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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	12. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Ada Compiler Validation Summary Report: SYSTEAM KG, SYSTEAM Ada Compiler VAX/VMS x MC68020/OS-9, Version 1.81, VAX 8350 (Host) and KWS EB68020 (Target), 89032911.10076		5. TYPE OF REPORT & PERIOD COVERED 29 March 1989 to 29 March 1989
7. AUTHOR(s) IABG, Ottobrunn, Federal Republic of Germany.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION AND ADDRESS IABG, Ottobrunn, Federal Republic of Germany.		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS Ada Joint Program Office United States Department of Defense Washington, DC 20301-3081		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) IABG, Ottobrunn, Federal Republic of Germany.		12. REPORT DATE
		13. NUMBER OF PAGES
		15. SECURITY CLASS (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A

DISTRIBUTION STATEMENT (of this Report)

proved for public release; distribution unlimited.

DISTRIBUTION STATEMENT (of the abstract entered in Block 20 If different from Report)

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SUPPLEMENTARY NOTES

SDTICD
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19. KEYWORDS (Continue on reverse side if necessary and identify by block number)

Ada Programming language, Ada Compiler Validation Summary Report, Ada Compiler Validation Capability, ACVC, Validation Testing, Ada Validation Office, AVO, Ada Validation Facility, AVF, ANSI/MIL-STD-1815A, Ada Joint Program Office, AJPO

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

SYSTEAM KG, SYSTEAM Ada Compiler VAX/VMS x MC68020/OS-9, Version 1.81, VAX 8350 under VMS Version 4.7 (Host) to KWS EB68020 under OS-9/68020, Version 2.1 (Target), Ottobrunn West Germany, ACVC 1.10.



AD-A210 423

AVF Control Number: IABG-VSR-033

Ada COMPILER
VALIDATION SUMMARY REPORT:
Certificate Number: 89032911.10076
SYSTEM KG
SYSTEM Ada Compiler VAX/VMS x MC68020/OS-9 Version 1.81
VAX 8350 Host and KWS EB68020 Target

Completion of On-Site Testing:
29 March 1989

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Ada Compiler Validation Summary Report:

Compiler Name: SYSTEAM Ada Compiler VAX/VMS x MC68020/OS-9
Version 1.81

Certificate Number: 890329I1.10076

Host: VAX 8350 under VMS Version 4.7

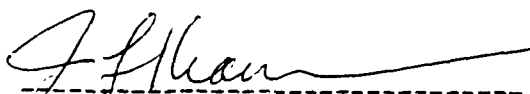
Target: KWS EB68020 under OS-9/68020 Version 2.1

Testing Completed 29 March 1989 Using ACVC 1.10

This report has been reviewed and is approved.



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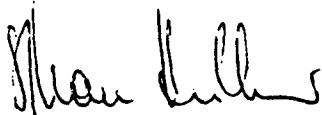
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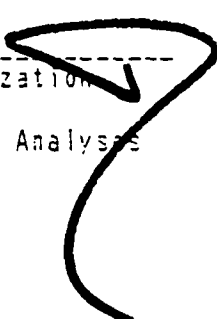
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CHAPTER 1

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:

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- . 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 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 29 March 1989 at IABG mbH, 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)
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1.3 REFERENCES

1. Reference Manual for the Ada Programming Language, ANSI/MIL-STD-1815A, February 1983 and ISO 8652-1987.
2. Ada Compiler Validation Procedures and Guidelines, Ada Joint Program Office, 1 January 1987.
3. Ada Compiler Validation Capability Implementers' Guide, SofTech, Inc., December 1986.
4. 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 <u>Ada Compiler Validation Procedures and Guidelines</u> .
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.

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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

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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 x MC68020/OS-9 Version 1.81

ACVC Version: 1.10

Certificate Number: 890329I1.10076

Host Computer:

Machine: VAX 8350

Operating System: VMS Version 4.7

Memory Size: 12 MB

Target Computer:

Machine: KWS EB68020

Operating System: OS-9/68020 Version 2.1

Memory Size: 2 MB

Communications Network: V24 connection

CONFIGURATION INFORMATION

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_FLOAT` and `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 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 to even. (See tests C46012A..Z (26 tests).)
- (2) The method used for rounding to longest integer is round to even. (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.)

CONFIGURATION INFORMATION

- (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.

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 subprogram declarations and bodies can be compiled in separate compilations. (See tests CA1012A and CA2009F.)
- (3) Generic library subprogram specifications and bodies can be compiled in separate compilations. (See test CA1012A.)
- (4) Generic non-library package bodies as subunits can be compiled in separate compilations. (See test CA2009C.)
- (5) Generic non-library subprogram bodies can be compiled in separate compilations from their stubs. (See test CA2009F.)
- (6) Generic unit bodies and their subunits can be compiled in separate compilations. (See test CA3011A.)
- (7) Generic package declarations and bodies can be compiled in separate compilations. (See tests CA2009C, BC3204C, and BC3205D.)
- (8) Generic library package specifications and bodies can be compiled in separate compilations. (See tests BC3204C and BC3205D.)
- (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.)

