

COVER

ILAC-G5:1994

**Guidelines for
Calibration and
Maintenance of
Test and Measuring
Equipment**

© Copyright ILAC 1996
ILAC publications may not be copied for sale by any individual or
body other than ILAC member organisations



ILAC-G5:1994

**Guidelines for
Calibration and
Maintenance of
Test and Measuring
Equipment**

PURPOSE

This guidance document is written to help calibration and test laboratories operating a quality system in accordance with ISO/IEC Guide 25 to implement a system to ensure that measuring and test equipment (including reference materials) used for calibration or testing, in the laboratory premises or on site, comply with the requirements defined.

AUTHORSHIP

This guidance document was prepared by Messrs. J Dominguez and R Visiers of Spain on behalf of a Working Group of ILAC Committee 3.

It was endorsed for publication by ILAC Resolution No. 24/94.

PURPOSE	4
AUTHORSHIP	4
1. DEFINITIONS	6
2. GUIDANCE	9
2.1 Quality system	9
2.2 Control of M&TE	9
2.2.1 Classification	9
2.2.2 Identification and code	9
2.2.3 Inventory	10
2.2.4 Documentation	10
2.2.5 Records of M&TE	10
2.2.6 Management of M&TE	10
2.2.7 Anomalous items	11
2.2.8 Accommodation and environment	12
2.2.9 Files	12
2.3 Calibration and verification of M&TE	12
2.3.1 Classification	12
2.3.2 Traceability	12
2.3.3 Intervals of calibration and verification	13
2.3.4 Calibration and verification programme	14
2.3.5 Calibration and verification procedures	14
2.3.6 Calibration and verification records	15
2.3.7 Calibration labelling	15
2.3.8 Sealing for integrity	15
2.4 Maintenance of M&TE	16
2.4.1 Corrective maintenance	16
2.4.2 Preventive maintenance	16
3. REFERENCES	17
APPENDIX A - COMPARATIVE TABLE BETWEEN ISO/IEC GUIDE 25 AND ILAC-G5:1994	18

1. DEFINITIONS

The relevant definitions from documents in **Section 3 References** are applicable. The most relevant are quoted below together with further definitions applicable for the purposes of this guide.

1.1 Calibration

The set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure, and the corresponding known values of a measurand. (VIM¹ - 6.13).

(NOTES

1. *The result of a calibration permits the estimation of errors of indication of the measuring instrument, measuring system or material measure, or the assignment of values to marks on arbitrary scales.*
2. *A calibration may also determine other metrological properties.*
3. *The result of a calibration may be recorded in a document, sometimes called calibration certificate or calibration report.*
4. *The result of a calibration is sometimes expressed as a calibration factor, or as a series of calibration factors in the form of a calibration curve.)*

1.2 Calibration method

Defined technical procedure for performing a calibration. (ISO/IEC Guide 25² - 3.6).

1.3 Certified reference material (CRM)

Reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes its traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence. (ISO/IEC Guide 30³ - 2.2).

(NOTES

1. *CRMs are generally prepared in batches for which the property values are determined within stated uncertainty limits by measurements on samples representative of the whole batch.*
2. *The certified properties of reference materials are sometimes conveniently and reliably realized when the material is incorporated into a specially fabricated device, (e.g. a substance of known triple-point into a triple-point cell; a glass of known optical density into a transmission filter; spheres of uniform particle size mounted on a microscope slide). Such devices may also be considered as CRMs.*
3. *All CRMs lie within the definition of measurement standards or etalons given in the International Vocabulary of Basic and General Terms in Metrology (VIM¹).*

4. *Properties of some RMs and CRMs, cannot be determined by exactly defined physical and chemical measurement methods because they cannot be correlated with an established chemical structure or for other reasons. Such materials include certain biological materials such as vaccines to which an International Unit has been assigned by the World Health Organization).*

1.4 Influence quantity

A quantity which is not the subject of the measurement but which influences the values of the measurand or the indication of the measuring instrument. (VIM¹ 2.10).

(e.g: ambient temperature; frequency of an alternating measured voltage).

1.5 International (measurement) standard

A standard recognized by an international agreement to serve internationally as the basis for fixing the value of all other standards of the quantity concerned. (VIM¹ 6.4).

