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Ada COMPILER
VALIDATION SUMMARY REPORT:
Certificate Number: 890131I1.10035
SYSTEAM KG
SYSTEAM Ada Compiler VAX/VMS version 1.31
VAX 8350 Host and Target

Completion of On-Site Testing:
31st January 1989

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Washington DC 20301-3081

Ada Compiler Validation Summary Report:

Compiler Name: SYSTEAM Ada Compiler VAX/VMS version 1.81

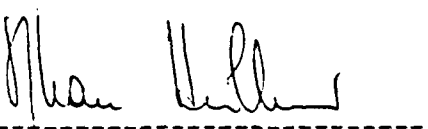
Certificate Number: 890131I1.10035

Host: VAX 8350 under VMS version 4.6

Target: VAX 8350 under VMS version 4.6

Testing Completed 31st January 1989 Using ACVC 1.10

This report has been reviewed and is approved.



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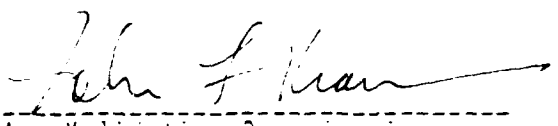

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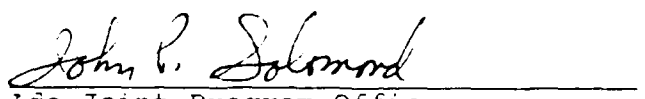

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CHAPTER 1

INTRODUCTION

This Validation Summary Report (VSR) describes the extent to which a specific Ada compiler conforms to the Ada Standard, ANSI/MIL-STD-1815A. This report explains all technical terms used within it and thoroughly reports the results of testing this compiler using the Ada Compiler Validation Capability (ACVC). An Ada compiler must be implemented according to the Ada Standard, and any implementation-dependent features must conform to the requirements of the Ada Standard. The Ada Standard must be implemented in its entirety, and nothing can be implemented that is not in the Standard.

Even though all validated Ada compilers conform to the Ada Standard, it must be understood that some differences do exist between implementations. The Ada Standard permits some implementation dependencies--for example, the maximum length of identifiers or the maximum values of integer types. Other differences between compilers result from the characteristics of particular operating systems, hardware, or implementation strategies. All the dependencies observed during the process of testing this compiler are given in this report.

The information in this report is derived from the test results produced during validation testing. The validation process includes submitting a suite of standardized tests, the ACVC, as inputs to an Ada compiler and evaluating the results. The purpose of validating is to ensure conformity of the compiler to the Ada Standard by testing that the compiler properly implements legal language constructs and that it identifies and rejects illegal language constructs. The testing also identifies behavior that is implementation dependent, but is permitted by the Ada Standard. Six classes of tests are used. These tests are designed to perform checks at compile time, at link time, and during execution.

1.1 PURPOSE OF THIS VALIDATION SUMMARY REPORT

This VSR documents the results of the validation testing performed on an Ada compiler. Testing was carried out for the following purposes:

- To attempt to identify any language constructs supported by the compiler that do not conform to the Ada Standard
- To attempt to identify any language constructs not supported by the compiler but required by the Ada Standard
- To determine that the implementation-dependent behavior is allowed by the Ada Standard

Testing of this compiler was conducted by IABG mbH under the direction of the AVF according to procedures established by the Ada Joint Program Office and administered by the Ada Validation Organization (AVO). On-site testing was completed 31st January 1989 at IABG, Ottobrunn.

1.2 USE OF THIS VALIDATION SUMMARY REPORT

Consistent with the national laws of the originating country, the AVO may make full and free public disclosure of this report. In the United States, this is provided in accordance with the "Freedom of Information Act" (5 U.S.C. #552). The results of this validation apply only to the computers, operating systems, and compiler versions identified in this report.

The organizations represented on the signature page of this report do not represent or warrant that all statements set forth in this report are accurate and complete, or that the subject compiler has no nonconformities to the Ada Standard other than those presented. Copies of this report are available to the public from:

Ada Information Clearinghouse
Ada Joint Program Office
OUSDRE
The Pentagon, Rm 3D-139 (Fern Street)
Washington DC 20301-3081

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Questions regarding this report or the validation test results should be directed to the AVF listed above or to:

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1.3 REFERENCES

Reference Manual for the Ada Programming Language, ANSI/MIL-STD-1815A, February 1983 and ISO 8652-1987.

Ada Compiler Validation Procedures and Guidelines, Ada Joint Program Office, 1 January 1987.

Ada Compiler Validation Capability Implementers' Guide, SofTech, Inc., December 1986.

Ada Compiler Validation Capability User's Guide, December 1986.

1.4 DEFINITION OF TERMS

ACVC	The Ada Compiler Validation Capability. The set of Ada programs that tests the conformity of an Ada compiler to the Ada programming language.
Ada Commentary	An Ada Commentary contains all information relevant to the point addressed by a comment on the Ada Standard. These comments are given a unique identification number having the form AI-ddddd.
Ada Standard	ANSI/MIL-STD-1815A, February 1983 and ISO 8652-1987.
Applicant	The agency requesting validation.
AVF	The Ada Validation Facility. The AVF is responsible for conducting compiler validations according to procedures contained in the Ada Compiler Validation Procedures and Guidelines.
AVO	The Ada Validation Organization. The AVO has oversight authority over all AVF practices for the purpose of maintaining a uniform process for validation of Ada compilers. The AVO provides administrative and technical support for Ada validations to ensure consistent practices.
Compiler	A processor for the Ada language. In the context of this report, a compiler is any language processor, including cross-compilers, translators, and interpreters.
Failed test	An ACVC test for which the compiler generates a result that demonstrates nonconformity to the Ada Standard.
Host	The computer on which the compiler resides.

Inapplicable test	An ACVC test that uses features of the language that a compiler is not required to support or may legitimately support in a way other than the one expected by the test.
Passed test	An ACVC test for which a compiler generates the expected result.
Target	The computer which executes the code generated by the compiler.
Test	A program that checks a compiler's conformity regarding a particular feature or a combination of features to the Ada Standard. In the context of this report, the term is used to designate a single test, which may comprise one or more files.
Withdrawn test	An ACVC test found to be incorrect and not used to check conformity to the Ada Standard. A test may be incorrect because it has an invalid test objective, fails to meet its test objective, or contains illegal or erroneous use of the language.

1.5 ACVC TEST CLASSES

Conformity to the Ada Standard is measured using the ACVC. The ACVC contains both legal and illegal Ada programs structured into six test classes: A, B, C, D, E, and L. The first letter of a test name identifies the class to which it belongs. Class A, C, D, and E tests are executable, and special program units are used to report their results during execution. Class B tests are expected to produce compilation errors. Class L tests are expected to produce errors because of the way in which a program library is used at link time.

Class A tests ensure the successful compilation and execution of legal Ada programs with certain language constructs which cannot be verified at run time. There are no explicit program components in a Class A test to check semantics. For example, a Class A test checks that reserved words of another language (other than those already reserved in the Ada language) are not treated as reserved words by an Ada compiler. A Class A test is passed if no errors are detected at compile time and the program executes to produce a PASSED message.

Class B tests check that a compiler detects illegal language usage. Class B tests are not executable. Each test in this class is compiled and the resulting compilation listing is examined to verify that every syntax or semantic error in the test is detected. A Class B test is passed if every illegal construct that it contains is detected by the compiler.

Class C tests check the run time system to ensure that legal Ada programs can be correctly compiled and executed. Each Class C test is self-checking and produces a PASSED, FAILED, or NOT APPLICABLE message indicating the result when it is executed.

Class D tests check the compilation and execution capacities of a compiler. Since there are no capacity requirements placed on a compiler by the Ada Standard for some parameters--for example, the number of identifiers permitted in a compilation or the number of units in a library--a compiler may refuse to compile a Class D test and still be a conforming compiler. Therefore, if a Class D test fails to compile because the capacity of the compiler is exceeded, the test is classified as inapplicable. If a Class D test compiles successfully, it is self-checking and produces a PASSED or FAILED message during execution.

Class E tests are expected to execute successfully and check implementation-dependent options and resolutions of ambiguities in the Ada Standard. Each Class E test is self-checking and produces a NOT APPLICABLE, PASSED, or FAILED message when it is compiled and executed. However, the Ada Standard permits an implementation to reject programs containing some features addressed by Class E tests during compilation. Therefore, a Class E test is passed by a compiler if it is compiled successfully and executes to produce a PASSED message, or if it is rejected by the compiler for an allowable reason.

Class L tests check that incomplete or illegal Ada programs involving multiple, separately compiled units are detected and not allowed to execute. Class L tests are compiled separately and execution is attempted. A Class L test passes if it is rejected at link time--that is, an attempt to execute the main program must generate an error message before any declarations in the main program or any units referenced by the main program are elaborated. In some cases, an implementation may legitimately detect errors during compilation of the test.

Two library units, the package REPORT and the procedure CHECK_FILE, support the self-checking features of the executable tests. The package REPORT provides the mechanism by which executable tests report PASSED, FAILED, or NOT APPLICABLE results. It also provides a set of identity functions used to defeat some compiler optimizations allowed by the Ada Standard that would circumvent a test objective. The procedure CHECK_FILE is used to check the contents of text files written by some of the Class C tests for Chapter 14 of the Ada Standard. The operation of REPORT and CHECK_FILE is checked by a set of executable tests. These tests produce messages that are examined to verify that the units are operating correctly. If these units are not operating correctly, then the validation is not attempted.

The text of each test in the ACVC follows conventions that are intended to ensure that the tests are reasonably portable without modification. For example, the tests make use of only the basic set of 55 characters, contain lines with a maximum length of 72 characters, use small numeric values, and place features that may not be supported by all implementations in separate tests. However, some tests contain values that require the test to be

customized according to implementation-specific values--for example, an illegal file name. A list of the values used for this validation is provided in Appendix C.

A compiler must correctly process each of the tests in the suite and demonstrate conformity to the Ada Standard by either meeting the pass criteria given for the test or by showing that the test is inapplicable to the implementation. The applicability of a test to an implementation is considered each time the implementation is validated. A test that is inapplicable for one validation is not necessarily inapplicable for a subsequent validation. Any test that was determined to contain an illegal language construct or an erroneous language construct is withdrawn from the ACVC and, therefore, is not used in testing a compiler. The tests withdrawn at the time of this validation are given in Appendix D.

CHAPTER 2

CONFIGURATION INFORMATION

2.1 CONFIGURATION TESTED

The candidate compilation system for this validation was tested under the following configuration:

Compiler: SYSTEAM Ada Compiler VAX/VMS version 1.81

ACVC Version: 1.10

Certificate Number: 890131I1.10035

Host Computer:

Machine:	VAX 8350
Operating System:	VMS Version 4.5
Memory Size:	12 Mb

Target Computer:

Machine:	VAX 8350
Operating System:	VMS Version 4.5
Memory Size:	12 Mb

2.2 IMPLEMENTATION CHARACTERISTICS

One of the purposes of validating compilers is to determine the behavior of a compiler in those areas of the Ada Standard that permit implementations to differ. Class D and E tests specifically check for such implementation differences. However, tests in other classes also characterize an implementation. The tests demonstrate the following characteristics:

a. Capacities.

(1) The compiler correctly processes a compilation containing 723 variables in the same declarative part. (See test D29002K.)

(2) The compiler correctly processes tests containing loop statements nested to 65 levels. (See tests D55A03A..H (8 tests).)

(3) The compiler correctly processes tests containing block statements nested to 65 levels. (See test D56001B.)

(4) The compiler correctly processes tests containing recursive procedures separately compiled as subunits nested to 17 levels. (See tests D64005E..G (3 tests).)

b. Predefined types.

(1) This implementation supports the additional predefined types SHORT_INTEGER, SHORT_SHORT_INTEGER, SHORT_FLOAT, LONG_FLOAT and LONG_LONG_FLOAT in the package STANDARD. (See tests B86001T..Z (7 tests).)

c. Expression evaluation.

