RTEMS POSIX 1003.1 Compliance Guide

Edition 4.6.1, for RTEMS 4.6.1

1 September 2003

On-Line Applications Research Corporation

On-Line Applications Research Corporation
TEXinfo 2002-11-25.11

COPYRIGHT © 1988 - 2003.
On-Line Applications Research Corporation (OAR).

The authors have used their best efforts in preparing this material. These efforts include the development, research, and testing of the theories and programs to determine their effectiveness. No warranty of any kind, expressed or implied, with regard to the software or the material contained in this document is provided. No liability arising out of the application or use of any product described in this document is assumed. The authors reserve the right to revise this material and to make changes from time to time in the content hereof without obligation to notify anyone of such revision or changes.

The RTEMS Project is hosted at `http://www.rtems.com`. Any inquiries concerning RTEMS, its related support components, its documentation, or any custom services for RTEMS should be directed to the contacts listed on that site. A current list of RTEMS Support Providers is at `http://www.rtems.com/support.html`.

Table of Contents

Preface 1

1 General 3

1.1 Scope 3
1.2 Normative References 3
1.3 Conformance 3

2 Terminology and General Requirements 5

2.1 Conventions 5
2.2 Definitions 5
2.3 General Concepts 5
2.4 Error Numbers 5
2.5 Primitive System Types 6
2.6 Environment Description 6
2.7 C Language Definitions 6
2.7.1 Symbols From the C Standard 6
2.7.2 POSIX.1 Symbols 7
2.8 Numerical Limits 7
2.9 C Language Limits 7
2.9.1 Minimum Values 7
2.9.2 Run-Time Increasable Values 8
2.9.3 Run-Time Invariant Values (Possible Indeterminate) 8
2.9.4 Pathname Variable Values 8
2.9.5 Invariant Values 9
2.9.6 Maximum Values 9
2.10 Symbolic Constants 9
2.10.1 Symbolic Constants for the access Function 9
2.10.2 Symbolic Constants for the lseek Function 9
2.10.3 Compile-Time Symbolic Constants for Portability Specifications 9
2.10.4 Execution-Time Symbolic Constants for Portability Specifications 10

3 Process Primitives 11

3.1 Process Creation and Execution 11
3.1.1 Process Creation 11
3.1.2 Execute a File 11
3.1.3 Register Fork Handlers 11
3.2 Process Termination 11
3.2.1 Wait for Process Termination 11
3.2.2 Terminate a Process 11

3.3 Signals 12
3.3.1 Signal Concepts 12
3.3.1.1 Signal Names 12
3.3.1.2 Signal Generation and Delivery 12
3.3.1.3 Signal Actions 13
3.3.2 Send a Signal to a Process 13
3.3.3 Manipulate Signal Sets 13
3.3.4 Examine and Change Signal Action 13
3.3.5 Examine and Change Blocked Signals 13
3.3.6 Examine Pending Signals 13
3.3.7 Wait for a Signal 13
3.3.8 Synchronously Accept a Signal 14
3.3.9 Queue a Signal to a Process 14
3.3.10 Send a Signal to a Thread 14
3.4 Timer Operations 14
3.4.1 Schedule Alarm 14
3.4.2 Suspend Process Execution 14
3.4.3 Delay Process Execution 14

4 Process Environment 15

4.1 Process Identification 15
4.1.1 Get Process and Parent Process IDs 15
4.2 User Identification 15
4.2.1 Get Real User Effective User Real Group and Effective Group IDs 15
4.2.2 Set User and Group IDs 15
4.2.3 Get Supplementary Group IDs 15
4.2.4 Get User Name 15
4.3 Process Groups 15
4.3.1 Get Process Group ID 15
4.3.2 Create Session and Set Process Group ID 16
4.3.3 Set Process Group ID for Job Control 16
4.4 System Identification 16
4.4.1 Get System Name 16
4.5 Time 16
4.5.1 Get System Time 16
4.5.2 Get Process Times 16
4.6 Environment Variables 16
4.6.1 Environment Access 16
4.7 Terminal Identification 16
4.7.1 Generate Terminal Pathname 16
4.7.2 Determine Terminal Device Name 17
4.8 Configurable System Variables 17
4.8.1 Get Configurable System Variables 17

5 Files and Directories 19

5.1 Directories 19
5.1.1 Format of Directory Entries 19
5.1.2 Directory Operations 19
5.2 Working Directory 19
5.2.1 Change Current Working Directory 19
5.2.2 Get Working Directory Pathname 19
5.3 General File Creation 19
5.3.1 Open a File 19
5.3.2 Create a New File or Rewrite an Existing One . . . 20
5.3.3 Set File Creation Mask 20
5.3.4 Link to a File 20
5.4 Special File Creation 20
5.4.1 Make a Directory 20
5.4.2 Make a FIFO Special File 20
5.5 File Removal 20
5.5.1 Remove Directory Entries 20
5.5.2 Remove a Directory 20
5.5.3 Rename a File 20
5.6 File Characteristics 21
5.6.1 File Characteristics Header and Data Structure . . 21
5.6.1.1 <sys/stat.h> File Types 21
5.6.1.2 <sys/stat.h> File Modes 21
5.6.1.3 <sys/stat.h> Time Entries 21
5.6.2 Get File Status 21
5.6.3 Check File Accessibility 21
5.6.4 Change File Modes 22
5.6.5 Change Owner and Group of a File 22
5.6.6 Set File Access and Modification Times 22
5.6.7 Truncate a File to a Specified Length 22
5.7 Configurable Pathname Variable 22
5.7.1 Get Configurable Pathname Variables 22