1.6 Measurement

The set of operations having the object of determining the value of a quantity. (VIM¹ 2.1).

1.7 Measuring and test equipment (M&TE)

All of the inspection, measuring and test instruments, measurement standards, reference materials, auxiliary apparatus, installations, materials, reagents and instructions, including software, that are necessary to carry out a measurement or a test. This term includes equipment and materials used in the course of measurements, testing and inspection, as well as that used in calibration.

(NOTE For the purpose of this guide MAJOR EQUIPMENT are all those M&TE needed to carry out the calibrations or tests in the conditions and with the procedures defined and that are significant to the calibrations or test performed.)

1.8 National (measurement) standard

A standard recognized by an official national decision to serve, in a country, as the basis for fixing the values of all other standards of the quantity concerned. (VIM¹ 6.7).

(NOTE The national standard in a country is often a “primary standard”.)

1.9 Reference material (RM)

Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO/IEC Guide 30³ - 2.1).

(NOTE A reference material may be in the form of a pure or mixed gas, liquid or solid. Examples are water for the calibration of viscometers, sapphire as a heat-capacity calibrant in calorimetry, and solutions used for calibration in chemical analysis.)

1.10 Reference standard

A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM¹ - 6.08)

1.11 Test

A technical operation that consists of the determination of one or more characteristics or performance of a given product, materials, equipment, organism, physical phenomenon, process or service according to a specified procedure. (ISO/IEC Guide 2⁴ - 12.1, amended)

(NOTE The result of a test is normally recorded in a document sometimes called a test report or a test certificate.)

1.12 Test method

Defined technical procedure for performing a test. (ISO/IEC Guide 25² - 3.7).

1.13 Traceability

Property of the result of a measurement or the value of a standard whereby it can be related, with a stated uncertainty, to stated references, usually national or international standards, through an unbroken chain of comparisons. (ISO/IEC Guide 30³ - 3.8).

(NOTES

1 The concept is often expressed by the adjective traceable.

2 The unbroken chain of comparisons is called a traceability chain.

3 Traceability of values in the certification of reference materials for chemical composition is discussed in ISO Guide 35:1989 (subclause 9.3.1) where attention is drawn to the special problems associated with chemical analysis. Traceability of the chemical species is frequently of equal or greater importance than the traceability of the calibration of the instruments used in the analysis.)

1.14 Uncertainty of measurement

Result of the evaluation aimed at characterizing the range within which the true values of a measurand is estimated to lie, generally with a given likelihood. (VIM¹ 3.9).

(NOTE Uncertainty of measurement comprises, in general, many components. Some of these components may be estimated on the basis of the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. Estimates of other components can only be based on experience or other information.)

1.15 Verification

Confirmation by examination and provision of evidence that specified requirements have been met. (ISO/IEC Guide 25² - 3.8).

(NOTE In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measured instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

The result of verifications leads to a decision either to restore to service, or to perform adjustments, or to repair, or to downgrade, or to declare obsolete. In all cases a written record of the verification performed should be kept on the file for the measuring instrument.)

2. GUIDANCE

2.1 Quality system

The laboratory's quality system definition, management, audit and review should include all the policies and objectives and its commitment, procedures, responsibilities, etc., related with calibration and maintenance of measuring and test equipment.

The quality manual and related quality documentation (quality assurance procedures including calibration, test, operating, maintenance, etc, procedures) should contain provisions for control, calibration and verification and maintenance of M&TE in accordance with the recommendations of the following clauses of this guide.

The laboratory should assign responsibilities for each of the activities included in this guide, and should maintain records of training and competency of the personnel involved.

2.2 Control of M&TE

2.2.1 Classification

This classification should establish:

- M&TE subjected to control in the laboratory.
- M&TE subjected to calibration and/or verification.
- M&TE subjected to corrective and/or preventive maintenance.

2.2.2 Identification and code

The identification should ensure for each item in the laboratory that it is under control and, when necessary, that no doubt is possible when referring to it in a record, procedure, etc. Identification is normally done through identification labels, marks, etc. The system selected should ensure security and durability.

For materials, tools, consumable products, etc. an unique identification can be avoided if other means are implemented to avoid the use of them in inappropriate conditions (e.g. only usable items are present in the laboratory).

