel;

h) work instructions and procedures of guidance and training for support personnel when necessary;

i) requirements for on-site facility, and

j) procedures for data processing and certificate issuance at the main premises of the remote calibration NMI laboratory.

3.2.2 The remote calibration NMI laboratory should provide support personnel with all operational procedures and work instructions necessary to enable them to provide support service correctly. It should make these documents available whenever support personnel need them (ISO/IEC 17025, 4.3.2.2).

NOTE: The work instructions may be complemented by customer’s procedures for controlling on-site facility, equipment and instruments.

**3.3 Contract review (ISO/IEC 17025, 4.4)**

3.3.1 When the remote calibration NMI laboratory receives a calibration request it should notify the customer of any specific conditions that may be required for the on-site facility, performance of on-site equipment and, when necessary, details of preconditioning of the transfer device and relevant instruments. It should confirm whether such facilities and equipment are available and comply with the requirements stated (ISO/IEC 17025, 4.4.1).

3.3.2 When a remote calibration requires support services, the remote calibration NMI laboratory should notify the customer and confirm whether the support service is to be provided by the customer or an external body. When the support service is provided by an external body, the remote calibration laboratory should exchange a contract for the support services with this body. This contract should be part of or referred to in the calibration contract with customers (ISO/IEC 17025, 4.4.1).

The contract for support services should include:

1. details of the support services (e.g. handling of transfer device for remote calibration, provision of on-site facility, on-site equipment for remote calibration and support personnel etc.),
2. date(s) of the support services,
3. contract conditions for the support services (in particular, any requirement for support personnel training may have to be agreed),
4. outline of guidance/training and qualifications or experience required for the support services,
5. written statement about confidentiality and impartiality of the support services, and
6. responsibilities for any nonconforming work that may be identified.

**3.4 Control of records (ISO/IEC 17025, 4.13)**

3.4.1 When a computer is used to record calibration or measurement data, the remote calibration NMI laboratory should carry out sufficient measures to ensure confidentiality so as to ensure that its customers do not have access to information about other customers (ISO/IEC 17025, 4.13.1.3).

3.4.2 The remote calibration NMI laboratory should carry out effective measures to limit access for data entry or collection, data storage and data transmission in order to ensure the integrity of the data and to prevent amendment of calibration/measurement data. Procedures should be in place to back up electronically-stored calibration/measurement data (ISO/IEC 17025, 4.13.1.4).

3.4.3 As necessary, the remote calibration laboratory should retain results of measurements taken at on-site facility together with related records such as measured environmental conditions (ISO/IEC 17025, 4.13.2.1).

**3.5 Support personnel**

3.5.1 When activities conducted by support personnel can have a significant impact on calibration results, the remote calibration NMI laboratory should, prior to initiation of remote calibration, verify whether the support personnel are able to provide support services fulfilling the requirements of the remote calibration laboratory. The remote calibration NMI laboratory should ensure that the support personnel are instructed, trained and have a suitable level of technical competence to provide support services.

The remote calibration NMI laboratory may train support personnel itself or delegate it to the customer or to another external body which provides support services. It is the responsibility of the remote calibration NMI laboratory to ensure the competence of any such support services. An acceptable means of confirmation of competence is to demonstrate that support services are provided by a calibration laboratory accredited to ISO/IEC17025. In such cases, the remote calibration NMI laboratory should at least review records provided by the customer or other external body to evaluate whether support personnel are provided with appropriate guidance and training (ISO/IEC 17025, 5.2.1).

NOTE 1: The extent of guidance and training depends on the level of technical competence of the support personnel and the importance and complexity of activities to be conducted by support personnel.

NOTE 2: If qualified technical staff of a calibration laboratory that is accredited to ISO/IEC 17025 for same measurand, using similar methodology, are used as support personnel, they will be regarded as a competent support personnel.

3.5.2 Support personnel should not be permitted to deviate from the defined activities and processes. If remote calibration NMI laboratory personnel find a need for a specific operation other than those written in the work instructions, support personnel may conduct such activities provided that special instructions are given by the calibration personnel in a timely manner and that the performance of support personnel is monitored during the calibration (ISO/IEC 17025, 5.2.3). Consideration should be given to subsequent amendment of these instructions to minimize the possibility of any future deviations.

NOTE: Monitoring activities conducted by calibration personnel does not necessarily mean continuous monitoring.

**3.6 Accommodation and environmental conditions (ISO/IEC 17025, 5.3)**

3.6.1 The remote calibration NMI laboratory should determine whether required environmental conditions including specified pre-conditioning are satisfied at the on-site facility during remote calibration and take any necessary actions if there is evidence that the environmental conditions deviate from those specified (ISO/IEC 17025, 5.3.1).

