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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 8652 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information Technology* Subcommittee SC22, *Programming languages, their environments and system software interfaces*.

This third edition cancels and replaces the second edition (ISO/IEC 8652:1995), which has been technically revised. It also incorporates the Technical Corrigendum ISO/IEC 8652:1995:COR.1:2001 and Amendment ISO/IEC 8652:1995:AMD 1:2007.

Introduction

Design Goals

Ada was originally designed with three overriding concerns: program reliability and maintenance, programming as a human activity, and efficiency. The 1995 revision to the language was designed to provide greater flexibility and extensibility, additional control over storage management and synchronization, and standardized packages oriented toward supporting important application areas, while at the same time retaining the original emphasis on reliability, maintainability, and efficiency. This third edition provides further flexibility and adds more standardized packages within the framework provided by the 1995 revision.

The need for languages that promote reliability and simplify maintenance is well established. Hence emphasis was placed on program readability over ease of writing. For example, the rules of the language require that program variables be explicitly declared and that their type be specified. Since the type of a variable is invariant, compilers can ensure that operations on variables are compatible with the properties intended for objects of the type. Furthermore, error-prone notations have been avoided, and the syntax of the language avoids the use of encoded forms in favor of more English-like constructs. Finally, the language offers support for separate compilation of program units in a way that facilitates program development and maintenance, and which provides the same degree of checking between units as within a unit.

Concern for the human programmer was also stressed during the design. Above all, an attempt was made to keep to a relatively small number of underlying concepts integrated in a consistent and systematic way while continuing to avoid the pitfalls of excessive involution. The design especially aims to provide language constructs that correspond intuitively to the normal expectations of users.

Like many other human activities, the development of programs is becoming ever more decentralized and distributed. Consequently, the ability to assemble a program from independently produced software components continues to be a central idea in the design. The concepts of packages, of private types, and of generic units are directly related to this idea, which has ramifications in many other aspects of the language. An allied concern is the maintenance of programs to match changing requirements; type extension and the hierarchical library enable a program to be modified while minimizing disturbance to existing tested and trusted components.

No language can avoid the problem of efficiency. Languages that require over-elaborate compilers, or that lead to the inefficient use of storage or execution time, force these inefficiencies on all machines and on all programs. Every construct of the language was examined in the light of present implementation techniques. Any proposed construct whose implementation was unclear or that required excessive machine resources was rejected.

Language Summary

An Ada program is composed of one or more program units. Program units may be subprograms (which define executable algorithms), packages (which define collections of entities), task units (which define concurrent computations), protected units (which define operations for the coordinated sharing of data between tasks), or generic units (which define parameterized forms of packages and subprograms). Each program unit normally consists of two parts: a specification, containing the information that must be visible to other units, and a body, containing the implementation details, which need not be visible to other units. Most program units can be compiled separately.

This distinction of the specification and body, and the ability to compile units separately, allows a program to be designed, written, and tested as a set of largely independent software components.

An Ada program will normally make use of a library of program units of general utility. The language provides means whereby individual organizations can construct their own libraries. All libraries are structured in a hierarchical manner; this enables the logical decomposition of a subsystem into

individual components. The text of a separately compiled program unit must name the library units it requires.

Program Units

A subprogram is the basic unit for expressing an algorithm. There are two kinds of subprograms: procedures and functions. A procedure is the means of invoking a series of actions. For example, it may read data, update variables, or produce some output. It may have parameters, to provide a controlled means of passing information between the procedure and the point of call. A function is the means of invoking the computation of a value. It is similar to a procedure, but in addition will return a result.

A package is the basic unit for defining a collection of logically related entities. For example, a package can be used to define a set of type declarations and associated operations. Portions of a package can be hidden from the user, thus allowing access only to the logical properties expressed by the package specification.

Subprogram and package units may be compiled separately and arranged in hierarchies of parent and child units giving fine control over visibility of the logical properties and their detailed implementation.

A task unit is the basic unit for defining a task whose sequence of actions may be executed concurrently with those of other tasks. Such tasks may be implemented on multicomputers, multiprocessors, or with interleaved execution on a single processor. A task unit may define either a single executing task or a task type permitting the creation of any number of similar tasks.