All other M&TE should have an unique identification. This is normally ensured assigning a code to each of them. This code must be unique for each item. The laboratory should define the level of items for which a code is needed (M&TE, accessories, etc.) and the information in it (number; type of item; calibration,

verification and/or maintenance requirements; allocation; etc.). When a code is defined it should be normally included in the identification label, mark or any other identification system.

2.2.3 Inventory

The laboratory should have an inventory of all its major M&TE.

The inventory could be a list or a database with the following contents: code, M&TE description, manufacturer's name, type identification and serial number.

2.2.4 Documentation

The existing M&TE documentation (catalogues, characteristic sheets, user's manuals, operating and maintenance instructions, etc.) should be compiled, organized and maintained up to date to be used, when needed, by the laboratory staff.

2.2.5 Records of M&TE

The laboratory should define the content of the records for M&TE, significant to the calibrations or tests performed.

The laboratory should maintain records, (e.g. record cards) that shall include, where appropriate:

- the name of the item of equipment;
- the manufacturer's name, type identification, and serial number or other unique identification;
- date received and date placed in service;
- current location, where appropriate;
- condition when received (e.g. new, used, reconditioned);
- copy of the manufacturer's instructions, where available;
- dates and results of calibrations and/or verifications and date of next calibration and/or verification;
- dates and results of preventive maintenance and adjustments carried out to date and planned to the future;
- history of any damage, malfunction, modification or repair.

2.2.6 Management of M&TE

The laboratory shall be furnished with all M&TE required for the correct performance of calibrations and tests.

The laboratory should define a purchase process for M&TE including:

- Specifications of characteristics required taking into account requirements on tolerances and uncertainties.
- Supplier's selection, including quality requirements and procedures to ensure that purchased equipment, materials and services comply with specified requirements where no independent assurance of the quality of these services or suppliers is available.
- Analysis of offers against specification and selection of equipment.
- Written order to the supplier including requirements on documentation, calibration, delivery period, etc.

When the M&TE is received the laboratory should check before putting it in service that:

- The M&TE is as ordered.
- Documentation, calibration or compliance certificates (if required), etc. are included and are proper.
- The M&TE has not been damaged and it works correctly.
- The M&TE must be coded, included in an inventory and identified as established.
- If calibration and/or details of compliance with requirements are not included, or are not proper they must be undertaken before placing the M&TE in service.

(NOTE: Requirements of clause 2.3 shall be taken into account.

When the laboratory needs to use equipment outside its permanent control it should ensure the compliance with the requirements of this guide. Special care should be taken with relation to calibration (traceability and uncertainty), maintenance, verification against the standard (if appropriate), records (at least last calibration and analysis of history, etc.), general inspection of the state, etc.

The laboratory should define the conditions of use and storage of M&TE (environmental, etc) considering the standard requirements, manufacturer's recommendations, etc. These conditions, if specified, could be documented through the record cards.

Provisions must be taken to ensure that reference standards are used for calibration only (e.g. special labelling, special location and control), unless it can be demonstrated by documentation that their performance as reference standards can not be invalidated.

Where relevant, reference standards and M&TE shall be subjected to in service checks between calibrations and verifications. Purpose, intervals (e.g. regularly, when deficiencies are suspected, before/after being sent outside for any cause...) and methods (e.g. inspections, analysis of results, use of references at one or several points and control of compliance with tolerances specified, comparison with similar equipment, etc.) should be documented.

The laboratory should define and document, for M&TE that is sent externally for calibration, repair, etc, any special conditions needed when transporting.)

2.2.7 Anomalous items

Any item of M&TE which has been subjected to overloading or mishandling, or which gives suspect results, or has been shown by verification or otherwise to be defective, shall be:

- Taken out of service by an authorized person.
- Identified as "OUT OF SERVICE" (e.g. through a red label indicating code, description, date and reason).
- Stored at a specified place until it has been repaired and shown to perform satisfactorily.
- Examined for the effect of the defect on previous calibrations or tests. This situation must be documented indicating: problem detected, date and person; activities to be done with the M&TE (including calibration, verification or test, if necessary to demonstrate it performs satisfactorily); effect on previous calibrations or test and actions to be taken.