6 Input and Output Primitives 23

6.1 Pipes 23
6.1.1 Create an Inter-Process Channel 23
6.2 File Descriptor Manipulation 23
6.2.1 Duplicate an Open File Descriptor 23
6.3 File Descriptor Deassignment 23
6.3.1 Close a File 23
6.4 Input and Output 23
6.4.1 Read from a File 23
6.4.2 Write to a File 23
6.5 Control Operations on Files 23
6.5.1 Data Definitions for File Control Operations 23
6.5.2 File Control 24
6.5.3 Reposition Read/Write File Offset 24
6.6 File Synchronization 24

6.6.1 Synchronize the State of a File 24
6.6.2 Synchronize the Data of a File 24
6.7 Asynchronous Input and Output 24
6.7.1 Data Definitions for Asynchronous Input and Output 24
6.7.1.1 Asynchronous I/O Control Block 25
6.7.1.2 Asynchronous I/O Manifest Constants .. 25
6.7.2 Asynchronous Read 25
6.7.3 Asynchronous Write 25
6.7.4 List Directed I/O 25
6.7.5 Retrieve Error Status of Asynchronous I/O Operation 25
6.7.6 Retrieve Return Status of Asynchronous I/O Operation 25
6.7.7 Cancel Asynchronous I/O Request 25
6.7.8 Wait for Asynchronous I/O Request 25
6.7.9 Asynchronous File Synchronization 26

7 Device- and Class-Specific Functions 27

7.1 General Terminal Interface 27
7.1.1 Interface Characteristics 27
7.1.1.1 Opening a Terminal Device File 27
7.1.1.2 Process Groups (TTY) 27
7.1.1.3 The Controlling Terminal 27
7.1.1.4 Terminal Access Control 27
7.1.1.5 Input Processing and Reading Data 27
7.1.1.6 Canonical Mode Input Processing 27
7.1.1.7 Noncanonical Mode Input Processing ... 27
7.1.1.8 Writing Data and Output Processing ... 27
7.1.1.9 Special Characters 28
7.1.1.10 Modem Disconnect 28
7.1.1.11 Closing a Terminal Device File 28
7.1.2 Parameters That Can Be Set 28
7.1.2.1 termios Structure 28
7.1.2.2 Input Modes 28
7.1.2.3 Output Modes 28
7.1.2.4 Control Modes 29
7.1.2.5 Local Modes 29
7.1.2.6 Special Control Characters 29
7.1.3 Baud Rate Values 29
7.1.3.1 Baud Rate Functions 30
7.2 General Terminal Interface Control Functions 30
7.2.1 Get and Set State 30
7.2.2 Line Control Functions 30
7.2.3 Get Foreground Process Group ID 30
7.2.4 Set Foreground Process Group ID 31

8 Language-Specific Services for the C Programming Language 33

8.1 Referenced C Language Routines 33
8.1.1 Extensions to Time Functions 36
8.1.2 Extensions to setlocale Function 36
8.2 C Language Input/Output Functions 36
8.2.1 Map a Stream Pointer to a File Descriptor 36
8.2.2 Open a Stream on a File Descriptor 36
8.2.3 Interactions of Other FILE-Type C Functions 36
8.2.4 Operations on Files - the remove Function 36
8.2.5 Temporary File Name - the tmpnam Function 36
8.2.6 Stdio Locking Functions 36
8.2.7 Stdio With Explicit Client Locking 37
8.3 Other C Language Functions 37
8.3.1 Nonlocal Jumps 37
8.3.2 Set Time Zone 37
8.3.3 Find String Token 37
8.3.4 ASCII Time Representation 37
8.3.5 Current Time Representation 37
8.3.6 Coordinated Universal Time 37
8.3.7 Local Time 37
8.3.8 Pseudo-Random Sequence Generation Functions 37

9 System Databases 39

9.1 System Databases Section 39
9.2 Database Access 39
9.2.1 Group Database Access 39
9.2.2 User Database Access 39

10 Data Interchange Format 41

10.1 Archive/Interchange File Format 41
10.1.1 Extended tar Format 41
10.1.2 Extended cpio Format 41
10.1.3 Multiple Volumes 42

11 Synchronization 43
11.1 Semaphore Characteristics 43
11.2 Semaphore Functions 43
11.2.1 Initialize an Unnamed Semaphore 43
11.2.2 Destroy an Unnamed Semaphore 43
11.2.3 Initialize/Open a Named Semaphore 43
11.2.4 Close a Named Semaphore 43
11.2.5 Remove a Named Semaphore 43
11.2.6 Lock a Semaphore 43
11.2.7 Unlock a Semaphore 43
11.2.8 Get the Value of a Semaphore 43
11.3 Mutexes 44
11.3.1 Mutex Initialization Attributes 44
11.3.2 Initializing and Destroying a Mutex 44
11.3.3 Locking and Unlocking a Mutex 44
11.4 Condition Variables 44
11.4.1 Condition Variable Initialization Attributes 44
11.4.2 Initialization and Destroying Condition Variables 44
11.4.3 Broadcasting and Signaling a Condition 44
11.4.4 Waiting on a Condition 45

