AD-A240 540

# [DOCUM]ENTATION PAGE

Form Approved
OPM No. 0704-0188

...erage 1 hour per response, including the time for reviewing instructions, searching existing data sources gathering and maintaining the data ...arding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington ... 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Information and Regulatory Affairs, Office of

1. AGENCY USE ONLY *(Leave Blank)*

2. REPORT DATE

3. REPORT TYPE AND DATES COVERED
Final: 04 Jan 1991 to 01 Jun 1993

4. TITLE AND SUBTITLE
Irvine CompilerCorporation, ICC Ada v7.0.0, Vaxstation 3100 Model M38, VMS 5.3-1 (Host ) to Intel i80960MC (bare machine)(Target), 910510W1.11148

5. FUNDING NUMBERS

6. AUTHOR(S)
Wright-Patterson AFB, Dayton, OH
USA

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Ada Validation Facility, Language Control Facility ASD/SCEL
Bldg. 676, Rm 135
Wright-Patterson AFB, Dayton, OH 45433

8. PERFORMING ORGANIZATION REPORT NUMBER
AVF-VSR-468-0891

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Ada Joint Program Office
United States Department of Defense
Pentagon, Rm 3E114
Washington, D.C. 20301-3081

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
Irvine Compiler Corporation, ICC Ada v7.0.0, Wright-Patterson AFB, OH, Vaxstation 3100 Model M38, VMS 5.3-1 (Host ) to Intel i80960MC(bare machine)(Target), ACVC 1.11.

DTIC ELECTE SEP 19 1991 S D D

91-11062

14. SUBJECT TERMS
Ada programming language, Ada Compiler Val. Summary Report, Ada Compiler Val. Capability, Val. Testing, Ada Val. Office, Ada Val. Facility, ANSI/MIL-STD-1815A, AJPO.

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT
UNCLASSIFIED

18. SECURITY CLASSIFICATION
UNCLASSIFED

19. SECURITY CLASSIFICATION OF ABSTRACT
UNCLASSIFIED

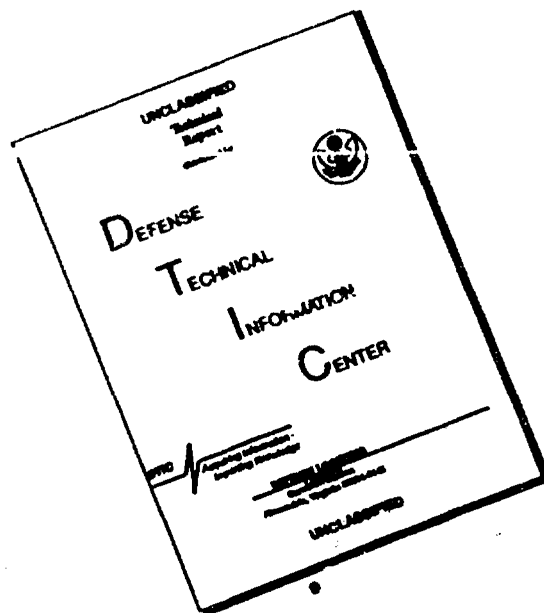
20. LIMITATION OF ABSTRACT

NSN 7540-01-280-550

Standard Form 298, (Rev. 2-89)
Prescribed by ANSI Std. 239-128

91 9 19 012

# DISCLAIMER NOTICE



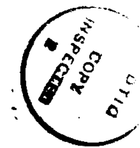

**THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.**

AVF Control Number: AVF-VSR-468-0891
1 August 1991
91-01-04-ICC

# Ada COMPILER
# VALIDATION SUMMARY REPORT:
Certificate Number: 910510W1.11148
Irvine Compiler Corporation
ICC Ada v7.0.0
Vaxstation 3100 Model M38, VMS 5.3-1 => Intel i80960MC (bare machine)

Prepared By:
Ada Validation Facility
ASD/SCEL
Wright Patterson AFB OH 45433-6503


Accesion For
NTIS CRA&I ✓
DTIC TAB
Unannounced
Justification
By
Distribution /
Availability Codes
Dist | Avail and / or Special
A-1

Certificate Information

The following Ada implementation was tested and determined to pass ACVC 1.11. Testing was completed on 10 May 1991.

Compiler Name and Version: ICC Ada v7.0.0

Host Computer System: Vaxstation 3100 Model M38, VMS 5.3-1

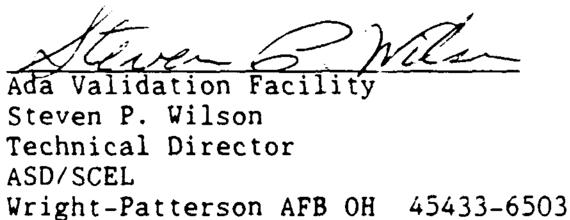
Target Computer System: Intel i80960MC (bare machine)

Customer Agreement Number: 91-01-04-ICC

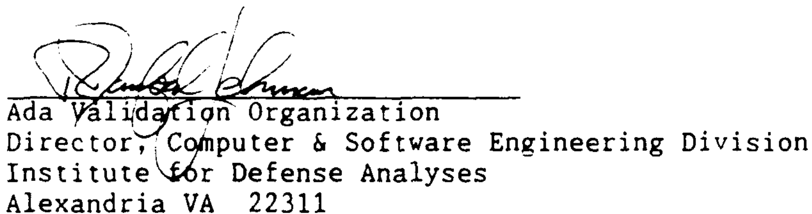
See section 3.1 for any additional information about the testing environment.

As a result of this validation effort, Validation Certificate 910510W1.11148 is awarded to Irvine Compiler Corporation. This certificate expires on 1 March 1993.

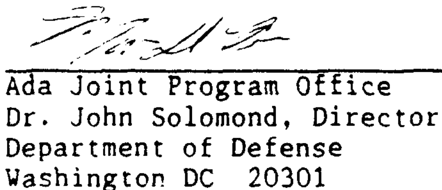
This report has been reviewed and is approved.



Ada Validation Facility
Steven P. Wilson
Technical Director
ASD/SCEL
Wright-Patterson AFB OH 45433-6503



Ada Validation Organization
Director, Computer & Software Engineering Division
Institute for Defense Analyses
Alexandria VA 22311



Ada Joint Program Office
Dr. John Solomond, Director
Department of Defense
Washington DC 20301

# DECLARATION OF CONFORMANCE

Customer: Irvine Compiler Corporation

Ada Validation Facility: ASD/SCEL, Wright-Patterson AFB OH 45433-6503

ACVC Version: 1.11

Ada Implementation:

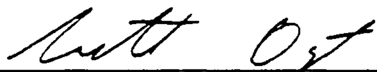
Compiler Name and Version: ICC Ada v7.0.0

Host Computer System: VAXstation 3100 Model M38, VMS 5.3-1

Target Computer System: i80960MC (bare machine)

## Customer's Declaration

I, the undersigned, representing Irvine Compiler Corporation, declare that Irvine Compiler Corporation has no knowledge of deliberate deviations from the Ada Language Standard ANSI/MIL-STD-1815A in the implementation listed in this declaration.



Date: 4/8/91

Scott Ogata, Executive Vice-President
Irvine Compiler Corporation
34 Executive Park, Suite 270
Irvine, CA 92714

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION

1.1 USE OF THIS VALIDATION SUMMARY REPORT . . . . . . 1-1
1.2 REFERENCES . . . . . . . . . . . . . . . . . . . . 1-2
1.3 ACVC TEST CLASSES . . . . . . . . . . . . . . . . 1-2
1.4 DEFINITION OF TERMS . . . . . . . . . . . . . . . 1-3

CHAPTER 2 IMPLEMENTATION DEPENDENCIES

2.1 WITHDRAWN TESTS . . . . . . . . . . . . . . . . . 2-1
2.2 INAPPLICABLE TESTS . . . . . . . . . . . . . . . . 2-1
2.3 TEST MODIFICATIONS . . . . . . . . . . . . . . . . 2-4

CHAPTER 3 PROCESSING INFORMATION

3.1 TESTING ENVIRONMENT . . . . . . . . . . . . . . . 3-1
3.2 SUMMARY OF TEST RESULTS . . . . . . . . . . . . . 3-1
3.3 TEST EXECUTION . . . . . . . . . . . . . . . . . . 3-2

APPENDIX A MACRO PARAMETERS

APPENDIX B COMPILATION SYSTEM AND LINKER OPTIONS

APPENDIX C APPENDIX F OF THE Ada STANDARD

# CHAPTER 1

# INTRODUCTION

The Ada implementation described above was tested according to the Ada Validation Procedures [Pro90] against the Ada Standard [Ada83] using the current Ada Compiler Validation Capability (ACVC). This Validation Summary Report (VSR) gives an account of the testing of this Ada implementation. For any technical terms used in this report, the reader is referred to [Pro90]. A detailed description of the ACVC may be found in the current ACVC User's Guide [UG89].

