
Manipulating industrial robots — EMC test methods and performance evaluation criteria — Guidelines

Robots manipulateurs industriels — Méthodes d'essai EMC et critères d'évaluation de performance — Lignes directrices



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO members bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 11062, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 2, *Robots for manufacturing environment*.

This document is being issued in the type 2 Technical Report series of publications (according to subclause G.4.2.2 of part 1 of the ISO/IEC Directives, 1992) as a "prospective standard for provisional application" in the field of electromagnetic compatibility applied to robots because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this type 2 Technical Report will be carried out not later than two years after its publication with the options of: extension for another two years; conversion into an International Standard; or withdrawal.

Annex A forms an integral part of this Technical Report.

Annexes B, C and D are for information only.

Introduction

In the past, electromechanical devices and systems were generally not sensitive to electromagnetic disturbances (i.e. conducted electric, electrostatic and radiated electromagnetic disturbances).

The electronic components and equipment now in use are much more sensitive to these disturbances, particularly “high frequency” and “transient” phenomena.

In addition, electronic components and equipment are themselves source of electromagnetic interferences.

The increasing occurrence of malfunctions or damage caused by electromagnetic disturbances is typically correlated to the increasing usage of the electronic devices.

These guidelines deal with the selection of appropriate electromagnetic compatibility (EMC) tests applicable to manipulating industrial robots, which are complex and sophisticated electronic devices with several degrees of freedom.

Some basic performance criteria defined in ISO 9283 are applied to evaluate the EMC behaviour of the robot. The robot control check is also included to evaluate the electrical characteristics of the robot control system.

This Technical Report is also related to ISO 10218 because some safety aspects are very close to EMC.

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Manipulating industrial robots — EMC test methods and performance evaluation criteria — Guidelines

1 Scope

This Technical Report provides guidelines on how to apply the already existing Electromagnetic Compatibility (EMC) International Standards for testing electromagnetic influences on the performance of manipulating industrial robots.

The existing EMC Standards do not specifically address test methods for robots and the intention of this Technical Report is to define appropriate testing procedures for robots in their normal working environment and applications and to provide guidance for the evaluation of the test results.

In addition, these guidelines are useful for evaluating the safety of manipulating industrial robots affected by electromagnetic disturbances.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/TR 8373:1994, *Manipulating industrial robots — Vocabulary*.

ISO 9283:1990, *Manipulating industrial robots — Performance criteria and related testing methods*.

ISO 9283:1990/Amd.1:1991, *Manipulating industrial robots — Performance criteria and related testing methods — Amendment 1: Guide for selection of the performance criteria for typical robotic applications*.

IEC 1000-1-1:1992, *Electromagnetic compatibility (EMC) — Part 1: General — Section 1: Application and interpretation of fundamental definitions and terms*.

IEC 1000-4-1:1992, *Electromagnetic compatibility (EMC) — Part 4: Testing and measuring techniques — Section 1: Overview of immunity tests*.

IEC CISPR Publication 11:1990, *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*.

IEC CISPR Publication 22:1985, *Limits and methods of measurement of radio interference characteristics of information technology equipment*.

3 Definitions

For the purposes of this Technical Report, the definitions given in ISO/TR 8373 and IEC 1000-1-1, and the following definitions, apply.

3.1 manipulating industrial robot; robot: Automatically controlled, reprogrammable, multi-purpose, manipulative machine with several degrees of freedom, which may be either fixed in place or mobile for use in industrial automation applications.

3.2 electromagnetic environment: Totality of electromagnetic phenomena existing at a given location.

3.3 electromagnetic disturbance: Any electromagnetic phenomenon which may degrade the performance of a device, equipment or system.

3.4 electromagnetic interference; EMI: Degradation of the performance of a device, transmission channel or system caused by an electromagnetic disturbance.

NOTE 1 Disturbance and interference are respectively cause and effect.

3.5 electromagnetic compatibility; EMC: Ability of equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable disturbances to anything in that environment.

3.6 (electromagnetic) compatibility level: Specified maximum electromagnetic disturbance level expected to be impressed on a device, equipment or system operating in particular conditions.

NOTE 2 In practice the electromagnetic compatibility level is not an absolute maximum level but may be exceeded by a small probability.

3.7 (electromagnetic) emission: Phenomenon by which electromagnetic energy emanates from a source.

3.8 immunity (to a disturbance): Ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance.

3.9 (electromagnetic) susceptibility: Inability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance.

NOTE 3 Susceptibility is a lack of immunity.

4 Units of measurement

The units of measurement adopted in this Technical Report are in accordance with ISO 9283 and ISO 9946.

In addition, unless otherwise stated, all quantities in EMC are given in SI units, their decimal multiples or submultiples.

NOTE 4 The level difference of a field is defined as 1 dB (decibel) when $10 \lg \frac{W_1}{W_2} = 1$ where W_1 and W_2 are amplitudes of that field.

If W_1 and W_2 are electrical power levels, a level difference of 1 dB may also be defined as when $20 \lg \frac{V_1}{V_2} = 1$ or $20 \lg \frac{A_1}{A_2} = 1$ where V_1 and V_2 are voltages measured over the same impedance and A_1 and A_2 are currents measured over the same impedance.

5 Requirements for the testing conditions

5.1 Environmental conditions

The environmental conditions adopted as reference for testing activities shall be reported. Any changes of settled environmental parameters shall be made in accordance with the manufacturer and included in the test report.

The recommended values of the typical environmental parameters controlled in a laboratory (temperature, atmospherical pressure and relative humidity) are based on IEC 801.

The climatic conditions shall be maintained at the following values during EMC tests:

- a) ambient temperature of between 15 °C and 35 °C;
- b) relative humidity of between 10 % and 75 % (between 30 % and 60 % during the electrostatic discharge test);
- c) atmospheric pressure of between 86 kPa and 106 kPa (between 860 mbar and 1 060 mbar).

Electromagnetic environment conditions shall not influence the test results.

Electromagnetic emission measurements, particularly those ones related to the radiated field emitted by the robot (radiated emission tests), are normally performed in electromagnetically screened anechoic rooms in accordance with the standard requirements regarding the usage of a test site free from objects reflecting the electromagnetic field in the measurement frequency range.

Proper broadband pyramidal absorbers mounted on nearly all the surfaces of a screened room can ensure that reflections and resonances are controlled from very low frequencies (i.e. 30 MHz) in such a screened and also anechoic room.

Conducted emission tests that measure the currents generated by the robot on its cables (mains, signal or control cables) are normally performed in a screened or anechoic room.

Screened rooms are used to protect the test site from the electromagnetic field outside, that is the field generated by sources located out of the test room and whose contribution, when it is not eliminated, makes the measurement incorrect and unrepeatable.

For this reason, before each emission test, IEC CISPR Publications require that a preliminary "environmental noise" measurement be carried out that is lower than the CISPR limits.

In addition, during radiated emission tests it is necessary to carefully determine the robot configuration and its operating state that are related to the robot maximum radiated and conducted electromagnetic emission.

Radiated immunity tests that measure the effect of fields on the correct operation of the robot are performed in test sites where the required field uniformity shall be achieved at all measurement frequencies.

For the safety of the test operators, who must be protected from the high frequency and high intensity