IEC 61069-4

Edition 2.0 2016-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment –
Part 4: Assessment of system performance

Mesure, commande et automation dans les processus industriels – Appréciation des propriétés d'un système en vue de son évaluation –
Partie 4: Évaluation des caractéristiques de fonctionnement d'un système

IEC 61069-4:2016-06(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 25.040.40

ISBN 978-2-8322-3408-2

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FOREWORD

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International Standard IEC 61069-4 has been prepared by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 1997. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Reorganization of the material of IEC 61069-4:1997 to make the overall set of standards more organized and consistent;
b) IEC TS 62603-1:2014 has been incorporated into this edition.

The text of this standard is based on the following documents:

FDIS	Report on voting
65A/792/FDIS	65A/801/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61069 series, published under the general title *Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

IEC 61069 deals with the method which should be used to assess system properties of a basic control system (BCS). IEC 61069 consists of the following parts:

Part 1: Terminology and basic concepts

Part 2: Assessment methodology

Part 3: Assessment of system functionality

Part 4: Assessment of system performance

Part 5: Assessment of system dependability

Part 6: Assessment of system operability

Part 7: Assessment of system safety

Part 8: Assessment of other system properties

Assessment of a system is the judgement, based on evidence, of the suitability of the system for a specific mission or class of missions.

To obtain total evidence would require complete evaluation (for example under all influencing factors) of all system properties relevant to the specific mission or class of missions.

Since this is rarely practical, the rationale on which an assessment of a system should be based is:

– the identification of the importance of each of the relevant system properties;

– the planning for evaluation of the relevant system properties with a cost-effective dedication of effort to the various system properties.

In conducting an assessment of a system, it is crucial to bear in mind the need to gain a maximum increase in confidence in the suitability of a system within practical cost and time constraints.

An assessment can only be carried out if a mission has been stated (or given), or if any mission can be hypothesized. In the absence of a mission, no assessment can be made; however, evaluations can still be specified and carried out for use in assessments performed by others. In such cases, IEC 61069 can be used as a guide for planning an evaluation and it provides methods for performing evaluations, since evaluations are an integral part of assessment.

In preparing the assessment, it can be discovered that the definition of the system is too narrow. For example, a facility with two or more revisions of the control systems sharing resources, for example a network, should consider issues of co-existence and inter-operability. In this case, the system to be investigated should not be limited to the “new” BCS; it should include both. That is, it should change the boundaries of the system to include enough of the other system to address these concerns.

The part structure and the relationship among the parts of IEC 61069 are shown in Figure 1.

