

Contents

Foreword	xi
Introduction	xiv
1. Scope	1
2. Normative references	2
3. Terms, definitions, and symbols	3
4. Conformance	7
5. Environment	9
5.1 Conceptual models	9
5.1.1 Translation environment	9
5.1.2 Execution environments	11
5.2 Environmental considerations	17
5.2.1 Character sets	17
5.2.2 Character display semantics	19
5.2.3 Signals and interrupts	20
5.2.4 Environmental limits	20
6. Language	29
6.1 Notation	29
6.2 Concepts	29
6.2.1 Scopes of identifiers	29
6.2.2 Linkages of identifiers	30
6.2.3 Name spaces of identifiers	31
6.2.4 Storage durations of objects	32
6.2.5 Types	33
6.2.6 Representations of types	37
6.2.7 Compatible type and composite type	40
6.3 Conversions	42
6.3.1 Arithmetic operands	42
6.3.2 Other operands	46
6.4 Lexical elements	49
6.4.1 Keywords	50
6.4.2 Identifiers	51
6.4.3 Universal character names	53
6.4.4 Constants	54
6.4.5 String literals	62
6.4.6 Punctuators	63
6.4.7 Header names	64
6.4.8 Preprocessing numbers	65
6.4.9 Comments	66
6.5 Expressions	67

6.5.1	Primary expressions	69
6.5.2	Postfix operators	69
6.5.3	Unary operators	78
6.5.4	Cast operators	81
6.5.5	Multiplicative operators	82
6.5.6	Additive operators	82
6.5.7	Bitwise shift operators	84
6.5.8	Relational operators	85
6.5.9	Equality operators	86
6.5.10	Bitwise AND operator	87
6.5.11	Bitwise exclusive OR operator	88
6.5.12	Bitwise inclusive OR operator	88
6.5.13	Logical AND operator	89
6.5.14	Logical OR operator	89
6.5.15	Conditional operator	90
6.5.16	Assignment operators	91
6.5.17	Comma operator	94
6.6	Constant expressions	95
6.7	Declarations	97
6.7.1	Storage-class specifiers	98
6.7.2	Type specifiers	99
6.7.3	Type qualifiers	108
6.7.4	Function specifiers	112
6.7.5	Declarators	114
6.7.6	Type names	122
6.7.7	Type definitions	123
6.7.8	Initialization	125
6.8	Statements and blocks	131
6.8.1	Labeled statements	131
6.8.2	Compound statement	132
6.8.3	Expression and null statements	132
6.8.4	Selection statements	133
6.8.5	Iteration statements	135
6.8.6	Jump statements	136
6.9	External definitions	140
6.9.1	Function definitions	141
6.9.2	External object definitions	143
6.10	Preprocessing directives	145
6.10.1	Conditional inclusion	147
6.10.2	Source file inclusion	149
6.10.3	Macro replacement	151
6.10.4	Line control	158
6.10.5	Error directive	159
6.10.6	Pragma directive	159

6.10.7	Null directive	160
6.10.8	Predefined macro names	160
6.10.9	Pragma operator	161
6.11	Future language directions	163
6.11.1	Floating types	163
6.11.2	Linkages of identifiers	163
6.11.3	External names	163
6.11.4	Character escape sequences	163
6.11.5	Storage-class specifiers	163
6.11.6	Function declarators	163
6.11.7	Function definitions	163
6.11.8	Pragma directives	163
6.11.9	Predefined macro names	163
7.	Library	164
7.1	Introduction	164
7.1.1	Definitions of terms	164
7.1.2	Standard headers	165
7.1.3	Reserved identifiers	166
7.1.4	Use of library functions	166
7.2	Diagnostics <assert.h>	169
7.2.1	Program diagnostics	169
7.3	Complex arithmetic <complex.h>	170
7.3.1	Introduction	170
7.3.2	Conventions	171
7.3.3	Branch cuts	171
7.3.4	The CX_LIMITED_RANGE pragma	171
7.3.5	Trigonometric functions	172
7.3.6	Hyperbolic functions	174
7.3.7	Exponential and logarithmic functions	176
7.3.8	Power and absolute-value functions	177
7.3.9	Manipulation functions	178
7.4	Character handling <ctype.h>	181
7.4.1	Character classification functions	181
7.4.2	Character case mapping functions	184
7.5	Errors <errno.h>	186
7.6	Floating-point environment <fenv.h>	187
7.6.1	The FENV_ACCESS pragma	189
7.6.2	Floating-point exceptions	190
7.6.3	Rounding	192
7.6.4	Environment	194
7.7	Characteristics of floating types <float.h>	196
7.8	Format conversion of integer types <inttypes.h>	197
7.8.1	Macros for format specifiers	197
7.8.2	Functions for greatest-width integer types	198