2.2.8 Accommodation and environment

Laboratory accommodation, calibration and test areas, energy sources, lightning, heating and ventilation shall be such as to facilitate proper performance of calibration or tests.

The laboratory should define the characteristics and requirements for these installations and areas.

The environment where calibrations, verifications, maintenance, storage, handling, etc., are undertaken shall not invalidate the results or adversely affect the required accuracy of measurement, particularly at sites other than the permanent laboratory premises.

The laboratory shall provide facilities for the effective monitoring, control and recording of environmental conditions as appropriate.

Those conditions, (for example, biological sterility, dust, electromagnetic interference, humidity, mains voltage, temperature, sound and vibration level, etc), having an influence on calibration or test results, should be monitored using calibrated equipment.

In those cases, conditions should be recorded continuously or, at least, at a regular and frequent period (e.g. daily, and more extensively at longer periods such as one year; continuously, or hourly every day, or weekly) and during each activity done (calibration, verification, etc). Such records could be included for example, in the calibration, verification, or data sheet.

2.2.9 Files

Files shall include the records on M&TE (clause 2.2.5), suppliers of services or supplies required for calibrations (clause 2.2.6), calibration and verification (clause 2.3.6) and maintenance (clause 2.4).

Files should be readily accessible and should ensure safe storage, security and confidence to the client.

Files should be maintained until it is no longer probable that they may need to be referred to (considering regulatory or legal requirements, liability, etc.).

2.3 Calibration and Verification of M&TE

2.3.1 Classification

The laboratory should identify the M&TE that needs calibration and/or verification (see clause 2.2.1) and those that will be calibrated and/or verified internally and externally. This should be documented through record cards, a Level's Chart (diagram in which each M&TE or group of them are represented by a block with indication of the calibrating standard; for those that are not calibrated internally it is possible to indicate the external laboratory instead of the code for the block of standards that is used to calibrate it), or other means (labels, special lists or inventories, etc.).

2.3.2 Traceability

The laboratory shall calibrate and/or verify M&TE before being put into service and later when programmed (clause 2.3.4) either in external laboratories ensuring traceability or internally maintaining the internal traceability chains defined and the methods established in the calibration and/or verification procedures.

The laboratory should define its policy of traceability and the external laboratories responsible to ensure it, including use of any reference materials.

This policy of external traceability should contain the following considerations:

- The external laboratory should be accredited by a National Accreditation Body or by an Accreditation Body with Mutual Recognition Agreements with the national body.

(NOTE External laboratories covered by International Mutual Recognition Agreements could also be considered.)

- The external laboratory can demonstrate by documentation traceability to national or international standards, and its standards, methods, etc., evaluated by the laboratory, are acceptable.
- The Certified Reference Materials are traceable to national or international standards of measurement, or to national or international reference materials.
- The Certified Reference Materials have been certified in accordance with ISO Guide 35 and their certificates are in accordance with ISO Guide 31.
- The Reference Material is traceable to a CRM included in the previous two categories. This traceability can be demonstrated by documentation and the methods and sampling used and evaluated by the laboratory, are acceptable.
- Where traceability to national standards of measurement is not applicable, the laboratory should participate in a suitable programme of interlaboratory comparisons or proficiency testing. Laboratories participating should be carefully selected and the report with the analysis of results should be maintained.

Calibration certificates shall wherever applicable indicate the traceability to national or international standards of measurement and shall provide the measurement results and associated uncertainty of measurement.

Wherever applicable, and suitable for the laboratory requirements, a statement of compliance with an identified metrological specification taking into account the associated uncertainty can be accepted instead of the measurement results and associated uncertainties.

2.3.3 Intervals of calibration and verification

The intervals should be such that the next calibration and/or verification should be undertaken before any probable change in accuracy that is of significance in the use of the M&TE. They should be defined taking into account the following considerations:

- Accuracy and permissible limits of errors.
- Stability of the M&TE.
- Purpose and usage (frequency, persons, environmental conditions, etc.).
- Experience with similar M&TE.
- Manufacturer's recommendations.
- Other characteristics of the item (eg: roughness) and the laboratory (eg: staff qualifications, etc.).

The intervals can be defined as a period, a number of uses (a tally of uses is then necessary), before every use or combinations of these.

The intervals defined should be documented (e.g. in record cards, calibration and/or verification certificates, etc.).