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- (2) The package `DIRECT_IO` can be instantiated with unconstrained array types and record types with discriminants without defaults. However, this implementation raises `USE_ERROR` upon creation of a file for unconstrained array types. (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 does not truncate the file. (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 permanent (not temporary) file for sequential files when reading only or writing only. (See tests `CE2107A..E` (5 tests), `CE2102L`, `CE2110B`, and `CE2111D`.)
- (14) More than one internal file can be associated with each external permanent (not temporary) file for direct files when reading only or writing only. (See tests `CE2107F..H` (3 tests), `CE2110D` and `CE2111H`.)
- (15) More than one internal file can be associated with each external permanent (not temporary) file for text files when reading only or writing only. (See tests `CE3111A..E` (5 tests), `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, 43 tests had been withdrawn because of test errors. The AVF determined that 266 tests were inapplicable to this implementation. All inapplicable tests were processed during validation testing except for 159 executable tests that use floating-point precision exceeding that supported by the implementation. Modifications to the code, processing, or grading for 14 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	1132	2057	17	27	46	3408
Inapplicable	0	6	259	0	1	0	266
Withdrawn	1	2	34	0	6	0	43
TOTAL	130	1140	2350	17	34	46	3717

TEST INFORMATION

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	202	591	566	245	172	99	161	332	137	36	252	325	290	3408	
N/A	11	58	114	3	0	0	5	1	0	0	0	44	30	266	
Wdrn	0	1	0	0	0	0	0	1	0	0	1	35	5	43	
TOTAL	213	650	680	248	172	99	166	334	137	36	253	404	325	3717	

3.4 WITHDRAWN TESTS

The following 43 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
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, 266 tests were inapplicable for the reasons indicated:

- a. The following 159 tests are not applicable because they have floating-point type declarations requiring more digits than SYSTEM.MAX_DIGITS:

C241130..Y (11 tests) C357050..Y (11 tests)

TEST INFORMATION

C357060..Y (11 tests)	C357070..Y (11 tests)
C357080..Y (11 tests)	C358020..Z (12 tests)
C452410..Y (11 tests)	C453210..Y (11 tests)
C454210..Y (11 tests)	C455210..Z (12 tests)
C455240..Z (12 tests)	C456210..Z (12 tests)
C456410..Y (11 tests)	C460120..Z (12 tests)

- b. C34007P and 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 not applicable because this implementation does not support a predefined type LONG_INTEGER:

C45231C	C45304C	C45502C	C45503C	C45504C
C45504F	C45611C	C45613C	C45614C	C45631C
C45632C	B520C4D	C55B07A	B55B09C	B86001W
CD7101F				
- e. C45531M..P (4 tests) and 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. C86001F is not applicable because, for this implementation, the package TEXT_IO is dependent upon package SYSTEM. This test recompiles package SYSTEM, making package TEXT_IO, and hence package REPORT, obsolete.
- h. B86001X, C45231D, and CD7101G are not applicable because this implementation does not support any predefined integer type with a name other than INTEGER, LONG_INTEGER, or SHORT_INTEGER.
- i. B86001Y is not applicable because this implementation supports no predefined fixed-point type other than DURATION.
- j. B86001Z is not applicable because this implementation supports no predefined floating-point type with a name other than FLOAT, LONG_FLOAT, or SHORT_FLOAT.

TEST INFORMATION

- k. C96005B is not applicable because there are no values of type DURATION'BASE that are outside the range of DURATION.
- l. CD1009C, CD2A41A, CD2A41B, CD2A41E and CD2A42A..J (10 tests) are inapplicable because this implementation imposes restrictions on 'SIZE length clauses for floating point types.
- m. CD2A61I and CD2A61J are inapplicable because this implementation imposes restrictions on 'SIZE length clauses for array types.
- n. 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.
- o. CD2A84B..I (8 tests), CD2A84K and CD2A84L are inapplicable because this implementation imposes restrictions on 'SIZE length clauses for access types.
- p. CE2102D is inapplicable because this implementation supports CREATE with IN_FILE mode for SEQUENTIAL_IO.
- q. CE2102E is inapplicable because this implementation supports CREATE with OUT_FILE mode for SEQUENTIAL_IO.
- r. CE2102F is inapplicable because this implementation supports CREATE with INOUT_FILE mode for DIRECT_IO.
- s. CE2102I is inapplicable because this implementation supports CREATE with IN_FILE mode for DIRECT_IO.
- t. CE2102J is inapplicable because this implementation supports CREATE with OUT_FILE mode for DIRECT_IO.
- u. CE2102N is inapplicable because this implementation supports OPEN with IN_FILE mode for SEQUENTIAL_IO.
- v. CE2102O is inapplicable because this implementation supports RESET with IN_FILE mode for SEQUENTIAL_IO.
- w. CE2102P is inapplicable because this implementation supports OPEN with OUT_FILE mode for SEQUENTIAL_IO.
- x. CE2102Q is inapplicable because this implementation supports RESET with OUT_FILE mode for SEQUENTIAL_IO.
- y. CE2102R is inapplicable because this implementation supports OPEN with INOUT_FILE mode for DIRECT_IO.
- z. CE2102S is inapplicable because this implementation supports RESET with INOUT_FILE mode for DIRECT_IO.