## 1.1 USE OF THIS VALIDATION SUMMARY REPORT

Consistent with the national laws of the originating country, the Ada Certification Body 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 implementation has no nonconformities to the Ada Standard other than those presented. Copies of this report are available to the public from the AVF which performed this validation or from:

National Technical Information Service
5285 Port Royal Road
Springfield VA 22161

Questions regarding this report or the validation test results should be directed to the AVF which performed this validation or to:

Ada Validation Organization
Computer & Software Engineering Division
Institute for Defense Analyses
1801 North Beauregard Street
Alexandria VA 22311-1772

## 1.2 REFERENCES

[Ada83] Reference Manual for the Ada Programming Language, ANSI/MIL-STD-1815A, February 1983 and ISO 8652-1987.

[Pro90] Ada Compiler Validation Procedures, Version 2.1, Ada Joint Program Office, August 1990.

[UG89] Ada Compiler Validation Capability User's Guide, 21 June 1989.

## 1.3 ACVC TEST CLASSES

Compliance of Ada implementations is tested by means of the ACVC. The ACVC contains a collection of test 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. Class B and class L tests are expected to produce errors at compile time and link time, respectively.

The executable tests are written in a self-checking manner and produce a PASSED, FAILED, or NOT APPLICABLE message indicating the result when they are executed. Three Ada library units, the packages REPORT and SPPRT13, and the procedure CHECK_FILE are used for this purpose. The package REPORT 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 package SPPRT13 is used by many tests for Chapter 13 of the Ada Standard. 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. If these units are not operating correctly, validation testing is discontinued.

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 all violations of the Ada Standard are detected. Some of the class B tests contain legal Ada code which must not be flagged illegal by the compiler. This behavior is also verified.

Class L tests check that an Ada implementation correctly detects violation of the Ada Standard involving multiple, separately compiled units. Errors are expected at link time, and execution is attempted.

In some tests of the ACVC, certain macro strings have to be replaced by implementation-specific values -- for example, the largest integer. A list of the values used for this implementation is provided in Appendix A. In addition to these anticipated test modifications, additional changes may be required to remove unforeseen conflicts between the tests and implementation-dependent characteristics. The modifications required for this implementation are described in section 2.3.

For each Ada implementation, a customized test suite is produced by the AVF. This customization consists of making the modifications described in the preceding paragraph, removing withdrawn tests (see section 2.1) and, possibly some inapplicable tests (see section 2.2 and [UG89]).

In order to pass an ACVC an Ada implementation must process each test of the customized test suite according to the Ada Standard.

## 1.4 DEFINITION OF TERMS

| | |
|---|---|
| Ada Compiler | The software and any needed hardware that have to be added to a given host and target computer system to allow transformation of Ada programs into executable form and execution thereof. |
| Ada Compiler Validation Capability (ACVC) | The means for testing compliance of Ada implementations, consisting of the test suite, the support programs, the ACVC user's guide and the template for the validation summary report. |
| Ada Implementation | An Ada compiler with its host computer system and its target computer system. |
| Ada Joint Program Office (AJPO) | The part of the certification body which provides policy and guidance for the Ada certification system. |
| Ada Validation Facility (AVF) | The part of the certification body which carries out the procedures required to establish the compliance of an Ada implementation. |
| Ada Validation Organization (AVO) | The part of the certification body that provides technical guidance for operations of the Ada certification system. |
| Compliance of an Ada Implementation | The ability of the implementation to pass an ACVC version. |
| Computer System | A functional unit, consisting of one or more computers and associated software, that uses common storage for all or part of a program and also for all or part of the data necessary for the execution of the program; executes user-written or user-designated programs; performs user-designated data manipulation, including arithmetic operations and logic operations; and that can execute programs that modify themselves during execution. A computer system may be a stand-alone unit or may consist of several inter-connected units. |

| | |
|---|---|
| Conformity | Fulfillment by a product, process, or service of all requirements specified. |
| Customer | An individual or corporate entity who enters into an agreement with an AVF which specifies the terms and conditions for AVF services (of any kind) to be performed. |
| Declaration of Conformance | A formal statement from a customer assuring that conformity is realized or attainable on the Ada implementation for which validation status is realized. |
| Host Computer System | A computer system where Ada source programs are transformed into executable form. |
| Inapplicable test | A test that contains one or more test objectives found to be irrelevant for the given Ada implementation. |
| ISO | International Organization for Standardization. |
| LRM | The Ada standard, or Language Reference Manual, published as ANSI/MIL-STD-1815A-1983 and ISO 8652-1987. Citations from the LRM take the form "<section>.<subsection>:<paragraph>." |
| Operating System | Software that controls the execution of programs and that provides services such as resource allocation, scheduling, input/output control, and data management. Usually, operating systems are predominantly software, but partial or complete hardware implementations are possible. |
| Target Computer System | A computer system where the executable form of Ada programs are executed. |
| Validated Ada Compiler | The compiler of a validated Ada implementation. |
| Validated Ada Implementation | An Ada implementation that has been validated successfully either by AVF testing or by registration [Pro90]. |
| Validation | The process of checking the conformity of an Ada compiler to the Ada programming language and of issuing a certificate for this implementation. |
| Withdrawn test | A test found to be incorrect and not used in conformity testing. A test may be incorrect because it has an invalid test objective, fails to meet its test objective, or contains erroneous or illegal use of the Ada programming language. |

CHAPTER 2

IMPLEMENTATION DEPENDENCIES

## 2.1 WITHDRAWN TESTS

The following tests have been withdrawn by the AVO. The rationale for withdrawing each test is available from either the AVO or the AVF. The publication date for this list of withdrawn tests is 14 March 1991.

| | | | | | |
|---|---|---|---|---|---|
| E28005C | B28006C | C34006D | C35702A | C35702B | C35508I |
| C35508J | C35508M | C35508N | B41308B | C43004A | C45114A |
| C45346A | C45612A | C45612B | C45612C | C45651A | C46022A |
| B49008A | A74006A | C74308A | B83022B | B83022H | B83025B |
| B83025D | C83026A | B83026B | C83041A | B85001L | C86001F |
| C94021A | C97116A | C98003B | BA2011A | CB7001A | CB7001B |
| CB7004A | CC1223A | BC1226A | CC1226B | BC3009B | BD1B02B |
| BD1B06A | AD1B08A | BD2A02A | CD2A21E | CD2A23E | CD2A32A |
| CD2A41A | CD2A41E | CD2A87A | CD2B15C | BD3006A | BD4008A |
| CD4022A | CD4022D | CD4024B | CD4024C | CD4024D | CD4031A |
| CD4051D | CD5111A | CD7004C | ED7005D | CD7005E | AD7006A |
| CD7006E | AD7201A | AD7201E | CD7204B | AD7206A | BD8002A |
| BD8004C | CD9005A | CD9005B | CDA201E | CE2107I | CE2117A |
| CE2117B | CE2119B | CE2205B | CE2405A | CE3111C | CE3116A |
| CE3118A | CE3411B | CE3412B | CE3607B | CE3607C | CE3607D |
| CE3812A | CE3814A | CE3902B | | | |

## 2.2 INAPPLICABLE TESTS

A test is inapplicable if it contains test objectives which are irrelevant for a given Ada implementation. Reasons for a test's inapplicability may be supported by documents issued by the ISO and the AJPO known as Ada Commentaries and commonly referenced in the format AI-ddddd. For this implementation, the following tests were determined to be inapplicable for the reasons indicated; references to Ada Commentaries are included as appropriate.

