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Contents

Foreword . . . xii

Introduction . . . xiii

1 Scope . . . 1

2 Normative references . . . 2

3 Terms and definitions . . . 3

4 Notation, conformance, and compatibility . . . 30
4.1 Notation, symbols and abbreviated terms . . . 30
4.1.1 Syntax rules . . . 30
4.1.2 Constraints . . . 31
4.1.3 Assumed syntax rules . . . 31
4.1.4 Syntax conventions and characteristics . . . 31
4.1.5 Text conventions . . . 32
4.2 Conformance . . . 32
4.3 Compatibility . . . 33
4.3.1 Previous Fortran standards . . . 33
4.3.2 New intrinsic procedures . . . 33
4.3.3 Fortran 2018 compatibility . . . 33
4.3.4 Fortran 2008 compatibility . . . 34
4.3.5 Fortran 2003 compatibility . . . 35
4.3.6 Fortran 95 compatibility . . . 36
4.3.7 Fortran 90 compatibility . . . 36
4.3.8 FORTRAN 77 compatibility . . . 37
4.4 Deleted and obsolescent features . . . 37
4.4.1 General . . . 37
4.4.2 Nature of deleted features . . . 37
4.4.3 Nature of obsolescent features . . . 38

5 Fortran concepts . . . 39
5.1 High level syntax . . . 39
5.2 Program unit concepts . . . 42
5.2.1 Program units and scoping units . . . 42
5.2.2 Program . . . 42
5.2.3 Procedure . . . 42
5.2.4 Module . . . 43
5.2.5 Submodule . . . 43
5.3 Execution concepts . . . 43
5.3.1 Statement classification . . . 43
5.3.2 Statement order . . . 43
5.3.3 The END statement . . . 44
5.3.4 Program execution . . . 44
5.3.5 Execution sequence . . . 45

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5.3.6 Image execution states . . . 45
5.3.7 Termination of execution . . . 46
5.4 Data concepts . . . 46
5.4.1 Type . . . 46
5.4.2 Data value . . . 47
5.4.3 Data entity . . . 47
5.4.4 Definition of objects and pointers . . . 48
5.4.5 Reference . . . 49
5.4.6 Array . . . 49
5.4.7 Coarray . . . 49
5.4.8 Established coarrays . . . 50
5.4.9 Pointer . . . 50
5.4.10 Allocatable variables . . . 50
5.4.11 Storage . . . 51
5.5 Fundamental concepts . . . 51
5.5.1 Names and designators . . . 51
5.5.2 Statement keyword . . . 51
5.5.3 Other keywords . . . 51
5.5.4 Association . . . 51
5.5.5 Intrinsic . . . 51
5.5.6 Operator . . . 52
5.5.7 Companion processors . . . 52

6 Lexical tokens and source form . . . 53
6.1 Processor character set . . . 53
6.1.1 Characters . . . 53
6.1.2 Letters . . . 53
6.1.3 Digits . . . 53
6.1.4 Underscore . . . 53
6.1.5 Special characters . . . 53
6.1.6 Other characters . . . 54
6.2 Low-level syntax . . . 54
6.2.1 Tokens . . . 54
6.2.2 Names . . . 54
6.2.3 Constants . . . 55
6.2.4 Operators . . . 55
6.2.5 Statement labels . . . 56
6.2.6 Delimiters . . . 56
6.3 Source form . . . 57
6.3.1 Program units, statements, and lines . . . 57
6.3.2 Free source form . . . 57
6.3.3 Fixed source form . . . 58
6.4 Including source text . . . 59

7 Types . . . 61
7.1 Characteristics of types . . . 61
7.1.1 The concept of type . . . 61
7.1.2 Type classification . . . 61
7.1.3 Set of values . . . 61
7.1.4 Constants . . . 61
7.1.5 Operations . . . 61
7.2 Type parameters . . . 62
7.3 Types, type specifiers, and values . . . 63
7.3.1 Relationship of types and values to objects . . . 63
7.3.2 Type specifiers . . . 63
7.3.3 Type compatibility . . . 65