12 Memory Management 47
12.1 Memory Locking Functions 47
12.1.1 Lock/Unlock the Address Space of a Process 47
12.1.2 Lock/Unlock a Rand of Process Address Space 47
12.2 Memory Mapping Functions 47
12.2.1 Map Process Addresses to a Memory Object 47
12.2.2 Unmap Previously Mapped Addresses 47
12.2.3 Change Memory Protection 47
12.2.4 Memory Object Synchronization 47
12.3 Shared Memory Functions 48
12.3.1 Open a Shared Memory Object 48
12.3.2 Remove a Shared Memory Object 48

13 Execution Scheduling 49
13.1 Scheduling Parameters 49
13.2 Scheduling Policies 49
13.2.1 SCHED_FIFO 49
13.2.2 SCHED_RR 49
13.2.3 SCHED_OTHER 49
13.3 Process Scheduling Functions 49
13.3.1 Set Scheduling Parameters 49
13.3.2 Get Scheduling Parameters 49
13.3.3 Set Scheduling Policy and Scheduling Parameters 49
13.3.4 Get Scheduling Policy 49

13.3.5 Yield Processor ... 50
13.3.6 Get Scheduling Parameter Limits ... 50
13.4 Thread Scheduling ... 50
13.4.1 Thread Scheduling Attributes ... 50
13.4.2 Scheduling Contention Scope ... 50
13.4.3 Scheduling Allocation Domain ... 50
13.4.4 Scheduling Documentation ... 50
13.5 Thread Scheduling Functions ... 50
13.5.1 Thread Creation Scheduling Attributes ... 50
13.5.2 Dynamic Thread Scheduling Parameters Access ... 51
13.6 Synchronization Scheduling ... 51
13.6.1 Mutex Initialization Scheduling Attributes ... 51
13.6.2 Change the Priority Ceiling of a Mutex ... 51

14 Clocks and Timers ... 53
14.1 Data Definitions for Clocks and Timers ... 53
14.1.1 Time Value Specification Structures ... 53
14.1.2 Timer Event Notification Control Block ... 53
14.1.3 Type Definitions ... 53
14.1.4 Timer Event Notification Manifest Constants ... 53
14.2 Clock and Timer Functions ... 53
14.2.1 Clocks ... 53
14.2.2 Create a Per-Process Timer ... 53
14.2.3 Delete a Per-Process Timer ... 53
14.2.4 Per-Process Timers ... 54
14.2.5 High Resolution Sleep ... 54

15 Message Passing ... 55
15.1 Data Definitions for Message Queues ... 55
15.1.1 Data Structures ... 55
15.2 Message Passing Functions ... 55
15.2.1 Open a Message Queue ... 55
15.2.2 Close a Message Queue ... 55
15.2.3 Remove a Message Queue ... 55
15.2.4 Send a Message to a Message Queue ... 55
15.2.5 Receive a Message From a Message Queue ... 55
15.2.6 Notify Process That a Message is Available on a Queue ... 55
15.2.7 Set Message Queue Attributes ... 55
15.2.8 Get Message Queue Attributes ... 56

16 Thread Management 57
16.1 Threads 57
16.2 Thread Functions 57
16.2.1 Thread Creation Attributes 57
16.2.2 Thread Creation 57
16.2.3 Wait for Thread Termination 57
16.2.4 Detaching a Thread 57
16.2.5 Thread Termination 57
16.2.6 Get Thread ID 57
16.2.7 Compare Thread IDs 57
16.2.8 Dynamic Package Initialization 58

17 Thread-Specific Data 59
17.1 Thread-Specific Data Functions 59
17.1.1 Thread-Specific Data Key Creation 59
17.1.2 Thread-Specific Data Management 59
17.1.3 Thread-Specific Data Key Deletion 59

18 Thread Cancellation 61
18.1 Thread Cancellation Overview 61
18.1.1 Cancelability States 61
18.1.2 Cancellation Points 61
18.1.3 Thread Cancellation Cleanup Handlers 61
18.1.4 Async-Cancel Safety 61
18.2 Thread Cancellation Functions 61
18.2.1 Canceling Execution of a Thread 61
18.2.2 Setting Cancelability State 61
18.2.3 Establishing Cancellation Handlers 61
18.3 Language-Independent Cancellation Functionality 62
18.3.1 Requesting Cancellation 62
18.3.2 Associating Cleanup Code With Scopes 62
18.3.3 Controlling Cancellation Within Scopes 62
18.3.4 Defined Cancellation Sequence 62
18.3.5 List of Cancellation Points 62

19 Compliance Summary 63

19.1 General Chapter 63
19.2 Terminology and General Requirements Chapter 64
19.3 Process Primitives Chapter 65
19.4 Process Environment Chapter 66
19.5 Files and Directories Chapter 67
19.6 Input and Output Primitives Chapter 68
19.7 Device- and Class-Specific Functions Chapter 69
19.8 Language-Specific Services for the C Programming Language Chapter 70
19.9 System Databases Chapter 71
19.10 Data Interchange Format Chapter 72
19.11 Synchronization Chapter 73
19.12 Memory Management Chapter 74
19.13 Execution Scheduling Chapter 75
19.14 Clocks and Timers Chapter 76
19.15 Message Passing Chapter 77
19.16 Thread Management Chapter 78
19.17 Thread-Specific Data Chapter 79
19.18 Thread Cancellation Chapter 80
19.19 Overall Summary 81

Command and Variable Index 83

Concept Index 85

Preface

This document lists the functions, constant, macros, feature flags, and types defined in the POSIX 1003.1 standard. Each section in this document corresponds to a section in the 1003.1 standard and the implementation status of the items required by the standard are listed.