The intervals could be revised (shortened or lengthened) considering the results of previous calibrations and verifications, changes of usage, etc., ensuring continued accuracy. The revisions of intervals must be justified (e.g. in history of record cards, change of interval reports, etc.).

2.3.4 Calibration and verification program

The calibration and verification program should contain, for each M&TE with calibration and/or verification, the dates of last and next calibration and/or verification. This program can be defined in a list, a database, a Level's Chart, etc. The content could include for each M&TE its code, description, usage, last and next calibration date.

To ensure their compliance with recalibration intervals or other requirements, a periodic list showing the work to be done on specific M&TE could be needed. To follow it, periodic audits and daily staff checks of the list before use may be required.

2.3.5 Calibration and verification procedures

The staff should have the necessary education, training, technical knowledge and experience for calibration and verification activities. They should use documented procedures when performing calibrations and verifications. The training and qualification program established for staff should be considered to define the level of detail in development of procedures.

The content of procedures should be that necessary to ensure their proper implementation, to ensure consistency of application from one application to another and to ensure valid measurement results. They should include environmental conditions, location, if relevant, and preparation (conditioning, warming, handling, checks, etc.).

The content for these procedures should include:

- Scope, indicating the M&TE that would be calibrated and/or verified according to the procedure, including model, (identification number).
- Standards, reference materials, auxiliary instruments, etc.
- Environmental conditions and, if relevant, location.
- Preparation (conditioning, M&TE warming, handling, checks, etc.).
- Sequence of activities.
- Records (enough to allow the repetition of the calibration or verification).
- Uncertainties analysis. (See Note below)
- Results analysis and consequences (labelling, revision of intervals, actions to be taken, etc.)

These procedures could be a document or a set of documents including, for example, manufacturer's recommendations, published standard measurement practices, etc, and should be included in the Quality System documentation.

(NOTE The laboratory should define a method for the estimation and composition of uncertainties in accordance with internationally accepted methods (e.g. Guide to the Expression of Uncertainty in Measurement, ISO-1993). This method should be applied to determine the limits of uncertainties associated with each calibration/verification method. This analysis, including components considered, could be included in the calibration/verification procedure and quantified in the same or a separate document.

Estimated uncertainties should be considered to define or reduce permissible limits of error and limits of tolerance.)

2.3.6 Calibration and verification records

The laboratory should ensure that records of all activities related to M&TE are completed and contain sufficient information to permit their repetition (personnel, date, environmental conditions, procedure, measurements, calculations, results, etc).

The recorded information of each internal calibration and/or verification should include:

- the description and unique identification of equipment;
- the date on which each calibration or verification was completed;
- the calibration/verification results obtained after and, where relevant, before any adjustment and repair, and/or a statement of compliance with an identified metrological specification.
- the source of the calibration used to obtain traceability (standards, reference materials, etc.);
- a statement of the uncertainties involved in the calibration/verification performed;
- details of any maintenance or adjustment carried out;
- any limitations in assigned use as a consequence of the calibration/verification;
- identification of the person(s) performing the preparation and/or the calibration/verification;

A copy of the calibration certificate shall be maintained as a record.

2.3.7 Calibration labelling

All M&TE should be securely and durably labelled (see Note below), coded or otherwise identified to indicate its calibration status, or any restriction of use. The laboratory could define different labels according to the procedure of its own quality system, such as:

- A label which indicates that the M&TE is working according to its permissible limits of error. Its content could be: code, description, calibration date, next calibration date and signature of responsibility.
- A label which indicates that the M&TE has any restriction of use (accuracy, capabilities, etc.). Its content could be: code, description, calibration date, next calibration date, signature of responsibility and limitation of use.

Other labels could also be defined according to situations described in previous clauses (e.g. “identification” label, “out of use” label).

(NOTE Labelling may be by a secure self-adhesive stick-on label or by a tie-on label or by a durable marking directly on the measuring equipment.)

2.3.8 Sealing for integrity

The laboratory should define the M&TE which needs sealing and the points to be sealed.