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7.4 Intrinsic types . . . 66
7.4.1 Classification and specification . . . 66
7.4.2 Intrinsic operations on intrinsic types . . . 66
7.4.3 Numeric intrinsic types . . . 66
7.4.4 Character type . . . 70
7.4.5 Logical type . . . 73
7.5 Derived types . . . 73
7.5.1 Derived type concepts . . . 73
7.5.2 Derived-type definition . . . 74
7.5.3 Derived-type parameters . . . 77
7.5.4 Components . . . 79
7.5.5 Type-bound procedures . . . 85
7.5.6 Final subroutines . . . 88
7.5.7 Type extension . . . 90
7.5.8 Derived-type values . . . 92
7.5.9 Derived-type specifier . . . 92
7.5.10 Construction of derived-type values . . . 92
7.5.11 Derived-type operations and assignment . . . 95
7.6 Other nonintrinsic types . . . 95
7.6.1 Interoperable enumerations and enum types . . . 95
7.6.2 Enumeration types . . . 97
7.7 Binary, octal, and hexadecimal literal constants . . . 99
7.8 Construction of array values . . . 100

8 Attribute declarations and specifications . . . 103
8.1 Attributes of procedures and data objects . . . 103
8.2 Type declaration statement . . . 103
8.3 Automatic data objects . . . 105
8.4 Initialization . . . 105
8.5 Attributes . . . 105
8.5.1 Attribute specification . . . 105
8.5.2 Accessibility attribute . . . 106
8.5.3 ALLOCATABLE attribute . . . 106
8.5.4 ASYNCHRONOUS attribute . . . 106
8.5.5 BIND attribute for data entities . . . 107
8.5.6 CODIMENSION attribute . . . 107
8.5.7 CONTIGUOUS attribute . . . 109
8.5.8 DIMENSION attribute . . . 110
8.5.9 EXTERNAL attribute . . . 114
8.5.10 INTENT attribute . . . 114
8.5.11 INTRINSIC attribute . . . 116
8.5.12 OPTIONAL attribute . . . 116
8.5.13 PARAMETER attribute . . . 116
8.5.14 POINTER attribute . . . 117
8.5.15 PROTECTED attribute . . . 117
8.5.16 SAVE attribute . . . 118
8.5.17 RANK clause . . . 118
8.5.18 TARGET attribute . . . 119
8.5.19 VALUE attribute . . . 119
8.5.20 VOLATILE attribute . . . 119
8.6 Attribute specification statements . . . 120
8.6.1 Accessibility statement . . . 120
8.6.2 ALLOCATABLE statement . . . 121
8.6.3 ASYNCHRONOUS statement . . . 121
8.6.4 BIND statement . . . 121
8.6.5 CODIMENSION statement . . . 122

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8.6.6 CONTIGUOUS statement . . . 122
8.6.7 DATA statement . . . 122
8.6.8 DIMENSION statement . . . 124
8.6.9 INTENT statement . . . 125
8.6.10 OPTIONAL statement . . . 125
8.6.11 PARAMETER statement . . . 125
8.6.12 POINTER statement . . . 125
8.6.13 PROTECTED statement . . . 126
8.6.14 SAVE statement . . . 126
8.6.15 TARGET statement . . . 126
8.6.16 VALUE statement . . . 126
8.6.17 VOLATILE statement . . . 127
8.7 IMPLICIT statement . . . 127
8.8 IMPORT statement . . . 129
8.9 NAMELIST statement . . . 131
8.10 Storage association of data objects . . . 132
8.10.1 EQUIVALENCE statement . . . 132
8.10.2 COMMON statement . . . 134
8.10.3 Restrictions on common and equivalence . . . 135

9 Use of data objects . . . 136
9.1 Designator . . . 136
9.2 Variable . . . 136
9.3 Constants . . . 137
9.4 Scalars . . . 137
9.4.1 Substrings . . . 137
9.4.2 Structure components . . . 137
9.4.3 Coindexed named objects . . . 139
9.4.4 Complex parts . . . 139
9.4.5 Type parameter inquiry . . . 139
9.5 Arrays . . . 140
9.5.1 Order of reference . . . 140
9.5.2 Whole arrays . . . 140
9.5.3 Array elements and array sections . . . 140
9.5.4 Simply contiguous array designators . . . 144
9.6 Image selectors . . . 144
9.7 Dynamic association . . . 146
9.7.1 ALLOCATE statement . . . 146
9.7.2 NULLIFY statement . . . 150
9.7.3 DEALLOCATE statement . . . 150
9.7.4 STAT= specifier . . . 152
9.7.5 ERRMSG= specifier . . . 153