The order in which expressions are evaluated and the time at which constraints are checked are not defined by the language. While the ACVC tests do not specifically attempt to determine the order of evaluation of expressions, test results indicate the following:

(1) None of the default initialization expressions for record components are evaluated before any value is checked for membership in a component's subtype. (See test C32117A.)

(2) Assignments for subtypes are performed with the same precision as the base type. (See test C35712B.)

(3) This implementation uses no extra bits for extra precision and uses all extra bits for extra range. (See test C35903A.)

(4) No exception is raised when an integer literal operand in a comparison or membership test is outside the range of the base type. (See test C45232A.)

(5) No exception is raised when a literal operand in a fixed-point comparison or membership test is outside the range of the base type. (See test C45252A.)

(6) Underflow is not gradual. (See tests C45524A..Z (26 tests).)

d. Rounding.

The method by which values are rounded in type conversions is not defined by the language. While the ACVC tests do not specifically attempt to determine the method of rounding, the test results indicate the following:

(1) The method used for rounding to integer is round away from zero. (See tests C46012A..Z (26 tests).)

(2) The method used for rounding to longest integer is round away from zero. (See tests C46012A..Z (26 tests).)

(3) The method used for rounding to integer in static universal real expressions is round away from zero. (See test C4A014A.)

e. Array types.

An implementation is allowed to raise NUMERIC_ERROR or CONSTRAINT_ERROR for an array having a 'LENGTH that exceeds STANDARD.INTEGER'LAST and/or SYSTEM.MAX_INT.

This implementation evaluates the 'LENGTH of each constrained array subtype during elaboration of the type declaration. This causes the declaration of a constrained array subtype with more than INTEGER'LAST (which is equal to SYSTEM.MAX_INT for this implementation) components to raise CONSTRAINT_ERROR. However the optimisation mechanism of this implementation suppresses the evaluation of 'LENGTH if no object of the array type is declared depending on whether the bounds of the array are static, the visibility of the array type, and the presence of local subprograms. These general remarks apply to points (1) to (6).

(1) Declaration of an array type or subtype declaration with more than SYSTEM.MAX_INT components raises no exception if the bounds of the array are static. (See test C36003A.)

(2) CONSTRAINT_ERROR is raised when 'LENGTH is applied to an array type with INTEGER'LAST + 2 components if the bounds of the array are not static and if the subprogram declaring the array type contains no local subprograms. (See test C36202A.)

(3) CONSTRAINT_ERROR is raised when 'LENGTH is applied to an array type with INTEGER'LAST + 2 components if the bounds of the array are not static and if the subprogram declaring the array type contains a local subprogram. (See test C36202B.)

(4) A packed BOOLEAN array having a 'LENGTH exceeding INTEGER'LAST raises CONSTRAINT_ERROR when the array type is declared if the bounds of the array are not static and if there are objects of the array type. (See test C52103X.)

(5) A packed two-dimensional BOOLEAN array with more than INTEGER'LAST components raises CONSTRAINT_ERROR when the array type is declared if the bounds of the array are not static and if there are objects of the array type. (See test C52104Y.)

(6) A null array with one dimension of length greater than INTEGER'LAST may raise NUMERIC_ERROR or CONSTRAINT_ERROR either when declared or assigned. Alternatively, an implementation may accept the declaration. However, lengths must match in array slice assignments. This implementation raises CONSTRAINT_ERROR when the array type is declared if the bounds of the array are not static and if there are objects of the array type. (See test E52103Y).

f. Discriminated types.

(1) In assigning record types with discriminants, the expression is not evaluated in its entirety before CONSTRAINT_ERROR is raised when checking whether the expression's subtype is compatible with the target's subtype. (See test C52013A.)

g. Aggregates.

(1) In the evaluation of a multi-dimensional aggregate, the test results indicate that all choices are evaluated before checking against the index type. (See tests C43207A and C43207B.)

(2) In the evaluation of an aggregate containing subaggregates, all choices are evaluated before being checked for identical bounds. (See test E43212B.)

(3) CONSTRAINT_ERROR is raised after all choices are evaluated when a bound in a non-null range of a non-null aggregate does not belong to an index subtype. (See test E43211B.)

h. Pragmas.

(1) The pragma INLINE is supported for functions and procedures (See tests LA3004A..B (2 tests), EA3004C..D (2 tests), and CA3004E..F (2 tests).)

i. Generics.

(1) Generic specifications and bodies can be compiled in separate compilations. (See tests CA1012A, CA2009C, CA2009F, BC3204C, and BC3205D.)

(2) Generic unit bodies and their subunits can be compiled in separate compilations. (See test CA3011A.)

(3) Generic subprogram declarations and bodies can be compiled in separate compilations. (See tests CA1012A and CA2009F.)

(4) Generic library subprogram specifications and bodies can be compiled in separate compilations. (See test CA1012A.)

(5) Generic non-library subprogram bodies can be compiled in separate compilations from their stubs. (See test CA2009F.)

(6) Generic package declarations and bodies can be compiled in separate compilations. (See tests CA2009C, BC3204C, and BC3205D.)

(7) Generic library package specifications and bodies can be compiled in separate compilations. (See tests BC3204C and BC3205D.)

(8) Generic non-library package bodies as subunits can be compiled in separate compilations. (See test CA2009C.)

(9) Generic unit bodies and their subunits can be compiled in separate compilations. (See test CA3011A.)

j. Input and output.

(1) The package SEQUENTIAL_IO can be instantiated with unconstrained array types and record types with discriminants without defaults. (See tests AE2101C, EE2201D, and EE2201E.)

(2) The package DIRECT_IO can be instantiated with unconstrained array types or record types with discriminants without defaults. However, an attempt to create a file with an unconstrained array type raises USE_ERROR. (See tests AE2101H, EE2401D and EE2401G.)

(3) Modes IN_FILE and OUT_FILE are supported for SEQUENTIAL_IO. (See tests CE2102D..E, CE2102N, and CE2102P.)

(4) Modes IN_FILE, OUT_FILE, and INOUT_FILE are supported for DIRECT_IO. (See tests CE2102F, CE2102I..J (2 tests), CE2102R, CE2102T, and CE2102V.)

(5) Modes IN_FILE and OUT_FILE are supported for text files. (See tests CE3102E and CE3102I..K (3 tests).)

(6) RESET and DELETE operations are supported for SEQUENTIAL_IO. (See tests CE2102G and CE2102X.)

(7) RESET and DELETE operations are supported for DIRECT_IO. (See tests CE2102K and CE2102Y.)

(8) RESET and DELETE operations are supported for text files. (See tests CE3102F..G (2 tests), CE3104C, CE3110A, and CE3114A.)

(9) Overwriting to a sequential file truncates to the last element written. (See test CE2208B.)

(10) Temporary sequential files are not given names. (See test CE2108A.)

(11) Temporary direct files are not given names. (See test CE2108C.)

(12) Temporary text files are not given names. (See test CE3112A.)

(13) More than one internal file can be associated with each external file for sequential files when reading only. (See tests CE2107A..E (5 tests), CE2102L, CE2110B, and CE2111D.)

(14) More than one internal file can be associated with each external file for direct files when reading only. (See tests CE2107F..H (3 tests), CE2110D and CE2111H.)

(15) More than one internal file can be associated with each external file for text files when reading only. (See tests CE3111A..B, CE3111D..E, CE3114B, and CE3115A.)

CHAPTER 3

TEST INFORMATION

3.1 TEST RESULTS

Version 1.10 of the ACVC comprises 3717 tests. When this compiler was tested, 36 tests had been withdrawn because of test errors, and were not processed during validation testing. A further 7 tests were withdrawn after validation testing. The AVF determined that 118 tests were inapplicable to this implementation. All inapplicable tests were processed during validation testing. Modifications to the code, processing, or grading for 16 tests were required to successfully demonstrate the test objective. (See section 3.6.)

The AVF concludes that the testing results demonstrate acceptable conformity to the Ada Standard.

3.2 SUMMARY OF TEST RESULTS BY CLASS

RESULT	TEST CLASS						TOTAL
	A	B	C	D	E	L	
Passed	129	1134	2204	17	27	46	3557
Inapplicable	0	4	112	0	1	0	117
Withdrawn	1	2	34	0	6	0	43
TOTAL	130	1140	2350	17	34	46	3717

3.3 SUMMARY OF TEST RESULTS BY CHAPTER

RESULT	CHAPTER													TOTAL
	2	3	4	5	6	7	8	9	10	11	12	13	14	
Passed	209	647	659	245	172	99	163	332	137	36	252	326	280	3557
N/A	3	2	21	3	0	0	3	1	0	0	0	43	41	117
Wdrn	1	1	0	0	0	0	0	1	0	0	1	35	4	43
TOTAL	213	650	680	248	172	99	166	334	137	36	253	404	325	3717

3.4 WITHDRAWN TESTS

The following 36 tests were withdrawn from ACVC Version 1.10 at the time of this validation:

A39005G	B97102E	BC3009B	CD2A62D	CD2A63A	CD2A63B
CD2A83C	CD2A63D	CD2A66A	CD2A66B	CD2A66C	CD2A66D
CD2A73A	CD2A73B	CD2A73C	CD2A73D	CD2A76A	CD2A76B
CD2A76C	CD2A76D	CD2A81G	CD2A83G	CD2A84N	CD2A84M
CD50110	CD2B15C	CD7205C	CD5007B	CD7105A	CD7203B
CD7204B	CD7205D	CE2107I	CE3111C	CE3301A	CE3411B

The following 7 tests were withdrawn from ACVC Version 1.10 after this validation:

E28005C	CD2D11B	ED7004B	ED7005C	ED7005D	ED7006C
ED7006D					

See Appendix D for the reason that each of these tests was withdrawn.

3.5 INAPPLICABLE TESTS

Some tests do not apply to all compilers because they make use of features that a compiler is not required by the Ada Standard to support. Others may depend on the result of another test that is either inapplicable or withdrawn. The applicability of a test to an implementation is considered each time a validation is attempted. A test that is inapplicable for one validation attempt is not necessarily inapplicable for a subsequent attempt. For this validation attempt, 118 tests were inapplicable for the reasons indicated:

a. C24113W..Y (3 tests) contain lines of length greater than 255 characters, which are not supported by this implementation.

b. C34007P, C34007S are expected to raise CONSTRAINT_ERROR. This implementation optimizes the code at compile time on lines 205 and 221 respectively, thus avoiding the operation which would raise CONSTRAINT_ERROR and so no exception is raised.

c. C41401A is expected to raise CONSTRAINT_ERROR for the evaluation of certain attributes, however this implementation derives the values from the subtypes of the prefix at compile time, as allowed by 11.6(7) LRM. Therefore elaboration of the prefix is not involved and CONSTRAINT_ERROR is not raised.

d. The following 16 tests are inapplicable because this implementation does not support a predefined type LONG_INTEGER:

C45231C	C45304C	C45502C	C45503C	C45504C
C45504F	C45611C	C45613C	C45614C	C45631C
C45632C	B52004D	C55B07A	B55B09C	B86001W
CD7101F				

e. C45531M..P (4 tests), C45532M..P (4 tests) are inapplicable because this implementation has a value of MAX_MANTISSA of less than 48.

f. C47004A is expected to raise CONSTRAINT_ERROR whilst evaluating the comparison on line 51, but this compiler evaluates the result without invoking the basic operation qualification (as allowed by 11.6(7) LRM) which would raise CONSTRAINT_ERROR and so no exception is raised.

g. B86001Y is inapplicable because this implementation supports no predefined fixed-point type other than DURATION.

h. C86001F is inapplicable because, for this implementation, the package TEXT_IO is dependent upon package SYSTEM. These tests recompile package SYSTEM, making package TEXT_IO, and hence package REPORT, obsolete.

i. C96005B is inapplicable because there are no values of type DURATION'BASE that are outside the range of DURATION.