A protected unit is the basic unit for defining protected operations for the coordinated use of data shared between tasks. Simple mutual exclusion is provided automatically, and more elaborate sharing protocols can be defined. A protected operation can either be a subprogram or an entry. A protected entry specifies a Boolean expression (an entry barrier) that must be True before the body of the entry is executed. A protected unit may define a single protected object or a protected type permitting the creation of several similar objects.

Declarations and Statements

The body of a program unit generally contains two parts: a declarative part, which defines the logical entities to be used in the program unit, and a sequence of statements, which defines the execution of the program unit.

The declarative part associates names with declared entities. For example, a name may denote a type, a constant, a variable, or an exception. A declarative part also introduces the names and parameters of other nested subprograms, packages, task units, protected units, and generic units to be used in the program unit.

The sequence of statements describes a sequence of actions that are to be performed. The statements are executed in succession (unless a transfer of control causes execution to continue from another place).

An assignment statement changes the value of a variable. A procedure call invokes execution of a procedure after associating any actual parameters provided at the call with the corresponding formal parameters.

Case statements and if statements allow the selection of an enclosed sequence of statements based on the value of an expression or on the value of a condition.

The loop statement provides the basic iterative mechanism in the language. A loop statement specifies that a sequence of statements is to be executed repeatedly as directed by an iteration scheme, or until an exit statement is encountered.

A block statement comprises a sequence of statements preceded by the declaration of local entities used by the statements.

Certain statements are associated with concurrent execution. A delay statement delays the execution of a task for a specified duration or until a specified time. An entry call statement is written as a procedure call statement; it requests an operation on a task or on a protected object, blocking the caller until the operation can be performed. A called task may accept an entry call by executing a corresponding accept statement, which specifies the actions then to be performed as part of the rendezvous with the calling task. An entry call on a protected object is processed when the corresponding entry barrier evaluates to true, whereupon the body of the entry is executed. The requeue statement permits the provision of a service as a number of related activities with preference control. One form of the select statement allows a selective wait for one of several alternative rendezvous. Other forms of the select statement allow conditional or timed entry calls and the asynchronous transfer of control in response to some triggering event.

Execution of a program unit may encounter error situations in which normal program execution cannot continue. For example, an arithmetic computation may exceed the maximum allowed value of a number, or an attempt may be made to access an array component by using an incorrect index value. To deal with such error situations, the statements of a program unit can be textually followed by exception handlers that specify the actions to be taken when the error situation arises. Exceptions can be raised explicitly by a raise statement.

Data Types

Every object in the language has a type, which characterizes a set of values and a set of applicable operations. The main classes of types are elementary types (comprising enumeration, numeric, and access types) and composite types (including array and record types).

An enumeration type defines an ordered set of distinct enumeration literals, for example a list of states or an alphabet of characters. The enumeration types Boolean, Character, Wide_Character, and Wide_Wide_Character are predefined.

Numeric types provide a means of performing exact or approximate numerical computations. Exact computations use integer types, which denote sets of consecutive integers. Approximate computations use either fixed point types, with absolute bounds on the error, or floating point types, with relative bounds on the error. The numeric types Integer, Float, and Duration are predefined.

Composite types allow definitions of structured objects with related components. The composite types in the language include arrays and records. An array is an object with indexed components of the same type. A record is an object with named components of possibly different types. Task and protected types are also forms of composite types. The array types String, Wide_String, and Wide_Wide_String are predefined.

Record, task, and protected types may have special components called discriminants which parameterize the type. Variant record structures that depend on the values of discriminants can be defined within a record type.

Access types allow the construction of linked data structures. A value of an access type represents a reference to an object declared as aliased or to an object created by the evaluation of an allocator. Several variables of an access type may designate the same object, and components of one object may designate the same or other objects. Both the elements in such linked data structures and their relation to other elements can be altered during program execution. Access types also permit references to subprograms to be stored, passed as parameters, and ultimately dereferenced as part of an indirect call.

Private types permit restricted views of a type. A private type can be defined in a package so that only the logically necessary properties are made visible to the users of the type. The full structural details that are externally irrelevant are then only available within the package and any child units.

From any type a new type may be defined by derivation. A type, together with its derivatives (both direct and indirect) form a derivation class. Class-wide operations may be defined that accept as a parameter an operand of any type in a derivation class. For record and private types, the derivatives

may be extensions of the parent type. Types that support these object-oriented capabilities of class-wide operations and type extension must be tagged, so that the specific type of an operand within a derivation class can be identified at run time. When an operation of a tagged type is applied to an operand whose specific type is not known until run time, implicit dispatching is performed based on the tag of the operand.