10 Expressions and assignment . . . 154
10.1 Expressions . . . 154
10.1.1 Expression semantics . . . 154
10.1.2 Form of an expression . . . 154
10.1.3 Precedence of operators . . . 158
10.1.4 Evaluation of operations . . . 160
10.1.5 Intrinsic operations . . . 161
10.1.6 Defined operations . . . 167
10.1.7 Evaluation of operands . . . 168
10.1.8 Integrity of parentheses . . . 169
10.1.9 Type, type parameters, and shape of an expression . . . 169
10.1.10 Conformability rules for elemental operations . . . 171
10.1.11 Specification expression . . . 171

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10.1.12 Constant expression . . . 173
10.2 Assignment . . . 174
10.2.1 Assignment statement . . . 174
10.2.2 Pointer assignment . . . 179
10.2.3 Masked array assignment – WHERE . . . 183
10.2.4 FORALL . . . 186

11 Execution control . . . 189
11.1 Executable constructs containing blocks . . . 189
11.1.1 Blocks . . . 189
11.1.2 Rules governing blocks . . . 189
11.1.3 ASSOCIATE construct . . . 190
11.1.4 BLOCK construct . . . 191
11.1.5 CHANGE TEAM construct . . . 193
11.1.6 CRITICAL construct . . . 195
11.1.7 DO construct . . . 196
11.1.8 IF construct and statement . . . 204
11.1.9 SELECT CASE construct . . . 205
11.1.10 SELECT RANK construct . . . 208
11.1.11 SELECT TYPE construct . . . 210
11.1.12 EXIT statement . . . 213
11.2 Branching . . . 213
11.2.1 Branch concepts . . . 213
11.2.2 GO TO statement . . . 213
11.2.3 Computed GO TO statement . . . 214
11.3 CONTINUE statement . . . 214
11.4 STOP and ERROR STOP statements . . . 214
11.5 FAIL IMAGE statement . . . 215
11.6 NOTIFY WAIT statement . . . 215
11.7 Image execution control . . . 216
11.7.1 Image control statements . . . 216
11.7.2 Segments . . . 217
11.7.3 SYNC ALL statement . . . 218
11.7.4 SYNC IMAGES statement . . . 219
11.7.5 SYNC MEMORY statement . . . 220
11.7.6 SYNC TEAM statement . . . 221
11.7.7 EVENT POST statement . . . 222
11.7.8 EVENT WAIT statement . . . 222
11.7.9 FORM TEAM statement . . . 222
11.7.10 LOCK and UNLOCK statements . . . 223
11.7.11 STAT= and ERRMSG= specifiers in image control statements . . . 225

12 Input/output statements . . . 228
12.1 Input/output concepts . . . 228
12.2 Records . . . 228
12.2.1 Definition of a record . . . 228
12.2.2 Formatted record . . . 228
12.2.3 Unformatted record . . . 228
12.2.4 Endfile record . . . 229
12.3 External files . . . 229
12.3.1 External file concepts . . . 229
12.3.2 File existence . . . 229
12.3.3 File access . . . 230
12.3.4 File position . . . 232
12.3.5 File storage units . . . 233
12.4 Internal files . . . 234

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12.5 File connection . . . 234
12.5.1 Referring to a file . . . 234
12.5.2 Connection modes . . . 235
12.5.3 Unit existence . . . 236
12.5.4 Connection of a file to a unit . . . 236
12.5.5 Preconnection . . . 237
12.5.6 OPEN statement . . . 237
12.5.7 CLOSE statement . . . 241
12.6 Data transfer statements . . . 243
12.6.1 Form of input and output statements . . . 243
12.6.2 Control information list . . . 243
12.6.3 Data transfer input/output list . . . 248
12.6.4 Execution of a data transfer input/output statement . . . 250
12.6.5 Termination of data transfer statements . . . 261
12.7 Waiting on pending data transfer . . . 261
12.7.1 Wait operation . . . 261
12.7.2 WAIT statement . . . 261
12.8 File positioning statements . . . 262
12.8.1 Syntax . . . 262
12.8.2 BACKSPACE statement . . . 263
12.8.3 ENDFILE statement . . . 263
12.8.4 REWIND statement . . . 263
12.9 FLUSH statement . . . 264
12.10 File inquiry statement . . . 264
12.10.1 Forms of the INQUIRE statement . . . 264
12.10.2 Inquiry specifiers . . . 265
12.10.3 Inquire by output list . . . 271
12.11 Error, end-of-record, and end-of-file conditions . . . 271
12.11.1 Occurrence of input/output conditions . . . 271
12.11.2 Error conditions and the ERR= specifier . . . 272
12.11.3 End-of-file condition and the END= specifier . . . 272
12.11.4 End-of-record condition and the EOR= specifier . . . 273
12.11.5 IOSTAT= specifier . . . 273
12.11.6 IOMSG= specifier . . . 274
12.12 Restrictions on input/output statements . . . 274