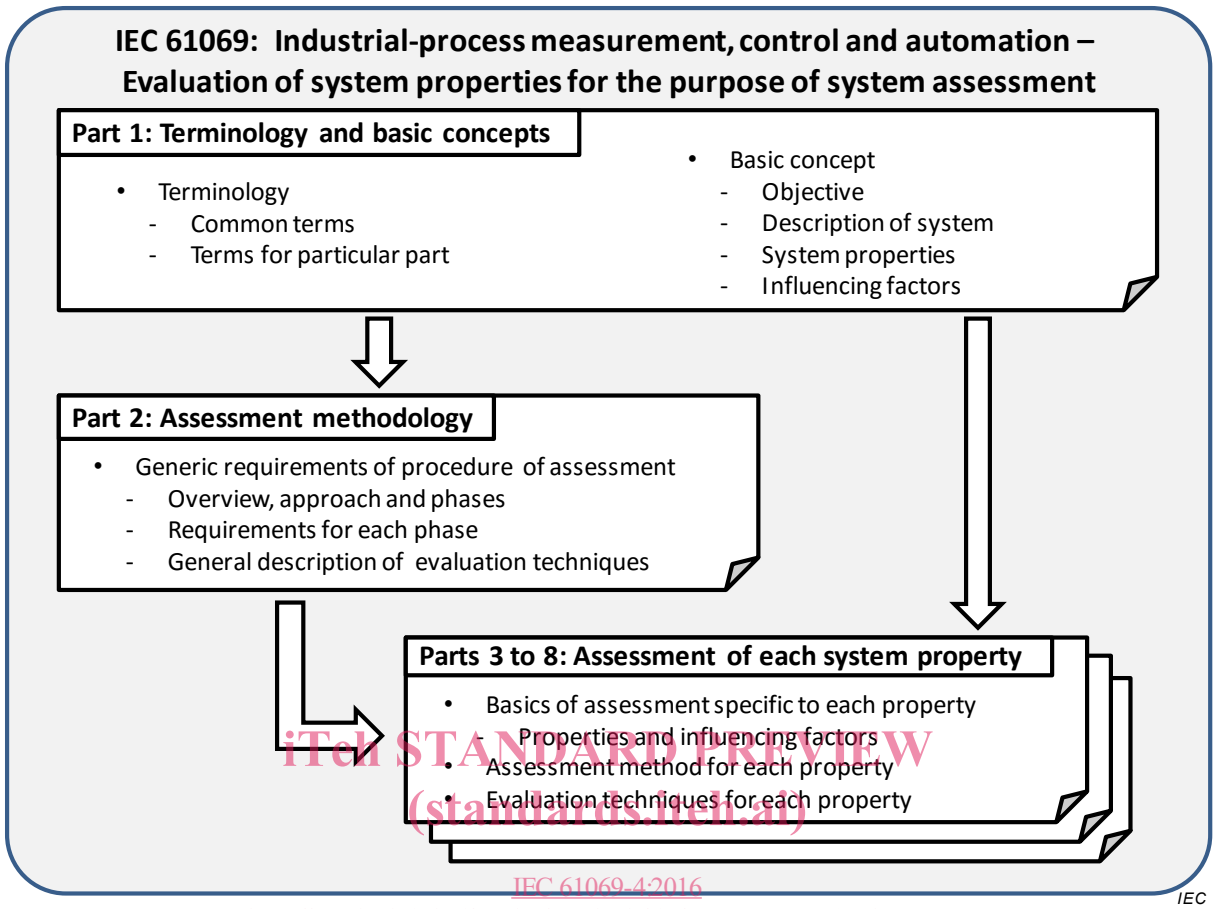

Figure 1 – General layout of IEC 61069

Some example assessment items are integrated in Annex C.

INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – EVALUATION OF SYSTEM PROPERTIES FOR THE PURPOSE OF SYSTEM ASSESSMENT –

Part 4: Assessment of system performance

1 Scope

This part of IEC 61069:

– specifies the detailed method of the assessment of performance of a basic control system (BCS) based on the basic concepts of IEC 61069-1 and methodology of IEC 61069-2,

– defines basic categorization of performance properties,

– describes the factors that influence performance and which need to be taken into account when evaluating performance, and

– provides guidance in selecting techniques from a set of options (with references) for evaluating the performance.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068 (all parts), *Environmental testing*

IEC 60654 (all parts), *Industrial-process measurement and control equipment – Operating conditions*

IEC 60721 (all parts), *Classification of environmental conditions*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61069-1:—[1], *Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment – Part 1: Terminology and basic concepts*

IEC 61069-2:—[2], *Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment – Part 2: Assessment methodology*

IEC 61326 (all parts), *Electrical equipment for measurement, control and laboratory use – EMC requirements*

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1 Second edition to be published simultaneously with this part of IEC 61069.

2 Second edition to be published simultaneously with this part of IEC 61069.

3 Terms, definitions, abbreviated terms, acronyms, conventions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61069-1 apply.

3.2 Abbreviated terms, acronyms, conventions and symbols

For the purposes of this document, the abbreviated terms, acronyms, conventions and symbols given in IEC 61069-1 apply.

4 Basis of assessment specific to performance

4.1 Performance properties

4.1.1 General

A system is expected to be able to perform tasks required by the system mission with accuracy and within a specified response time. If the system executes several tasks, it handles these tasks without obstructing the execution of the other tasks. Hence capacity, which indicates the number of tasks which can be executed within a time frame, is important.

To assess the performance of a system it is therefore necessary to categorise system properties in a hierarchical way.

Performance properties are categorized as shown in Figure 2.