3.6.2 The remote calibration NMI laboratory should establish two-way communication with its customers by use of telecommunication tools such as, where appropriate, real-time video monitoring or use of a telephone service during calibration to monitor and control the process of calibration, including environment conditions (ISO/IEC 17025, 5.3.2).

**3.7 Calibration methods and their validation (ISO/IEC 17025, 5.4)**

3.7.1 The remote calibration NMI laboratory should validate methods of remote calibration that it uses. For this purpose, either or combination of the following should be considered:

1. comparison of the results of remote calibration with those of calibration performed at a permanent facility or with those of on-site calibration,
2. review of the results of the comparison for remote calibration performed by multiple remote calibration NMIs laboratories,
3. study of scientific papers, preferably peer-reviewed, about remote calibration methods,
4. participation in interlaboratory comparisons for the relevant remote calibration, and
5. use of a check standard at the on-site facility.

3.7.2 The remote calibration NMI laboratory should evaluate calibration and measurement capabilities for remote calibrations. If a calibration NMI laboratory provides calibration services at its permanent facility and remote calibrations, it should estimate and claim the calibration and measurement capabilities for both types of calibration (ISO/IEC 17025, 5.4.6.1).

3.7.3 Uncertainty budgets should give considerations to sources of uncertainty specific to remote calibration. such as handling of transfer device at the remote calibration laboratory, control of environmental conditions at on-site facility, transport of transfer device for remote calibration to on-site facility, handling of transfer device by customers and data transmission.

When necessary, the evaluation of on-site facility and on-site equipment should be performed at on-site facility prior to initiation of remote calibration. Also after completion of remote calibration, the remote calibration NMI laboratory should, when necessary, visit the on-site facility and evaluate relevant support services provided (ISO/IEC 17025, 5.4.6.3).

**3.8 Control of data (ISO/IEC 17025, 5.4.7)**

Throughout remote calibration activities, the remote calibration NMI laboratory should be able to have appropriate access to data obtained at one-site facility. When equipment operation as well as acquisition and transmission of measured data is performed with computers and via the Internet, security measures including authentication, access control, confidentiality, protection of data integrity and privacy protection should function appropriately and effectively (ISO/IEC 17025, 5.4.7.2).

**3.9 Transfer device for remote calibration (ISO/IEC 17025,** **5.5)**

3.9.1 The remote calibration laboratory should evaluate critical characteristics of the transfer device for remote calibration against potential changes of environmental conditions, mains power supplies and other relevant parameters, and take appropriate precautions against mishandling of device to maintain its specified performance in the remote calibration (ISO/IEC 17025, 5.5.6). Such precautions may include, for example, inclusion of shock indicators and maximum/minimum recording thermometers in packaging in which equipment is transported it may also include calibration or verification before and after the equipment is sent to the on-site facility.

3.9.2 When transporting a set of transfer devices for remote calibration to on-site facility, the remote calibration laboratory should prepare a contents list and provide it to the customer. The remote calibration laboratory should also provide its customer with instructions about unpacking, packaging, handling, installation etc. of transfer devices for remote calibration as necessary (ISO/IEC 17025, 5.6.3.4).

3.9.3 Records about transfer devices for remote calibration should include history of its transport, results of checks before and after transport, details of any adjustments and details of incidents that could cause damage or malfunction (ISO/IEC 17025, 5.5.5).

**3.10 Metrological traceability** (ISO/IEC 17025, 5.6)

When the remote calibration NMI laboratory uses on-site equipment owned by the customer of other external bodies that significantly affects on the validity of the calibration results or uncertainty, it should ensure that all such equipment and instruments are properly calibrated and obtain their calibration certificate or data before and/or during calibration.

**3.11 Calibration certificate (**ISO/IEC 17025, 5.10)

3.11.1 In addition to the general requirements for calibration certificate content, the certificate issued for remote calibration(s) should state that the calibration was performed remotely and indicate where the on-site facility is located (ISO/IEC 17025, 5.10.2).

3.11.2 When a certificate for remote calibration is prepared in electronic format and is sent to customers via electronic means, appropriate precautions should be taken so as to ensure the integrity of the data during transmission (ISO/IEC 17025, 5.10.1).

**4. References**

ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories

ISO/IEC 17000:2004 Conformity assessment – Vocabulary and general principles

ISO Guide 99:2007 International vocabulary of metrology – Basic and general concepts and associated terms (VIM)