13 Input/output editing . . . 275
13.1 Format specifications . . . 275
13.2 Explicit format specification methods . . . 275
13.2.1 FORMAT statement . . . 275
13.2.2 Character format specification . . . 275
13.3 Form of a format item list . . . 276
13.3.1 Syntax . . . 276
13.3.2 Edit descriptors . . . 276
13.3.3 Fields . . . 278
13.4 Interaction between input/output list and format . . . 278
13.5 Positioning by format control . . . 280
13.6 Decimal symbol . . . 280
13.7 Data edit descriptors . . . 280
13.7.1 Purpose of data edit descriptors . . . 280
13.7.2 Numeric editing . . . 281
13.7.3 Logical editing . . . 288
13.7.4 Character editing . . . 288
13.7.5 Generalized editing . . . 289
13.7.6 User-defined derived-type editing . . . 290
13.8 Control edit descriptors . . . 290

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13.8.1 Position edit descriptors . . . 290
13.8.2 Slash editing . . . 291
13.8.3 Colon editing . . . 292
13.8.4 SS, SP, and S editing . . . 292
13.8.5 LZS, LZP and LZ editing . . . 292
13.8.6 P editing . . . 292
13.8.7 BN and BZ editing . . . 293
13.8.8 RU, RD, RZ, RN, RC, and RP editing . . . 293
13.8.9 DC and DP editing . . . 293
13.9 Character string edit descriptors . . . 293
13.10 List-directed formatting . . . 294
13.10.1 Purpose of list-directed formatting . . . 294
13.10.2 Values and value separators . . . 294
13.10.3 List-directed input . . . 294
13.10.4 List-directed output . . . 296
13.11 Namelist formatting . . . 298
13.11.1 Purpose of namelist formatting . . . 298
13.11.2 Name-value subsequences . . . 298
13.11.3 Namelist input . . . 298
13.11.4 Namelist output . . . 301

14 Program units . . . 303
14.1 Main program . . . 303
14.2 Modules . . . 303
14.2.1 Module syntax and semantics . . . 303
14.2.2 The USE statement and use association . . . 304
14.2.3 Submodules . . . 307
14.3 Block data program units . . . 307

15 Procedures . . . 309
15.1 Concepts . . . 309
15.2 Procedure classifications . . . 309
15.2.1 Procedure classification by reference . . . 309
15.2.2 Procedure classification by means of definition . . . 309
15.3 Characteristics . . . 310
15.3.1 Characteristics of procedures . . . 310
15.3.2 Characteristics of dummy arguments . . . 310
15.3.3 Characteristics of function results . . . 310
15.4 Procedure interface . . . 311
15.4.1 Interface and abstract interface . . . 311
15.4.2 Implicit and explicit interfaces . . . 311
15.4.3 Specification of the procedure interface . . . 312
15.5 Procedure reference . . . 321
15.5.1 Syntax of a procedure reference . . . 321
15.5.2 Actual arguments, dummy arguments, and argument association . . . 323
15.5.3 Function reference . . . 335
15.5.4 Subroutine reference . . . 335
15.5.5 Resolving named procedure references . . . 336
15.5.6 Resolving type-bound procedure references . . . 338
15.6 Procedure definition . . . 338
15.6.1 Intrinsic procedure definition . . . 338
15.6.2 Procedures defined by subprograms . . . 338
15.6.3 Definition and invocation of procedures by means other than Fortran . . . 344
15.6.4 Statement function . . . 344
15.7 Pure procedures . . . 345
15.8 Simple procedures . . . 347

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15.9 Elemental procedures . . . 348
15.9.1 Elemental procedure declaration and interface . . . 348
15.9.2 Elemental function actual arguments and results . . . 348
15.9.3 Elemental subroutine actual arguments . . . 349