7.9	Alternative spellings <code><iso646.h></code>	201
7.10	Sizes of integer types <code><limits.h></code>	202
7.11	Localization <code><locale.h></code>	203
7.11.1	Locale control	204
7.11.2	Numeric formatting convention inquiry	205
7.12	Mathematics <code><math.h></code>	211
7.12.1	Treatment of error conditions	213
7.12.2	The <code>FP_CONTRACT</code> pragma	214
7.12.3	Classification macros	215
7.12.4	Trigonometric functions	217
7.12.5	Hyperbolic functions	220
7.12.6	Exponential and logarithmic functions	222
7.12.7	Power and absolute-value functions	227
7.12.8	Error and gamma functions	229
7.12.9	Nearest integer functions	230
7.12.10	Remainder functions	234
7.12.11	Manipulation functions	235
7.12.12	Maximum, minimum, and positive difference functions	237
7.12.13	Floating multiply-add	238
7.12.14	Comparison macros	239
7.13	Nonlocal jumps <code><setjmp.h></code>	242
7.13.1	Save calling environment	242
7.13.2	Restore calling environment	243
7.14	Signal handling <code><signal.h></code>	245
7.14.1	Specify signal handling	246
7.14.2	Send signal	247
7.15	Variable arguments <code><stdarg.h></code>	248
7.15.1	Variable argument list access macros	248
7.16	Boolean type and values <code><stdbool.h></code>	252
7.17	Common definitions <code><stddef.h></code>	253
7.18	Integer types <code><stdint.h></code>	254
7.18.1	Integer types	254
7.18.2	Limits of specified-width integer types	256
7.18.3	Limits of other integer types	258
7.18.4	Macros for integer constants	259
7.19	Input/output <code><stdio.h></code>	261
7.19.1	Introduction	261
7.19.2	Streams	263
7.19.3	Files	265
7.19.4	Operations on files	267
7.19.5	File access functions	269
7.19.6	Formatted input/output functions	273
7.19.7	Character input/output functions	294
7.19.8	Direct input/output functions	299

7.19.9	File positioning functions	300
7.19.10	Error-handling functions	303
7.20	General utilities <stdlib.h>	305
7.20.1	Numeric conversion functions	306
7.20.2	Pseudo-random sequence generation functions	311
7.20.3	Memory management functions	312
7.20.4	Communication with the environment	314
7.20.5	Searching and sorting utilities	317
7.20.6	Integer arithmetic functions	319
7.20.7	Multibyte/wide character conversion functions	320
7.20.8	Multibyte/wide string conversion functions	322
7.21	String handling <string.h>	324
7.21.1	String function conventions	324
7.21.2	Copying functions	324
7.21.3	Concatenation functions	326
7.21.4	Comparison functions	327
7.21.5	Search functions	329
7.21.6	Miscellaneous functions	332
7.22	Type-generic math <tgmath.h>	334
7.23	Date and time <time.h>	337
7.23.1	Components of time	337
7.23.2	Time manipulation functions	338
7.23.3	Time conversion functions	340
7.24	Extended multibyte and wide character utilities <wchar.h>	347
7.24.1	Introduction	347
7.24.2	Formatted wide character input/output functions	348
7.24.3	Wide character input/output functions	366
7.24.4	General wide string utilities	370
7.24.5	Wide character time conversion functions	384
7.24.6	Extended multibyte/wide character conversion utilities	385
7.25	Wide character classification and mapping utilities <wctype.h>	392
7.25.1	Introduction	392
7.25.2	Wide character classification utilities	393
7.25.3	Wide character case mapping utilities	398
7.26	Future library directions	400
7.26.1	Complex arithmetic <complex.h>	400
7.26.2	Character handling <ctype.h>	400
7.26.3	Errors <errno.h>	400
7.26.4	Format conversion of integer types <inttypes.h>	400
7.26.5	Localization <locale.h>	400
7.26.6	Signal handling <signal.h>	400
7.26.7	Boolean type and values <stdbool.h>	400
7.26.8	Integer types <stdint.h>	400
7.26.9	Input/output <stdio.h>	401