TEST INFORMATION

- aa. CE2102T is inapplicable because this implementation supports OPEN with IN_FILE mode for DIRECT_IO.
- ab. CE2102U is inapplicable because this implementation supports RESET with IN_FILE mode for DIRECT_IO.
- ac. CE2102V is inapplicable because this implementation supports OPEN with OUT_FILE mode for DIRECT_IO.
- ad. CE2102W is inapplicable because this implementation supports RESET with OUT_FILE mode for DIRECT_IO.
- ae. CE2107C..D (2 tests) raise USE_ERROR when the function NAME is applied to temporary sequential files, which are not given names.
- af. CE2107L is inapplicable because, for this implementation, temporary sequential files are not given names.
- ag. CE2107H is inapplicable because, for this implementation, temporary direct files are not given names.
- ah. CE3102E is inapplicable because text file CREATE with IN_FILE mode is supported by this implementation.
- ai. CE3102F is inapplicable because text file RESET is supported by this implementation.
- aj. CE3102G is inapplicable because text file deletion of an external file is supported by this implementation.
- ak. CE3102I is inapplicable because text file CREATE with OUT_FILE mode is supported by this implementation.
- al. CE3102J is inapplicable because text file OPEN with IN_FILE mode is supported by this implementation.
- am. CE3102K is inapplicable because text file OPEN with OUT_FILE mode is supported by this implementation.
- an. CE3111B and CE3115A are inapplicable because they assume that a PUT operation writes data to an external file immediately. This implementation uses line buffers; only complete lines are written to an external file by a PUT_LINE operation. Thus attempts to GET data before a PUT_LINE operation in these tests raise END_ERROR.
- ao. CE3112B is inapplicable because, for this implementation, temporary text files are not given names.
- ap. CE3202A is inapplicable because the underlying operating system does not allow this implementation to support the NAME operation for STANDARD_INPUT and STANDARD_OUTPUT. Thus the calls of the NAME operation for the standard files in this test raise

TEST INFORMATION

USE_ERROR.

- aq. EE2401D contains 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 14 tests.

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	BC3205D				

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 x MC68020/OS-9 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 x MC68020/OS-9 Version 1.81 using ACVC Version 1.10 was conducted by IABG on the premises of IABG. 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 4.7
Target computer:	KWS EB68020
Target operating system:	OS-9/68020 Version 2.1
Compiler:	SYSTEM Ada Compiler VAX/VMS x MC68020/OS-9 Version 1.81

The host and target computers were linked via a V24 connection.

The original distribution tape for ACVC 1.10 was read on the VAX 8350, and customized to remove withdrawn tests and tests requiring unsupported floating-point precision and to customize tests that make use of implementation-specific values. Tests requiring modifications were modified accordingly as detailed in section 3.6.

The full set of tests was compiled and linked on the VAX 8350, then all executable images were transferred to the KWS EB68020 via the V24 connection and run. Results were printed from the host computer.

The compiler was tested using command scripts provided by SYSTEM KG and reviewed by the validation team. The compiler was tested using all default option settings as explained in appendix F. All chapter B tests were compiled with the LIST option on. The compiler was not called explicitly during this validation, but is called, when needed, by the link command.

Tests were compiled, linked, and executed (as appropriate) using a single host and target 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 mbH, Ottobrunn and was completed on 29 March 1989.

APPENDIX A

DECLARATION OF CONFORMANCE

SYSTEM KG has submitted the following Declaration
of Conformance concerning the SYSTEM Ada Compiler
VAX/VMS x MC68020/OS-9 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 x MC68020/OS-9 Version 1.81
Host Architecture: VAX 8350
Host OS and Version: VMS 4.7
Target Architecture: KWS EB68020
Target OS and Version: OS-9/68020 Version 2.1

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 ANIS/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: April 11, 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: April 11, 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 x MC68020/OS-9 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 SHORT_INTEGER is range - 32_768 .. 32_767;
type INTEGER is range - 2_147_483_648 .. 2_147_483_647;

type SHORT_FLOAT is digits 6 range
  - 16#0.FFFF_FB#E32 .. 16#0.FFFF_FB#E32;
type FLOAT is digits 15 range
  - 16#0.FFFF_FFFF_FFFF_E#E256 .. 16#0.FFFF_FFFF_FFFF_E#E256;
type LONG_FLOAT is digits 18 range
  - 16#0.FFFF_FFFF_FFFF_FFF8#E4096 .. 16#FFF_FFFF_FFFF_FFF8#E4096;

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 the 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 assembler and for the call of OS-9 kernel functions from an Ada program. For each Ada subprogram for which

```
PRAGMA interface (OS9, <ada_name>)
```

is specified, the body of the subprogram <ada_name> must be implemented by the OS-9 kernel.

