Specific Accreditation Criteria

Inspection ISO/IEC 17020 Annex

Application to modelling

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Application to Modelling

Modelling is the construction of mathematical or physical analogues to objects, systems or environments with a view to the determination of otherwise hard-to-obtain properties. Modelling data may be used to characterise systems of interest, to resolve management problems associated with the object, system or environment, or to predict behaviour under variant conditions. The modelling process involves the selection of suitable media, then the selection, validation and combination of parameters, to establish a predicted performance. Modelling has application in many fields, including engineering design, design verification, construction and in-service asset management. Parameters that may be addressed in modelling can include load, deflection, fluid flow, signal dissemination, fire propagation, remaining asset life, weather patterns etc.

This annex provides additional amplification of those requirements of ISO/IEC 17020 relevant to the accreditation of modelling activities.

Process background

It is assumed that the process flow in modelling an activity may be detailed as in the following table.

Step	Process	Notes
1	Identification of problem	
2	Selection of appropriate modelling technique	A range of physical and mathematical techniques offer solutions
3	Construction of the model	May be through physical construction, programming or setting parameters in an existing program
4	Collection of input data	Data may be sourced from clients, measurement or other public data
5	Application of data to model	Data entry task
6	Determination of outcome	Operation of the key algorithms and input data
7	Iterations of modelling	Time/step-based development, or noting slight variations from parametric changes
8	Output data analysis	As appropriate to task
9	Report generation	To include limitations and details of relevant parameters

Personnel (6.1)

Where models are developed or adapted for specific jobs, the inspection body shall have staff conversant with the techniques or software used.

Facilities and equipment (6.2)

Note: Equipment for the construction of a model may range from workshop machinery to computers. Models may vary from purpose-built structures to

electronic configurations and software. In many instances standard modelling tools are modified to suit case-specific applications.

Where physical analogues of input parameters are required in the model (e.g. masses in some structural models), the equipment shall be appropriately calibrated and the scaled effects of the uncertainty of the analogue upon the outcomes of the model shall be determined.

Where the analogous performance of the model is determined by environmental considerations (e.g. temperature of a material analogue) the inspection body shall have procedures in place to ensure the continued suitability of the material in question.

Computers (6.2.13)

Where computers are used (in data capture, storage or manipulation) the inspection body shall be able to demonstrate the adequacy of the complete system.

Where software is open to modification by the inspection body (at all levels from the algorithm used, the input parameters selected and the match of data to inputs i.e. the extended dataset) the inspection body shall record the extended dataset applied to the model, and shall be able to demonstrate the validity of the inputs used.

Inspection methods and procedures (7.1)

Choice of model

The inspection body shall provide guidance to staff upon the selection of models appropriate to the job.

Worst-case models are to be applied unless reasonable justification is available for not doing so.

The inspection body shall perform **validation** of the model chosen. Validation is understood here to entail the steps necessary to establish that the assumptions and governing equations of the model are relevant to the problem as outlined by the client. Considerations relevant here may include geometry, the size, separation and discretisation of both grid and steps, boundary conditions, spatial, temporal, static/dynamic conditions and other limitations relevant to the problem.

The inspection body shall perform **verification** of the model chosen. Verification is understood here to entail the steps necessary to determine the correctness of the solutions generated by the model, including both algorithm validation and code validation.

The inspection body shall also establish systems to control the software in use to ensure that the most appropriate version of software is used in the modelling process. In cases where extensive development of software is necessary, this will include systems for documenting and control of updates and, where necessary, training of staff in new functions.

Selection of parameters

In many models, appropriate parameters will not be available. Examples where this may arise include job specific parameters (such as crushability and impact

resistance) or where parameters are not consistently defined between designer, specifier and manufacturer (e.g. 'Yield strength' can have at least four different definitions). Frequently solutions to this matter involve the substitution of alternative parameters or the use of approximations. Where such substitution or approximation is applied to a model the justification of the substitution or approximations shall be recorded by the inspection body.

Relevance of data (7.1.6)

The inspection body shall identify all data sources, and any data validation performed, that are used in the model. There shall be an evaluation of the possibility and consequences of parameter variation under conditions of interest.

Note: Product datasheets typically report single-point values under standard or stable conditions. Such data may not be suited to application in modelling dynamic conditions. Inspection bodies should establish property profiles considering the potential variation in environmental conditions in the model.

Where data sources are based upon statistical data the inspection bodies shall detail the assumptions pertaining to the distribution and homogeneity of samples contributing to the data.

In some models the properties of interest may be influenced by transient or ephemeral sources adjacent to the field of interest. Where possible the effects of uncontrolled influences from adjacent sites are to be accommodated in the model and reported. This may be by estimation, approximation, direct measurement or other means. The means of identifying the magnitude of such influences is to be identified and reported.

Output constraints

The inspection body must consider issues of rounding of output data and issues related to non-linear responses / interpolation between grid points. Where such issues have the potential to be significant they must be reported.

Iterations

The reasons for the application of iterations and the application of changes to the extended dataset shall be recorded.

Confirmatory testing

Where possible, modelling statements should be corroborated by confirmatory testing – relating data generated back to:

- Standard test results;
- Full-scale test results;
- Previous experience;
- Accepted benchmarks;
- Other quantitative means.

Records of such confirmatory testing shall be kept.

Records (7.3)

Records must be sufficient to allow replication of the model by an equivalent organisation. Records of validation, verification and confirmatory testing shall be kept.

Inspection reports and inspection certificates (7.4)

Inspection reports and inspection certificates must include the following data:

- General problem description;
- Model objectives;
- Model selected;
- Software used;
- Data set up and sources;
- Model set-up including geometry, discretisation, boundary conditions and model features;
- Results;
- Sensitivity of results to parametric variation, including measurement uncertainty;
- Limitations of the model applied;
- Discussion of results.

References

This section lists publications referenced in this document. The year of publication is not included as it is expected that only current versions of the references shall be used.

Standards

ISO/IEC 17020 *Conformity assessment – Requirements for the operation of various types of bodies performing inspection*

Amendment Table

The table below provides a summary of changes made to the document with this issue.

AMENDMENT TABLE	
Section or Title	**Amendment**
New document	This document represents a direct adoption of the former ISO/IEC 17020 Inspection Standard Application Document Appendix B.
Whole document	Addition of Security Classification Label