RTEMS supports a number of POSIX process, user, and group oriented routines in what is referred to as a "SUSP" (Single-User, Single Process) manner. RTEMS supports a single process, multithreaded POSIX 1003.1b environment. In a pure world, there would be no reason to even include routines like `getpid()` when there can only be one process. But providing routines like `getpid()` and making them work in a sensible fashion for an embedded environment while not returning ENOSYS (for not implemented) makes it significantly easier to port code from a UNIX environment without modifying it.

1 General

1.1 Scope

1.2 Normative References

1.3 Conformance

NGROUPS_MAX, Feature Flag,
_POSIX_ASYNCHRONOUS_IO, Feature Flag,
_POSIX_CHOWN_RESTRICTED, Feature Flag,
_POSIX_FSYNC, Feature Flag,
_POSIX_JOB_CONTROL, Feature Flag,
_POSIX_MAPPED_FILES, Feature Flag,
_POSIX_MEMLOCK, Feature Flag,
_POSIX_MEMLOCK_RANGE, Feature Flag,
_POSIX_MEMORY_PROTECTION, Feature Flag,
_POSIX_MESSAGE_PASSING, Feature Flag,
_POSIX_PRIORITIZED_IO, Feature Flag,
_POSIX_PRIORITY_SCHEDULING, Feature Flag,
_POSIX_REALTIME_SIGNALS, Feature Flag,
_POSIX_SEMAPHORES, Feature Flag,
_POSIX_SHARED_MEMORY_OBJECTS, Feature Flag,
_POSIX_SYNCHRONIZED_IO, Feature Flag,
_POSIX_TIMERS, Feature Flag,
_POSIX_THREAD_PRIO_INHERIT, Feature Flag,
_POSIX_THREAD_PRIORITY_SCHEDULING, Feature Flag,
_POSIX_THREADS, Feature Flag,
_POSIX_THREAD_SAFE_FUNCTIONS, Feature Flag,

2 Terminology and General Requirements

2.1 Conventions

2.2 Definitions

2.3 General Concepts

2.4 Error Numbers

E2BIG, Constant, Implemented
EACCES, Constant, Implemented
EAGAIN, Constant, Implemented
EBADF, Constant, Implemented
EBADMSG, Constant, Implemented
EBUSY, Constant, Implemented
ECANCELED, Constant, Unimplemented
ECHILD, Constant, Implemented
EDEADLK, Constant, Implemented
EDOM, Constant, Implemented
EEXIST, Constant, Implemented
EFAULT, Constant, Implemented
EFBIG, Constant, Implemented
EINPROGRESS, Constant, Implemented
EINTR, Constant, Implemented
EINVAL, Constant, Implemented
EIO, Constant, Implemented
EISDIR, Constant, Implemented
EMFILE, Constant, Implemented
EMLINK, Constant, Implemented
EMSGSIZE, Constant, Implemented
ENAMETOOLONG, Constant, Implemented
ENFILE, Constant, Implemented
ENODEV, Constant, Implemented
ENOENT, Constant, Implemented
ENOEXEC, Constant, Implemented
ENOLCK, Constant, Implemented
ENOMEM, Constant, Implemented
ENOSPC, Constant, Implemented
ENOSYS, Constant, Implemented
ENOTDIR, Constant, Implemented

```
ENOTEMPTY, Constant, Implemented
ENOTSUP, Constant, Implemented
ENOTTY, Constant, Implemented
ENXIO, Constant, Implemented
EPERM, Constant, Implemented
EPIPE, Constant, Implemented
ERANGE, Constant, Implemented
EROFS, Constant, Implemented
ESPIPE, Constant, Implemented
ESRCH, Constant, Implemented
ETIMEDOUT, Constant, Implemented
EXDEV, Constant, Implemented
```

2.5 Primitive System Types

```
dev_t, Type, Implemented
gid_t, Type, Implemented
ino_t, Type, Implemented
mode_t, Type, Implemented
nlink_t, Type, Implemented
off_t, Type, Implemented
pid_t, Type, Implemented
pthread_t, Type, Implemented
pthread_attr_t, Type, Implemented
pthread_mutex_t, Type, Implemented
pthread_mutex_attr_t, Type, Implemented
pthread_cond_t, Type, Implemented
pthread_cond_attr_t, Type, Implemented
pthread_key_t, Type, Implemented
pthread_once_t, Type, Implemented
size_t, Type, Implemented
ssize_t, Type, Implemented
time_t, Type, Implemented
uid_t, Type, Implemented
```

NOTE: time_t is not listed in this section but is used by many functions.