Interface types provide abstract models from which other interfaces and types may be composed and derived. This provides a reliable form of multiple inheritance. Interface types may also be implemented by task types and protected types thereby enabling concurrent programming and inheritance to be merged.

The concept of a type is further refined by the concept of a subtype, whereby a user can constrain the set of allowed values of a type. Subtypes can be used to define subranges of scalar types, arrays with a limited set of index values, and records and private types with particular discriminant values.

Other Facilities

Aspect clauses can be used to specify the mapping between types and features of an underlying machine. For example, the user can specify that objects of a given type must be represented with a given number of bits, or that the components of a record are to be represented using a given storage layout. Other features allow the controlled use of low level, nonportable, or implementation-dependent aspects, including the direct insertion of machine code.

The predefined environment of the language provides for input-output and other capabilities by means of standard library packages. Input-output is supported for values of user-defined as well as of predefined types. Standard means of representing values in display form are also provided.

The predefined standard library packages provide facilities such as string manipulation, containers of various kinds (vectors, lists, maps, etc.), mathematical functions, random number generation, and access to the execution environment.

The specialized annexes define further predefined library packages and facilities with emphasis on areas such as real-time scheduling, interrupt handling, distributed systems, numerical computation, and high-integrity systems.

Finally, the language provides a powerful means of parameterization of program units, called generic program units. The generic parameters can be types and subprograms (as well as objects and packages) and so allow general algorithms and data structures to be defined that are applicable to all types of a given class.

Language Changes

This International Standard replaces the second edition of 1995. It modifies the previous edition by making changes and additions that improve the capability of the language and the reliability of programs written in the language. This edition incorporates the changes from Amendment 1 (ISO/IEC 8652:1995:AMD 1:2007), which were designed to improve the portability of programs, interfacing to other languages, and both the object-oriented and real-time capabilities.

Significant changes originating in Amendment 1 are incorporated:

- Support for program text is extended to cover the entire ISO/IEC 10646:2003 repertoire. Execution support now includes the 32-bit character set. See subclauses 2.1, 3.5.2, 3.6.3, A.1, A.3, and A.4.
- The object-oriented model has been improved by the addition of an interface facility which provides multiple inheritance and additional flexibility for type extensions. See subclauses 3.4, 3.9, and 7.3. An alternative notation for calling operations more akin to that used in other languages has also been added. See subclause 4.1.3.
- Access types have been further extended to unify properties such as the ability to access constants and to exclude null values. See clause 3.10. Anonymous access types are now

permitted more freely and anonymous access-to-subprogram types are introduced. See subclauses 3.3, 3.6, 3.10, and 8.5.1.

- The control of structure and visibility has been enhanced to permit mutually dependent references between units and finer control over access from the private part of a package. See subclauses 3.10.1 and 10.1.2. In addition, limited types have been made more useful by the provision of aggregates, constants, and constructor functions. See subclauses 4.3, 6.5, and 7.5.
- The predefined environment has been extended to include additional time and calendar operations, improved string handling, a comprehensive container library, file and directory management, and access to environment variables. See subclauses 9.6.1, A.4, A.16, A.17, and A.18.
- Two of the Specialized Needs Annexes have been considerably enhanced:
  - The Real-Time Systems Annex now includes the Ravenscar profile for high-integrity systems, further dispatching policies such as Round Robin and Earliest Deadline First, support for timing events, and support for control of CPU time utilization. See subclauses D.2, D.13, D.14, and D.15.
  - The Numerics Annex now includes support for real and complex vectors and matrices as previously defined in ISO/IEC 13813:1997 plus further basic operations for linear algebra. See subclause G.3.
- The overall reliability of the language has been enhanced by a number of improvements. These include new syntax which detects accidental overloading, as well as pragmas for making assertions and giving better control over the suppression of checks. See subclauses 6.1, 11.4.2, and 11.5.

In addition, this third edition makes enhancements to address two important issues, namely, the particular problems of multiprocessor architectures, and the need to further increase the capabilities regarding assertions for correctness. It also makes additional changes and additions that improve the capability of the language and the reliability of programs written in the language.