The following 201 tests have floating-point type declarations requiring more digits than SYSTEM.MAX_DIGITS:

| | |
|---|---|
| C24113L..Y (14 tests) | C35705L..Y (14 tests) |
| C35706L..Y (14 tests) | C35707L..Y (14 tests) |
| C35708L..Y (14 tests) | C35802L..Z (15 tests) |
| C45241L..Y (14 tests) | C45321L..Y (14 tests) |
| C45421L..Y (14 tests) | C45521L..Z (15 tests) |
| C45524L..Z (15 tests) | C45621L..Z (15 tests) |
| C45641L..Y (14 tests) | C46012L..Z (15 tests) |

The following 20 tests check for the predefined type LONG_INTEGER; for this implementation, there is no such type:

| | | | | |
|---|---|---|---|---|
| C35404C | C45231C | C45304C | C45411C | C45412C |
| C45502C | C45503C | C45504C | C45504F | C45611C |
| C45613C | C45614C | C45631C | C45632C | B52004D |
| C55B07A | B55B09C | B86001W | C86006C | CD7101F |

C35713C, B86001U, and C86006G check for the predefined type LONG_FLOAT; for this implementation, there is no such type.

C35713D and B86001Z check for a predefined floating-point type with a name other than FLOAT, LONG_FLOAT, or SHORT_FLOAT; for this implementation, there is no such type.

C45423A..B (2 tests), C45523A, and C45622A check that the proper exception is raised if MACHINE_OVERFLOWS is TRUE and the results of various floating-point operations lie outside the range of the base type; for this implementation, MACHINE_OVERFLOWS is FALSE.

C45531M..P and C45532M..P (8 tests) check fixed-point operations for types that require a SYSTEM.MAX_MANTISSA of 47 or greater; for this implementation, MAX_MANTISSA is less than 47.

C45536A, C46013B, C46031B, C46033B, and C46034B contain length clauses that specify values for 'SMALL that are not powers of two or ten; this implementation does not support such values for 'SMALL.

B86001Y uses the name of a predefined fixed-point type other than type DURATION; for this implementation, there is no such type.

CD1009C checks whether a length clause can specify a non-default size for a floating-point type; this implementation does not support such sizes.

CD2A53A checks operations of a fixed-point type for which a length clause specifies a power-of-ten TYPE'SMALL; this implementation does not support decimal 'SMALLs. (See section 2.3.)

CD2A84A, CD2A84E, CD2A84I..J (2 tests), and CD2A84O use length clauses to specify non-default sizes for access types; this implementation does not support such sizes.

BD8001A, BD8003A, BD8004A..B (2 tests), and AD8011A use machine code insertions; this implementation provides no package MACHINE_CODE.

AE2101C and EE2201D..E (2 tests) use instantiations of package SEQUENTIAL_IO with unconstrained array types and record types with discriminants without defaults; these instantiations are rejected by this compiler.

AE2101H, EE2401D, and EE2401G use instantiations of package DIRECT_IO with unconstrained array types and record types with discriminants without defaults; these instantiations are rejected by this compiler.

The tests listed in the following table check that USE_ERROR is raised if the given file operations are not supported for the given combination of mode and access method; this implementation supports these operations.

| Test | File Operation | Mode | File Access Method |
|---|---|---|---|
| CE2102D | CREATE | IN_FILE | SEQUENTIAL_IO |
| CE2102E | CREATE | OUT_FILE | SEQUENTIAL_IO |
| CE2102F | CREATE | INOUT_FILE | DIRECT_IO |
| CE2102I | CREATE | IN_FILE | DIRECT_IO |
| CE2102J | CREATE | OUT_FILE | DIRECT_IO |
| CE2102N | OPEN | IN_FILE | SEQUENTIAL_IO |
| CE2102O | RESET | IN_FILE | SEQUENTIAL_IO |
| CE2102P | OPEN | OUT_FILE | SEQUENTIAL_IO |
| CE2102Q | RESET | OUT_FILE | SEQUENTIAL_IO |
| CE2102R | OPEN | INOUT_FILE | DIRECT_IO |
| CE2102S | RESET | INOUT_FILE | DIRECT_IO |
| CE2102T | OPEN | IN_FILE | DIRECT_IO |
| CE2102U | RESET | IN_FILE | DIRECT_IO |
| CE2102V | OPEN | OUT_FILE | DIRECT_IO |
| CE2102W | RESET | OUT_FILE | DIRECT_IO |
| CE3102E | CREATE | IN_FILE | TEXT_IO |
| CE3102F | RESET | Any Mode | TEXT_IO |
| CE3102G | DELETE | -------- | TEXT_IO |
| CE3102I | CREATE | OUT_FILE | TEXT_IO |
| CE3102J | OPEN | IN_FILE | TEXT_IO |
| CE3102K | OPEN | OUT_FILE | TEXT_IO |

CE2203A checks that WRITE raises USE_ERROR if the capacity of an external sequential file is exceeded; this implementation cannot restrict file capacity.

CE2403A checks that WRITE raises USE_ERROR if the capacity of an external direct file is exceeded; this implementation cannot restrict file capacity.

CE3304A checks that SET_LINE_LENGTH and SET_PAGE_LENGTH raise USE_ERROR if they specify an inappropriate value for the external file; there are no inappropriate values for this implementation.

CE3413B checks that PAGE raises LAYOUT_ERROR when the value of the page number exceeds COUNT'LAST; for this implementation, the value of COUNT'LAST is greater than 150000, making the checking of this objective impractical.

CE2108B, CE2108D, CE2108F, CE2108H, CE3112B, CE3112D (6 tests) checks for support of permanent files, and for this implementation, a file system has been implemented on the bare target that cannot support permanent files, making these tests inapplicable.

## 2.3 TEST MODIFICATIONS

Modifications (see section 1.3) were required for 48 tests and 2 support packages.

The following tests were split into two or more tests because this implementation did not report the violations of the Ada Standard in the way expected by the original tests.

| | | | |
|---|---|---|---|
| B24009A | B59001E | B59001F | B83033B |

CD2A53A was graded inapplicable by Evaluation Modification as directed by the AVO. The test contains a specification of a power-of-10 value as 'SMALL for a fixed-point type. The AVO ruled that, under ACVC 1.11, support of decimal 'SMALLs may be omitted.

The tests below were graded passed by Test Modification as directed by the AVO. These tests all use one of the generic support procedures, Length_Check or Enum_Check (in support files LENCHECK.ADA & ENUMCHEK.ADA), which use the generic procedure Unchecked_Conversion. This implementation rejects instantiations of Unchecked_Conversion with array types that have non-static index ranges. The AVO ruled that since this issue was not addressed by AI-00590, which addresses required support for Unchecked_Conversion, and since AI-00590 is considered not binding under ACVC 1.11, the support procedures could be modified to remove the use of Unchecked_Conversion. Lines 40..43, 50, and 56..58 in LENCHECK and lines 42, 43, and 58..63 in ENUMCHEK were commented out.

| | | | | | |
|---|---|---|---|---|---|
| CD1009A | CD1009I | CD1009M | CD1009V | CD1009W | CD1C03A |
| CD1C04D | CD2A21A..C | CD2A22J | CD2A23A..B | CD2A24A | CD2A31A..C |
| CD2A81A | CD3014C | CD3014F | CD3015C | CD3015E..F | CD3015H |
| CD3015K | CD3022A | CD4061A | | | |

LA3004A and LA3004B were graded passed by Processing and Evaluation Modification as directed by the AVO. These tests check that when the bodies of library units (a procedure, function, and package) are made obsolete, that the implementation will detect the missing bodies at link time. This implementation will detect the missing bodies at link time. This implementation detects the missing bodies, but it also issues error messages that indicate that the main procedures must be re-compiled; this

behavior violates LRM 10.3:6 & 8. To confirm that the implementation does not in fact require recompilation of the main procedures, the obsolete bodies were re-compiled (files LA3004A2..4 and LA3004B2..4 were modified to contain only the bodies) and the tests were then linked and executed; Report.Result output "NOT APPLICABLE" as expected.

The AVO ruled that CE2102C, CE2102H, CE2103A..B, CE3102B, CE3107A (6 tests) are graded passed by Evaluation Modification.