16 Intrinsic procedures and modules . . . 350
16.1 Classes of intrinsic procedures . . . 350
16.2 Arguments to intrinsic procedures . . . 350
16.2.1 General rules . . . 350
16.2.2 The shape of array arguments . . . 351
16.2.3 Mask arguments . . . 351
16.2.4 DIM arguments and reduction functions . . . 351
16.3 Bit model . . . 351
16.3.1 General . . . 351
16.3.2 Bit sequence comparisons . . . 352
16.3.3 Bit sequences as arguments to INT and REAL . . . 352
16.4 Numeric models . . . 352
16.5 Atomic subroutines . . . 353
16.6 Collective subroutines . . . 354
16.7 Standard generic intrinsic procedures . . . 355
16.8 Specific names for standard intrinsic functions . . . 360
16.9 Specifications of the standard intrinsic procedures . . . 362
16.9.1 General . . . 362
16.10 Standard intrinsic modules . . . 457
16.10.1 General . . . 457
16.10.2 The ISO_FORTRAN_ENV intrinsic module . . . 458

17 Exceptions and IEEE arithmetic . . . 465
17.1 Overview of IEEE arithmetic support . . . 465
17.2 Derived types, constants, and operators defined in the modules . . . 466
17.3 The exceptions . . . 466
17.4 The rounding modes . . . 469
17.5 Underflow mode . . . 469
17.6 Halting . . . 470
17.7 The floating-point modes and status . . . 470
17.8 Exceptional values . . . 470
17.9 IEEE arithmetic . . . 470
17.10 Summary of the procedures . . . 471
17.11 Specifications of the procedures . . . 473
17.11.1 General . . . 473
17.12 Examples . . . 499

18 Interoperability with C . . . 502
18.1 General . . . 502
18.2 The ISO_C_BINDING intrinsic module . . . 502
18.2.1 Summary of contents . . . 502
18.2.2 Named constants and derived types in the module . . . 502
18.2.3 Procedures in the module . . . 503
18.3 Interoperability between Fortran and C entities . . . 511
18.3.1 Interoperability of intrinsic types . . . 511
18.3.2 Interoperability with C pointer types . . . 512
18.3.3 Interoperability of enum types . . . 512
18.3.4 Interoperability of derived types and C structure types . . . 512
18.3.5 Interoperability of scalar variables . . . 513
18.3.6 Interoperability of array variables . . . 514
18.3.7 Interoperability of procedures and procedure interfaces . . . 514

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18.4 C descriptors . . . 517
18.5 The source file ISO_Fortran_binding.h . . . 517
18.5.1 Summary of contents . . . 517
18.5.2 The CFI_dim_t structure type . . . 517
18.5.3 The CFI_cdesc_t structure type . . . 518
18.5.4 Macros and typedefs in ISO_Fortran_binding.h . . . 519
18.5.5 Functions declared in ISO_Fortran_binding.h . . . 521
18.6 Restrictions on C descriptors . . . 529
18.7 Restrictions on formal parameters . . . 529
18.8 Restrictions on lifetimes . . . 529
18.9 Interoperation with C global variables . . . 530
18.9.1 General . . . 530
18.9.2 Binding labels for common blocks and variables . . . 531
18.10 Interoperation with C functions . . . 531
18.10.1 Definition and reference of interoperable procedures . . . 531
18.10.2 Binding labels for procedures . . . 532
18.10.3 Exceptions and IEEE arithmetic procedures . . . 532
18.10.4 Asynchronous communication . . . 533

19 Scope, association, and definition . . . 534
19.1 Scopes, identifiers, and entities . . . 534
19.2 Global identifiers . . . 534
19.3 Local identifiers . . . 535
19.3.1 Classes of local identifiers . . . 535
19.3.2 Local identifiers that are the same as common block names . . . 536
19.3.3 Function results . . . 536
19.3.4 Components, type parameters, and bindings . . . 536
19.3.5 Argument keywords . . . 536
19.4 Statement and construct entities . . . 537
19.5 Association . . . 538
19.5.1 Name association . . . 538
19.5.2 Pointer association . . . 542
19.5.3 Storage association . . . 545
19.5.4 Inheritance association . . . 547
19.5.5 Establishing associations . . . 547
19.6 Definition and undefinition of variables . . . 548
19.6.1 Definition of objects and subobjects . . . 548
19.6.2 Variables that are always defined . . . 548
19.6.3 Variables that are initially defined . . . 548
19.6.4 Variables that are initially undefined . . . 549
19.6.5 Events that cause variables to become defined . . . 549
19.6.6 Events that cause variables to become undefined . . . 551
19.6.7 Variable definition context . . . 553
19.6.8 Pointer association context . . . 554

Annex A (informative) Processor dependencies . . . 555

Annex B (informative) Deleted and obsolescent features . . . 562

Annex C (informative) Extended notes . . . 566

Index . . . 643

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*.