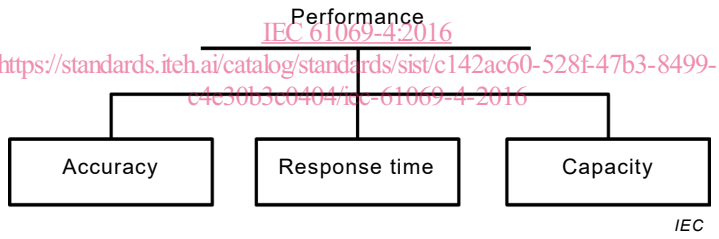

Figure 2 – Performance

Performance cannot be assessed directly and cannot be described by a single property. Performance can only be determined by analysis and testing of each of performance properties individually.

To be able to determine the system performance properties it is necessary to analyze the system in terms of information translations.

It is necessary to examine the system performance properties for each of the information translations in the system.

It should be noted that the system performance properties can be mutually dependent.

When a system accomplishes several tasks, the performance can vary, and for each of the relevant tasks a separate analysis is required.

Performance should be described for each task, which is represented by an information translation, with specified conditions for the other tasks concurrently operating.

4.1.2 Accuracy

Accuracy indicates closeness of agreement between the specified and the realized information translation executed by the system under defined conditions.

The accuracy of an information translation function includes potentially many system properties, for example:

– hysteresis,
– dead band,
– repeatability error,
– resolution.

4.1.3 Response time

Response time indicates the time interval between the initiation of an information translation and the instant when the associated response is made available under defined conditions.

An information translation function generally comprises the following functional steps:

– information collection, which depends on the time constant of input filters (hard and/or software) and input cycle times;
– information processing, which depends on the processing cycle time;
– output actuation, which depends on the times of output filters (hard and/or software) and output cycle times.

Each of the above functional steps of an information translation function can be executed in a synchronous or asynchronous way.

Attention should be paid to the fact that the overall response time of an information translation is not simply the sum of the time spent for functional steps, due to interdependencies. For example, new initiation can coincide in time with a running information translation resulting in an increase in response time.

The response time differs with respect to each information translation, and depends on priority settings of concurrent tasks, cycle time settings, activated credibility mechanisms, etc.

The response time can be quantified for individual tasks. In some cases, the value calculated may contain a degree of uncertainty and that should be recorded with the value, for example 50 % ± 10 % or 50 % with a 90 % certainty.

4.1.4 Capacity

Capacity is a property of the system performance which indicates the maximum number of information translations of a given information translation function which the system is able to execute within a defined period of time, without negatively impacting any other system capabilities.

The capacity of a system depends on the amount of calculation capability, the available storage, and the available I/O bandwidth.

For a given system, the capacity (maximum load) is fixed. Capacity can only be changed through additions or changes to the given system. The following are some concepts of interest:

Capacity = base load + operating load + spare capacity

A system is at maximum load when there is no spare capacity available. Overload occurs when the user-defined tasks do not operate in the designed time frame due to resource restrictions.

The evaluation of the system capacity should be done by checking that the spare capacity is available under that operating load as specified in the SRD. The assessment will ensure that the spare capacity is available under that operating load.

4.2 Factors influencing performance

The performance of a system can be affected by the influencing factors listed in IEC 61069-1:—, 5.3.

For each of the system performance properties listed in 4.1, the primary influencing factors are as follows:

Accuracy can be affected by influencing factors originating from:

- the environment, such as ambient temperature;
- infrastructure, such as voltage variations and surges expected from the main power supply;
- electrical noise, such as pick-up by in-coming and out-going lines from and to field-mounted equipment, due to earthing problems, and/or conducted and/or radiated electro-magnetic interferences;
- time exposed to temperature and heat radiation;
- humidity;
- vibration.

Accuracy should be tested over at least the total range to which the system will be subjected.

Response time is mainly affected by conditions originating in the tasks, such as:

- increase in activities (e.g. an alarm burst);
- externally generated interruptions, for example from the main power supply, and/or from electrical noise.

Capacity and spare capacity are affected by:

- increase in activities (e.g. an alarm burst);
- enhancing the system;
- externally generated interruptions, for example from the main power supply, and/or from electrical noise;
- loss of memory due to poor memory management.