The AVO accepts the implementation's behavior, given that there is no way to create an illegal filename; these tests may be graded PASSED by the Evaluation Modification that allows the result FAILED only if the sole Report.Failed output is as follows (as was submitted in the dispute):

```
CE2102C:  NAME_ERROR NOT RAISED - CREATE {SEQ (DIR)} 1  [63 (60)]
 (& -H)   NAME_ERROR NOT RAISED - CREATE {SEQ (DIR)} 2  [81 (78)]

CE2103A:  NAME_ERROR NOT RAISED - UNSUCCESSFUL CREATE   [52 (51) <45>]
 (& -B)
 <& -3107A>

CE3102B:  NO EXCEPTION RAISED FOR <S...NAME1> - CREATE  [ 95]
          NO EXCEPTION RAISED FOR <S...NAME2> - CREATE  [110]
          OTHER EXCEPTION RAISED FOR <S...NAME1> - OPEN [135]
          OTHER EXCEPTION RAISED FOR <S...NAME2> - OPEN [151]
```

These tests are ruled to have been passed, since they all contain applicable checks that indeed were passed. This implementation supports a file system, and in cases where an I/O operation is attempted with a name parameter that does not identify an external file the exception NAME_ERROR must be raised; this implementation accepts all strings as valid file_names and so the conditions that raise NAME_ERROR are reduced, but when they obtain the implementation conforms.

The AVO ruled that CE2108B, CE2108D, CE2108F, CE2108H, CE3112B, CE3112D (6 tests) are graded inapplicable by Evaluation Modification.

The AVO accepts the implementation's behavior, given that a file system has been implemented on the bare target that cannot support permanent files; these tests may be graded inapplicable by Evaluation Modification if the tests report FAILED and the sole Report.Failed messages are

```
CE2108B/D:  UNEXPECTED EXCEPTION RAISED ON OPENING OF TEXT FILE,
            WHICH SHOULD HAVE BEEN CREATED BY TEST CE2108{A/C}.ADA [77]

& CE3112B:  " ... <as above, but with test name:> CE3112A.ADA      [61]
```

or if a run-time system error report results from an unhandled NAME_ERROR, for tests CE2108F/H & CE3112D.

C34009D and C34009J were graded passed by Evaluation Modification as directed by the AVO. These tests check that 'SIZE for a composite type is greater than or equal to the sum of its components' 'SIZE values; but this

issue is addressed by AI-00825, which has not been considered; there is not an obvious interpretation. This implementation represents array components whose length depends on a discriminant with a default value by implicit pointers into the heap space; thus, the 'SIZE of such a record type might be less than the sum of its components 'SIZEs, since the size of the heap space that is used by the varying-length array components is not counted as part of the 'SIZE of the record type. These tests were graded passed given that the Report.Result output was "FAILED" and the only Report.Failed output was "INCORRECT 'BASE'SIZE", from line 195 of C34009D and line 193 in C34009J.

# CHAPTER 3

# PROCESSING INFORMATION

## 3.1 TESTING ENVIRONMENT

The Ada implementation tested in this validation effort is described adequately by the information given in the initial pages of this report.

For technical and sales information about this Ada implementation, contact:

Joe Kohli
Irvine Compiler Corporation
34 Executive Park, Suite 270
Irvine, California 92714

Testing of this Ada implementation was conducted at the customer's site by a validation team from the AVF.

## 3.2 SUMMARY OF TEST RESULTS

An Ada Implementation passes a given ACVC version if it processes each test of the customized test suite in accordance with the Ada Programming Language Standard, whether the test is applicable or inapplicable; otherwise, the Ada Implementation fails the ACVC [Pro90].

PROCESSING INFORMATION

For all processed tests (inapplicable and applicable), a result was obtained that conforms to the Ada Programming Language Standard.

| | |
|---|---|
| a) Total Number of Applicable Tests | 3784 |
| b) Total Number of Withdrawn Tests | 93 |
| c) Processed Inapplicable Tests | 92 |
| d) Non-Processed I/O Tests | 0 |
| e) Non-Processed Floating-Point Precision Tests | 201 |
| f) Total Number of Inapplicable Tests | 293 |
| g) Total Number of Tests for ACVC 1.11 | 4170 |

All I/O tests of the test suite were processed because this implementation supports a file system. The above number of floating-point tests were not processed because they used floating-point precision exceeding that supported by the implementation. When this compiler was tested, the tests listed in section 2.1 had been withdrawn because of test errors.

## 3.3 TEST EXECUTION

A magnetic tape containing the customized test suite (see section 1.3) was taken on-site by the validation team for processing. The contents of the magnetic tape were loaded onto the host computer using NFS from a remote host with a directly connected 9-track tape drive. The communication network was Ethernet.

After the test files were loaded onto the host computer, the full set of tests was processed by the Ada implementation.

The tests were compiled and linked on the host computer system, as appropriate. The executable images were transferred to the target computer system by the communications link described above, and run. The results were captured on the host computer system.

Testing was performed using command scripts provided by the customer and reviewed by the validation team. See Appendix B for a complete listing of the processing options for this implementation. It also indicates the default options. The options invoked explicitly for validation testing during this test were:

| Option \| Switch | Effect |
|---|---|
| -stack_check | Enable stack overflow checking |
| -numeric_check | Enable arithmetic overflow checks |
| -elaboration_check | Enable elaboration checking |
| -noinfo | Suppress informationals |
| -quiet | Suppress compiler banners |
| -link=<main program> | Link the provided subprogram |
| -listing | Generate a compilation listing |
| -maximum_error=0 | Set maximum number of errors before abort (A value of zero specifies that there is no maximum error limit.) |
| -nopreprocess | Disable compilation of preprocessor directives |
| -nowarnings | Suppress warnings |

Test output, compiler and linker 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.

## APPENDIX A

## MACRO PARAMETERS

This appendix contains the macro parameters used for customizing the ACVC. The meaning and purpose of these parameters are explained in [UG89]. The parameter values are presented in two tables. The first table lists the values that are defined in terms of the maximum input-line length, which is the value for $MAX_IN_LEN--also listed here. These values are expressed here as Ada string aggregates, where "V" represents the maximum input-line length.

| Macro Parameter | Macro Value |
|---|---|
| $MAX_IN_LEN | 254 |
| $BIG_ID1 | (1..V-1 => 'A', V => '1') |
| $BIG_ID2 | (1..V-1 => 'A', V => '2') |
| $BIG_ID3 | (1..V/2 => 'A') & '3' & (1..V-1-V/2 => 'A') |
| $BIG_ID4 | (1..V/2 => 'A') & '4' & (1..V-1-V/2 => 'A') |
| $BIG_INT_LIT | (1..V-3 => '0') & "298" |
| $BIG_REAL_LIT | (1..V-5 => '0') & "690.0" |
| $BIG_STRING1 | '"' & (1..V/2 => 'A') & '"' |
| $BIG_STRING2 | '"' & (1..V-1-V/2 => 'A') & '1' & '"' |
| $BLANKS | (1..V-20 => ' ') |
| $MAX_LEN_INT_BASED_LITERAL | "2:" & (1..V-5 => '0') & "11:" |
| $MAX_LEN_REAL_BASED_LITERAL | "16:" & (1..V-7 => '0') & "F.E:" |

MACRO PARAMETERS

$MAX_STRING_LITERAL '"' & (1..V-2 => 'A') & '"'

The following table lists all of the other macro parameters and their respective values.