7.26.10	General utilities <stdlib.h>	401
7.26.11	String handling <string.h>	401
7.26.12	Extended multibyte and wide character utilities	
	<wchar.h>	401
7.26.13	Wide character classification and mapping utilities	
	<wctype.h>	401
Annex A	(informative) Language syntax summary	402
A.1	Lexical grammar	402
A.2	Phrase structure grammar	408
A.3	Preprocessing directives	415
Annex B	(informative) Library summary	417
B.1	Diagnostics <assert.h>	417
B.2	Complex <complex.h>	417
B.3	Character handling <ctype.h>	419
B.4	Errors <errno.h>	419
B.5	Floating-point environment <fenv.h>	419
B.6	Characteristics of floating types <float.h>	420
B.7	Format conversion of integer types <inttypes.h>	420
B.8	Alternative spellings <iso646.h>	421
B.9	Sizes of integer types <limits.h>	421
B.10	Localization <locale.h>	421
B.11	Mathematics <math.h>	421
B.12	Nonlocal jumps <setjmp.h>	426
B.13	Signal handling <signal.h>	426
B.14	Variable arguments <stdarg.h>	426
B.15	Boolean type and values <stdbool.h>	426
B.16	Common definitions <stddef.h>	427
B.17	Integer types <stdint.h>	427
B.18	Input/output <stdio.h>	427
B.19	General utilities <stdlib.h>	429
B.20	String handling <string.h>	431
B.21	Type-generic math <tgmath.h>	432
B.22	Date and time <time.h>	432
B.23	Extended multibyte/wide character utilities <wchar.h>	433
B.24	Wide character classification and mapping utilities <wctype.h>	435
Annex C	(informative) Sequence points	437
Annex D	(normative) Universal character names for identifiers	438
Annex E	(informative) Implementation limits	440
Annex F	(normative) IEC 60559 floating-point arithmetic	442
F.1	Introduction	442
F.2	Types	442
F.3	Operators and functions	443

F.4	Floating to integer conversion	445
F.5	Binary-decimal conversion	445
F.6	Contracted expressions	446
F.7	Floating-point environment	446
F.8	Optimization	449
F.9	Mathematics <code><math.h></code>	452
Annex G (informative) IEC 60559-compatible complex arithmetic		465
G.1	Introduction	465
G.2	Types	465
G.3	Conventions	465
G.4	Conversions	466
G.5	Binary operators	466
G.6	Complex arithmetic <code><complex.h></code>	470
G.7	Type-generic math <code><tgmath.h></code>	478
Annex H (informative) Language independent arithmetic		479
H.1	Introduction	479
H.2	Types	479
H.3	Notification	483
Annex I (informative) Common warnings		485
Annex J (informative) Portability issues		487
J.1	Unspecified behavior	487
J.2	Undefined behavior	490
J.3	Implementation-defined behavior	503
J.4	Locale-specific behavior	510
J.5	Common extensions	511
Bibliography		514
Index		517