j. CD1009C, CD2A41A,B,E, CD2A42A..J (10 tests) are inapplicable because this implementation imposes restrictions on 'SIZE length clauses for floating point types.

k. CD2A61I,J are inapplicable because this implementation imposes restrictions on 'SIZE length clauses for array types.

l. CD2A71A..D (4 tests), CD2A72A..D (4 tests), CD2A74A..D (4 tests) and CD2A75A..D (4 tests) are inapplicable because this implementation imposes restrictions on 'SIZE length clauses for record types.

m. CD2A84B..I (8 tests), CD2A84K and CD2A84L are inapplicable because this implementation imposes restrictions on 'SIZE length clauses for access types.

n. CE2102D is inapplicable because this implementation supports CREATE with IN_FILE mode for SEQUENTIAL_IO.

o. CE2102E is inapplicable because this implementation supports CREATE with OUT_FILE mode for SEQUENTIAL_IO.

p. CE2102F is inapplicable because this implementation supports CREATE with INOUT_FILE mode for DIRECT_IO.

q. CE2102I is inapplicable because this implementation supports CREATE with IN_FILE mode for DIRECT_IO.

r. CE2102J is inapplicable because this implementation supports CREATE with OUT_FILE mode for DIRECT_IO.

s. CE2102N is inapplicable because this implementation supports OPEN with IN_FILE mode for SEQUENTIAL_IO.

t. CE2102O is inapplicable because this implementation supports RESET with IN_FILE mode for SEQUENTIAL_IO.

u. CE2102P is inapplicable because this implementation supports OPEN with OUT_FILE mode for SEQUENTIAL_IO.

v. CE2102Q is inapplicable because this implementation supports RESET with OUT_FILE mode for SEQUENTIAL_IO.

w. CE2102R is inapplicable because this implementation supports OPEN with INOUT_FILE mode for DIRECT_IO.

x. CE2102S is inapplicable because this implementation supports RESET with INOUT_FILE mode for DIRECT_IO.

y. CE2102T is inapplicable because this implementation supports OPEN with IN_FILE mode for DIRECT_IO.

z. CE2102U is inapplicable because this implementation supports RESET with IN_FILE mode for DIRECT_IO.

aa. CE2102V is inapplicable because this implementation supports OPEN with OUT_FILE mode for DIRECT_IO.

ab. CE2102W is inapplicable because this implementation supports RESET with OUT_FILE mode for DIRECT_IO.

ac. CE2107B..E (4 tests), CE2107L, CE2110B and CE2111D are inapplicable because multiple internal files cannot be associated with the same external file when one or more files is writing for sequential files. The proper exception is raised when multiple access is attempted.

ad. CE2107G..H (2 tests), CE2110D, and CE2111H are inapplicable because multiple internal files cannot be associated with the same external file when one or more files is writing for direct files. The proper exception is raised when multiple access is attempted.

ae. CE2108B is inapplicable because, for this implementation, temporary sequential files have no name.

af. CE2108D is inapplicable because, for this implementation, temporary direct files have no name.

ag. CE3102E is inapplicable because text file CREATE with IN_FILE mode is supported by this implementation.

ah. CE3102F is inapplicable because text file RESET is supported by this implementation.

ai. CE3102G is inapplicable because text file deletion of an external file is supported by this implementation.

aj. CE3102I is inapplicable because text file CREATE with OUT_FILE mode is supported by this implementation.

ak. CE3102J is inapplicable because text file OPEN with IN_FILE mode is supported by this implementation.

al. CE3102K is inapplicable because text file OPEN with OUT_FILE mode is not supported by this implementation.

am. CE3111B, CE3111D..E (2 tests), CE3114B, and CE3115A are inapplicable because multiple internal files cannot be associated with the same external file when one or more files is writing for text files. The proper exception is raised when multiple access is attempted.

an. CE3112B is inapplicable because, for this implementation, temporary text files have no name.

ao. EE2401D uses instantiations of package DIRECT_IO with unconstrained array types. This implementation raises USE_ERROR upon creation of such a file.

3.6 TEST, PROCESSING, AND EVALUATION MODIFICATIONS

It is expected that some tests will require modifications of code, processing, or evaluation in order to compensate for legitimate implementation behavior. Modifications are made by the AVF in cases where legitimate implementation behavior prevents the successful completion of an (otherwise) applicable test. Examples of such modifications include: adding a length clause to alter the default size of a collection; splitting a Class B test into subtests so that all errors are detected; and confirming that messages produced by an executable test demonstrate conforming behavior that was not anticipated by the test (such as raising one exception instead of another).

Modifications were required for 16 tests:

a. The following tests were split because syntax errors at one point resulted in the compiler not detecting other errors in the test:

B22003A	B24009A	B29001A	B38003A	B38009A
B38009B	B51001A	B91001H	BA1101E	BC2001D
BC2001E	BC3204B	BC3205B	BC3205D0	BC3205D1M
BC3205D2				

Test BD5005B contains an illegal reference to a package, PAKG1, on line 34 that should be PKG1. But the test recognises all errors and so was considered passed.

3.7 ADDITIONAL TESTING INFORMATION

3.7.1 Prevalidation

Prior to validation, a set of test results for ACVC Version 1.10 produced by the SYSTEAM Ada Compiler VAX/VMS version 1.81 was submitted to the AVF by the applicant for review. Analysis of these results demonstrated that the compiler successfully passed all applicable tests, and the compiler exhibited the expected behavior on all inapplicable tests.

3.7.2 Test Method

Testing of the SYSTEAM Ada Compiler VAX/VMS version 1.81 using ACVC Version 1.10 was conducted on-site by a validation team from the AVF. The configuration in which the testing was performed is described by the following designations of hardware and software components:

Host computer:	VAX 8350
Host operating system:	VMS Version 4.6
Target computer:	VAX 8350
Target operating system:	VMS Version 4.6
Compiler:	SYSTEAM Ada Compiler VAX/VMS version 1.81

A magnetic tape containing all tests except for withdrawn tests and tests requiring unsupported floating-point precisions was taken on-site by the validation team for processing. Tests that make use of implementation-specific values were customized before being written to the magnetic tape. Tests requiring modifications during the prevalidation testing were included in their modified form on the magnetic tape.

The contents of the magnetic tape were loaded directly onto the host computer.

After the test files were loaded to disk, the full set of tests was compiled , linked, and all executable tests were run on the VAX 8350. Results were printed from the host computer.

The compiler was tested using command scripts provided by SYSTEAM KG and reviewed by the validation team. The compiler was invoked using the command

```
@ADA:COMPILE <test_name>
```

for all tests except those requiring a listing, which were compiled using the command

```
@ADA:COMPILE <test_name> OPTIONS=LIST=>ON
```

Tests were linked using the command

```
@ADA:LINK <test_name> <test_name>
```

Hence, all tests were compiled and linked with the default options (except for the listing option), as listed in appendix E.

Tests were compiled, linked, and executed (as appropriate) using a single computer. Test output, compilation listings, and job logs were captured on magnetic tape and archived at the AVF. The listings examined on-site by the validation team were also archived.

3.7.3 Test Site

Testing was conducted at IABG, Ottobrunn and was completed on 31st January 1989.

APPENDIX A

DECLARATION OF CONFORMANCE

SYSTEAM KG has submitted the following Declaration of Conformance concerning the SYSTEAM Ada Compiler VAX/VMS version 1.81.

DECLARATION OF CONFORMANCE

DECLARATION OF CONFORMANCE

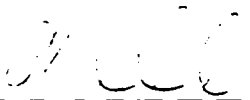
Compiler Implementor: SYSTEAM KG
Ada Validation Facility: IABG m. b. H., Abt. SZT
Ada Compiler Validation Capability (ACVC) Version 1.10

BASE CONFIGURATION

Base Compiler Name:	SYSTEAM Ada Compiler VAX/VMS version V1.81
Host Architecture:	VAX 8350
Host OS and Version:	VMS 4.6
Target Architecture:	VAX 8350
Target OS and Version:	VMS 4.6

Implementor's Declaration

I, the undersigned, representing SYSTEAM KG Karlsruhe, have implemented no deliberate extensions to the Ada Language Standard ANSI/MIL-STD-1815A in the compiler(s) listed in this declaration. I declare that SYSTEAM KG Karlsruhe is the owner of record of the Ada language compiler(s) listed above and, as such, is responsible for maintaining said compiler(s) in conformance to ANSI/MIL-STD-1815A. All certificates and registrations for Ada language compiler(s) listed in this declaration shall be made only in the owner's corporate name.



Date: February 27, 1989

SYSTEAM KG Dr. Winterstein
Dr. Georg Winterstein, President

Owner's Declaration

I, the undersigned, representing SYSTEAM KG Karlsruhe, take full responsibility for implementation and maintenance of the Ada compiler(s) listed above, and agree to the public disclosure of the final Validation Summary Report. I declare that all of the Ada language compilers listed, and their host/target performance, are in compliance with the Ada Language Standard ANSI/MIL-STD-1815A.

Date: February 27, 1989

SYSTEAM KG Karlsruhe
Dr. Winterstein

APPENDIX B

APPENDIX F OF THE Ada STANDARD

The only allowed implementation dependencies correspond to implementation-dependent pragmas, to certain machine-dependent conventions as mentioned in chapter 13 of the Ada Standard, and to certain allowed restrictions on representation clauses. The implementation-dependent characteristics of the SYSTEAM Ada Compiler VAX/VMS version 1.81 as described in this Appendix, are provided by SYSTEAM KG. Unless specifically noted otherwise, references in this appendix are to compiler documentation and not to this report. Implementation-specific portions of the package STANDARD, which are not a part of Appendix F, are:

```
package STANDARD is

   ...

     type INTEGER is range - 2_147_483_648 .. 2_147_483_647;

     type SHORT_INTEGER is range - 32_768 .. 32_767;

     type SHORT_SHORT_INTEGER is range - 128 .. 127;

     type FLOAT is digits 9
          range - 16#0.7FFF_FFFF_FFFF_FF8#E+32 ..
                  16#0.7FFF_FFFF_FFFF_FF8#E+32;

     type SHORT_FLOAT is digits 6
          range - 16#0.7FFF_FF8#E+32 ..
                  16#0.7FFF_FF8#E+32;

     type LONG_FLOAT is digits 15
          range - 16#0.7FFF_FFFF_FFFF_FC#E+256 ..
                  16#0.7FFF_FFFF_FFFF_FC#E+256;

     type LONG_LONG_FLOAT is digits 33
          range - 16#0.7FFF_FFFF_FFFF_FFFF_FFFF_FFFF_FFFF_C#E+4096 ..
                  16#0.7FFF_FFFF_FFFF_FFFF_FFFF_FFFF_FFFF_C#E+4096;
```

```
        type DURATION is delta 2#1.0#E-14
             range - 131_072.0 ..
                     131_071.999_938_964_843_75;

    ...

end STANDARD;
```

7 Appendix F

This chapter, together with the Chapters 8 and 9, is the Appendix F required in [Ada], in which all implementation-dependent characteristics of an Ada implementation are described.

7.1 Implementation-Dependent Pragmas

The form, allowed places, and effect of every implementation-dependent pragma is stated in this section.

7.1.1 Predefined Language Pragmas

The form and allowed places of the following pragmas are defined by the language; their effect is (at least partly) implementation-dependent and stated here. All the other pragmas listed in Appendix B of [Ada] are implemented and have the effect described there.

CONTROLLED
: has no effect.

INLINE
: Inline expansion of subprograms is supported with following restrictions: the subprogram must not contain declarations of other subprograms, tasks, generic units or body stubs. If the subprogram is called recursively only the outer call of this subprogram will be expanded.

INTERFACE

is supported for all languages which obey the calling conventions of the VAX procedure calling standard.
For each Ada subprogram for which

```
PRAGMA interface (VMS, <ada_name>);
```

is specified, a routine implementing the body of the subprogram <ada_name> must be provided, written in any language which conforms to the VMS calling standard. VMS system routines are allowed too. If the subprogram is implemented by an assembly language program the

```
PRAGMA interface (assembler, <ada_name>);
```

can be used.