The pragma ensures the OS-9 standard, in particular:

- Saving of registers
- Calling mechanism.

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.

The functions of the OS-9 kernel use registers for the transport of parameters. Therefore, the package `system` provides some types to specify parameters.

```
SUBTYPE os9_wordlong IS integer RANGE - 2 ** 31 .. 2 ** 31 - 1;
-- signed 4-bytes
```

```
TYPE os9_parameter
  IS RECORD
    d0, d1, d2, d3, d4, d5 : os9_wordlong;
    a0, a1, a2             : address;
    error                  : boolean;
  END RECORD;
```

The components `d0 .. d5` and `a0 .. a3` indicate the use of the corresponding registers of the target machine. Before any call of an OS-9 function the values of those components are copied into the corresponding registers. After the call the values of the registers are copied into the corresponding components of the parameter block. To indicate whether the result of a call is valid the OS-9 functions will set the condition code register and the pragma will set a corresponding boolean value into the component `error`.

The SYSTEAM Ada Compiler does not check the correct use of the registers. If it is violated the call will be erroneous.

The following example will show the intended usage of the pragma `interface (os9)`. The given procedure serves to open a file with a constant name. It is called in the body of the main program.

```

WITH system;

PROCEDURE os9_call IS

    read_mode : CONSTANT system.os9_wordlong := 2 ** 0;

    file_name : CONSTANT string := "/HO/TEST/F1" & ascii.nul;

    PRAGMA resident (file_name);

    -- The file "F1" must exist in the directory "/HO/TEST".

    param_os9 : system.os9_parameter;

    path      : system.os9_wordlong;

    use_error : EXCEPTION;

    PROCEDURE os9_i_open (pb : IN OUT system.os9_parameter);
        PRAGMA interface (os9, os9_i_open);
        PRAGMA external_name ("I$Open", os9_i_open);

BEGIN
    param_os9.d0 := read_mode;
    param_os9.a0 := file_name'address;
    os9_i_open (param_os9);
    IF param_os9.error THEN
        RAISE use_error;
    END IF;
    path := param_os9.d0;
END os9_call;

```

If the subprogram is implemented by an assembly language program the

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

can be used. In this case, the actual parameters for the subprogram are written into a parameter block before the call; within the subprogram body, the address of this parameter block is stored at (4,A7). It is recommended to store all parameters in a record object; then the subprogram has only one parameter (of the corresponding record type) and the parameter block contains only the address of the record object.

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 subprogram 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 precedes immediately.

This pragma will be used in connection with the pragmas `interface (os9)` or `interface (assembler)` (see §7.1.1).

RESIDENT (<ada_name>)

this pragma prevents assignments 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 `(os9, ...)` (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_OVERFLOW

Yields `true` for each fixed point type or subtype and `false` for each floating point 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** has been 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'size USE 32;
```

```
FOR address'storage_size USE 0;
```

```
address_zero      : CONSTANT address := NULL;
```

```
TYPE name IS (motorola_68020_os9);
```

```
system_name       : CONSTANT name := motorola_68020_os9;
```

```
storage_unit      : CONSTANT := 8;
```

```
memory_size       : CONSTANT := 2 ** 31;
```

```
min_int           : CONSTANT := - 2 ** 31;
```

```
max_int           : CONSTANT := 2 ** 31 - 1;
```

```
max_digits        : CONSTANT := 18;
```

```
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'.
```

```
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 := ... ;
```

```
SUBTYPE os9_wordlong IS integer RANGE - 2 ** 31 .. 2 ** 31 - 1;
```

```
TYPE os9_parameter IS
```

```
RECORD
```

```
  d0, d1, d2, d3, d4, d5 : os9_wordlong;
```

```
  a0, a1, a2             : address;
```

```
  error                  : boolean;
```

```
END RECORD;
```

```
FOR os9_parameter USE
```

```
RECORD AT MOD 4;
```

```
  d0 AT 0 RANGE 0 .. 31;
```

```
  d1 AT 4 RANGE 0 .. 31;
```

```
  d2 AT 8 RANGE 0 .. 31;
```

```
  d3 AT 12 RANGE 0 .. 31;
```

```
  d4 AT 16 RANGE 0 .. 31;
```

```
  d5 AT 20 RANGE 0 .. 31;
```

```
  a0 AT 24 RANGE 0 .. 31;
```

```
  a1 AT 28 RANGE 0 .. 31;
```

```
  a2 AT 32 RANGE 0 .. 31;
```

```
  error AT 36 RANGE 0 .. 7;
```

```
END RECORD;
```

```
FOR os9_parameter'size USE 37 * storage_unit;
```

```
no_error_code      : CONSTANT := 0;
```

```
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 occurred. Depending  
  -- on the kind of the exception it may be the 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 occurred.
```

```
  error_code   : integer;
```

```
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 := 10;
success        : 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 Pragma

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 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. 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` types the value must be $= 64$ (this is the amount of storage which is associated with these types anyway).
for `long_float` types the value must be $= 96$ (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. If an address clause is given for a task entry, 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.

