

Validation of EXPRESS models

ICS 35.020

Committees responsible for this Published Document

The preparation of this Published Document was entrusted to Technical Committee GEL/93, Design automation, upon which the following bodies were represented:

- British Aerospace plc
- Department of Trade and Industry
- Federation of the Electronics Industry
- Institution of Electrical Engineers
- Manchester Metropolitan University
- University of Manchester
- University of Southampton

This Published Document, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 September 1996

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Amendments issued since publication

Amd. No.	Date	Text affected

The following BSI references relate to the work on this Published Document:
Committee reference GEL/93
Draft for comment 95/211311SA

ISBN 0 580 26313 4

Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
Text of CENELEC Report R117-003	2

National foreword

This Published Document has been prepared by Technical Committee GEL/93 and is identical with CENELEC Report R117-003 : 1995 *Validation of EXPRESS models* published by the European Committee for Electrotechnical Standardization (CENELEC).

October 1995

English version

Validation of EXPRESS models

This CENELEC Report has been prepared by the Technical Committee CENELEC TC 117, Electronic Design Automation (EDA). It was approved by TC 117 on 1994-10-25 and endorsed by the CENELEC Technical Board on 1994-12-06.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

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Ref. No. R117-003 : 1995 E

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Foreword

This report was submitted to CENELEC TC 117 by Wolfgang Mueller¹, Georg Lehrenfeld², and Norbert Wiechers¹). The work is based on the EC1P (ESPRIT Project No. 2072) Deliverable R:C1.6.2.51B. The authors gratefully acknowledge the comments of the EC1P WP1 team as well as the TC117/WG1 team when reviewing this work.

This Technical Report has finally been prepared by CENELEC Technical Committee TC 117, Electronic Design Automation. It was approved by TC 117 on 1994-10-25 and approved for publication by the CENELEC Technical Board on 1994-12-06.

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Contents

1	Introduction	4
2	EXPRESS	6
3	The Physical File Format	9
4	Classification of Conformance Tests	12
4.1	Class A: Type Checks	13
4.1.1	Simple Type Checks	13
4.1.2	Complex Type Checks	14
4.2	Class B: Simple Rule Checks	15
4.2.1	Uniqueness Checks	15
4.2.2	Simple Domain Rule Checks	16
4.2.3	Simple Global Rule Checks	16
4.3	Class C: Complex Rule Checks	16
5	Implementation Issues	18
5.1	C++	18
5.2	Alternative Approaches	21
5.2.1	Prolog	21
5.2.2	SML	21
5.3	Conclusion	24

Abstract

The report gives first an introduction to ISO10303-11 and ISO10303-21 dedicated to the problem domain of conformance checking. Different classes of conformance checks are identified in the second part. The last part discusses the implementation of a checker.

1 Introduction

EXPRESS is an object oriented data specification language which is currently under standardisation by the ISO. It has currently been accepted as a Draft International Standard (DIS) [ISO10303-11] by the beginning of 1993. The final agreement on the standard is expected by the beginning of 1994.

Typical EXPRESS information models cover 50 up to 300 entity specifications defining very complex super/subtype inheritance structures. Though inheritance eases the writing of models, it is not always obvious whether an EXPRESS model serves its intended data specification. We denote the checking of EXPRESS models with respect to its intended specification as *validation* in this report. Concerning validation of EXPRESS models we can classify two kinds of validation techniques:

1. solely checking of EXPRESS models
2. defining instances for EXPRESS models

The first technique is a preliminary check concerning EXPRESS specifications only. This is mainly to evaluate the super/subtype hierarchy in order to get a “flattened” view of EXPRESS models. This permits a first visual inspection of the compositions of attributes for each entity.

```
TYPE date = ARRAY[1:3] OF INTEGER; END_TYPE;

TYPE hair_type = ENUMERATION OF (blonde,brown); END_TYPE;

ENTITY person;
  first_name : STRING;
  birthdate  : date;
  hair       : OPTIONAL hair_type;
  children   : SET [0:?] OF person;
END_ENTITY;
```

Figure 1: EXPRESS Specification

When a set of real instances exists, the user check them when evaluating the correspondence with the EXPRESS specification.

We can distinguish

- interactive checkers
- batch checkers

Interactive checkers provide forms which can be filled in by a user. Forms can be represented by widgets within an X11 window environment, for instance (see [Sauder93]). Interactive validation means to perform checks incrementally on a particular EXPRESS model. Interactive definition of instances are best suited to apply simple checks that do not concern consistency checks between instances. This is because the definition of an instance might result in an inconsistent state due to cardinality constraints and local/global consistency rules, for instance. Thus, it is more appropriate to perform full conformance checks by *batch checkers* which run their validation on an existing set of instances.

There are two possibilities to define instances in terms of lexical descriptions. The first format is the so-called *Physical File Format* which has already been accepted as a DIS [ISO10303-21]. The second format is called *EXPRESS-I* [Wilson92] which has been introduced to ISO 10303 as a Working Document in 1992. The main difference between both is that ISO 10303-21 presumes a flattened super/subtype relationship. Additionally, in this format the attribute names are omitted in order to reduce the size of files. EXPRESS-I is a direct representation of the hierarchical super/subtype structure containing also the identifiers of the corresponding attributes. Given the EXPRESS specification in Figure 1, Figure 2 depicts the corresponding EXPRESS-I definition and the equivalent ISO10303-21 instance. In this report we ignore EXPRESS-I since we want to concentrate on the validation in the context of product data exchange.

```

/* ISO 10303-21 Instance for ENTITY person */
#2=PERSON('W.',(11,10,60),.blonde.,(#4,#5,#6));

(* EXPRESS-I Instance for ENTITY person *)
d1 = date{(11,10,60)};
e1 = hair_type{!blonde};

p2 = person{ first_name --> 'W.';
             birthdate  --> @d1;
             hair       --> @e1;
             children   --> (@p4,@p5,@p6);};

```

Figure 2: ISO 10303-21 vs. EXPRESS-I

In the following sections we briefly introduce EXPRESS especially dedicated to the evaluation of super/subtype relationships. Additionally, we introduce the STEP physical file format as it is defined in [ISO10303-21]. Thereafter we identify the different classes of validation checks which have to be performed by a full conformance test. These tests are explained giving EXPRESS and ISO 10303-21 instances presuming an already flattened super/subtype structure. Finally we give some preliminary outlines on the implementation of a validation suite.