2.6 Environment Description

2.7 C Language Definitions

2.7.1 Symbols From the C Standard

```
NULL, Constant, Implemented
```

2.7.2 POSIX.1 Symbols

_POSIX_C_SOURCE, Feature Flag,

2.8 Numerical Limits

2.9 C Language Limits

CHAR_BIT, Constant, Implemented
CHAR_MAX, Constant, Implemented
CHAR_MIN, Constant, Implemented
INT_MAX, Constant, Implemented
INT_MIN, Constant, Implemented
LONG_MAX, Constant, Implemented
LONG_MIN, Constant, Implemented
MB_LEN_MAX, Constant, Implemented
SCHAR_MAX, Constant, Implemented
SCHAR_MIN, Constant, Implemented
SHRT_MAX, Constant, Implemented
SHRT_MIN, Constant, Implemented
UCHAR_MAX, Constant, Implemented
UINT_MAX, Constant, Implemented
ULONG_MAX, Constant, Implemented
USHRT_MAX, Constant, Implemented

NOTE: These are implemented in GCC's limits.h file.

2.9.1 Minimum Values

_POSIX_AIO_LISTIO_MAX, Constant, Implemented
_POSIX_AIO_MAX, Constant, Implemented
_POSIX_ARG_MAX, Constant, Implemented
_POSIX_CHILD_MAX, Constant, Implemented
_POSIX_DELAYTIMER_MAX, Constant, Implemented
_POSIX_LINK_MAX, Constant, Implemented
_POSIX_LOGIN_NAME_MAX, Constant, Implemented
_POSIX_MAX_CANON, Constant, Implemented
_POSIX_MAX_INPUT, Constant, Implemented
_POSIX_MQ_OPEN_MAX, Constant, Implemented
_POSIX_MQ_PRIO_MAX, Constant, Implemented
_POSIX_NAME_MAX, Constant, Implemented
_POSIX_NGROUPS_MAX, Constant, Implemented
_POSIX_OPEN_MAX, Constant, Implemented
_POSIX_PATH_MAX, Constant, Implemented
_POSIX_PIPE_BUF, Constant, Implemented

_POSIX_RTSIG_MAX, Constant, Implemented
_POSIX_SEM_NSEMS_MAX, Constant, Implemented
_POSIX_SEM_VALUE_MAX, Constant, Implemented
_POSIX_SIGQUEUE_MAX, Constant, Implemented
_POSIX_SSIZE_MAX, Constant, Implemented
_POSIX_STREAM_MAX, Constant, Implemented
_POSIX_THREAD_DESTRUCTOR_ITERATIONS, Constant, Implemented
_POSIX_THREAD_KEYS_MAX, Constant, Implemented
_POSIX_THREAD_THREADS_MAX, Constant, Implemented
_POSIX_TTY_NAME_MAX, Constant, Implemented
_POSIX_TIME_MAX, Constant, Unimplemented
_POSIX_TZNAME_MAX, Constant, Implemented

2.9.2 Run-Time Increasable Values

_POSIX_NGROUPS_MAX, Constant, Implemented

2.9.3 Run-Time Invariant Values (Possible Indeterminate)

AIO_LISTIO_MAX, Constant, Implemented
AIO_MAX, Constant, Implemented
AIO_PRIO_DELTA_MAX, Constant, Implemented
ARG_MAX, Constant, Implemented
CHILD_MAX, Constant, Implemented
DELAYTIMER_MAX, Constant, Implemented
LOGIN_NAME_MAX, Constant, Implemented
MQ_OPEN_MAX, Constant, Implemented
OPEN_MAX, Constant, Implemented
PAGESIZE, Constant, Implemented
PTHREAD_DESTRUCTOR_ITERATIONS, Constant, Implemented
PTHREAD_KEYS_MAX, Constant, Implemented
PTHREAD_STACK_MIN, Constant, Implemented
PTHJREAD_THREADS_MAX, Constant, Implemented
RTSIG_MAX, Constant, Implemented
SEM_NSEMS_MAX, Constant, Implemented
SEM_VALUE_MAX, Constant, Implemented
SIGQUEUE_MAX, Constant, Implemented
STREAM_MAX, Constant, Implemented
TIMER_MAX, Constant, Implemented
TTY_NAME_MAX, Constant, Implemented
TZNAME_MAX, Constant, Implemented

2.9.4 Pathname Variable Values

LINK_MAX, Constant, Implemented
MAX_CANON, Constant, Implemented

MAX_INPUT, Constant, Implemented
NAME_MAX, Constant, Implemented
PATH_MAX, Constant, Implemented
PIPE_BUF, Constant, Implemented

2.9.5 Invariant Values

SSIZE_MAX, Constant, Implemented

2.9.6 Maximum Values

_POSIX_CLOCKRES_MIN, Constant, Implemented

2.10 Symbolic Constants

2.10.1 Symbolic Constants for the access Function

R_OK, Constant, Implemented
W_OK, Constant, Implemented
X_OK, Constant, Implemented
F_OK, Constant, Implemented

2.10.2 Symbolic Constants for the lseek Function

SEEK_SET, Constant, Implemented
SEEK_CUR, Constant, Implemented
SEEK_END, Constant, Implemented