The following significant changes with respect to the 1995 edition as amended by Amendment 1 are incorporated:

- New syntax (the aspect specification) is introduced to enable properties to be specified for various entities in a more structured manner than through pragmas. See subclause 13.1.1.
- The concept of assertions introduced in the 2005 edition is extended with the ability to specify preconditions and postconditions for subprograms, and invariants for private types. The concept of constraints in defining subtypes is supplemented with subtype predicates that enable subsets to be specified other than as simple ranges. These properties are all indicated using aspect specifications. See subclauses 3.2.4, 6.1.1, and 7.3.2.
- New forms of expressions are introduced. These are if expressions, case expressions, quantified expressions, and expression functions. As well as being useful for programming in general by avoiding the introduction of unnecessary assignments, they are especially valuable in conditions and invariants since they avoid the need to introduce auxiliary functions. See subclauses 4.5.7, 4.5.8, and 6.8. Membership tests are also made more flexible. See subclauses 4.4 and 4.5.2.
- A number of changes are made to subprogram parameters. Functions may now have parameters of all modes. In order to mitigate consequent (and indeed existing) problems of inadvertent order dependence, rules are introduced to reduce aliasing. A parameter may now be explicitly marked as aliased and the type of a parameter may be incomplete in certain circumstances. See subclauses 3.10.1, 6.1, and 6.4.1.
- The use of access types is now more flexible. The rules for accessibility and certain conversions are improved. See subclauses 3.10.2, 4.5.2, 4.6, and 8.6. Furthermore, better control of storage pools is provided. See subclause 13.11.4.

- The Real-Time Systems Annex now includes facilities for defining domains of processors and assigning tasks to them. Improvements are made to scheduling and budgeting facilities. See subclauses D.10.1, D.14, and D.16.
- A number of important improvements are made to the standard library. These include packages for conversions between strings and UTF encodings, and classification functions for wide and wide wide characters. Internationalization is catered for by a package giving locale information. See subclauses A.3, A.4.11, and A.19. The container library is extended to include bounded forms of the existing containers and new containers for indefinite objects, multiway trees, and queues. See subclause A.18.
- Finally, certain features are added primarily to ease the use of containers, such as the ability to iterate over all elements in a container without having to encode the iteration. These can also be used for iteration over arrays, and within quantified expressions. See subclauses 4.1.5, 4.1.6, 5.5.1, and 5.5.2.

Instructions for Comment Submission

Informal comments on this International Standard may be sent via e-mail to **ada-comment@ada-auth.org**. If appropriate, the Project Editor will initiate the defect correction procedure.

Comments should use the following format:

> **!topic** *Title summarizing comment*
> **!reference** Ada 2012 RM*ss.ss(pp)*
> **!from** *Author Name yy-mm-dd*
> **!keywords** *keywords related to topic*
> **!discussion**
>
> *text of discussion*

where *ss.ss* is the clause or subclause number, *pp* is the paragraph number where applicable, and *yy-mm-dd* is the date the comment was sent. The date is optional, as is the **!keywords** line.

Please use a descriptive "Subject" in your e-mail message, and limit each message to a single comment.

When correcting typographical errors or making minor wording suggestions, please put the correction directly as the topic of the comment; use square brackets [ ] to indicate text to be omitted and curly braces { } to indicate text to be added, and provide enough context to make the nature of the suggestion self-evident or put additional information in the body of the comment, for example:

> **!topic** [c]{C}haracter
> **!topic** it[']s meaning is not defined

Formal requests for interpretations and for reporting defects in this International Standard may be made in accordance with the ISO/IEC JTC 1 Directives and the ISO/IEC JTC 1/SC 22 policy for interpretations. National Bodies may submit a Defect Report to ISO/IEC JTC 1/SC 22 for resolution under the JTC 1 procedures. A response will be provided and, if appropriate, a Technical Corrigendum will be issued in accordance with the procedures.

Information technology — Programming Languages — Ada

1 General

1.1 Scope

This International Standard specifies the form and meaning of programs written in Ada. Its purpose is to promote the portability of Ada programs to a variety of computing systems.

Ada is a programming language designed to support the construction of long-lived, highly reliable software systems. The language includes facilities to define packages of related types, objects, and operations. The packages may be parameterized and the types may be extended to support the construction of libraries of reusable, adaptable software components. The operations may be implemented as subprograms using conventional sequential control structures, or as entries that include synchronization of concurrent threads of control as part of their invocation. Ada supports object-oriented programming by providing classes and interfaces, inheritance, polymorphism of variables and methods, and generic units. The language treats modularity in the physical sense as well, with a facility to support separate compilation.