| Macro Parameter | Macro Value |
|---|---|
| $ACC_SIZE | 96 |
| $ALIGNMENT | 4 |
| $COUNT_LAST | 2147483647 |
| $DEFAULT_MEM_SIZE | 2097152 |
| $DEFAULT_STOR_UNIT | 8 |
| $DEFAULT_SYS_NAME | I80960 |
| $DELTA_DOC | 0.000_000_000_465_661_287_307_739_257_812_5 |
| $ENTRY_ADDRESS | address_of_entry1 |
| $ENTRY_ADDRESS1 | address_of_entry2 |
| $ENTRY_ADDRESS2 | address_of_entry3 |
| $FIELD_LAST | 2147483647 |
| $FILE_TERMINATOR | ' ' |
| $FIXED_NAME | NO_SUCH_FIXED_TYPE |
| $FLOAT_NAME | NO_SUCH_FLOAT_NAME |
| $FORM_STRING | "" |
| $FORM_STRING2 | "CANNOT_RESTRICT_FILE_CAPACITY" |
| $GREATER_THAN_DURATION | 524287.5 |
| $GREATER_THAN_DURATION_BASE_LAST | 10000000.0 |
| $GREATER_THAN_FLOAT_BASE_LAST | 1.1235582092889469433370739E+307 |
| $GREATER_THAN_FLOAT_SAFE_LARGE | 1.1235582092889469433370739E+307 |

| | |
|---|---|
| $GREATER_THAN_SHORT_FLOAT_SAFE_LARGE | 1.0E308 |
| $HIGH_PRIORITY | 255 |
| $ILLEGAL_EXTERNAL_FILE_NAME1 | /NODIRECTORY/FILENAME |
| $ILLEGAL_EXTERNAL_FILE_NAME2 | /NODIRECTORY/THIS-FILE-NAME-IS-ILLEGAL |
| $INAPPROPRIATE_LINE_LENGTH | -1 |
| $INAPPROPRIATE_PAGE_LENGTH | -1 |
| $INCLUDE_PRAGMA1 | PRAGMA INCLUDE ("a28006d1.tst") |
| $INCLUDE_PRAGMA2 | PRAGMA INCLUDE ("b28006f1.tst") |
| $INTEGER_FIRST | -2147483648 |
| $INTEGER_LAST | 2147483647 |
| $INTEGER_LAST_PLUS_1 | 2147483648 |
| $INTERFACE_LANGUAGE | C |
| $LESS_THAN_DURATION | -524287.5 |
| $LESS_THAN_DURATION_BASE_FIRST | -10000000.0 |
| $LINE_TERMINATOR | ASCII.LF |
| $LOW_PRIORITY | 0 |
| $MACHINE_CODE_STATEMENT | NULL; |
| $MACHINE_CODE_TYPE | NO_SUCH_TYPE |
| $MANTISSA_DOC | 31 |
| $MAX_DIGITS | 15 |
| $MAX_INT | 2147483647 |
| $MAX_INT_PLUS_1 | 2147483648 |
| $MIN_INT | -2147483648 |

MACRO PARAMETERS

| | |
|---|---|
| $NAME | TINY_INTEGER |
| $NAME_LIST | I80960 |
| $NAME_SPECIFICATION1 | ./X2120A |
| $NAME_SPECIFICATION2 | ./X2102B |
| $NAME_SPECIFICATION3 | ./X3119A |
| $NEG_BASED_INT | 16#FFFFFFFE# |
| $NEW_MEM_SIZE | 2097152 |
| $NEW_STOR_UNIT | 8 |
| $NEW_SYS_NAME | I80960 |
| $PAGE_TERMINATOR | ASCII.FF |
| $RECORD_DEFINITION | NEW INTEGER; |
| $RECORD_NAME | NO_SUCH_MACHINE_CODE_TYPE |
| $TASK_SIZE | 32 |
| $TASK_STORAGE_SIZE | 16383 |
| $TICK | (1.0/4096.0) |
| $VARIABLE_ADDRESS | address_of_var1 |
| $VARIABLE_ADDRESS1 | address_of_var2 |
| $VARIABLE_ADDRESS2 | address_of_var3 |
| $YOUR_PRAGMA | EXPORT_OBJECT |

# APPENDIX B

## COMPILATION SYSTEM AND LINKER OPTIONS

The compiler and linker options of this Ada implementation, as described in this Appendix, are provided by the customer. Unless specifically noted otherwise, references in this appendix are to compiler and linker documentation and not to this report.

```
Passive ICC Qualifiers
 -arguments -args            Display all arguments to the ICC command
 -display                    Display all actions as they are performed
 -help                       List commonly used qualifiers
 -helpall -all               List all available qualifiers
 -hide                       Suppress naming ICC subprocesses (VMS only)
 -ignore_cfg -icfg           Ignore configuration file qualifiers
 -ignore_env -ienv           Ignore environment variable qualifiers
 -normal                     Compile with 'normal' messages
 -quiet                      Compile quietly
 -save_pas2                  Save all intermediate files
 -save_temps -save           Save temporary files generated by pas2
 -succeed                    Always return the success status
 -symbols -syms              Show current value of ICC command's symbols
 -temp                       Use temporary directory for intermediate files
 -tmp=<arg>                  Use <arg> as the temporary directory
 -unique                     Use unique file names for intermediate files
 -verbose                    Compile with verbose messages

Active ICC Qualifiers
 -architecture=<arg>         Specify i80960 architecture KA,KB,MC,CA,MM,MX
 -asm                        Stop at the generated assembly file
 -asm_flag -asmf=<arg>       Explicitly add flag(s) for the assembler
 -asm_name -asmn=<arg>       Use <arg> as the assembler
 -c                          Stop at the generated C source file
 -cc_flag -ccf=<arg>         Explicitly add flag(s) for the C compiler
 -cc_name -ccn=<arg>         Use <arg> as the C compiler
 -coptimize                  Invoke the C optimizer
 -exe                        Link a non-Ada program
 -execute                    Execute and delete executable after linking
 -execute_flag -execf=<arg>  Explicitly add flag(s) for the executable
 -ada_ext=<arg>              Set Ada file extension
 -asm_ext=<arg>              Set assembly file extension
 -c_ext=<arg>                Set C file extension
 -exe_ext=<arg>              Set executable file extension
 -int_ext=<arg>              Set IFORM file extension
 -lib_ext=<arg>              Set object archive/library file extension
 -mrg_ext=<arg>              Set list merge file extension
 -obj_ext=<arg>              Set object file extension
 -opt_ext=<arg>              Set optimized IFORM file extension
 -pas_ext=<arg>              Set Pascal file extension
 -int                        Stop at the generated iform file
 -keep_temps=<arg>           Save file(s) with extension(s) in <arg>
 -library -lib=<arg>         Set the compilation library directory
 -loader_name -loader=<arg>  Use <arg> as the loader
 -loader_preflag -loadpref=<arg>
                             Explicitly add pre-flag(s) for loader
 -loader_postflag -loadpstf=<arg>
                             Explicitly add post-flag(s) for loader
 -map=<arg>                  Generate a link map file (ICC linker only)
 -merge                      Invoke the ICC list merger
 -mrg                        Stop at the generated list merge file
 -obj                        Stop at the generated object file [default]
 -objlib=<arg>               Install the object file in library <arg>
 -objlib_flag -objlibf=<arg> Explicitly add flag(s) for object librarian
 -objlib_name -objlibn=<arg> Use <arg> as the object librarian
 -ont                        Stop at the optimizer iform file
 -optimize -opt              Invoke the Ada optimizer
 -preloader=<arg>            Execute <arg> before linking
 -preloader_flag -preloadf=<arg>
                             Explicitly add flag(s) for preloader
 -postloader=<arg>           Execute <arg> after linking
 -postloader_flag -pstloadf=<arg>
                             Explicitly add flag(s) for postloader
 -ranlib_name -ranlibn=<arg> Use <arg> as the ranlib library processor
 -release=<arg>              Set the release directory
 -show_only                  Display all actions to be performed
 -system=<arg>               Set the system library directory
 -tool_version=<arg>         Specify the ICC toolset version

Ada Qualifiers
 -information                Enable informational warnings [default]
 -checks                     Enable all runtime checks [default]
 -compatible_calls           Generate calls compatible with C calls
 -cross_reference -xref      Generate cross-reference file (.xrf)
 -declare=<arg>              Declare an identifier
 -debugger                   Compile for the Ada symbolic debugger
 -elaboration_check -elab_check
                             Generate ELABORATION checking
 -exception_info             Enable extra EXCEPTION information [default]
 -information                Enable informational warnings [default]
 -listing                    Generate list file (.lst)
 -maximum_errors=<arg>       Set maximum number of errors reported
 -preprocess                 Generate commented preprocess file (.app)
 -rate                       Rate code efficiency
 -stack_check                Generate stack checking code
 -syntax_only                Syntax check only
 -trim                       Generate trimmed preprocess file (.app)
 -warnings -w                Enable warnings
 -wrap                       Enable auto-wrapping error messages [default]
```

```
 -zero                        Zero all records [default]

ICC Code Generator Qualifiers
 -branch_relative             Use relative branches (BSO only)
 -const_in_code               Place constant aggregates in CODE segment
 -hostdebugger -dbx -cdb -xdbGenerate host debugger information
 -extended_listing -exl       Generate extended code listing output
 -leaf_procedures             Generate LEAF procs when possible (i80960 only)
 -gprofile                    Generate runtime 'gprof' profiling
 -loc_info                    Generate extended local information
 -frame_size                  Generate frame size for each subp (i80960 only)
 -names                       Generate namelist file (.n)
 -numeric_check -numchk       Generate overflow detection code
 -probe_stack                 Generate stack probes
 -profile                     Generate runtime profiling
 -real                        Use real names
 -static                      Static mode (C code generator only)

ICC Prelinker Qualifiers
 -complink -cl=<arg>          Ada compile and link <arg> into one file
 -force_link                  Force link, even if dependency errors
 -heap_size=<arg>             Allocate <arg> bytes of heap (i80960 only)
 -link -l=<arg>               Ada link compilation unit <arg>
 -output -o=<arg>             Use <arg> as the executable file name
 -stack_size -stack=<arg>     Allocate <arg> bytes of user stack (i80960 only)
 -trap                        Establish numeric fault trap handler
```