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 text files (including the two standard files), sequential files and direct files must not exceed 10 for each class. Any attempt to exceed this limit raises the exception `use_error`.

File sharing is allowed for reading and writing without any restriction.

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.
- 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 OS-9 random block 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 an OS-9 file name. The function NAME will return a file name string 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, Apper.dix 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 bytes which are allocated initially; it is only used in a create operation and ignored in an open operation. The default value for the initial file size is 0.

```
RECORD_SIZE => numeric_literal
```

This value specifies the record size in bytes. This form specification is only allowed for files with fixed record format. If the value is specified for an existing file, it must agree with the value of the external file.

By default, `element_type'SIZE / system.storage_unit` will be chosen as record size, if the evaluation of this expression does not raise an exception. In this case, the attempt to write or read a record will raise `use_error`.

If a fixed record format is used, all objects written to a file which are shorter than the record size are filled up with zeros (ASCII.NUL). An attempt to write an element which is larger than the specified record size will result in the exception `use_error` being raised. This can only occur if the record size is specified explicitly.

9.2.1.2 Sequential Files

A sequential file is represented by a random block 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).

```
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.

Variable record size is used as default. It means that each record is written with its actual length. A read operation transfers exactly one file element with its actual length.

Fixed record size means that every record is written with the size specified as record size.

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 OS-9 random block files with fixed-length records.

9.3 Text Input-Output

Text files are represented as random block files or sequential character files depending on whether the file name denotes a disk file or a terminal device. Each line consists of a sequence of characters terminated by a line terminator, i.e. an ASCII.CR character.

A page terminator is represented as a line consisting of a single ASCII.FF. A page terminator is always preceded by a line terminator.

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 an explicit one as the last record of the file.

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. Arbitrary characters (including all control characters) 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.

9.3.2 Default Input and Output Files

The Ada standard input and output files are associated with the corresponding standard files in OS-9.

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 specified file already exists;
- if the `name` parameter in a call of the `create` or `open` procedure is not a legal OS-9 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) so that there are more than 10 in one of the three file classes `text`, `sequential` and `direct`;
- whenever an error occurred during an operation of the underlying OS-9 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; in general it is only guaranteed that a file which is created by an Ada program may be reopened and read successfully by another program if the file types and the form strings are the same;
- if the function `name` is applied to a temporary file;
- if an attempt is made to write or read to/from a file with fixed record format a record which is larger than the record size determined when the file was opened (cf. §9.2.1.1);

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 OS-9 system.

DATA_ERROR

the conditions under which `data_error` is raised by `text_io` are laid down in [Ada]. In the packages `sequential_io` and `direct_io`, the exception `data_error` is not raised in all cases by the procedure `read` if the element read is not a legal value of the element type.

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.

10 References

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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 preceding and following strings. The values within single or double quotation marks are to highlight characters or string values:

<u>Name and Meaning</u>	<u>Value</u>
\$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'

TEST PARAMETERS

Name and Meaning	Value
<p>\$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.</p>	127 * 'A' & '4' & 127 * 'A'
<p>\$BIG_INT_LIT An integer literal of value 298 with enough leading zeroes so that it is the size of the maximum line length.</p>	252 * '0' & "298"
<p>\$BIG_REAL_LIT A universal real literal of value 690.0 with enough leading zeroes to be the size of the maximum line length.</p>	250 * '0' & "690.0"
<p>\$BIG_STRING1 A string literal which when catenated with BIG_STRING2 yields the image of BIG_ID1.</p>	'1' & 127 * 'A' & '1'
<p>\$BIG_STRING2 A string literal which when catenated to the end of BIG_STRING1 yields the image of BIG_ID1.</p>	'1' & 127 * 'A' & '1' & '1'
<p>\$BLANKS A sequence of blanks twenty characters less than the size of the maximum line length.</p>	200 * ' '
<p>\$COUNT_LAST A universal integer literal whose value is TEXT_IO.COUNT'LAST.</p>	2147483647
<p>\$DEFAULT_MEM_SIZE An integer literal whose value is SYSTEM.MEMORY_SIZE.</p>	2_147_483_648
<p>\$DEFAULT_STOR_UNIT An integer literal whose value is SYSTEM.STORAGE_UNIT.</p>	8

Name and Meaning	Value
\$DEFAULT_SYS_NAME The value of the constant SYSTEM.SYSTEM_NAME.	MOTOROLA_68020_059
\$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.	NO_SUCH_TYPE_AVAILABLE
\$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

TEST PARAMETERS

Name and Meaning	Value
<p>\$INTEGER_LAST</p> <p>A universal integer literal whose value is INTEGER'LAST.</p>	2147483647
<p>\$INTEGER_LAST_PLUS_1</p> <p>A universal integer literal whose value is INTEGER'LAST + 1.</p>	2147483648
<p>\$LESS_THAN_DURATION</p> <p>A universal real literal that lies between DURATION'BASE'FIRST and DURATION'FIRST or any value in the range of DURATION.</p>	-0.0
<p>\$LESS_THAN_DURATION_BASE_FIRST</p> <p>A universal real literal that is less than DURATION'BASE'FIRST.</p>	-200_000.0
<p>\$LOW_PRIORITY</p> <p>An integer literal whose value is the lower bound of the range for the subtype SYSTEM.PRIORITY.</p>	0
<p>\$MANTISSA_DOC</p> <p>An integer literal whose value is SYSTEM.MAX_MANTISSA.</p>	31
<p>\$MAX_DIGITS</p> <p>Maximum digits supported for floating-point types.</p>	18
<p>\$MAX_IN_LEN</p> <p>Maximum input line length permitted by the implementation.</p>	255
<p>\$MAX_INT</p> <p>A universal integer literal whose value is SYSTEM.MAX_INT.</p>	2147483647
<p>\$MAX_INT_PLUS_1</p> <p>A universal integer literal whose value is SYSTEM.MAX_INT+1.</p>	2_147_483_648
<p>\$MAX_LEN_INT_BASED_LITERAL</p> <p>A universal integer based literal whose value is 2#11# with enough leading zeroes in the mantissa to be MAX_IN_LEN long.</p>	"2:" & 250 * '0' & "11:"

TEST PARAMETERS

Name and Meaning	Value
<p>\$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.</p>	"16:" & 248 * '0' & "F.E:"
<p>\$MAX_STRING_LITERAL A string literal of size MAX_IN_LEN, including the quote characters.</p>	'"' & 253 * 'A' & '"'
<p>\$MIN_INT A universal integer literal whose value is SYSTEM.MIN_INT.</p>	-2147483648
<p>\$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.</p>	32
<p>\$NAME A name of a predefined numeric type other than FLOAT, INTEGER, SHORT_FLOAT, SHORT_INTEGER, LONG_FLOAT, or LONG_INTEGER.</p>	NO_SUCH_TYPE_AVAILABLE
<p>\$NAME_LIST A list of enumeration literals in the type SYSTEM.NAME, separated by commas.</p>	MOTROLA_68020_059
<p>\$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.</p>	16#FFFFFFF#
<p>\$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.</p>	2_147_483_648

TEST PARAMETERS

<u>Name and Meaning</u>	<u>Value</u>
\$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.	MOTOROLA_68020_059
\$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 respect 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.

WITHDRAWN TESTS

- g. CD2A81G, CD2A83G, CD2A84N & M, & CD5011G [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 control 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 WG7 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. CE9411B 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.

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 transmitted to the target system and executed.

§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.

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 Linker generates an executable program on the host without using the target.

To link a program, call the command