The language provides rich support for real-time, concurrent programming, and includes facilities for multicore and multiprocessor programming. Errors can be signaled as exceptions and handled explicitly. The language also covers systems programming; this requires precise control over the representation of data and access to system-dependent properties. Finally, a predefined environment of standard packages is provided, including facilities for, among others, input-output, string manipulation, numeric elementary functions, and random number generation, and definition and use of containers.

1.1.1 Extent

This International Standard specifies:

- The form of a program written in Ada;
- The effect of translating and executing such a program;
- The manner in which program units may be combined to form Ada programs;
- The language-defined library units that a conforming implementation is required to supply;
- The permissible variations within the standard, and the manner in which they are to be documented;

- Those violations of the standard that a conforming implementation is required to detect, and the effect of attempting to translate or execute a program containing such violations;
- Those violations of the standard that a conforming implementation is not required to detect.

This International Standard does not specify:

- The means whereby a program written in Ada is transformed into object code executable by a processor;
- The means whereby translation or execution of programs is invoked and the executing units are controlled;
- The size or speed of the object code, or the relative execution speed of different language constructs;
- The form or contents of any listings produced by implementations; in particular, the form or contents of error or warning messages;
- The effect of unspecified execution.
- The size of a program or program unit that will exceed the capacity of a particular conforming implementation.

1.1.2 Structure

This International Standard contains thirteen clauses, fifteen annexes, and an index.

The *core* of the Ada language consists of:

- Clauses 1 through 13
- Annex A, “Predefined Language Environment”
- Annex B, “Interface to Other Languages”
- Annex J, “Obsolescent Features”

The following *Specialized Needs Annexes* define features that are needed by certain application areas:

- Annex C, “Systems Programming”
- Annex D, “Real-Time Systems”
- Annex E, “Distributed Systems”
- Annex F, “Information Systems”
- Annex G, “Numerics”
- Annex H, “High Integrity Systems”

The core language and the Specialized Needs Annexes are normative, except that the material in each of the items listed below is informative:

- Text under a NOTES or Examples heading.
- Each subclause whose title starts with the word “Example” or “Examples”.

All implementations shall conform to the core language. In addition, an implementation may conform separately to one or more Specialized Needs Annexes.

The following Annexes are informative:

- Annex K, “Language-Defined Aspects and Attributes”
- Annex L, “Language-Defined Pragmas”
- Annex M, “Summary of Documentation Requirements”
- Annex N, “Glossary”

- Annex P, “Syntax Summary”
- Annex Q, “Language-Defined Entities”

Each section is divided into subclauses that have a common structure. Each clause and subclause first introduces its subject. After the introductory text, text is labeled with the following headings:

Syntax

Syntax rules (indented).

Name Resolution Rules

Compile-time rules that are used in name resolution, including overload resolution.

Legality Rules

Rules that are enforced at compile time. A construct is *legal* if it obeys all of the Legality Rules.

Static Semantics

A definition of the compile-time effect of each construct.

Post-Compilation Rules

Rules that are enforced before running a partition. A partition is legal if its compilation units are legal and it obeys all of the Post-Compilation Rules.

Dynamic Semantics

A definition of the run-time effect of each construct.

Bounded (Run-Time) Errors

Situations that result in bounded (run-time) errors (see 1.1.5).

Erroneous Execution

Situations that result in erroneous execution (see 1.1.5).

Implementation Requirements

Additional requirements for conforming implementations.

Documentation Requirements

Documentation requirements for conforming implementations.

Metrics

Metrics that are specified for the time/space properties of the execution of certain language constructs.

Implementation Permissions

Additional permissions given to the implementer.

Implementation Advice

Optional advice given to the implementer. The word “should” is used to indicate that the advice is a recommendation, not a requirement. It is implementation defined whether or not a given recommendation is obeyed.

NOTES
1 Notes emphasize consequences of the rules described in the (sub)clause or elsewhere. This material is informative.

Examples

Examples illustrate the possible forms of the constructs described. This material is informative.