# APPENDIX C

## 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 this Ada implementation, as described in this Appendix, are provided by the customer. Unless specifically noted otherwise, references in this Appendix are to compiler documentation and not to this report. Implementation-specific portions of the package STANDARD, which are not a part of Appendix F, are:

```
package STANDARD is
    ..........

    type INTEGER is range -2147483648 .. 2147483647;

    type FLOAT is digits 15
          range -1.12355820928895E+307 .. -1.12355820928895E+307;

    type DURATION is delta 2.0**(-12)
          range -524287.0 .. 524287.0;

    type SHORT_INTEGER is range -32768 .. 32767;

    type SHORT_FLOAT is digits 6
         range -2.12676E+37 .. 2.12676E+37;

    type TINY_INTEGER is range -128 ..127;

    ..........
end STANDARD;
```

# Appendix F
# ICC Ada Version 7.0
# VAX / VMS to Intel i80960MC / Bare

Irvine Compiler Corporation
34 Executive Park, Suite 270
Irvine, CA 92714
(714) 250-1366

April 23, 1991

## 1 ICC Ada Implementation

The Ada language definition leaves implementation of certain features to the language implementor. This appendix describes the implementation-dependent characteristics of ICC Ada.

## 2 Pragmas

The following predefined pragmas are implemented in ICC Ada as described by the Ada Reference Manual:

**Elaborate** This pragma allows the user to modify the elaboration order of compilation units.

**Inline** Subprogram inlining is implemented. Inline substitutions are performed by the ICC optimizer. This pragma is not supported for generic subprograms or subprograms which contain nested subprograms.

**List** This pragma enables or disables writing to the output list file.

**Pack** Packing on arrays and records is implemented to the bit level. Slices of packed arrays are not implemented, except boolean arrays.

**Page** This pragma ejects a new page in the output list file (if enabled).

**Priority** This pragma sets the priority of a task or main program. The range of the subtype **priority** is 0..255.

The following predefined pragmas have been extended by ICC:

**Interface** This pragma is allowed to designate variables in addition to subprograms. It is also allowed to have an optional third parameter which is a string designating the name for the linker to use to reference the variable or subprogram. The third parameter has the same effect as pragma **Interface_name**.

**Suppress** In addition to suppressing the standard checks, ICC also permits suppressing the following:

**Exception_info** Suppressing **Exception_info** improves run-time performance by reducing the amount of information maintained for messages that appear when exceptions are propagated out of the main program or any task.

**All_checks** Suppressing **All_checks** suppresses all the standard checks as well as **Exception_info**.

The following predefined pragmas are currently not implemented by ICC:

| | | |
|---|---|---|
| **Controlled** | **Memory_size** | **Optimize** |
| **Shared** | **Storage_unit** | **System_name** |

The following additional pragmas have been defined by ICC: (For further details on these pragmas refer to the *ICC Ada User's Reference Guide.*)

**Compatible_calls** This pragma is used to specify that pass-by-reference parameter passing should be used for `OUT` and `IN OUT` scalar parameters. By default some of the ICC code generators use copy-in/copyback for scalar `OUT` and `IN OUT` parameters. This pragma allows pass-by-reference calls to be performed (primarily for downward compatibility).

**Compress** This pragma reduces the storage required for discrete subtypes in structures (arrays and records). Its single argument is the name

of a discrete subtype. It specifies that the subtype should be represented as compactly as possible (regardless of the representation of the subtype's base type) when the subtype is used in a structured type. The storage requirement for variables and parameters is not affected. Pragma **Compress** must appear prior to any reference to the named subtype.

**Export** This pragma is a complement to the predefined pragma **Interface**. It enables subprograms written in Ada to be called from other languages. It takes 2 or 3 arguments. The first is the language to be called from, the second is the subprogram name, and the third is an optional string designating the actual subprogram name to be used by the linker. Pragma **Export** must appear prior to the body of the designated subprogram.

**External_name** This pragma is equivalent to the ICC pragma **Export** with an implicit language type of "Ada" and a required external name. This pragma allows the user to specify the exact name of the subprogram that will be used in the generated object file. This pragma is provided for compatibility with existing Ada source files.

**Foreign** This pragma is used to add an object file or an object library file to the link command line used when linking the current compilation unit. Pragma **Foreign** is most frequently used in conjunction with pragma **Interface** so that foreign object files may be automatically included when the Ada compilation unit is linked. This pragma accepts two parameters. The first parameter indicates the *location* of the foreign object name on the link command line. It must be either `Normal` or `Post`. The second parameter is a string denoting the foreign object. This string is passed unmodified to the linker, so it should be a complete filename. If the location is `Normal`, then the foreign object is included immediately after the current Ada compilation unit on the link command line. If the location is `Post`, then the foreign object name is included at the end of the link command line. When multiple **Foreign Post** pragmas are used in a single program, the order of the foreign objects on the link command line is not defined.

**Interface_Name** This pragma takes a variable or subprogram name and a string to be used by the linker to reference the variable or subprogram. It has the same effect as the optional third parameter to pragma

**Interface.**

**Interrupt_handler** This pragma is used when writing procedures that will be invoked as interrupt handlers (independent of the tasking runtime). It does not have any parameters and must appear immediately within the declarative part of a procedure. The presence of this pragma causes the code generator to produce additional code on procedure entrance and exit which preserves the values of all global registers. This pragma has no other effect. This pragma is not implemented for all targets.

**No_zero** The single parameter to **No_zero** is the name of a record type. If the named record type has *holes* (or *gaps*) between fields that are normally initialized with zeroes, this pragma will suppress the clearing of the holes. If the named record type has no holes this pragma has no effect. When zeroing is disabled, comparisons (equality and non-equality) of the named type are disallowed. The use of this pragma can significantly reduce initialization time for record objects. The ICC Command Interpreter also has the qualifier `NO_ZERO` which has the effect of implicitly applying pragma **No_zero** to all record types declared in the file.

**Put, Put_line** These pragmas take any number of arguments and write their value to standard output at compile time when encountered by the compiler. The arguments may be expressions of any string, enumeration, or integer type, whose value is known at compile time. Pragma **Put_line** adds a carriage return after printing all of its arguments. These pragmas are often useful in conjunction with conditional compilation. They may appear anywhere a pragma is allowed.

**Static_elaboration** This pragma is used immediately within a package specification to state that all elaboration for the package is intended to be static. A warning will be generated for all objects within the package specification or corresponding body which require dynamic elaboration.

**Unsigned_Literal** This pragma, when applied to a 32-bit signed integer type, affects the interpretation of literals for the type. Literals between 2**31 and 2**32 are accepted for the type and are represented as if the type were unsigned. Operations on the type are unaffected. Note that (with checking suppressed), signed addition, subtraction,

and multiplication are equivalent to the corresponding unsigned operations. However, division and relational operators are different and should be used with caution. This pragma is used for type `Address` in package `System`.

**Uselib** This pragma is used within a context clause to explicitly add a list of named searched libraries to the library search list of the current compilation. The specified libraries are searched *first* in all following `WITH` clauses.