In general, any deviations from the operating conditions specified can affect the performance of the system.

When specifying tests to evaluate the effects of influencing factors, the following International standards shall be consulted:

- IEC 60068;
- IEC 60721;
- IEC 60654;
- IEC 61000;
- IEC 61326.

5 Assessment method

5.1 General

The assessment shall follow the method as laid down in IEC 61069-2:—, Clause 5.

5.2 Defining the objective of the assessment

Defining the objective of the assessment shall follow the method as laid down in IEC 61069-2:—, 5.2.

5.3 Design and layout of the assessment

Design and layout of the assessment shall follow the method as laid down in IEC 61069-2:—, 5.3.

Defining the scope of assessment shall follow the method laid down in IEC 61069-2:—, 5.3.1.

Collation of documented information shall be conducted in accordance with IEC 61069-2:—, 5.3.3.

The statements compiled in accordance with IEC 61069-2:—, 5.3.3, should include the following in addition to the items listed in IEC 61069-2:—, 5.3.3:

– the required task(s) as defined in the SRD, and the information translation functions provided by the system to support these;
– the location of the end points of each information translation function.

Documenting collated information shall follow the method in IEC 61069-2:—, 5.3.4.

Selecting assessment items shall follow IEC 61069-2:—, 5.3.5.

Assessment specification should be developed in accordance with IEC 61069-2:—, 5.3.6.

Comparison of the SRD and the SSD shall follow IEC 61069-2:—, 5.3.

NOTE 1 A checklist of the SRD for system dependability is provided in Annex A.

NOTE 2 A checklist of the SSD for system dependability is provided in Annex B.

5.4 Planning of the assessment program

Planning the assessment program shall follow the method as laid down in IEC 61069-2:—, 5.4.

Assessment activities shall be developed in accordance with IEC 61069-2:—, 5.4.2.

The final assessment program should specify the points specified in IEC 61069-2:—, 5.4.3.

5.5 Execution of the assessment

The execution of the assessment shall be in accordance with IEC 61069-2:—, 5.5.

5.6 Reporting of the assessment

The reporting of the assessment shall be in accordance with IEC 61069-2:—, 5.6.

The report shall include information specified in IEC 61069-2:—, 5.6. Additionally, the assessment report should address the following points:

– No additional items are noted.

6 Evaluation techniques

6.1 General

Within IEC 61069-4, several evaluation techniques are suggested. Other methods may be applied but, in all cases, the assessment report should provide references to documents describing the techniques used.

Those evaluation techniques are categorized as described in IEC 61069-2:—, Clause 6.

NOTE An example of a list of assessment items is provided in Annex C.

Factors influencing system performance properties as per 4.2 shall be taken into account.

The techniques as given in 6.2, 6.3 and 6.4 are recommended to evaluate system performance properties.

6.2 Analytical evaluation techniques

An analytical evaluation is a qualitative analysis of the system configuration complemented with quantification of the basic performance properties of the elements.

In order to evaluate performance properties, it is recommended to use models which represent the way in which the elements are used to implement the required information translations.

The same model can be used to infer system performance from the evaluation of the performance of the individual elements.

An example of such a model is developed in Annex D.

The model, representing the performance aspects, shows the information translations, the elements used and their interconnection.

Basic quantified performance data are added to each of the elements shown in the model. These quantitative data can be obtained from generic data, system documentation, and data obtained from evaluations of the elements and/or a detailed analysis of the design of the elements. The data used shall be those applicable for the range of influencing factors for which the evaluation is required.

The values on accuracy, response time and capacity are then obtained by inference, based upon the individual specification of the modules and elements and the chaining of these to support the information translations.

A more refined method of analyzing the performance properties can be made by the construction of a simulation model of the analytical model described above, simulating random agitation of the input channels and recording the outputs, traffic on busses, etc.

6.3 Empirical evaluation techniques

6.3.1 General topics

Although it is often feasible to conduct an empirical evaluation, (also called a test) in isolated individual modules and elements within an information translation function, these tests do not often provide sufficient data on the performance of the task(s) required. Such tests can only be performed at the boundary of each information translation.