```
$ QADA:LINK <ada_name> <filename> [LIBRARY=<directory>] -  
[OPTIONS=<string>] -  
[LIST=<filespec>] -  
[COMPLETE=ON/OFF] -  
[DEBUG=ON/OFF] -  
[SELECT=ON/OFF] -  
[STACK_SIZE=<integer>]  
[EXTERNAL=<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. No file type is assumed if none is specified.

<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 debug information is to be generated. `DEBUG=ON` causes a second file containing the symbol table of the executable program to be generated; this symbol table is needed for debugging the program with the OS-9 debugger. The name of this file is also `<filename>` with file type `.STB`; default is `ON`.

`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 `ON`.

The `STACK_SIZE` parameter specifies the stack size of the resulting program in bytes; the default is 64K bytes.

The `EXTERNAL` parameter specifies files which contain object code 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 (assembler. ...)` -- (cf. §7.1.1)
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, separated by commas.

Example:

```
EXTERNAL="A.OBJ,B.OBJ"
A and B denote object files
```

§3.4.1 gives additional information concerning the inclusion of external object code.

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, all object files including those specified by the `EXTERNAL` parameter are linked.

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 elaboration 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.

3.4.1 Inclusion of External Object Code

The Linker is able to read only those object files which were written by a tool of the SYSTEAM Ada System; files which have a format that does not conform to the internal object code format used by the SYSTEAM Ada System cannot be read. This restriction must be obeyed when additional code is linked to the program by use of the EXTERNAL parameter.

If an object file is transmitted from the target to the host by use of the TRANSMIT tool (cf. §3.5), the resulting file on the host has the appropriate format and no further action is necessary.

If an object file is copied to the host by another tool (that is not part of the SYSTEAM Ada System), the file must be converted into S-Record format before copying. On the host, this S-Record file is converted into the binary format appropriate for the Linker by giving the command

```
$ QADA:EXBIN <s_filename> [OUT=<b_filename>]
```

<s_filename> is the name of the input file; if no file type is specified, .S is assumed.

The OUT parameter specifies the name of the output file; the default file name is the name of <s_filename>, default file type is .OBJ and default directory is [].

It is also possible to convert binary format into S-Record format on the host by calling

```
$ QADA:BINEX <b_filename> [OUT=<s_filename>]
```

<b_filename> is the name of the binary input file; if no file type is specified, .OBJ is assumed.

