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## Artificial intelligence exchange and service tie to all test environments (AI-ESTATE)



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# ARTIFICIAL INTELLIGENCE EXCHANGE AND SERVICE TIE TO ALL TEST ENVIRONMENTS (AI-ESTATE)

## FOREWORD

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

| IEEE Std | FDIS | Report on voting |
|---|---|---|
| 1232 (2002) | 93/214/FDIS | 93/220/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.

The committee has decided that the contents of this publication will remain unchanged until 2007.

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# IEEE Standard for Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATES)

Sponsor

**IEEE Standards Coordinating Committee 20**

Approved 13 November 2002

**American National Standards Institute**

Approved 13 June 2002

**IEEE-SA Standards Board**

**Abstract:** AI-ESTATE is a set of specifications for data interchange and for standard services for the test and diagnostic environment. The purpose of AI-ESTATE is to standardize interfaces between functional elements of an intelligent diagnostic reasoner and representations of diagnostic knowledge and data for use by such diagnostic reasoners. Formal information models are defined to form the basis for a format to facilitate exchange of persistent diagnostic information between two reasoners, and also to provide a formal typing system for diagnostic services. This standard then defines the services to manipulate diagnostic information and to control a diagnostic reasoner.
**Keywords:** AI-ESTATE, diagnosis, diagnostic interference, diagnostic model, diagnostic services, dynamic content, fault tree, knowledge exchange, system test

## IEEE Introduction

This AI-ESTATE standard provides a formal framework for exchanging diagnostic knowledge and constructing diagnostic reasoners. The intent is to provide a standard framework for identifying required information for diagnosis and defining the diagnostic information in a machine-processable way. In addition, software interfaces are defined whereby diagnostic tools can be developed to process the diagnostic information in a consistent and reliable way.

# Artificial intelligence exchange and service tie to all test environments (AI-ESTATE)

## 1. Overview

The Artificial Intelligence Exchange and Service Tie to All Test Environments (AI-ESTATE) standard was developed by the Diagnostic and Maintenance Control (D & MC) Subcommittee of the IEEE Standards Coordinating Committee 20 (SCC 20) on Test and Diagnosis for Electronic Systems to serve as a standard for the application of artificial intelligence to system test and diagnosis. This AI-ESTATE standard defines interfaces among reasoners and reasoning system users, test information knowledge bases, and more conventional databases. In addition to interface standards, the AI-ESTATE standard includes a set of formal data specifications to facilitate the exchange of system under test related diagnostic information.

This standard describes a set of formal data and knowledge specifications consisting of the logical representation of devices, their constituents, the failure modes of those constituents, and tests of those constituents. The data and knowledge specification provides a standard representation of the common data elements required for system test and diagnosis. This will facilitate portability of test-related knowledge bases for intelligent system test and diagnosis.

The goals of this standard are summarized as follows:

— Incorporate domain specific terminology
— Facilitate portability of diagnostic knowledge
— Permit extensibility of diagnostic knowledge
— Enable the consistent exchange and integration of diagnostic capabilities

This standard provides a controlled extension mechanism to allow inclusion of new diagnostic technology outside the scope of the AI-ESTATE specification.

One of the purposes of this standard is to define information models for knowledge bases to be used in the context of test and diagnosis and, from these models, to derive a data interchange format. The specifications in this standard shall support fully portable diagnostic knowledge. No host computer dependence is contained in the AI-ESTATE standard.

AI-ESTATE defines key data and knowledge specification formats. Implementations that use only these specification formats will be portable. This does not preclude use of AI-ESTATE interfaces with nonconformant specification formats; however, such implementations may not be portable. As shown in Figure 1, a diagnostic model can be moved from one AI-ESTATE implementation to another by translating it into the interchange format. Another AI-ESTATE implementation can then utilize this information as a complete package by translating the data and knowledge from the interchange format to its own internal form.