# 3 Preprocessor Directives

ICC Ada incorporates an integrated preprocessor whose directives begin with the keyword **Pragma**. They are as follows:

**Abort** This pragma causes the current compilation to be immediately halted. It is useful when unexpected circumstances arise inside conditionally compiled code.

**If, Elsif, Else, End** These preprocessor directives provide a conditional compilation mechanism. The directives **If** and **Elsif** take a boolean static expression as their single argument. If the expression evaluates to **False** then all text up to the next **End**, **Elsif** or **Else** directive is ignored. Otherwise, the text is compiled normally. The usage of these directives is identical to that of the similar Ada constructs. These directives may appear anywhere pragmas are allowed and can be nested to any depth.

**Include** This preprocessor directive provides a compile-time source file inclusion mechanism. It is integrated with the library management system, and the automatic recompilation facilities.

The results of the preprocessor pass, with the preprocessor directives deleted and the appropriate source code included, may be output to a file at compile-time. The preprocessor *may* be disabled by using the `NOPREPROCESS` command-line qualifier, in which case the above directives are ignored.

# 4 Attributes

ICC Ada implements all of the predefined attributes, including the Representation Attributes described in section 13.7 of the Ada RM.

Limitations of the predefined attributes are:

**Address** This attribute cannot be used with a statement label or a task entry.

The implementation defined attributes for ICC Ada are:

**Linear_address** This attribute is currently identical to the predefined attribute **Address**. In the future it will return the 32-bit linear address for 80960 targets and **Address** will return a full 64-bit virtual address.

**Version, System, Target, CG_mode** These attributes are used by ICC for conditional compilation. The prefix must be a discrete type. The values returned vary depending on the target architecture and operating system.

# 5 Input/Output Facilities

## 5.1

Standard Input and Output for embedded targets is implemented through the serial communications link between the host and embedded system. The normal PUT and GET TEXT_IO calls can be used for console-I/O.

Since embedded systems typically do not have access to disk storage, file I/O operations are *simulated* through a RAM-based *virtual file system* implemented by a low-level runtime support package. This virtual file system behaves like a disk-based file system, except that *files* do not persist between program executions. Therefore, it is not possible to write a virtual file with one program and it read it using another one. Also, the virtual file system never raises the exception NAME_ERROR since all file names are considered legal.

The implementation dependent specifications from TEXT_IO and DIRECT_IO are:

```
type COUNT is range 0 .. INTEGER'LAST;
subtype FIELD is INTEGER range 0 .. INTEGER'LAST;
```

## 5.2 FORM Parameter

ICC Ada implements the FORM parameter to the procedures OPEN and CREATE in DIRECT_IO, SEQUENTIAL_IO, and TEXT_IO to perform a variety of ancillary functions. The FORM parameter is a string literal containing parameters in the style of named parameter notation. In general the FORM parameter has the following format:

"$field_1$ => $value_1$ [, $field_n$ => $value_n$ ]"

where $field_i$ => $value_i$ can be

| | | |
|---|---|---|
| OPTION | => | NORMAL |
| OPTION | => | APPEND |
| PAGE_MARKERS | => | TRUE |
| PAGE_MARKERS | => | FALSE |
| READ_INCOMPLETE | => | TRUE |
| READ_INCOMPLETE | => | FALSE |
| MASK | => | <9 character protection mask> |

Each *field* is separated from its *value* with a "=>" and each *field/value* pair is separated by a comma. Spaces may be added anywhere between tokens and upper-case/lower-case is insignificant. For example:

```
create( f, out_file, "list.data",
    "option => append, PAGE_MARKERS => FALSE, Mask => rwxrwx---");
```

The interpretation of the fields and their values is presented below.

**OPTION** Files may be opened for appendage. This causes data to be appended directly onto the end of an existing file. The default is NORMAL which overwrites existing data. This field applies to OPEN in all three standard I/O packages. It has no effect if applied to procedure CREATE.

**PAGE_MARKERS** If FALSE then all TEXT_IO routines dealing with page terminators are disabled. They can be called, however they will not have any effect. In addition the page terminator character (^L) is allowed to be read with GET and GET_LINE. The default is TRUE which leaves page terminators active. Disabling page terminators is particularly useful when using TEXT_IO with an interactive device. For output files, disabling page terminators will suppress the page terminator character that is normally written at the end of the file.

**READ_INCOMPLETE** This field applies only to DIRECT_IO and SEQUENTIAL_IO and dictates what will be done with reads of incomplete records. Normally, if a READ is attempted and there is not enough data in the file for a complete record, then END_ERROR or DATA_ERROR will be raised. By setting READ_INCOMPLETE to TRUE, an incomplete record will be read successfully and the remaining bytes in the record will be zeroed. Attempting a read after the last incomplete record will raise END_ERROR. The SIZE function will reflect the fact that there is one more record when the last record is incomplete and READ_INCOMPLETE is TRUE.

**MASK** Set a protection mask to control access to a file. The mask is a standard nine character string notation used by Unix. The letters cannot be rearranged or deleted so that the string is always exactly nine characters long. This applies to CREATE in all three standard I/O packages. The default is determined at runtime by the user's environment settings.

The letters in the **Mask** are used to define the **Read**, **Write** and **eXecute** permissions for the User, Group and World respectively. Wherever the appropriate letter exists, the corresponding privilege is granted. If a "-" is used instead, then that privilege is denied. For example if **Mask** were set to "rw-rw----" then read and write privilege is granted to the file owner and his/her group, but no world rights are given.

If a syntax error is encountered within the FORM parameter then the exception USE_ERROR is raised at the OPEN or CREATE call. Also, the standard function TEXT_IO.FORM returns the current setting of the form fields, including default values, as a single string.

# 6 Package SYSTEM

Package SYSTEM is defined as:

```
package SYSTEM is

   type NAME is (I80960);

   -- Language Defined Constants

   SYSTEM_NAME  : constant NAME := I80960;
```

```
   STORAGE_UNIT : constant := 8;
   MEMORY_SIZE  : constant := 2*(2**20);
   MIN_INT      : constant := -2**31;
   MAX_INT      : constant := 2**31-1;
   MAX_DIGITS   : constant := 15;
   MAX_MANTISSA : constant := 31;
   FINE_DELTA   : constant := 2.0**(-31);
   TICK         : constant := 1.0/4096.0;

   type ADDRESS is range MIN_INT .. MAX_INT;    -- Signed 32-bit range.

   subtype PRIORITY is INTEGER range 0 .. 255;

   -- Constants for the STNHEAP package

   BITS_PER_BMU  : constant := 8;               -- Bits per basic machine unit.
   MAX_ALIGNMENT : constant := 4;               -- Maximum alignment required.
   MIN_MEM_BLOCK : constant := 1024;            -- Minimum chunk request size.

   -- Constants for the HOST package

   HOST_CLOCK_RESOLUTION : constant := 128;     -- 128 microseconds
   BASE_DATE_CORRECTION  : constant := 25_202;  -- Unix base date is 1/1/1970.

   pragma UNSIGNED_LITERAL (ADDRESS);           -- Allow unsigned literals.

   NULL_ADDRESS : constant ADDRESS := 0;        -- Value of type ADDRESS
                                                -- equal to NULL.
   pragma PUT_LINE ("Target: ", SYSTEM_NAME);
end SYSTEM;
```

# 7 Limits

Most data structures held within the ICC Ada compiler are dynamically allocated, and hence have no inherent limit (other than available memory). Some limitations are:

The maximum input line length is 254 characters.

The maximum number of tasks abortable by a single abort statement is 64.

Include files can be nested to a depth of 3.

The number of packages, subprograms, tasks, variables, aggregates, types or labels which can appear in a compilation unit is unlimited.

The number of compilation units which can appear in one file is unlimited.

The number of statements per subprogram or block is unlimited.

Packages, tasks, subprograms and blocks can be nested to any depth.

There is no maximum number of compilation units per library, nor any maximum number of libraries per library system.