The pragma ensures the VMS calling standard, in particular:

- Saving registers
- Ordering of parameters
- Number of parameters
- Calling mechanism.

The following parameter types with the respective calling mechanism are supported:

VMS Data Type	Ada Type	Calling Mechanism
longword	`standard.integer`	by value
address	`system.address`	by value

The type `address` may also serve to implement all kinds of call by references: the user may build all kinds of objects, e.g. descriptors, and pass their addresses to the system routine.

The name of the routine which implements the subprogram <ada_name> should be specified using the pragma `external_name` (see §7.1.2), otherwise the Compiler will generate an internal name that leads to an unsolved reference during linking. These generated names are prefixed with an underscore; therefore the user should not use names beginning with an underscore.

The subprogram <ada_name> specified in the pragma `interface` may be a function or a procedure. If the Ada subprogram is a function, the returned result is the result delivered by the called routine (in the case the routine is a function); it is the completion status of the routine otherwise. If results are to be returned by a procedure this must

be done through an IN parameter of type address, which passes the storage location at which the result is to be delivered.

The first parameter of the subprogram specified in the pragma interface must be of type integer and is interpreted in the VMS calling standard as the number of the remaining parameters. The subprogram specification should provide a default for it, so that the caller must not worry about it.

The SYSTEAM Ada Compiler does not check the observance of the VAX procedure calling standard. If it is violated the call of the system routine will be erroneous.

The following example shows the intended usage of the pragma interface (vms) to call a VMS system routine. First some types with representation specifications and objects of those types are declared. Then the Ada specification of sys_qio appears and is related through appropriate pragmas to the system service SYS$QIO. The function is called in the body of the main program.

```
WITH system, text_io;

PROCEDURE vms_routine IS

   readprompt     : CONSTANT := 55;
   m_noecho       : CONSTANT := 64;
   null_address   : CONSTANT system.address := system.address_zero;

   TYPE iosb_type IS
      RECORD
         condition_value : short_integer;
         transfer_count  : short_integer;
         dev_spec_info   : integer;
      END RECORD;

   FOR iosb_type USE
      RECORD
         condition_value AT 0 RANGE 0  .. 15;
         transfer_count  AT 0 RANGE 16 .. 31;
         dev_spec_info   AT 4 RANGE 0  .. 31;
      END RECORD;

   chan           : integer;                  -- channel number
   res            : integer;                  -- return code

   io_buffer      : string (1 .. 80);
   PRAGMA resident (io_buffer);
```

```
   prompt_buffer : string (1 .. 2) := "* ";
   PRAGMA resident (prompt_buffer);

   iosb          : iosb_type;
   PRAGMA resident (iosb);

   FUNCTION  sys_qio (n      : integer := 12;  -- number of parameters
                      efn    : integer := 0;   -- event flag number
                      chan   : integer;        -- channel
                      func   : integer;        -- function code
                      iosb   : system.address := null_address;
                                               -- IO status block
                      astadr : system.address := null_address;
                                               -- AST routine
                      astprm : integer := 0;
                      p1     : system.address; -- IO buffer
                      p2     : integer := 0;   -- IO buffer length
                      p3     : integer := 0;   -- timecut
                      p4     : integer := 0;   -- read terminator
                      p5     : system.address := null_address;
                                               -- prompt buffer
                      p6     : integer := 0)   -- prompt buffer length
                RETURN integer;

   PRAGMA interface (vms, sys_qio);
-- and additionally
   PRAGMA external_name ("SYS$QIO", sys_qio);

   vector_number : CONSTANT := 0;
   ast_parameter : CONSTANT := 123_456_789;

   TASK buffer_handler IS
      PRAGMA priority (15);

      ENTRY buffer_read (param : integer);
      FOR buffer_read USE AT system.interrupt_vector (vector_number);
   END buffer_handler;

   TASK BODY buffer_handler IS
   BEGIN
      ACCEPT buffer_read (param : integer) DO
         text_io.put_line (io_buffer);
      END buffer_read;

   END buffer_handler;
BEGIN
```

```
   -- after an appropriate ASSIGN channel call:

   res :=
      sys_qio (chan => chan,
               func => readprompt + m_noecho,
               iosb => iosb'address,
               astadr => system.ast_service (vector_number),
               astprm => ast_parameter,
               p1 => io_buffer'address,
               p2 => io_buffer'length,
               p3 => 0,
               p4 => 0,
               p5 => prompt_buffer'address,
               p6 => prompt_buffer'length);
END vms_routine;
```

MEMORY_SIZE
has no effect.

OPTIMIZE
has no effect.

PACK
see §8.1.

PRIORITY
There are two implementation-defined aspects of this pragma: First, the range of the subtype priority, and second, the effect on scheduling (§6) of not giving this pragma for a task or main program. The range of subtype priority is 0 .. 15, as declared in the predefined library package system (see §7.3); and the effect on scheduling of leaving the priority of a task or main program undefined by not giving pragma priority for it is the same as if the pragma priority 0 had been given (i.e. the task has the lowest priority). Moreover, in this implementation the package system must be named by a with clause of a compilation unit if the predefined pragma priority is used within that unit.

SHARED
is supported.

STORAGE_UNIT
has no effect.

SUPPRESS
has no effect, but see §7.1.2 for the implementation-defined pragma `suppress_all`.

SYSTEM_NAME
has no effect.

7.1.2 Implementation-Defined Pragmas

SQUEEZE
see §8.1.

SUPPRESS_ALL
causes all the run_time checks described in [Ada,§11.7] to be suppressed; this pragma is only allowed at the start of a compilation before the first compilation unit; it applies to the whole compilation.

EXTERNAL_NAME (<string>, <ada_name>)
<ada_name> specifies the name of a subprogram, <string> must be a string literal. It defines the external name of the specified subprogram. The Compiler uses a symbol with this name in the `call` instruction for the subprogram. The suprogram declaration of <ada_name> must precede this pragma. If several subprograms with the same name satisfy this requirement the pragma refers to that subprogram which preceds immediately.
This pragma will be used in connection with the pragmas `interface (vms)` or `interface (assembler)` (see §7.1.1).

RESIDENT (<ada_name>)

this pragma prevents assigments of a value to the object <ada_name> from being eliminated by the optimizer (see §3.2) of the SYSTEAM Ada Compiler. The following code sequence demonstrates the intended usage of the pragma:

```
...
x : integer;
a : SYSTEM.address;
PROCEDURE do_something (a : SYSTEM.address);
   ...
BEGIN
  x := 5;
  a := x'ADDRESS;
  do_something (a);  -- a.ALL will be read in the body
                     -- of do_something
  x := 6;
  ...
```

If this code sequence is compiled by the SYSTEAM Ada Compiler with the option

```
OPTIMIZER=>ON
```

the statement `x := 5;` will be eliminated because from the point of view of the optimizer the value of x is not used before the next assignment to x. Therefore

```
PRAGMA resident (x);
```

should be inserted after the declaration of x.

This pragma can be applied to all those kinds of objects for which the address clause is supported (cf. §8.5).
It will often be used in connection with the pragma `interface (vms, ... )` (see §7.1.1).

7.2 Implementation-Dependent Attributes

The name, type and implementation-dependent aspects of every implementation-dependent attribute is stated in this chapter.

7.2.1 Language-Defined Attributes

The name and type of all the language-defined attributes are as given in [Ada]. We note here only the implementation-dependent aspects.

ADDRESS

The value delivered by this attribute applied to an object is the address of the storage unit where this object starts.
For any other entity this attribute is not supported and will return the value `system.address_zero`.

MACHINE_OVERFLOWS

Yields `true` for each real type or subtype.

MACHINE_ROUNDS

Yields `true` for each real type or subtype.

STORAGE_SIZE

The value delivered by this attribute applied to an access type is as follows:
If a length specification (`STORAGE_SIZE`, see §8.2) has been given for that type (static collection), the attribute delivers that specified value.
In case of a dynamic collection, i.e. no length specification by `STORAGE_SIZE` given for the access type, the attribute delivers the number of storage units currently allocated for the collection. Note that dynamic collections are extended if needed.
If the collection manager (cf. §5.3.1) is used for a dynamic collection the attribute delivers the number of storage units currently allocated for the collection. Note that in this case the number of storage units currently allocated may be decreased by release operations.

The value delivered by this attribute applied to a task type or task object is as follows:

If a length specification (STORAGE_SIZE, see §8.2) has been given for the task type, the attribute delivers that specified value; otherwise, the default value is returned.

7.2.2 Implementation-Defined Attributes

There are no implementation-defined attributes.

7.3 Specification of the Package SYSTEM

The package system required in [Ada,§13.7] is reprinted here with all implementation-dependent characteristics and extensions filled in.

```
PACKAGE system IS

   TYPE designated_by_address IS LIMITED PRIVATE;

   TYPE address IS ACCESS designated_by_address;
   FOR address'storage_size USE 0;

   address_zero : CONSTANT address := NULL;

   TYPE name IS (vax_vms);

   system_name  : CONSTANT name := vax_vms;

   storage_unit : CONSTANT := 8;
   memory_size  : CONSTANT := 2 ** 31;
   min_int      : CONSTANT := - 2 ** 31;
   max_int      : CONSTANT := 2 ** 31 - 1;
   max_digits   : CONSTANT := 33;
   max_mantissa : CONSTANT := 31;
   fine_delta   : CONSTANT := 2.0 ** (-31);
   tick         : CONSTANT := 0.01;

   SUBTYPE priority IS integer RANGE 0 .. 15;

   FUNCTION "+" (left : address; right : integer) RETURN address;

   FUNCTION "+" (left : integer; right : address) RETURN address;
```

```
FUNCTION "-" (left : address; right : integer) RETURN address;

FUNCTION "-" (left : address; right : address) RETURN integer;

SUBTYPE external_address IS STRING;

-- External addresses use hexadecimal notation with characters
-- '0'..'9', 'a'..'f' and 'A'..'F'. For instance:
--    "7FFFFFFF"
--    "80000000"
--    "8" represents the same address as "00000008"

FUNCTION convert_address (addr : external_address) RETURN address;

   -- CONSTRAINT_ERROR is raised if the external address ADDR
   -- is the empty string, contains characters other than
   -- '0'..'9', 'a'..'f', 'A'..'F' or if the resulting address
   -- value cannot be represented with 32 bits.

FUNCTION convert_address (addr : address) RETURN external_address;

   -- The resulting external address consists of exactly 8
   -- characters '0'..'9', 'A'..'F'.

TYPE interrupt_number IS RANGE 0 .. 31;

TYPE interrupt_addresses IS ARRAY (interrupt_number) OF address;

ast_service,
interrupt_vector : interrupt_addresses;

-- The initialisation of these arrays is performed during the
-- elaboration of the package body.

non_ada_error       : EXCEPTION;

-- non_ada_error is raised, if some event occurs which does not
-- correspond to any situation covered by Ada, e.g.:
--    illegal instruction encountered
--    error during address translation
--    illegal address

TYPE exception_id IS NEW integer;

no_exception_id     : CONSTANT exception_id := 0;
```

```
-- Coding of the predefined exceptions:

constraint_error_id : CONSTANT exception_id := ... ;
numeric_error_id    : CONSTANT exception_id := ... ;
program_error_id    : CONSTANT exception_id := ... ;
storage_error_id    : CONSTANT exception_id := ... ;
tasking_error_id    : CONSTANT exception_id := ... ;

non_ada_error_id    : CONSTANT exception_id := ... ;

status_error_id     : CONSTANT exception_id := ... ;
mode_error_id       : CONSTANT exception_id := ... ;
name_error_id       : CONSTANT exception_id := ... ;
use_error_id        : CONSTANT exception_id := ... ;
device_error_id     : CONSTANT exception_id := ... ;
end_error_id        : CONSTANT exception_id := ... ;
data_error_id       : CONSTANT exception_id := ... ;
layout_error_id     : CONSTANT exception_id := ... ;

time_error_id       : CONSTANT exception_id := ... ;

TYPE argument_array IS ARRAY (1 .. 4) OF integer;

no_condition_name   : CONSTANT := 1;

TYPE exception_information IS
   RECORD
      excp_id          : exception_id;

         -- Identification of the exception. The codings of
         -- the predefined exceptions are given above.

      code_addr        : address;

         -- Code address where the exception occured. Depending
         -- on the kind of the exception it may be be address of
         -- the instruction which caused the exception, or it
         -- may be the address of the instruction which would
         -- have been executed if the exception had not occured.

      condition_name   : integer;

         -- If /= no_condition_name, the exception was caused
         -- by a condition. In this case, the condition name
         -- and other following information made available.

      nr_of_arguments  : integer;   -- in the range 1 .. 4.
```

```
      arguments        : argument_array;

         -- Only arguments (1 .. nr_of_arguments) are valid.
         -- It contains a copy of the optional information
         -- supplied by VMS in the argument array when the
         -- condition occured. If there are more than 4 optional
         -- entries in the argument array, only the first 4
         -- are copied.

      psl              : integer;

         -- The processor status longword.

   END RECORD;

PROCEDURE get_exception_information
            (excp_info : OUT exception_information);

   -- The subprogram get_exception_information must only be called
   -- from within an exception handler BEFORE ANY OTHER EXCEPTION
   -- IS RAISED. It then returns the information record about the
   -- actually handled exception.
   -- Otherwise, its result is undefined.

TYPE exit_code IS NEW integer;

error         : CONSTANT exit_code := 2;
information   : CONSTANT exit_code := 3;
success       : CONSTANT exit_code := 1;
severe_error  : CONSTANT exit_code := 4;
warning       : CONSTANT exit_code := 0;

PROCEDURE set_exit_code (val : exit_code);

   -- Specifies the exit code which is returned to the
   -- operating system if the Ada program terminates normally.
   -- The default exit code is 'success'. If the program is
   -- abandoned because of an exception, the exit code is
   -- 'error'.

PRIVATE

   -- private declarations

END system;
```