Access to adjustable devices (different to adjustment devices that are intended to be set by the user without the need of external references, for example a zero adjuster) on M&TE, whose setting affects the performance, shall be sealed or otherwise safe guarded at an appropriate stage of the calibration/verification, in order to prevent tampering by unauthorized personnel. Seals shall be designed so that tampering is clearly apparent. Calibration/verification labels or special labels, solder, wire, paint, etc. could be used for sealing as appropriate.

(NOTE This consideration is also applicable to software used in the M&TE.)

2.4 Maintenance of M&TE

2.4.1 Corrective maintenance

Repairs should be done by organisations with the required level of quality. When confidence in repair suppliers cannot be sufficiently assured, the laboratory should define special precautions to guarantee the required performance of the M&TE.

For internal repairs, adjustments or modifications written instructions should exist, (e.g. manufacturer instructions).

Records of all repairs, internal and external, should be required and kept in a suitable file.

2.4.2 Preventive maintenance

The laboratory should:

- define the preventive maintenance requirements and the M&TE subjected to it,
- establish and revise the intervals of preventive maintenance,
- define and ensure the compliance of the preventive maintenance programme and
- approve and implement written preventive maintenance instructions.

The intervals between preventive maintenance activities should be such that unprogrammed usage could not occur. Different intervals could be defined for different activities. They should be defined, taking into account the following considerations:

- Complexity of the M&TE.
- Existence of parts that wear with use.
- Purpose and usage (frequency, persons, etc.)
- Experience with similar M&TE.
- Manufacturer's recommendations.
- Other characteristics of the item and the laboratory (e.g. environmental conditions, etc.).

The intervals can be defined as a period, a number of uses, hours of performance, etc or combinations of these. The intervals defined should be documented (e.g. in record cards) as should be their revision (e.g. in history or record cards).

The intervals could be revised considering the results of previous maintenance, calibrations, verifications that ensure continued satisfactory performance.

The **Preventive Maintenance Programme** should contain, for each M&TE needing preventive maintenance (as defined in clause 2.2.1), the dates of last and next preventive maintenance activity. This programme should be defined in a list, a database, etc. The content could include for each M&TE: code, description, activity, last and next preventive maintenance date.

The laboratory should use written instructions when performing preventive maintenance activities. The content of these documents should be that necessary to ensure their proper implementation, and consistency of application from one use to another.

The training and qualification programme established for staff responsible for performing maintenance should be considered to define the level of detail in instructions.

Such instructions could be included, whenever appropriate, in record cards containing manufacturer's recommendations. When necessary, specific preventive maintenance procedures should be developed.

3. REFERENCES

The following documents contain provisions which, through reference in this text, constitute recommendations of this guide. Laboratories are encouraged to apply the most recent editions of the documents indicated below.

1. *International Vocabulary of Basic and General Terms in Metrology* (1984), and amendments (1987) issued by BIPM, IEC, ISO and OIML.
2. ISO/IEC Guide 25 1990 *General requirements for the competence of calibration and testing laboratories*.
3. ISO/IEC Guide 30 1992 *Terms and definitions used in connection with reference materials*.
4. ISO/IEC Guide 2 1986 *General terms and their definitions concerning standardization and related activities*.

APPENDIX A

COMPARATIVE TABLE BETWEEN ISO/IEC GUIDE 25 AND ILAC-G5:1994

ISO Guide 25	ILAC-G5:1994
3	1
5.2g)	2.1,2.3.2
5.2i)	2.1,2.2.6
5.2l)	2.1,2.2.3
5.2m)	2.1,2.3.5,2.4.2
5.3)	2.1
5.4	2.1
6.1	2.3.5,2.4.2
7.1	2.3.5
7.2	2.3.5
7.3	2.3.5,2.2.8
8.1	2.2.3,2.2.6
8.2	2.4.1,2.4.2
8.2	2.2.7
8.3	2.2.2,2.3.7
8.4	2.2.5,2.2.8,2.3.6,2.4
9.1	2.3.1,2.3.2,2.3.3,2.3.4
9.2	2.3.2,4.3.6
9.3	2.3.2
9.4	2.2.6
9.5	2.3.2,2.3.4
9.6	2.2.6
9.7	2.3.2
10.1	2.2.4,2.2.6,2.3.5
12.1	2.1,2.2.8,2.3.6
12.2	2.2.8
15.1	2.3.2,2.4.1
15.2	2.2.6
15.3	2.2.8