2.10.3 Compile-Time Symbolic Constants for Portability Specifications

_POSIX_ASYNCHRONOUS_IO, Feature Flag,
_POSIX_FSYNC, Feature Flag,
_POSIX_JOB_CONTROL, Feature Flag,
_POSIX_MAPPED_FILES, Feature Flag,
_POSIX_MEMLOCK, Feature Flag,
_POSIX_MEMLOCK_RANGE, Feature Flag,
_POSIX_MEMORY_PROTECTION, Feature Flag,
_POSIX_MESSAGE_PASSING, Feature Flag,
_POSIX_PRIORITIZED_IO, Feature Flag,
_POSIX_PRIORITY_SCHEDULING, Feature Flag,
_POSIX_REALTIME_SIGNALS, Feature Flag,
_POSIX_SAVED_IDS, Feature Flag,
_POSIX_SEMAPHORES, Feature Flag,

_POSIX_SHARED_MEMORY_OBJECTS, Feature Flag,
_POSIX_SYNCHRONIZED_IO, Feature Flag,
_POSIX_THREADS, Feature Flag,
_POSIX_THREAD_ATTR_STACKADDR, Feature Flag,
_POSIX_THREAD_ATTR_STACKSIZE, Feature Flag,
_POSIX_THREAD_PRIORITY_SCHEDULING, Feature Flag,
_POSIX_THREAD_PRIO_INHERIT, Feature Flag,
_POSIX_THREAD_PRIO_CEILING, Feature Flag,
_POSIX_THREAD_PROCESS_SHARED, Feature Flag,
_POSIX_THREAD_SAFE_FUNCTIONS, Feature Flag,
_POSIX_TIMERS, Feature Flag,
_POSIX_VERSION, Feature Flag,

2.10.4 Execution-Time Symbolic Constants for Portability Specifications

_POSIX_ASYNC_IO, Feature Flag,
_POSIX_CHOWN_RESTRICTED, Feature Flag,
_POSIX_NO_TRUNC, Feature Flag,
_POSIX_PRIO_IO, Feature Flag,
_POSIX_SYNC_IO, Feature Flag,
_POSIX_VDISABLE, Feature Flag,

3 Process Primitives

3.1 Process Creation and Execution

3.1.1 Process Creation

```
fork(), Function, Unimplementable, Requires Processes
```

3.1.2 Execute a File

```
execl(), Function, Unimplementable, Requires Processes
execv(), Function, Unimplementable, Requires Processes
execle(), Function, Unimplementable, Requires Processes
execve(), Function, Unimplementable, Requires Processes
execlp(), Function, Unimplementable, Requires Processes
execvp(), Function, Unimplementable, Requires Processes
```

3.1.3 Register Fork Handlers

```
pthread_atfork(), Function, Unimplementable, Requires Processes
```

3.2 Process Termination

3.2.1 Wait for Process Termination

```
wait(), Function, Unimplementable, Requires Processes
waitpid(), Function, Unimplementable, Requires Processes
WNOHANG, Constant, Unimplementable, Requires Processes
WUNTRACED, Constant, Unimplementable, Requires Processes
WIFEXITED(), Function, Unimplementable, Requires Processes
WEXITSTATUS(), Function, Unimplementable, Requires Processes
WIFSIGNALED(), Function, Unimplementable, Requires Processes
WTERMSIG(), Function, Unimplementable, Requires Processes
WIFSTOPPED(), Function, Unimplementable, Requires Processes
WSTOPSIG(), Function, Unimplementable, Requires Processes
```

3.2.2 Terminate a Process

```
_exit(), Function, Implemented
```

3.3 Signals

3.3.1 Signal Concepts

3.3.1.1 Signal Names

```
sigset_t, Type, Implemented
SIG_DFL, Constant, Implemented
SIG_IGN, Constant, Implemented
SIG_ERR, Constant, Implemented
SIGABRT, Constant, Implemented
SIGALRM, Constant, Implemented
SIGFPE, Constant, Implemented
SIGHUP, Constant, Implemented
SIGILL, Constant, Implemented
SIGINT, Constant, Implemented
SIGKILL, Constant, Implemented
SIGPIPE, Constant, Implemented
SIGQUIT, Constant, Implemented
SIGSEGV, Constant, Implemented
SIGTERM, Constant, Implemented
SIGUSR1, Constant, Implemented
SIGUSR2, Constant, Implemented
SIGCHLD, Constant, Unimplemented
SIGCONT, Constant, Unimplemented
SIGSTOP, Constant, Unimplemented
SIGTSTP, Constant, Unimplemented
SIGTTIN, Constant, Unimplemented
SIGTTOU, Constant, Unimplemented
SIGBUS, Constant, Implemented
SIGRTMIN, Constant, Implemented
SIGRTMAX, Constant, Implemented
```

NOTE: SIG_ERR is technically an extension to the C Library which is not documented anywhere else according to the index.