This fifth edition cancels and replaces the fourth edition (ISO/IEC 1539-1:2018), which has been technically revised.

The main changes are as follows:

— an array can have a coarray component;
— additional forms of declaration;
— additional edit descriptors;
— additional intrinsic procedures;
— conformance with ISO/IEC 60559:2020;
— other changes listed in the Introduction.

A list of all parts in the ISO/IEC 1539 series can be found on the ISO and IEC websites.

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Introduction

This document comprises the specification of the base Fortran language, informally known as Fortran 2023. With the limitations noted in 4.3.3, the syntax and semantics of Fortran 2018 are contained entirely within Fortran 2023. Therefore, any standard-conforming Fortran 2018 program not affected by such limitations is a standard-conforming Fortran 2023 program. New features of Fortran 2023 can be compatibly incorporated into such Fortran 2018 programs, with any exceptions indicated in the text of this document.

Fortran 2023 contains several extensions to Fortran 2018; these are listed below.

- Source form:
  The maximum length of a line in free form source has been increased. The maximum length of a statement has been increased. The limit on the number of continuation lines has been removed.
- Data declaration:
  A data object with a coarray component can be an array or allocatable. BIND(C) ENUM are now referred to as interoperable enumerations, and noninteroperable enumeration types are available. An interoperable enumeration can be given a type name. TYPEOF and CLASSOF type specifiers can be used to declare one or more entities to have the same type and type parameters as another entity. A PUBLIC namelist group can have a PRIVATE namelist group object. The DIMENSION attribute can be declared with a syntax that does not depend on the rank (8.5.8, 8.5.17).
- Data usage and computation:
  Binary, octal, and hexadecimal literal constants can be used in additional contexts. A deferred-length allocatable *errmsg-variable* is allocated by the processor to the length of the explanatory message. An ALLOCATE statement can specify the bounds of an array allocation with array expressions. A pointer assignment statement can specify lower bounds or rank remapping with array expressions. Arrays can be used to specify multiple subscripts or subscript triplets (9.5.3.2). Conditional expressions provide selective evaluation of subexpressions.
- Input/output:
  The AT edit descriptor provides output of character values with trailing blanks trimmed. The LEADING_ZERO= specifier in the OPEN and WRITE statements, and the LZP, LZS and LZ control edit descriptors, provide control of optional leading zeros during formatted output. A deferred-length allocatable *iomsg-variable* is allocated by the processor to the length of the explanatory message. A deferred-length allocatable scalar *io-unit* in a WRITE statement is allocated by the processor to the length of the record to be written.
- Execution control:
  The REDUCE locality specifier for the DO CONCURRENT construct specifies reduction variables for the loop. The NOTIFY WAIT statement, NOTIFY= specifier on an image selector, and the NOTIFY_TYPE from the intrinsic module ISO_FORTRAN_ENV provide one-sided data-oriented synchronization between images.
- Intrinsic procedures:
  The intrinsic functions ACOSD, ASIND, ATAND, ATAN2D, COSD, SIND, and TAND are trigonometric functions in which angles are specified in degrees. The intrinsic functions ACOSPI, ASINPI, ATANPI, ATAN2PI, COSPI, SINPI, and TANPI are trigonometric functions in which angles are specified in half-revolutions (that is, as multiples of π). The intrinsic function SELECTED_LOGICAL_KIND returns kind type parameter values for type logical. The intrinsic subroutine SPLIT parses a string into tokens, one at a time. The intrinsic subroutine SYSTEM_CLOCK supports more than one system clock for an image. The intrinsic subroutine TOKENIZE parses a string into tokens. When a deferred-length allocatable actual argument of an intrinsic procedure is assigned character data, it is allocated by the processor to the length of the data. Execution of a collective subroutine can be successful on an image even when an error condition occurs for the corresponding execution on another image.
- Intrinsic modules:
  Additional named constants LOGICAL8, LOGICAL16, LOGICAL32, LOGICAL64, and REAL16 have been added to the intrinsic module ISO_FORTRAN_ENV. The subroutines IEEE_GET_ROUNDING_MODE, IEEE_GET_UNDERFLOW_MODE, IEEE_SET_ROUNDING_MODE, and IEEE_SET_UNDERFLOW_MODE, from the intrinsic module IEEE_ARITHMETIC, are now considered to be pure and simple. The subroutines IEEE_GET_MODES, IEEE_GET_STATUS, IEEE_SET_MODES, and