The OUT parameter specifies the name of the output file; the default file name is the name of <b_filename>, default file type is .S and default directory is [].

3.5 Executing a Program

After linking, the program can be transmitted to the target.

3.5.1 File Transfer

File transfer is done by the TRANSMIT tool, which is able to transmit files from the host to the target and vice versa.

Transfer of one file is done by giving the command

```
$ @ADA:TRANSMIT <target_line> <direction> <kind> -  
                <vms_filename> <os9_filename> [STATISTICS=ON/OFF]
```

<target_line> is the terminal line used for the host-target communication. It must be connected to the target and an OS-9 session must be active on that line. The logical name of that line is defined during installation of the SYSTEAM Ada System.

The parameter <direction> specifies whether the file is sent to the target or received from the target. The allowed values are SEND and RECEIVE.

<kind> describes the kind of data (on the file) to be transmitted. The allowed values are TEXT and BINARY; if a binary file is to be sent to the target, the file must have the internal object format described in §3.4.1.

The file name on VMS is given by <vms_filename>.

The file name on OS-9 is given by <os9_filename>.

The parameter STATISTICS specifies whether statistical information about the file transfer is to be output.

If file transfer between host and target is not done via a terminal line (and therefore the TRANSMIT tool is not used), the BINEX tool (cf. §3.4.1) can be used to transform the executable program into S-Record format. Then the S-Record file is copied to the target and again transformed into binary format.

3.5.2 Operations on the Target

On the target, the program can be executed by giving the command (os9 is the prompt of the operating system)

```
os9 <filename>
```

<filename> must be a full path name.

Another way of executing the program is first to load it from the current data directory into main memory and then to start it:

```
os9 LOAD -D <filename>
os9 <filename>
```

In this case <filename> denotes the relative path name of the file in the current data directory.

The default stack size for the main task is 64k Bytes. Additional stack space is allocated if a modifier is added on the command line, e.g.

```
os9 <filename> #100
```

which results in a stack size of 164k Bytes. The default stack size for the main task can be modified permanently by using the LINK parameter STACK_SIZE (cf. §3.4).

If an Ada program is abandoned due to an unhandled exception, a message is displayed; the message has the following form:

```
(1) *** Ada program abandoned due to unhandled exception!
(2)   exception      : ...
(3)   raised at     : ...
(4)   error code    : ...
```

In line (2) the exception identification is displayed. For the predefined and I/O exceptions, the Ada names are printed. For all user-defined exceptions, a hexadecimal value `uuuuxxxx` is shown: `uuuu` indicates the library key of the compilation unit in which the exception is declared, `xxxx` is the compilation unit relative number of the exception. `Non_ada_error`, defined in package `system`, stands for any other exception.

In line (3) a code address is shown. Depending on the type of exception (fault or trap), this can be the address of the instruction that caused the exception (for a fault), or of the following instruction (for a trap). Line (4) shows the error number given by the OS-9 operating system. The corresponding messages are listed in [OS-9,Error Codes].

3.6 The Compiler Listing

The listing for a compilation unit starts with the kind and the name of the unit and the library key of the current unit.

Example:

```
= PROCEDURE MAIN.   Library Index   76
```

By default only source lines referred to by messages of the Compiler are listed. A complete listing can be obtained by using pragma LIST or the Compiler option LIST. The format effectors ASCII.HT, ASCII.VT, ASCII.CR, ASCII.LF and ASCII.FF are represented by a '~' character in the listing. In any case, those source lines which are included in the listing are numbered to make locating them in the source file easy.

Errors are classified into SYMBOL ERROR, SYNTAX ERROR, SEMANTIC ERROR, RESTRICTION, COMPILER ERROR, WARNING and INFORMATION:

SYMBOL ERROR

pinpoints an inappropriate lexical element. "Inappropriate" can mean "inappropriate in the given context". For example, '2' is a lexical element of Ada, but it is not appropriate in the literal 2#012#.

SYNTAX ERROR

indicates a violation of the Ada syntax rules as given in [Ada,Appendix E].

SEMANTIC ERROR

indicates a violation of Ada language rules other than the syntax rules.

RESTRICTION

indicates a restriction of this implementation. Examples are representation clauses which are provided by the language but are not supported in this implementation; or situations in which the internal storage capacity of the Compiler for some sort of entity is exceeded.

COMPILER ERROR

We hope you will never see a message of this sort.

WARNING

messages tell the user facts which are likely to cause errors (for example, the raising of exceptions) at runtime.

INFORMATION

messages tell the user facts which may be useful to know but probably do not endanger the correct running of the program. Examples are that a library unit named in a context clause is not used in the current compilation unit, or that another unit (which names the current compilation unit in a context clause) is made obsolete by the current compilation.

Warnings and information messages have no influence on the success of a compilation. If there are any other diagnostic messages, the compilation was unsuccessful.

All error messages are self-explanatory. If a source line contains errors, the error messages for that source line are printed immediately below it. The exact position in the source to which an error message refers is marked by a number. This number is also used to relate different error messages given for one line to their respective source positions.