3.3.1.2 Signal Generation and Delivery

```
struct sigevent, Type, Implemented
union sigval, Type, Implemented
SIGEV_NONE, Constant, Implemented
SIGEV_SIGNAL, Constant, Implemented
SIGEV_THREAD, Constant, Implemented
```

3.3.1.3 Signal Actions

```
siginfo_t, Type, Implemented
SI_USER, Constant, Implemented
SI_QUEUE, Constant, Implemented
SI_TIMER, Constant, Implemented
SI_ASYNCIO, Constant, Implemented
SI_MESGQ, Constant, Implemented
```

3.3.2 Send a Signal to a Process

```
kill(), Function, Implemented
```

3.3.3 Manipulate Signal Sets

```
sigemptyset(), Function, Implemented
sigfillset(), Function, Implemented
sigaddset(), Function, Implemented
sigdelset(), Function, Implemented
sigismember(), Function, Implemented
```

3.3.4 Examine and Change Signal Action

```
sigaction(), Function, Implemented
sigaction, Type, Implemented
SA_NOCLDSTOP, Constant, Implemented
SA_SIGINFO, Constant, Implemented
```

3.3.5 Examine and Change Blocked Signals

```
pthread_sigmask(), Function, Implemented
sigprocmask(), Function, Implemented
SIG_BLOCK, Constant, Implemented
SIG_UNBLOCK, Constant, Implemented
SIG_SETMASK, Constant, Implemented
```

3.3.6 Examine Pending Signals

```
sigpending(), Function, Implemented
```

3.3.7 Wait for a Signal

```
sigsuspend(), Function, Implemented
```

3.3.8 Synchronously Accept a Signal

```
sigwait(), Function, Implemented
sigwaitinfo(), Function, Implemented
sigtimedwait(), Function, Implemented
```

3.3.9 Queue a Signal to a Process

```
sigqueue(), Function, Implemented
```

3.3.10 Send a Signal to a Thread

```
pthread_kill(), Function, Implemented
```

3.4 Timer Operations

3.4.1 Schedule Alarm

```
alarm(), Function, Implemented
```

3.4.2 Suspend Process Execution

```
pause(), Function, Implemented
```

3.4.3 Delay Process Execution

```
sleep(), Function, Implemented
```

4 Process Environment

4.1 Process Identification

4.1.1 Get Process and Parent Process IDs

```
getpid(), Function, Implemented, SUSP Functionality
getppid(), Function, Implemented, SUSP Functionality
```

4.2 User Identification

4.2.1 Get Real User Effective User Real Group and Effective Group IDs

```
getuid(), Function, Implemented, SUSP Functionality
geteuid(), Function, Implemented, SUSP Functionality
getgid(), Function, Implemented, SUSP Functionality
getegid(), Function, Implemented, SUSP Functionality
```

4.2.2 Set User and Group IDs

```
setuid(), Function, Implemented, SUSP Functionality
setgid(), Function, Implemented, SUSP Functionality
```

4.2.3 Get Supplementary Group IDs

```
getgroups(), Function, Implemented, SUSP Functionality
```

4.2.4 Get User Name

```
getlogin(), Function, Implemented, SUSP Functionality
getlogin_r(), Function, Implemented, SUSP Functionality
```

4.3 Process Groups

4.3.1 Get Process Group ID

```
getpgrp(), Function, Implemented, SUSP Functionality
```

4.3.2 Create Session and Set Process Group ID

`setsid()`, Function, Implemented, SUSP Functionality

4.3.3 Set Process Group ID for Job Control

`setpgid()`, Function, Dummy Implementation

4.4 System Identification

4.4.1 Get System Name

`struct utsname`, Type, Implemented
`uname()`, Function, Implemented

4.5 Time

4.5.1 Get System Time

`time()`, Function, Implemented

4.5.2 Get Process Times

`struct tms`, Type, Implemented
`times()`, Function, Implemented

NOTE: `times` always returns 0 for tms_stime, tms_cutime, and tms_cstime fields of the `struct tms` returned.

4.6 Environment Variables

4.6.1 Environment Access

`getenv()`, Function, Implemented

4.7 Terminal Identification

4.7.1 Generate Terminal Pathname

`ctermid()`, Function, Implemented

4.7.2 Determine Terminal Device Name

```
ttyname(), Function, Implemented, untested
ttyname_r(), Function, Implemented, untested
isatty(), Function, Implemented
```