## 8 Numeric Types

ICC Ada supports three predefined integer types:

| | | |
|---|---|---|
| TINY_INTEGER | -128..127 | 8 bits |
| SHORT_INTEGER | -32768..32767 | 16 bits |
| INTEGER | -2147483648..2147483647 | 32 bits |

In addition, unsigned 8-bit, 16-bit and 32-bit integer types can be defined by the user via the SIZE length clause. Storage requirements for types can be reduced by using pragma **Pack** and record representation clauses and for subtypes by using the ICC pragma **Compress**.

Type **float** is available.

| Attribute | **FLOAT** value |
|---|---|
| size | 64 bits |
| digits | 15 |
| first | $-1.12355820928895E+307$ |
| last | $+1.12355820928895E+307$ |

Type **short_float** is available.

| Attribute | **SHORT_FLOAT** value |
|---|---|
| size | 32 bits |
| digits | 6 |
| first | $-2.12676E+37$ |
| last | $+2.12676E+37$ |

Fixed point types automatically assume the smallest storage size necessary to represent all of the model numbers with the indicated delta and range. The size of a fixed point type may be changed via the SMALL representation clause and the SIZE length clause. Unsigned fixed point types may be defined using the SIZE length clause.

ICC Ada rounds real (fixed and floating point) values away from zero at the mid-point between integral values (i.e. 1.5 rounds to 2.0 and -3.5 rounds to -4.0).

# 9 Tasks

The type DURATION is defined with the following characteristics:

| Attribute | **DURATION** value |
|---|---|
| delta | $2.44140625E-04$ sec |
| small | $2.44140625E-04$ sec |
| first | $-524287.0$ sec |
| last | 524287.0 sec |

The subtype SYSTEM.PRIORITY as defined provides the following range:

| Attribute | **PRIORITY** value |
|---|---|
| first | 0 |
| last | 255 |

Higher numbers correspond to higher priorities. If no priority is specified for a task, PRIORITY'FIRST is assigned during task creation.

# 10 Representation Clauses

## 10.1 Type Representation Clauses

### 10.1.1 Length Clauses

The amount of storage to be associated with an entity is specified by means of a length clause. The following is a list of length clauses and their implementation status:

- The SIZE length clause is implemented. When applied to integer range types this length clause can be used to reduce storage requirements

including storage as unsigned values. It *may* be used to declare an unsigned 32-bit type. Length clauses are allowed for float and fixed point types, however the storage requirements for these types cannot be reduced below the smallest applicable predefined type available.

- The STORAGE_SIZE length clause for task types is implemented. The size specified is used to allocate both the task's Task Information Block (TIB) and its stack.
- The STORAGE_SIZE length clause for access types is implemented. When a length clause is encountered for an access type, a block of memory is reserved in the user's heap space. This block of memory cannot be expanded beyond the bounds specified in the length cla e. When the memory in this block is exhausted, STORAGE_ERROR is rai Due to heap management overhead, the full amount of memory indicated in the length clause may not be available for allocation.
- The SMALL length clause for fixed point types is implemented for powers of two. ICC Ada does not support SMALL values that are not integral powers of two.

### 10.1.2 Enumeration Representation Clauses

Enumeration representation clauses are implemented. The use of enumeration representation clauses can greatly increase the overhead associated with their reference. In particular, **FOR** loops on such enumerations are very expensive. Representation clauses which define the default representation (i.e. The first element is ordinal 0, the second 1, the third 2, etc.) are detected and cause no additional overhead.

### 10.1.3 Record Representation Clauses

Record representation clauses are implemented to the bit-level. Records containing discriminants and dynamic arrays may not be organized as expected because of unexpected changes of representation. There are no implementation generated names that can be used in record representation clauses.

Record representation clauses allow more precise packing than pragma **Pack**. Record representation clauses allow the user to specify the exact location of fields within a record to the bit-level. The ICC Ada compiler implements bit-level record representation clauses including nested records

starting on bit-boundaries. Since the user specifies the exact bit location, overhead for extracts and stores *may* be very high, so record representation clauses should be applied very carefully. Record representation clauses are implemented using the following rules:

- Fields of records may be allocated to the nearest bit for elements which are smaller than 32-bits. This includes small nested records. Elements 32-bits or larger (and all arrays) *must* be placed on byte boundaries.
- If the specified storage space for an element is not adequate using its default allocation, it will automatically be *packed* in two stages: (1) Normal packing will be attempted using the default alignment rules. If this does not adequately reduce storage then (2) bit-level packing will be attempted with all fields aligned on 8-bit or smaller boundaries. If this bit-level packing still does not meet the storage requirement, an error message will be generated.
- The optional alignment clause may be used to specify an alignment up to 8 bytes.
- All fields of a record representation clause which are left unspecified will be allocated at the *end* of the record using the default alignment rules for each element.
- The fields of a record representation clause may be specified in any order and the storage order of the fields does *not* need to be the same as the order in which they were declared.
- If no alignment clause is specified, the alignment requirement for the record is equivalent to the largest alignment requirement of its elements.

## 10.2 Address Clauses

Address clauses are implemented for variables. Address clauses for local variables using dynamic values are implemented. The use of a dynamic address can facilitate overlaying since the address specified may be the value of a variable of type `System.Address` or may be the result of an expression using the predefined `Address` attribute. Address clauses are not implemented for subprograms, packages, tasks, constant objects, or statement labels.

## 11 Interface to Other Languages

Pragma **Interface** allows Ada programs to interface with (i.e., call) subprograms written in another language (e.g., assembly, C), and pragma **Export** allows programs written in another language to interface with programs written in Ada. The accepted languages are: **Intrinsic**, **Ada**, **C** and **Assembly**. The aliases **Assembler** and **ASM** can also be used instead of **Assembly**. The language **Intrinsic** should be used with care—it is used by ICC for internally handled operators.

## 12 Unchecked Type Conversion

The generic function **Unchecked_conversion** is implemented. In general, unchecked_conversion can be used when the underlying representations of values are similar.
Acceptable conversions are:

- Conversion of scalars. Unchecked_conversion can be used to change the type of scalar values without restriction. In most circumstances the unchecked conversion produces no additional code.
- Conversion of static constrained structures. Constrained static arrays and records are represented as contiguous areas of memory, and hence can be converted using unchecked_conversion.
- Conversion of scalars to static constrained structures. Scalar objects may be converted to static constrained structures with no additional overhead. If a scalar value is converted to a structure, an aggregate is first built to hold the scalar value and its address is used as the address of the resulting structure.

Because the representation of dynamic structures uses implicit pointers and dope-vectors, ICC Ada does *not* allow unchecked conversions to or from dynamic or unconstrained structures (arrays or records). A compile-time error message will be generated for such instantiations.

Although the Ada compiler does *not* produce errors for the following unchecked conversions, they should be avoided since their results are not obvious:

- Conversion from constrained discriminant records. Conversion from discriminant records can cause unpredictable behavior because of underlying representation changes. The unchecked_conversion will use the same rules as described above for performing the copy, however the results of this operation may not be what the user desires, since ICC Ada does *not* place arrays constrained by the discriminant in-line with the other fields in a discriminant record. In place of the array only a pointer is used and the array is allocated dynamically from the internally maintained heap.
- Conversion to or from pointers to unconstrained arrays. Unconstrained array pointers are implemented as special dope-vectors in ICC Ada. Conversions to or from these dope-vectors are not recommended.
- Conversion to or from any type or object declared in a generic. Generics can cause hidden representation changes. Unchecked_conversions of any object or type declared in a generic should be avoided.

ICC Ada does not require that the sizes of the parameters to an unchecked_conversion be identical. The size of the *target* type is used to determine the number of bytes to copy. The size of the *target* type (in bytes) is determined by the Ada front end and exactly that many bytes are copied from the source address to the target address. This can cause problems (e.g. memory faults) when the source object is smaller than the target object. For example, using unchecked_conversion to convert a character into an integer will cause 4 bytes to be copied starting from the address of the character. The first byte copied will be the value of the character, but the values of the remaining three bytes cannot be predicted since they depend on values of variables or fields immediately after the character in memory. If the source object is larger than the target object then only the bytes that will fit in the target object are copied from the source starting at the address of the first byte of the source.

## 13 Unchecked Storage Deallocation

**Unchecked_deallocation** is implemented. Unchecked_deallocation of structures containing dynamic elements (such as discriminant records with dynamic arrays) should not be performed since these nested structures are not automatically deallocated.