7.4 Restrictions on Representation Clauses

See Chapter 8 of this manual.

7.5 Conventions for Implementation-Generated Names

There are implementation generated components but these have no names. (cf. §8.4 of this manual).

7.6 Expressions in Address Clauses

See §8.5 of this manual.

7.7 Restrictions on Unchecked Conversions

The implementation supports unchecked type conversions for all kind of source and target types with the restriction that the target type must not be an unconstrained array type. The result value of the unchecked conversion is unpredictable, if

```
target_type'SIZE > source_type'SIZE
```

7.8 Characteristics of the Input-Output Packages

The implementation-dependent characteristics of the input-output packages as defined in Chapter 14 of [Ada] are reported in Chapter 9 of this manual.

7.9 Requirements for a Main Program

A main program must be a parameterless library procedure. This procedure may be a generic instantiation; the generic procedure need not be a library unit.

7.10 Unchecked Storage Deallocation

The generic procedure unchecked_deallocation is provided, but the only effect of calling an instantiation of this procedure with an object X as actual parameter is

```
X := NULL;
```

i.e. no storage is reclaimed.

However, the implementation does provide an implementation-defined package collection_manager to support unchecked storage deallocation (cf. §5.3.1).

7.11 Machine Code Insertions

A package machine_code is not provided and machine code insertions are not supported.

7.12 Numeric Error

The predefined exception numeric_error is never raised implicitly by any predefined operation; instead the predefined exception constraint_error is raised.

8 Appendix F: Representation Clauses

In this chapter we follow the section numbering of Chapter 13 of [Ada] and provide notes for the use of the features described in each section.

8.1 Pragmas

PACK

As stipulated in [Ada,§13.1], this pragma may be given for a record or array type. It causes the Compiler to select a representation for this type such that gaps between the storage areas allocated to consecutive components are minimized. For components whose type is an array or record type the pragma pack has no affect on the mapping of the component type. For all other component types the Compiler will try to choose a more compact representation for the component type. All components of a packed data structure will start at storage unit boundaries and the size of the components will be a multiple of `system.storage_unit`. Thus, the pragma pack does not effect packing down to the bit level (for this see pragma **squeeze**).

SQUEEZE

This is an implementation-defined pragma which takes the same argument as the predefined language pragma pack and is allowed at the same positions. It causes the Compiler to select a representation for the argument type that needs minimal storage space (packing down to the bit level). For components whose type is an array or record type the pragma squeeze has no effect on the mapping of the component type. For all other component types the Compiler will try to choose a more compact representation for the component type. The components of a squeezed data structure will not in general start at storage unit boundaries.

8.2 Length Clauses

SIZE

for all integer, fixed point and enumeration types the value must be <= 32;
for **short_float** types the value must be = 32 (this is the amount of storage which is associated with these types anyway);
for **float** and **long_float** types the value must be = 64 (this is the amount of storage which is associated with these types anyway).
for **long_long_float** types the value must be = 128 (this is the amount of storage which is associated with these types anyway);
for access types the value must be = 32 (this is the amount of storage which is associated with these types anyway).
If any of the above restrictions are violated, the Compiler responds with a RESTRICTION error message in the Compiler listing.

STORAGE_SIZE

Collection size: If no length clause is given, the storage space needed to contain objects designated by values of the access type and by values of other types derived from it is extended dynamically at runtime as needed. If, on the other hand, a length clause is given, the number of storage units stipulated in the length clause is reserved, and no dynamic extension at runtime occurs.

Storage for tasks: The memory space reserved for a task is 10K bytes if no length clause is given (cf. Chapter 6). If the task is to be allotted either more or less space, a length clause must be given for its task type, and then all tasks of this type will be allotted the amount of space stipulated in the length clause (the activation of a small task requires about 1.4K bytes). Whether a length clause is given or not, the space allotted is not extended dynamically at runtime.

SMALL

there is no implementation-dependent restriction. Any specification for SMALL that is allowed by the LRM can be given. In particular those values for SMALL are also supported which are not a power of two.

8.3 Enumeration Representation Clauses

The integer codes specified for the enumeration type have to lie inside the range of the largest integer type which is supported; this is the type **integer** defined in package **standard**.

8.4 Record Representation Clauses

Record representation clauses are supported. The value of the expression given in an alignment clause must be 0, 1, 2 or 4. If this restriction is violated, the Compiler responds with a RESTRICTION error message in the Compiler listing. If the value is 0 the objects of the corresponding record type will not be aligned, if it is 1, 2 or 4 the starting address of an object will be a multiple of the specified alignment.

The number of bits specified by the range of a component clause must not be greater than the amount of storage occupied by this component. (Gaps between components can be forced by leaving some bits unused but not by specifying a bigger range than needed.) Violation of this restriction will produce a RESTRICTION error message.

There are implementation-dependent components of record types generated in the following cases :

- If the record type includes variant parts and if it has either more than one discriminant or else the only discriminant may hold more than 256 different values, the generated component holds the size of the record object.
- If the record type includes array or record components whose sizes depend on discriminants, the generated components hold the offsets of these record components (relative to the corresponding generated component) in the record object.

But there are no implementation-generated names (cf. [Ada.§13.4(8)]) denoting these components. So the mapping of these components cannot be influenced by a representation clause.

8.5 Address Clauses

Address clauses are supported for objects declared by an object declaration and for single task entries. If an address clause is given for a subprogram, package or a task unit, the Compiler responds with a RESTRICTION error message in the Compiler listing.

If an address clause is given for an object, the storage occupied by the object starts at the given address. Address clauses for single entries are described in §8.5.1.

8.5.1 Interrupts

On VAX/VMS, all hardware interrupts are handled by VMS. It is not possible to handle the hardware interrupts directly. However, some system services allow a process to be interrupted when a particular event occurs. Since the interrupt occurs asynchronously, the interrupt mechanism is called an asynchronous system trap (AST) (cf. [VAX/VMS, System Services]). The trap transfers control to a user-specified service routine that handles the event.

VMS delivers an AST when requested to do so, for instance by calls of system services like $DCLAST, $ENQ, $GETDVI, $GETJPI, $GETSYI, $QIO, $SETIMR or by calls of RMS services. As parameters to a call of a system service the address of the AST service routine (usually the parameter `astadr`) and an AST parameter value (usually the parameter `astprm`) can be specified. The specified AST parameter value is passed to the AST service routine as argument when it is called. In this way one AST service routine can be used to handle several ASTs.

For example, the $SETIMR service can be used to request an AST after 10 seconds or at 12:00:00. After calling the $SETIMR service the program continues in its normal control flow. If the time event occurs, VMS causes the normal control flow to be interrupted and executes the AST service routine. Upon completion of the AST service routine the execution of the program is continued where it was interrupted.

An address clause for an entry associates the entry with an AST. When an AST occurs, the AST service routine initiates the entry call; the calling task and the called task continue their execution in parallel.

By this mechanism, an interrupt acts as an entry call to that task; such an entry is called an *interrupt entry*. An interrupt causes the `ACCEPT` statement corresponding to the entry to be executed.

The AST is mapped to an *ordinary* entry call. The entry may also be called by an Ada entry call statement. However, it is assumed that when an interrupt occurs there is no entry call waiting in the entry queue. Otherwise, the program is erroneous and behaves in the following way:

- If an entry call stemming from an interrupt is already queued, this previous entry call is lost.
- The entry call stemming from the interrupt is inserted into the front of the entry queue, so that it is handled before any entry call stemming from an Ada entry call statement.

8.5.1.1 Association between Entry and Interrupt

The association between an entry and an interrupt is achieved via an interrupt number (type `system.interrupt_number`) the range of interrupt numbers being 0 .. 31 (this means that 32 single entries can act as interrupt entries). A single entry of a task which has one IN parameter of type `integer` or `system.address` can be associated with an interrupt number by an address clause (the Compiler does not check these conventions). Since an address value must be given in the address clause, the interrupt number has to be converted into type `system.address`. The array `system.interrupt_vector` is provided for this purpose; it is indexed by an interrupt number to to get the corresponding address.

The following example associates the entries `timer_1`, `timer_2`, `io_failure` and `io_success` with the interrupt numbers 10, 11, 12 and 13, respectively.

```
...
TASK handler IS

   ENTRY timer_1 (x : IN integer);
   ENTRY timer_2 (x : IN integer);
   ENTRY io_failure (x : IN system.address);
   ENTRY io_success (x : IN system.address);

   FOR timer_1    USE AT system.interrupt_vector (10);
   FOR timer_2    USE AT system.interrupt_vector (11);
   FOR io_failure USE AT system.interrupt_vector (12);
   FOR io_success USE AT system.interrupt_vector (13);
END;
...
```

The task body contains ordinary accept statements for the entries.

8.5.1.2 Association between Interrupt and AST Service Routine

When a system service is called and an entry is to be called via interrupt, the address value `system.ast_service (nr)` must be specified as AST service routine, where nr indicates the interrupt number.

The effect of the execution of the AST service routine given by `system.ast_service (nr)` depends on whether there is a task currently waiting at an ACCEPT or selective wait statement for an entry which is associated with the interrupt number nr.

If there is a task waiting, a rendezvous with that task is performed immediately. If several tasks are waiting for the same interrupt, the program is erroneous (cf. [Ada, §13.5(8)]) and a rendezvous is performed with any of these tasks.

Otherwise, the information that the interrupt nr occurred and the corresponding AST parameter value are stored by the Ada runtime system. If later on a task performs an ACCEPT or selective wait statement for the entry associated with the interrupt nr the rendezvous is performed.

Therefore an interrupt is never treated as a conditional entry call. If the interrupt nr occurs again before the previous one has been handled, the previous one is lost.

A detailed example for an interrupt entry is given in Chapter 7, in the procedure vms_routine.