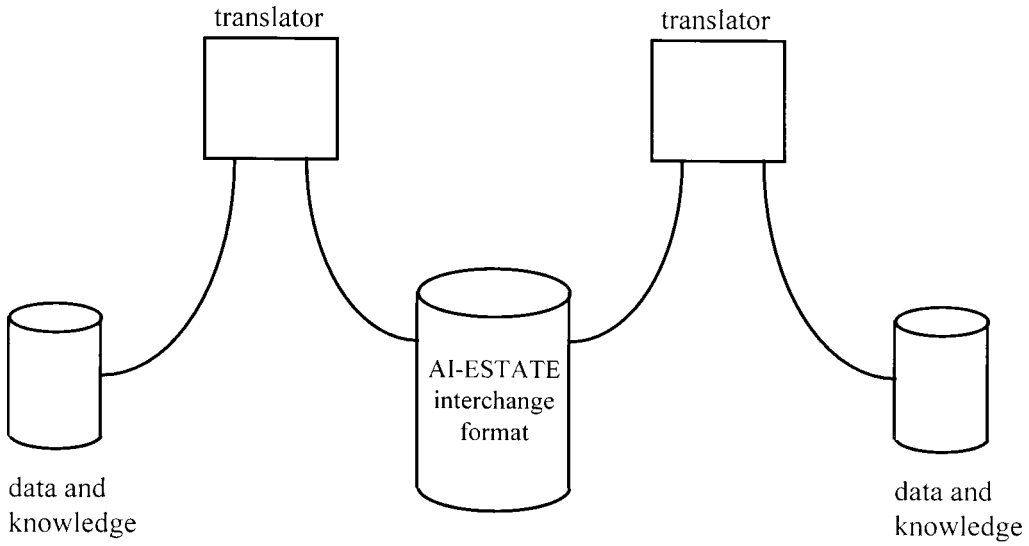


**Figure 1—An example of AI-ESTATE's portability mechanism for data and knowledge**

The translation step is not a requirement; an AI-ESTATE implementation may use the interchange format for its own internal form.

Software specifications defined in this standard will ensure the interchangeability of diagnostic reasoners through the definition of encapsulated services. This will allow diagnostic reasoners to be interchanged within an AI-ESTATE conformant system with no effect on the other elements of the system.

## 1.1 Scope

The AI-ESTATE standard defines formal specifications for supporting system diagnosis. These specifications support the exchange and processing of diagnostic information and the control of diagnostic processes. Diagnostic processes include, but are not limited to, testability analysis, diagnosability assessment, diagnostic reasoning, maintenance support, and diagnostic maturation.

## 1.2 Purpose

The AI-ESTATE standard provides formal models of diagnostic information to ensure unambiguous access to an understanding of the information supporting system test and diagnosis. The standard unifies and expands on the specifications published in IEEE Std 1232™-1995 [B3],[1] IEEE Std 1232.1™-1997 [B4], and IEEE Std 1232.2™-1998 [B5].

[1]The numbers in brackets correspond to those of the bibliography in Annex A.

### 1.3 Conventions used in this standard

This standard specifies information models using the EXPRESS language and uses the following conventions in their presentation:

All specifications in the EXPRESS language are given in the `Courier` type font. This includes references to entity and attribute names in the supporting text. The EXPRESS models found in Clause 5 include comment delimiters "(*" and "*)," thus allowing extraction of the models from an electronic version of the standard for direct use.

Each entity of each EXPRESS schema is presented in a separate subclause. Within a schema, subclauses are listed in alphabetical order by constants, types, enumerated types, select types, entities, and then functions. The subclause structure begins with the actual EXPRESS specification, then each attribute of the entity is described below the attribute definition heading. If any constraints have been specified, these are described below the formal propositions heading.

This standard uses the vocabulary and definitions of relevant IEEE standards. In case of conflict of definitions, the following precedence shall be observed: 1) AI-ESTATE definitions (Clause 3); 2) SCC20 documentation and standards; and 3) IEEE 100™, *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition [B2].

Clause 6 of this standard presents the formal specification of the encapsulated services of this standard. EXPRESS is used to represent the interface of each individual service defining the semantics and type of the required value to be returned.

## 2. References

This standard shall be used in conjunction with the following publications.

ISO 10303-11:1994, Industrial Automation Systems and Integration—Product Data Representation and Exchange—Part 11: Description Methods: The EXPRESS Language Reference Manual.[2]

ISO 10303-21:2002, Industrial Automation Systems and Integration—Product Data Representation and Exchange—Part 21: Implementation Methods: Clear Text Encoding of the Exchange Structure.

[2]ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genéve 20, Switzerland/Suisse (http://www.iso.ch/). ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).