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IEEE_SET_STATUS, from the intrinsic module IEEE_EXCEPTIONS, are now considered to be pure and simple. The procedures C_F_STRPOINTER and F_C_STRING have been added to the intrinsic module ISO_C_BINDING to assist in the use of null-terminated strings. The subroutine C_F_POINTER in the intrinsic module ISO_C_BINDING has an extra optional dummy argument, LOWER, that specifies the lower bounds for FPTR.

- Changes to the intrinsic module IEEE_ARITHMETIC for conformance with ISO/IEC 60559:2020:
  The new functions IEEE_MAX, IEEE_MAX_MAG, IEEE_MIN, and IEEE_MIN_MAG perform the operations maximum, maximumMagnitude, minimum, and miminumMagnitude in ISO/IEC 60559:2020. The functions IEEE_MAX_NUM, IEEE_MAX_NUM_MAG, IEEE_MIN_NUM, and IEEE_MIN_NUM_MAG now conform to the operations maximumNumber, maximumMagnitudeNumber, minimumNumber and minimumMagnitudeNumber in ISO/IEC 60559:2020; the changes affect the treatment of zeros and NaNs.
- Program units and procedures:
  A procedure can be specified to be a simple procedure; a simple procedure references or defines nonlocal variables only via its dummy arguments. Conditional arguments provide actual argument selection in a procedure reference.

This document is organized in 19 clauses, dealing with 8 conceptual areas. These 8 areas, and the clauses in which they are treated, are:

High/low level concepts	Clauses 4, 5, 6
Data concepts	Clauses 7, 8, 9
Computations	Clauses 10, 16, 17
Execution control	Clause 11
Input/output	Clauses 12, 13
Program units	Clauses 14, 15
Interoperability with C	Clause 18
Scoping and association rules	Clause 19

It also contains the following nonnormative material:

Processor dependencies	Annex A
Deleted and obsolescent features	Annex B
Extended notes	Annex C
Index	Index

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Programming languages —Fortran —

Part 1:
Base language

1 Scope

This document specifies the form and establishes the interpretation of programs expressed in the base Fortran language. The purpose of this document is to promote portability, reliability, maintainability, and efficient execution of Fortran programs for use on a variety of computing systems.

This document specifies

- the forms that a program written in the Fortran language can take,
- the rules for interpreting the meaning of a program and its data,
- the form of the input data to be processed by such a program, and
- the form of the output data resulting from the use of such a program.

Except where stated otherwise, requirements and prohibitions specified by this document apply to programs rather than processors.

This document does not specify

- the mechanism by which programs are transformed for use on computing systems,
- the operations required for setup and control of the use of programs on computing systems,
- the method of transcription of programs or their input or output data to or from a storage medium,
- the program and processor behavior when this document fails to establish an interpretation except for the processor detection and reporting requirements in items (2) to (10) of 4.2,
- the maximum number of images, or the size or complexity of a program and its data that will exceed the capacity of any particular computing system or the capability of a particular processor,
- the mechanism for determining the number of images of a program,
- the physical properties of an image or the relationship between images and the computational elements of a computing system,
- the physical properties of the representation of quantities and the method of rounding, approximating, or computing numeric values on a particular processor, except by reference to ISO/IEC 60559:2020 under conditions specified in Clause 17,
- the physical properties of input/output records, files, and units, or
- the physical properties and implementation of storage.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 646:1991, *Information technology—ISO 7-bit coded character set for information interchange*

ISO/IEC 9899:2018, *Programming languages—C*

ISO/IEC 10646, *Information technology—Universal Multiple-Octet Coded Character Set (UCS)*

ISO/IEC/IEEE 60559:2020, *Information technology — Microprocessor Systems — Floating-Point arithmetic*

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