8.5.1.3 Calling an Asynchronous VMS System Service

The following example shows how to call an entry from an AST delivered by a VMS system service, here the $SETIMR service.

```
...
PROCEDURE vms_setimr ( ... );
PRAGMA external_name (vms_setimr, "SYS$SETIMR");
PRAGMA interface (vms, vms_setimr);
...
vms_setimr  -- (1)
    (daytime => ... ,  -- e.g. 12:00:00.00
     astadr  => system.ast_service (10));

vms_setimr  -- (2)
    (daytime => ... ,  -- e.g. in 10 sec from now on
     astadr  => system.ast_service (11),
     reqidt  => 1234567);
...
```

The effect of the call (1) of vms_setimr is that at the specified time an AST is delivered which is mapped to a call of the entry timer_1 of the task specified above. No AST-parameter specified; VMS inserts the default 0, which is passed as argument x to the accept body of timer_1.

The effect of the call (2) of vms_setimr is similar. Here the AST-parameter is specified. It is passed as argument x to the accept body of timer_2.

8.5.1.4 Calling an Asynchronous RMS Service

The RMS routines are a little bit different from the VMS system services. When calling a RMS service the addresses of two completion routines (one for success, one for failure) can be given as parameters. If this is done, the service is performed asynchronously and upon completion one of the two completion routines is called as AST routine. The address of the FAB or RAB which was passed as operand to the RMS service is passed as AST parameter to the completion routine. Example:

```
...
PROCEDURE rms_open ( ... );
   PRAGMA external_name (rms_open, "SYS$OPEN");
   PRAGMA interface (vms, rms_open);
...
my_fab : fab_type;
...
rms_open (fab => my_fab'address,
          err => system.ast_service (12),
          suc => system.ast_service (13));
...
```

Upon successful completion of the open operation an AST is delivered which results in calling the entry `io_success` with parameter `x = my_fab'ADDRESS`. If an error occurs, `io_failure` is called instead.

8.6 Change of Representation

The implementation places no additional restrictions on changes of representation.

9 Appendix F: Input-Output

In this chapter we follow the section numbering of Chapter 14 of [Ada] and provide notes for the use of the features described in each section.

9.1 External Files and File Objects

The total number of open files (including the two standard files) must not exceed 18. Any attempt to exceed this limit raises the exception `use_error`.

The only form of file sharing which is allowed is shared reading. If two or more files are associated with the same external file at one time (regardless of whether these files are declared in the same program or task), all of these (internal) files must be opened with the mode `in_file`. An attempt to open one of these files with a mode other than `in_file` will raise the exception `use_error`.

Files associated with terminal devices (which is only legal for text files) are excepted from this restriction. Such files may be opened with an arbitrary mode at the same time and associated with the same terminal device.

The following restrictions apply to the generic actual parameter for `element_type`:

- input/output of access types is not defined.
- input/output of unconstrained array types is only possible with a variable record format.
- for RMS sequential [relative or indexed] files the size of an object to be input or output must not be greater than 32767 [16383] storage units.
- input/output is not possible for an object whose (sub)type has a size which is not a multiple of `system.storage_unit`. Such objects can only exist for types for which a representation clause or the pragma `squeeze` is given. `Use_error` will be raised by any attempt to read or write such an object or to open or create a file for such a (sub)type.

9.2 Sequential and Direct Files

Sequential and direct files are represented by RMS sequential, relative or indexed files with fixed-length or variable-length records. Each element of the file is stored in one record.

9.2.1 File Management

Since there is a lot to say about this section, we shall introduce subsection numbers which do not exist in [Ada].

9.2.1.1 The NAME and FORM Parameters

The name parameter string must be a VMS file specification string and must not contain wild cards, even if that would specify a unique file. The function name will return a file specification string (including version number) which is the file name of the file opened or created.

The syntax of the form parameter string is defined by:

```
form_parameter ::= [ form_specification { , form_specification } ]

form_specification ::=  keyword [ => value ]

keyword ::=  identifier

value   ::=  identifier | string_literal | numeric_literal
```

For identifier, numeric_literal, string_literal see [Ada,Appendix E]. Only an integer literal is allowed as numeric_literal (see [Ada,§2.4]).

In the following, the form specifications which are allowed for all files are described.

```
ALLOCATION => numeric_literal
```

This value specifies the number of blocks which are allocated initially; it is only used in a create operation and ignored in an open operation. The value of ALLOCATION in the form string returned by the function form specifies the initial allocation size for existing files too.

```
EXTENSION => numeric_literal
```

This value specifies the number of blocks by which a file is extended if necessary; the value 0 means that the RMS default value is taken. For existing files, this value only applies to extensions of the file between open and close operations in the Ada program.

For details see the [VAX/VMS, Record Management Services].

```
MAX_RECORD_SIZE => numeric_literal
```

This value specifies the maximum record size in bytes. The value 0 indicates that there is no limit; for direct files, this value is only allowed for indexed files, whereas for sequential files there is no such restriction. This form specification is only allowed for files with variable record format. If the value is specified for an existing file it must agree with the value of the external file.

For files with fixed-length records, the maximum record size equals `element_type'SIZE / system.storage_unit`. If a fixed record format is used, all objects written to a file which are shorter than the maximum record size are filled up with zeros (ASCII.NUL).

```
RECORD_FORMAT => VARIABLE | FIXED
```

This form specification is used to specify the record format. If the format is specified for an existing file it must agree with the format of the external file.

9.2.1.2 Sequential Files

A sequential file is represented by a RMS sequential file with either fixed-length or variable-length records (this may be specified by the form parameter).

If a fixed record format is used, all objects written to a file which are shorter than the maximum record size are filled up with zeros (ASCII.NUL).

```
END_OF_FILE
```

If the keyword END_OF_FILE is specified for an existing file in an open for an output file, then the file is opened at the end of the file; i.e. the existing file is extended and not rewritten. This keyword is only allowed for an output file; it only has an effect in an open operation and is ignored in a create.

The default form string for a sequential file is :

```
"ALLOCATION     => 0,          EXTENSION        => 0, " &
"RECORD_FORMAT => VARIABLE, MAX_RECORD_SIZE => 0  "
```

The default form may be used for all types (except for those excluded in §9.1).

9.2.1.3 Direct Files

The implementation dependent type count defined in the package specification of direct_io has an upper bound of :

```
COUNT'LAST = 2_147_483_647 (= INTEGER'LAST)
```

Direct files are represented by RMS sequential files with fixed-length records or by relative or indexed files with either fixed-length or variable-length records. For indexed files, the record index is stored as unsigned four bytes binary value in the first four bytes of each record. If not explicitly specified, the maximum record size equals element_type'SIZE / system.storage_unit.

```
BUCKET_SIZE => numeric_literal
```

This value specifies the number of blocks (one block is 512 bytes) for one bucket; the value 0 means that the value is evaluated by RMS to the minimal number of blocks which is necessary to contain one record. The value must be in the range from 0 up to 32. This form specification is only allowed for relative or indexed files. If the value is specified for an existing file it must agree with the value of the external file.

```
ORGANIZATION => INDEXED | RELATIVE | SEQUENTIAL
```

This form specification is used to specify the file organization. If the organization is specified for an existing file it must agree with the organization of the external file.

The default form string for a direct file is :

```
"ALLOCATION   => 0,          EXTENSION      => 0,    " &
"ORGANIZATION => SEQUENTIAL, RECORD_FORMAT => FIXED"
```

Indexed files with variable-length records and a maximum record size of 0 may be used for all types (except for those excluded in §9.1). Relative files with variable-length records may also be used for all types, but in this case a maximum record size must be specified explicitly. Sequential, relative or indexed files with fixed-length records may not be used for unconstrained array types.

9.3 Text Input-Output

Text files are represented as sequential files with variable record format. One line is represented as a sequence of one or more records; all records except for the last one have a length of exactly MAX_RECORD_SIZE and a continuation marker (ASCII.LF) at the last position. A line of length MAX_RECORD_SIZE is represented by one record of this length. A line terminator is not represented explicitly in the external file; the end of a record which is shorter than MAX_RECORD_SIZE or which has length exactly MAX_RECORD_SIZE and does not have a continuation marker as its last character is taken as a line terminator.

The value MAX_RECORD_SIZE may be specified by the form string for an output file and it is taken from the external file for an input file; for an input file, the value 0 stands for the default of 512. For all files which are created, the value MAX_RECORD_SIZE is used for the file attribute MRS (maximum record size).

A page terminator is represented as a record consisting of a single ASCII.FF. A record of length zero is assumed to precede a page terminator if the record before the page terminator is another page terminator or a record of length MAX_RECORD_SIZE with a continuation marker at the last position; this implies that a page terminator is preceded by a line terminator in all cases.

A file terminator is not represented explicitly in the external file: the end of the file is taken as a file terminator. A page terminator is assumed to precede the end of the file if there is not explicitly one as the last record of the file. For input from a terminal, a file terminator is represented as ASCII.SUB (= CTRL/Z).

9.3.1 File Management

In the following, the form specifications which are only allowed for text files or have a special meaning for text files are described.

CHARACTER_IO

The predefined package text_io was designed for sequential text files; moreover, this implementation always uses sequential files with a record structure, even for terminal devices. It therefore offers no language-defined facilities for modifying data previously written to the terminal (e.g. changing characters in a text which is already on the terminal screen) or for outputting characters to the terminal without following them by a line terminator. It also has no language-defined provision for input of single characters from the terminal (as opposed to lines, which must end with a line terminator, so that in order to input one character the user must type in that character and then a line terminator) or for suppressing the echo on the terminal of characters typed in at the keyboard.

For these reasons, in addition to the input/output facilities with record structured external files, another form of input/output is provided for text files: It is possible to transfer single characters from/to a terminal device. This form of input/output is specified by the keyword CHARACTER_IO in the form string. If CHARACTER_IO is specified, no other form specification is allowed and the file name must denote a terminal device.

For an infile, the external file (associated with a terminal) is considered to contain a single line. An ASCII.SUB (= CTRL/Z) character represents an line terminator followed by a page terminator followed by a file terminator. Arbitrary characters (including all control characters except for ASCII.SUB) may be read; a character read is not echoed to the terminal.

For an outfile, arbitrary characters (including all control characters and escape sequences) may be written on the external file (terminal). A line terminator is represented as ASCII.CR followed by ASCII.LF, a page terminator is represented as ASCII.FF and a file terminator is not represented on the external file.

Only for input files :

```
PROMPTING => string_literal
```

This string is output on the terminal before an input record is read if the input file is associated with a terminal; otherwise this form specification is ignored.

Only for output files :

```
MAX_RECORD_SIZE => numeric_literal
```

This value specifies the maximum length of a record in the external file. Each record which is not the last record of a line has exactly this maximum record size, with a continuation marker (ASCII.LF) at the last position. The value must be in the range 2 .. 512. If a file is created, the specified value (or the default of 512) is used for the file attribute MRS (maximum record size) of the external file. If the value is specified for an existing file it must be identical to the value of the external file.

The default form string for an input text file is :

```
"ALLOCATION => 0, EXTENSION => 0, PROMPTING => """"      "
```

The default form string for an output text file is :

```
"ALLOCATION => 0, EXTENSION => 0, MAX_RECORD_SIZE => 512"
```

9.3.2 Default Input and Output Files

The standard input (resp. output) file is associated with the system default logical names SYS$INPUT (resp. SYS$OUTPUT) of VMS. If a program reads from the standard input file, the logical name SYS$INPUT must denote an existing file. If a program writes to the standard output file, a file with the logical name SYS$OUTPUT is created if no such file exists; otherwise the existing file is extended.

The qualifiers /INPUT and /OUTPUT may be used for the VMS RUN command to associate VMS files with the standard files of `text_io`.