In order to enable semantic analysis to be carried out even if a program is syntactically incorrect, the Compiler corrects syntax errors automatically by inserting or deleting symbols. The source positions of insertions/deletions are marked with a vertical bar and a number. The number has the same meaning as above. If a larger region of the source text is affected by a syntax correction, this region is located for the user by repeating the number and the vertical bar at the end as well, with dots in between these bracketing markings.

The following page contains a reprint of a complete Compiler listing which shows the most common kinds of error messages, the technique for marking affected regions and the numbering scheme for relating error messages to source positions.

```
*****
**
** SYSTEM ADA - COMPILER          VAX/VMS x MC68020/OS-9  1.81    **
**                               **                               **
** 88-11-22 / 14:11:16          **                               **
**                               **                               **
*****
```

```
-----
=
=
=
= PROCEDURE LISTING_EXAMPLE
=
```

```
2      abc : procedure integer RANGE 0 .. 9 := 10E-1;
          |1.....1|
                                           1
```

```
>>>> SYNTAX ERROR
      Symbol(s) deleted (1)
>>>> SYMBOL ERROR (1)  An exponent for an integer literal must not
                        have a minus sign
```

```
3      def integer RANGE 0 .. 9;
          |1
```

```
>>>> SYNTAX ERROR
      Symbol(s) inserted (1): :
6      bool := (abc AND (def * 1)) OR adf;
          1      2      3
```

```
>>>> SEMANTIC ERROR (1) Actual parameter for LEFT is not of
                        appropriate type
```

```
>>>> SEMANTIC ERROR (2) Actual parameter for RIGHT is not of
                        appropriate type
```

```
>>>> SEMANTIC ERROR (3) Identifier ADF not declared
```

```
=
= PROCEDURE LISTING_EXAMPLE
=
```

```
= **** Number of Errors      :      6
= **** Number of Warnings    :      0
=
= **** Number of Source Lines :      7
= **** Number of Comment Lines :      0
= **** Number of Lexical Elements :     42
= **** Code Size in Bytes     :      0
= **** Number of Diana Nodes created :    51
= **** Symbol Error in Line   :      2.
= **** Syntax Error in Line   :      2,      3.
= **** Semantic Error in Line :      6.
= **** CPU Time used          :      1.6 Seconds
=
```

```
-----
*****
**                               **
** End of Ada Compilation      **
**                               **
*****
```


3.7 Sample Session: Compile, Link and Run

This chapter shows the log of a sample session. The lines starting with "\$" are VMS commands, all other lines are output.

(For example2 it is assumed that a routine with the name ASSEMBLER_EXAMPLE, which outputs the text "Assembler routine is called", has been written in assembly language and that the file A.OBJ contains its object code.)

```
$ QADA:CREATELIB
SYSTEM ADA - LIBRARY-MANAGER    VAX/VMS x MC68020/OS-9  1.81
```

```
$ QADA:COMPILE  example1 OPTIONS="list => on"
compiling DISKO:[ADA.TEST]EXAMPLE1.ADA:2
in library DISKO:[ADA.TEST.ADALIB]
SYSTEM ADA - COMPILER           VAX/VMS x MC68020/OS-9  1.81
PROCEDURE LISTING_EXAMPLE
**** Number of Errors           :      6
**** Number of Warnings         :      0
CPU Time used :      1.4 Seconds
```

```
$ TYPE  example2.ada
```

```
WITH text_io;
USE text_io;
```

```
PROCEDURE execution_example IS
  PROCEDURE assembler_routine;
  PRAGMA interface (assembler, assembler_routine);
  PRAGMA external_name ("ASSEMBLER_EXAMPLE",
                        assembler_routine);

BEGIN
  put_line ("Main program starts");
  assembler_routine;
  put_line ("Main program stops");
END execution_example;
```

```
$ @ADA:COMPILE example2
compiling DISKO:[ADA.TEST]EXAMPLE2.ADA;1
in library DISKO:[ADA.TEST.ADALIB]
SYSTEM ADA - COMPILER          VAX/VMS x MC68020/OS-9  1.81
PROCEDURE EXECUTION_EXAMPLE,  Library Index  47
*** No Errors during Compilation ***
CPU Time used :      2.1 Seconds

$ @ADA:LINK execution_example example EXTERNAL="A.OBJ"
SYSTEM ADA - COMPLETER          VAX/VMS x MC68020/OS-9  1.81
SYSTEM ADA - PRE-LINKER        VAX/VMS x MC68020/OS-9  1.81
SYSTEM ADA - LINKER           VAX/VMS x MC68020/OS-9  1.81

$ @ADA:TRANSMIT charly SEND BINARY example /h0/test/example
SYSTEM ADA - FILE-TRANSMITTER  VAX/VMS x MC68020/OS-9  1.81

$ SET HOST/DTE charly

os9 /h0/test/example

Main program starts
Assembler routine is called
Main program stops

os9 ~\

$ @ADA:DELETELIB
** Information: Program library DISKO:[ADA.TEST.ADALIB] deleted
```