1.1.3 Conformity of an Implementation with the Standard

Implementation Requirements

A conforming implementation shall:

- Translate and correctly execute legal programs written in Ada, provided that they are not so large as to exceed the capacity of the implementation;
- Identify all programs or program units that are so large as to exceed the capacity of the implementation (or raise an appropriate exception at run time);
- Identify all programs or program units that contain errors whose detection is required by this International Standard;
- Supply all language-defined library units required by this International Standard;
- Contain no variations except those explicitly permitted by this International Standard, or those that are impossible or impractical to avoid given the implementation's execution environment;
- Specify all such variations in the manner prescribed by this International Standard.

The *external effect* of the execution of an Ada program is defined in terms of its interactions with its external environment. The following are defined as *external interactions*:

- Any interaction with an external file (see A.7);
- The execution of certain code_statements (see 13.8); which code_statements cause external interactions is implementation defined.
- Any call on an imported subprogram (see Annex B), including any parameters passed to it;
- Any result returned or exception propagated from a main subprogram (see 10.2) or an exported subprogram (see Annex B) to an external caller;
- Any read or update of an atomic or volatile object (see C.6);
- The values of imported and exported objects (see Annex B) at the time of any other interaction with the external environment.

A conforming implementation of this International Standard shall produce for the execution of a given Ada program a set of interactions with the external environment whose order and timing are consistent with the definitions and requirements of this International Standard for the semantics of the given program.

An implementation that conforms to this Standard shall support each capability required by the core language as specified. In addition, an implementation that conforms to this Standard may conform to one or more Specialized Needs Annexes (or to none). Conformance to a Specialized Needs Annex means that each capability required by the Annex is provided as specified.

An implementation conforming to this International Standard may provide additional aspects, attributes, library units, and pragmas. However, it shall not provide any aspect, attribute, library unit, or pragma having the same name as an aspect, attribute, library unit, or pragma (respectively) specified in a Specialized Needs Annex unless the provided construct is either as specified in the Specialized Needs Annex or is more limited in capability than that required by the Annex. A program that attempts to use an unsupported capability of an Annex shall either be identified by the implementation before run time or shall raise an exception at run time.

Documentation Requirements

Certain aspects of the semantics are defined to be either *implementation defined* or *unspecified*. In such cases, the set of possible effects is specified, and the implementation may choose any effect in the set. Implementations shall document their behavior in implementation-defined situations, but

documentation is not required for unspecified situations. The implementation-defined characteristics are summarized in M.2.

The implementation may choose to document implementation-defined behavior either by documenting what happens in general, or by providing some mechanism for the user to determine what happens in a particular case.

Implementation Advice

If an implementation detects the use of an unsupported Specialized Needs Annex feature at run time, it should raise Program_Error if feasible.

If an implementation wishes to provide implementation-defined extensions to the functionality of a language-defined library unit, it should normally do so by adding children to the library unit.

NOTES
2 The above requirements imply that an implementation conforming to this Standard may support some of the capabilities required by a Specialized Needs Annex without supporting all required capabilities.

1.1.4 Method of Description and Syntax Notation

The form of an Ada program is described by means of a context-free syntax together with context-dependent requirements expressed by narrative rules.

The meaning of Ada programs is described by means of narrative rules defining both the effects of each construct and the composition rules for constructs.

The context-free syntax of the language is described using a simple variant of Backus-Naur Form. In particular:

- Lower case words in a sans-serif font, some containing embedded underlines, are used to denote syntactic categories, for example:

  case_statement

- Boldface words are used to denote reserved words, for example:

  array

- Square brackets enclose optional items. Thus the two following rules are equivalent.

  simple_return_statement ::= **return** [expression];
  simple_return_statement ::= **return**; | **return** expression;

- Curly brackets enclose a repeated item. The item may appear zero or more times; the repetitions occur from left to right as with an equivalent left-recursive rule. Thus the two following rules are equivalent.

  term ::= factor {multiplying_operator factor}
  term ::= factor | term multiplying_operator factor

- A vertical line separates alternative items unless it occurs immediately after an opening curly bracket, in which case it stands for itself:

  constraint ::= scalar_constraint | composite_constraint
  discrete_choice_list ::= discrete_choice {| discrete_choice}

- If the name of any syntactic category starts with an italicized part, it is equivalent to the category name without the italicized part. The italicized part is intended to convey some semantic information. For example *subtype*_name and *task*_name are both equivalent to name alone.

The delimiters, compound delimiters, reserved words, and numeric_literals are exclusively made of the characters whose code point is between 16#20# and 16#7E#, inclusively. The special characters for which names are defined in this International Standard (see 2.1) belong to the same range. For