The name and form strings for the standard files are :

```
standard_input  :  NAME => "SYS$INPUT:"
                   FORM => "PROMPTING => ""*""     "

standard_output :  NAME => "SYS$OUTPUT:"
                   FORM => "MAX_RECORD_SIZE => 512"
```

9.3.3 Implementation-Defined Types

The implementation-dependent types `count` and `field` defined in the package specification of `text_io` have the following upper bounds :

```
COUNT'LAST = 2_147_483_647 (= INTEGER'LAST)

FIELD'LAST = 512
```

9.4 Exceptions in Input-Output

For each of `name_error`, `use_error`, `device_error` and `data_error` we list the conditions under which that exception can be raised. The conditions under which the other exceptions declared in the package `io_exceptions` can be raised are as described in [Ada,§14.4].

NAME_ERROR

- in an `open` operation, if the specified file does not exist;
- in a `create` operation, if the `name` string contains an explicit version number and the specified file already exists;
- if the `name` parameter in a call of the `create` or `open` procedure is not a legal VMS file specification string; for example, if it contains illegal characters, is too long or is syntactically incorrect; and also if it contains wild cards, even if that would specify a unique file.

USE_ERROR

- if an attempt is made to increase the total number of open files (including the two standard files) to more than 18;
- whenever an error occurred during an operation of the underlying RMS system. This may happen if an internal error was detected, an operation is not possible for reasons depending on the file or device characteristics, a size restriction is violated, a capacity limit is exceeded or for similar reasons;
- if the function `name` is applied to a temporary file;
- if the characteristics of the external file are not appropriate for the file type; for example, if the record size of a file with fixed-length records does not correspond to the size of the element type of a `direct_io` or `sequential_io` file. In general it is only guaranteed that a file which is created by an Ada program may be reopened by another program if the file types and the form strings are the same;
- if two or more (internal) files are associated with the same external file at one time (regardless of whether these files are declared in the same program or task), and an attempt is made to open one of these files with mode other than `in_file`. However, files associated with terminal devices (which is only legal for text files) are excepted from this restriction. Such files may be opened with an arbitrary mode at the same time and associated with the same terminal device;
- if a given `form` parameter string does not have the correct syntax or if a condition on an individual form specification described in §§9.2-3 is not fulfilled;
- if an attempt is made to open or create a sequential or direct file for an element type whose size is not a multiple of `system.storage_unit`; or if an attempt is made to read or write an object whose (sub)type has a size which is not a multiple of `system.storage_unit` (such situations can only arise for types for which a representation clause or the pragma `squeeze` is given);

DEVICE_ERROR

is never raised. Instead of this exception the exception use_error is raised whenever an error occurred during an operation of the underlying RMS system.

DATA_ERROR

- the conditions under which data_error is raised by text_io are laid down in [Ada]; the following notes apply to the packages sequential_io and direct_io:
- by the procedure read if the size of a variable-length record in the external file to be read exceeds the storage size of the given variable or else the size of a fixed-length record in the external file to be read exceeds the storage size of the given variable which has exactly the size element_type'SIZE.
- In general, the exception data_error is not raised by the procedure read if the element read is not a legal value of the element type.
- by the procedure read if an element with the specified position in a direct file does not exist; this is only possible if the file is associated with a relative or an indexed file.

9.5 Low Level Input-Output

We give here the specification of the package low_level_io:

```
PACKAGE low_level_io IS

   TYPE device_type IS (null_device);

   TYPE data_type IS
      RECORD
         NULL;
      END RECORD;

   PROCEDURE send_control    (device : device_type;
                              data   : IN OUT data_type);

   PROCEDURE receive_control (device : device_type;
                              data   : IN OUT data_type);

END low_level_io;
```

Note that the enumeration type `device_type` has only one enumeration value, `null_device`; thus the procedures `send_control` and `receive_control` can be called, but `send_control` will have no effect on any physical device and the value of the actual parameter `data` after a call of `receive_control` will have no physical significance.

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APPENDIX C

TEST PARAMETERS

Certain tests in the ACVC make use of implementation-dependent values, such as the maximum length of an input line and invalid file names. A test that makes use of such values is identified by the extension .TST in its file name. Actual values to be substituted are represented by names that begin with a dollar sign. A value must be substituted for each of these names before the test is run. The values used for this validation are given below. The use of the operator '*' signifies a multiplication of the following character. The use of the '&' character signifies concatenation of the preceeding and following strings. The values within single or double quotation marks are to highlight characters or string values:

Name and Meaning	Value
$ACC_SIZE An integer literal whose value is the number of bits sufficient to hold any value of an access type.	32
$BIG_ID1 An identifier the size of the maximum input line length which is identical to $BIG_ID2 except for the last character.	254 * 'A' & '1'
$BIG_ID2 An identifier the size of the maximum input line length which is identical to $BIG_ID1 except for the last character.	254 * 'A' & '2'
$BIG_ID3 An identifier the size of the maximum input line length which is identical to $BIG_ID4 except for a character near the middle.	127 * 'A' & '3' & 127 * 'A'

Name and Meaning	Value
$BIG_ID4 An identifier the size of the maximum input line length which is identical to $BIG_ID3 except for a character near the middle.	127 * 'A' & '4' & 127 * 'A'
$BIG_INT_LIT An integer literal of value 298 with enough leading zeroes so that it is the size of the maximum line length.	252 * '0' & "298"
$BIG_REAL_LIT A universal real literal of value 690.0 with enough leading zeroes to be the size of the maximum line length.	200 * '0' & "690.0"
$BIG_STRING1 A string literal which when catenated with BIG_STRING2 yields the image of BIG_ID1.	'"' & 127 * 'A' & '"'
$BIG_STRING2 A string literal which when catenated to the end of BIG_STRING1 yields the image of BIG_ID1.	'"' & 127 * 'A' & '1' & '"'
$BLANKS A sequence of blanks twenty characters less than the size of the maximum line length.	235 * ' '
$COUNT_LAST A universal integer literal whose value is TEXT_IO.COUNT'LAST.	2147483647
$DEFAULT_MEM_SIZE An integer literal whose value is SYSTEM.MEMORY_SIZE.	2_147_483_648
$DEFAULT_STOR_UNIT An integer literal whose value is SYSTEM.STORAGE_UNIT.	8

Name and Meaning	Value
$DEFAULT_SYS_NAME The value of the constant SYSTEM.SYSTEM_NAME.	VAX_VMS
$DELTA_DOC A real literal whose value is SYSTEM.FINE_DELTA.	2#1.0#E-31
$FIELD_LAST A universal integer literal whose value is TEXT_IO.FIELD'LAST.	512
$FIXED_NAME The name of a predefined fixed-point type other than DURATION.	NO_SUCH_FIXED_TYPE
$FLOAT_NAME The name of a predefined floating-point type other than FLOAT, SHORT_FLOAT, or LONG_FLOAT.	LONG_LONG_FLOAT
$GREATER_THAN_DURATION A universal real literal that lies between DURATION'BASE'LAST and DURATION'LAST or any value in the range of DURATION.	0.0
$GREATER_THAN_DURATION_BASE_LAST A universal real literal that is greater than DURATION'BASE'LAST.	200_000.0
$HIGH_PRIORITY An integer literal whose value is the upper bound of the range for the subtype SYSTEM.PRIORITY.	15
$ILLEGAL_EXTERNAL_FILE_NAME1 An external file name which contains invalid characters.	abc!@def.dat
$ILLEGAL_EXTERNAL_FILE_NAME2 An external file name which is too long.	abc*def.dat
$INTEGER_FIRST A universal integer literal whose value is INTEGER'FIRST.	-2147483648

Name and Meaning	Value
$INTEGER_LAST A universal integer literal whose value is INTEGER'LAST.	2147483647
$INTEGER_LAST_PLUS_1 A universal integer literal whose value is INTEGER'LAST + 1.	2147483648
$LESS_THAN_DURATION A universal real literal that lies between DURATION'BASE'FIRST and DURATION'FIRST or any value in the range of DURATION.	-0.0
$LESS_THAN_DURATION_BASE_FIRST A universal real literal that is less than DURATION'BASE'FIRST.	-200_000.0
$LOW_PRIORITY An integer literal whose value is the lower bound of the range for the subtype SYSTEM.PRIORITY.	0
$MANTISSA_DOC An integer literal whose value is SYSTEM.MAX_MANTISSA.	31
$MAX_DIGITS Maximum digits supported for floating-point types.	33
$MAX_IN_LEN Maximum input line length permitted by the implementation.	255
$MAX_INT A universal integer literal whose value is SYSTEM.MAX_INT.	2147483647
$MAX_INT_PLUS_1 A universal integer literal whose value is SYSTEM.MAX_INT+1.	2147483648
$MAX_LEN_INT_BASED_LITERAL A universal integer based literal whose value is 2#11# with enough leading zeroes in the mantissa to be MAX_IN_LEN long.	"2:" & 250 * '0' & "11:"

Name and Meaning	Value
$MAX_LEN_REAL_BASED_LITERAL A universal real based literal whose value is 16:F.E: with enough leading zeroes in the mantissa to be MAX_IN_LEN long.	"16:" & 248 * '0' & "F.E:"
$MAX_STRING_LITERAL A string literal of size MAX_IN_LEN, including the quote characters.	'"' & 253 * 'A' & '"'
$MIN_INT A universal integer literal whose value is SYSTEM.MIN_INT.	-2147483648
$MIN_TASK_SIZE An integer literal whose value is the number of bits required to hold a task object which has no entries, no declarations, and "NULL;" as the only statement in its body.	32
$NAME A name of a predefined numeric type other than FLOAT, INTEGER, SHORT_FLOAT, SHORT_INTEGER, LONG_FLOAT, or LONG_INTEGER.	SHORT_SHORT_INTEGER
$NAME_LIST A list of enumeration literals in the type SYSTEM.NAME, separated by commas.	VAX_VMS
$NEG_BASED_INT A based integer literal whose highest order nonzero bit falls in the sign bit position of the representation for SYSTEM.MAX_INT.	16#FFFFFFFE#
$NEW_MEM_SIZE An integer literal whose value is a permitted argument for pragma MEMORY_SIZE, other than $DEFAULT_MEM_SIZE. If there is no other value, then use $DEFAULT_MEM_SIZE.	2_147_483_648

Name and Meaning	Value
$NEW_STOR_UNIT An integer literal whose value is a permitted argument for pragma STORAGE_UNIT, other than $DEFAULT_STOR_UNIT. If there is no other permitted value, then use value of SYSTEM.STORAGE_UNIT.	8
$NEW_SYS_NAME A value of the type SYSTEM.NAME, other than $DEFAULT_SYS_NAME. If there is only one value of that type, then use that value.	VAX_VMS
$TASK_SIZE An integer literal whose value is the number of bits required to hold a task object which has a single entry with one 'IN OUT' parameter.	32
$TICK A real literal whose value is SYSTEM.TICK.	0.01

APPENDIX D

WITHDRAWN TESTS

Some tests are withdrawn from the ACVC because they do not conform to the Ada Standard. The following 43 tests had been withdrawn at the time of validation testing for the reasons indicated. A reference of the form AI-ddddd is to an Ada Commentary.

a. E28005C This test expects that the string "-- TOP OF PAGE. --63" of line 204 will appear at the top of the listing page due to a pragma PAGE in line 203; but line 203 contains text that follows the pragma, and it is this that must appear at the top of the page.

b. A39005G This test unreasonably expects a component clause to pack an array component into a minimum size (line 30).

c. B97102E This test contains an unintended illegality: a select statement contains a null statement at the place of a selective wait alternative (line 31).

d. BC3009B This test wrongly expects that circular instantiations will be detected in several compilation units even though none of the units is illegal with re- spect to the units it depends on; by AI-00256, the illegality need not be detected until execution is attempted (line 95).

e. CD2A62D This test wrongly requires that an array object's size be no greater than 10 although its subtype's size was specified to be 40 (line 137).

f. CD2A63A..D, CD2A66A..D, CD2A73A..D, CD2A76A..D [16 tests] These tests wrongly attempt to check the size of objects of a derived type (for which a 'SIZE length clause is given) by passing them to a derived sub- program (which implicitly converts them to the parent type (Ada standard 3.4:14)). Additionally, they use the 'SIZE length clause and attribute, whose interpretation is considered problematic by the WG9 ARG.

g. CD2A81G, CD2A83G, CD2A84N & M, & CD50110 [5 tests] These tests assume that dependent tasks will terminate while the main program executes a loop that simply tests for task termination; this is not the case, and the main program may loop indefinitely (lines 74, 85, 86 & 96, 86 & 96, and 58, resp.).

h. CD2B15C & CD7205C These tests expect that a 'STORAGE_SIZE length clause provides precise con- trol over the number of designated objects in a collection; the Ada standard 13.2:15 allows that such control must not be expected.

i. CD2D11B This test gives a SMALL representation clause for a derived fixed-point type (at line 30) that defines a set of model numbers that are not necessarily represented in the parent type; by Commentary AI-00099, all model numbers of a derived fixed-point type must be representable values of the parent type.

j. CD5007B This test wrongly expects an implicitly declared subprogram to be at the the address that is specified for an unrelated subprogram (line 303).

k. ED7004B, ED7005C & D, ED7006C & D [5 tests] These tests check various aspects of the use of the three SYSTEM pragmas; the AVO withdraws these tests as being inappropriate for validation.

l. CD7105A This test requires that successive calls to CALENDAR.CLOCK change by at least SYSTEM.TICK; however, by Commentary AI-00201, it is only the expected frequency of change that must be at least SYSTEM.TICK--particular instances of change may be less (line 29).

m. CD7203B, & CD7204B These tests use the 'SIZE length clause and attribute, whose interpretation is considered problematic by the WG9 ARG.

n. CD7205D This test checks an invalid test objective: it treats the specification of storage to be reserved for a task's activation as though it were like the specification of storage for a collection.

o. CE2107I This test requires that objects of two similar scalar types be distinguished when read from a file--DATA_ERROR is expected to be raised by an attempt to read one object as of the other type. However, it is not clear exactly how the Ada standard 14.2.4:4 is to be interpreted; thus, this test objective is not considered valid. (line 90)

p. CE3111C This test requires certain behavior, when two files are associated with the same external file, that is not required by the Ada standard.

q. CE3301A This test contains several calls to END_OF_LINE & END_OF_PAGE that have no parameter: these calls were intended to specify a file, not to refer to STANDARD_INPUT (lines 103, 107,

118, 132, & 136).

r. CE3411B This test requires that a text file's column number be set to COUNT'LAST in order to check that LAYOUT_ERROR is raised by a subsequent PUT operation. But the former operation will generally raise an exception due to a lack of available disk space, and the test would thus encumber validation testing.

APPENDIX E

COMPILER AND LINKER OPTIONS

This appendix contains information concerning the compilation and linkage commands used within the command scripts for this validation. See section 3.2.2 for the options and commands used.

3 Compiling, Linking and Executing a Program

3.1 Overview

After a program library has been created, one or more compilation units can be compiled in the context of this library. The compilation units can be placed on different source files or they can all be on the same file. One unit, a parameterless procedure, acts as main program. If all units needed by the main program and the main program itself have been compiled successfully, they can be linked. The resulting code can then be executed by giving a RUN command.

§3.2 and §3.4 describe in detail how to call the Compiler and the Linker. Further on in §3.3 the Completer, which is called to generate code for instances of generic units, is described.
§3.5 explains the information which is given if the execution of a program is abandoned due to an unhandled exception.
The information the Compiler produces and outputs in the Compiler listing is explained in §3.6.
Finally, the log of a sample session is given in §3.7.

3.2 Starting the Compiler

To start the SYSTEAM Ada Compiler, call the command

```
$ @ADA:COMPILE  <source> [LIBRARY=<directory>] -
                         [OPTIONS=<string>]    -
                         [LIST=<filespec>]
```

The input file for the Compiler is <source>. If the file type of <source> is not specified, <source>.ADA is assumed. The maximum length of lines in <source> is 255; longer lines are cut and an error is reported.

<directory> is the name of the program library; [.ADALIB] is assumed if this parameter is not specified. The library must exist (see §2.2 for information on program library management).

The listing file is created in the default directory with the file name of <source> and the file type .LIS if no file specification <filespec> is given by the parameter LIST. Otherwise, the directory and file name are determined by the file specification <filespec>. If no full file specification is given, missing components are determined as described above (i.e. the default directory is used if no directory is specified, the file name of <source> if no file name is specified and the file type .LIS if the file type is missing). See §3.6 for information about the listing.

Options for the Compiler can be specified by using the parameter OPTIONS; they have an effect only for the current compilation. <string> must have the syntax

```
"[option {, option}]"
```

where blanks are allowed following and preceding lexical elements within the string.

The Compiler accepts the following options:

LIST => ON/OFF	(default is OFF)
OPTIMIZER => ON/OFF	(default is ON)
INLINE => ON/OFF	(default is ON)
COPY_SOURCE => ON/OFF	(default is OFF)
SUPPRESS_ALL	
SYMBOLIC_CODE	

The options LIST and SUPPRESS_ALL have the same effect as the corresponding pragmas would have at the beginning of the source (see [Ada,Appendix B] and §7.1.2 of this manual).

No optimizations like constant folding, dead code elimination or structural simplifications are done if OPTIMIZER => OFF is specified.

Inline expansion of subprograms which are specified by a pragma `inline` (cf. §7.1.1) in the Ada source can be suppressed generally by giving the option INLINE => OFF. The value ON will cause inline expansion of the respective subprograms.

COPY_SOURCE => ON causes the Compiler to copy the source file <source> into the program library. The Debugger of the SYSTEAM Ada System (cf. [ST16/87]) can then work on this copy (cf. §2.2.7) instead of on the original file.

A symbolic code listing can be produced by specifying the option SYMBOLIC_CODE when calling the Compiler. The code listing is written on a file with file type .SYM whose file name and directory are identical with those of the listing file.

The source file may contain a sequence of compilation units, cf. §10.1 of [Ada]. All compilation units in the source file are compiled individually. When a compilation unit is

compiled successfully, the program library is updated and the Compiler continues with the compilation of the next unit on the source file. If the compilation unit contained errors, they are reported (see §3.6). In this case, no update operation is performed on the program library and all subsequent compilation units in the compilation are only analyzed without generating code.

The Compiler delivers the status code WARNING on termination (see [VAX/VMS, DCL Dictionary, command EXIT]) if one of the compilation units contained errors. A message corresponding to this code has not been defined; hence %NONAME-W-NOMSG is printed upon notification of a batch job terminated with this status.

3.3 The Completer

The Compiler does not generate code for instances of generic bodies. Since this must be done before a program using such instances can be executed, the COMPLETER tool must be used to complete such units. This is done implicitly when LINK is called.

It is also possible to call the Completer explicitly by

```
$ @ADA:COMPLETE  <ada_name> [LIBRARY=<directory>] -
                            [OPTIONS=<string>]    -
                            [LIST=<filespec>]
```

<ada_name> must be the name of a library unit. All library units that are needed by that unit (cf. [Ada,§10.5]) are completed, if possible, and so are their subunits, the subunits of those subunits and so on. The meaning of the parameters LIBRARY and LIST corresponds to that of the COMPILE command (cf. §3.2). Options apply to all units that are completed; the following ones are accepted (cf. §3.2):

OPTIMIZER => ON/OFF
INLINE => ON/OFF
SUPPRESS_ALL
SYMBOLIC_CODE

The Completer delivers the status code WARNING on termination (see [VAX/VMS, DCL Dictionary, command EXIT]) if it detected some error. A message corresponding to this code has not been defined; hence %NONAME-W-NOMSG is printed upon notification of a batch job terminated with this status.

In this case a listing file containing the error messages (cf. §3.6) is created. If no file specification <filespec> is given by the parameter LIST, the listing file is created in the default directory with file name COMPLETE and the file type .LIS; otherwise, the directory and file name are determined by the file specification <filespec>. If no full file specification is given, missing components are determined as described above (i.e. the default directory is used if no directory is specified, the file name COMPLETE if no file name is specified and the file type .LIS if the file type is missing).

3.4 The Linker

An Ada program is a collection of units used by a main program which controls the execution. The main program must be a parameterless library procedure; any parameterless library procedure within a program library can be used as a main program.

The VAX/VMS system linker is used by the SYSTEAM Ada System Linker.

To link a program, call the command

```
$ @ADA:LINK  <ada_name> <filename> [LIBRARY=<directory>] -
                                   [OPTIONS=<string>] -
                                   [LIST=<filespec>] -
                                   [COMPLETE=ON/OFF] -
                                   [DEBUG=ON/OFF] -
                                   [MAP=<filespec>] -
                                   [SELECT=ON/OFF] -
                                   [EXTERNAL=<string>] -
                                   [LINK_OPT=<string>]
```

<ada_name> is the name of the library procedure which acts as the main program.

<filename> is the name of the file which is to contain the executable code after linking. If no filetype is specified, .EXE is assumed.

<directory> is the name of the program library which contains the main program; [.ADALIB] is assumed if this parameter is not specified.

The COMPLETE parameter specifies whether the program is to be completed before it is linked; default is ON. If the Completer is called, the parameters LIBRARY, OPTIONS and LIST are passed to it (cf. §3.3).

The DEBUG parameter specifies whether information for the SYSTEAM Debugger is to be generated; default is ON.

If the MAP parameter is given, the map listing of the VAX/VMS linker is preserved in the specified file. If no directory or file name is specified within <filespec>, the same directory resp. file name is used as for the file that contains the executable code; the default filetype is .MAP.

SELECT=ON causes the object code of subprogram bodies to be included in the executable program only if this subprogram may be called during program execution. In the case of OFF the code of all compilation units mentioned in a context clause (in a transitive manner) is linked together; the default is OFF.

The EXTERNAL parameter specifies object files or libraries which contain object modules of those program units which are not written in Ada (e.g. object modules of subprograms written in assembly language). For those program units the pragmas

```
   PRAGMA interface (VMS, ... )      -- (cf. §7.1.1)
(or interface (assembler, ... ) ) and

   PRAGMA external_name ( ... )      -- (cf. §7.1.1)
```

must be given in the Ada source.

<string>, specified by the parameter EXTERNAL, is a string literal that denotes the names of the external object files. It will be passed to the VAX/VMS linker (cf. [VAX/VMS, Linker]) without examining its correctness and for that reason it must have the VMS format:

```
file_spec [/file_qualifier] {, file_spec [/file_qualifier]}
```

file_spec specifies one input file. An input file can be an object file or an object library if the file_qualifier /LIBRARY or /INCLUDE is given. Multiple input files can be specified, separating the file specifications by commas.

Example:

```
EXTERNAL="A.OBJ,B.OLB/LIB"
```

A denotes an object file, B an object library file

The parameter LINK_OPT can be used to specify qualifiers for the VAX/VMS linker. Note that the starting character '/' must be given for each qualifier.

The following steps are performed during linking. First the Completer is called, unless suppressed by COMPLETE=OFF, to complete the bodies of instances. Then the

Pre-Linker is executed; it determines the compilation units that have to be linked together and a valid elaboration order. A code sequence to perform the elaboration is generated. Finally, the VAX/VMS linker is invoked to link all the object files including those specified by the EXTERNAL parameter. The command qualifiers passed to the VAX/VMS linker (cf. [VAX/VMS, Linker]) are those specified by the LINK_OPT parameter; the file specification names, in this order, two object files containing Ada object code, an object library which contains the runtime system, and the files specified by the EXTERNAL parameter.

The Linker of the SYSTEAM Ada System delivers the status code WARNING on termination (see [VAX/VMS, DCL Dictionary, command EXIT]) if one of the above mentioned steps failed (e.g. if one of the completed units contained errors, if any compilation unit cannot be found in the program library or if no valid eleboration order can be determined because of incorrect usage of the pragma elaborate). A message corresponding to this code has not been defined; hence %NONAME-W-NOMSG is printed upon notification of a batch job terminated with this status.

3.5 Executing a Program

After linking, the program can be executed by giving the command

```
$ RUN  <filename>
```