4.8 Configurable System Variables

4.8.1 Get Configurable System Variables

```
sysconf(), Function, Dummy Implementation
_SC_AIO_LISTIO_MAX, Constant, Implemented
_SC_AIO_MAX, Constant, Implemented
_SC_AIO_PRIO_DELTA_MAX, Constant, Implemented
_SC_ARG_MAX, Constant, Implemented
_SC_CHILD_MAX, Constant, Implemented
_SC_CLK_TCK, Constant, Implemented
CLK_TCK, Constant, Implemented
_SC_DELAYTIMER_MAX, Constant, Implemented
_SC_GETGR_R_SIZE_MAX, Constant, Implemented
_SC_GETPW_R_SIZE_MAX, Constant, Implemented
_SC_LOGIN_NAME_MAX, Constant, Implemented
_SC_MQ_OPEN_MAX, Constant, Implemented
_SC_MQ_PRIO_MAX, Constant, Implemented
_SC_NGROUPS_MAX, Constant, Implemented
_SC_OPEN_MAX, Constant, Implemented
_SC_PAGESIZE, Constant, Implemented
_SC_RTSIG_MAX, Constant, Implemented
_SC_SEM_NSEMS_MAX, Constant, Implemented
_SC_SEM_VALUE_MAX, Constant, Implemented
_SC_SIGQUEUE_MAX, Constant, Implemented
_SC_STREAM_MAX, Constant, Implemented
_SC_THREAD_DESTRUCTOR_ITERATIONS, Constant, Implemented
_SC_THREAD_KEYS_MAX, Constant, Implemented
_SC_THREAD_STACK_MIN, Constant, Implemented
_SC_THREAD_THREADS_MAX, Constant, Implemented
_SC_TIMER_MAX, Constant, Implemented
_SC_TTY_NAME_MAX, Constant, Implemented
_SC_TZNAME_MAX, Constant, Implemented
_SC_ASYNCHRONOUS_IO, Constant, Implemented
_SC_FSYNC, Constant, Implemented
_SC_JOB_CONROL, Constant, Implemented
_SC_MAPPED_FILES, Constant, Implemented
_SC_MEMLOCK, Constant, Implemented
_SC_MEMLOCK_RANGE, Constant, Implemented
```

```
_SC_MEMORY_PROTECTION, Constant, Implemented
_SC_MESSAGE_PASSING, Constant, Implemented
_SC_PRIORITIZED_IO, Constant, Implemented
_SC_PRIORITY_SCHEDULING, Constant, Unimplemented
_SC_REALTIME_SIGNALS, Constant, Implemented
_SC_SAVED_IDS, Constant, Implemented
_SC_SEMAPHORES, Constant, Implemented
_SC_SHARED_MEMORY_OBJECTS, Constant, Implemented
_SC_SYNCHRONIZED_IO, Constant, Implemented
_SC_TIMERS, Constant, Implemented
_SC_THREADS, Constant, Implemented
_SC_THREAD_ATTR_STACKADDR, Constant, Implemented
_SC_THREAD_ATTR_STACKSIZE, Constant, Implemented
_SC_THREAD_PRIORITY_SCHEDULING, Constant, Implemented
_SC_THREAD_PRIO_INHERIT, Constant, Implemented
_SC_THREAD_PRIO_PROTECT, Constant, Unimplemented
_SC_THREAD_PROCESS_SHARED, Constant, Implemented
_SC_THREAD_SAFE_FUNCTIONS, Constant, Implemented
_SC_VERSION, Constant, Implemented
```

5 Files and Directories

5.1 Directories

5.1.1 Format of Directory Entries

5.1.2 Directory Operations

```
struct dirent, Type, Implemented
opendir(), Function, Implemented
readdir(), Function, Implemented
readdir_r(), Function, Implemented
rewinddir(), Function, Implemented
closedir(), Function, Implemented
```

5.2 Working Directory

5.2.1 Change Current Working Directory

```
chdir(), Function, Implemented
```

5.2.2 Get Working Directory Pathname

```
getcwd(), Function, Implemented
```

5.3 General File Creation

5.3.1 Open a File

```
open(), Function, Implemented
O_RDONLY, Constant, Implemented
O_WRONLY, Constant, Implemented
O_RDWR, Constant, Implemented
O_APPEND, Constant, Implemented
O_CREAT, Constant, Implemented
O_DSYNC, Constant, Unimplemented
O_EXCL, Constant, Implemented
O_NOCTTY, Constant, Implemented
O_NONBLOCK, Constant, Implemented
```

```
O_RSYNC, Constant, Unimplemented
O_SYNC, Constant, Implemented
O_TRUNC, Constant, Implemented
```

NOTE: In the newlib fcntl.h, O_SYNC is defined only if _POSIX_SOURCE is not defined. This seems wrong.

5.3.2 Create a New File or Rewrite an Existing One

```
creat(), Function, Implemented
```

5.3.3 Set File Creation Mask

```
umask(), Function, Implemented
```

5.3.4 Link to a File

```
link(), Function, Implemented
```

5.4 Special File Creation

5.4.1 Make a Directory

```
mkdir(), Function, Implemented
```

5.4.2 Make a FIFO Special File

```
mkfifo(), Function, Untested Implementation
```

NOTE: mkfifo() is implemented but no filesystem supports FIFOs.

5.5 File Removal

5.5.1 Remove Directory Entries

```
unlink(), Function, Implemented
```

5.5.2 Remove a Directory

```
rmdir(), Function, Implemented
```

5.5.3 Rename a File

```
rename(), Function, Implemented
```

5.6 File Characteristics

5.6.1 File Characteristics Header and Data Structure

```
struct stat, Type, Implemented
```

5.6.1.1 <sys/stat.h> File Types

```
S_ISBLK(), Function, Implemented
S_ISCHR(), Function, Implemented
S_ISDIR(), Function, Implemented
S_ISFIFO(), Function, Implemented
S_ISREG(), Function, Implemented
S_TYPEISMQ(), Function, Unimplemented
S_TYPEISSEM(), Function, Unimplemented
S_TYPEISSHM(), Function, Unimplemented
```

5.6.1.2 <sys/stat.h> File Modes

```
S_IRWXU, Constant, Implemented
S_IRUSR, Constant, Implemented
S_IWUSR, Constant, Implemented
S_IXUSR, Constant, Implemented
S_IRWXG, Constant, Implemented
S_IRGRP, Constant, Implemented
S_IWGRP, Constant, Implemented
S_IXGRP, Constant, Implemented
S_IRWXO, Constant, Implemented
S_IROTH, Constant, Implemented
S_IWOTH, Constant, Implemented
S_IXOTH, Constant, Implemented
S_ISUID, Constant, Implemented
S_ISGID, Constant, Implemented
```

5.6.1.3 <sys/stat.h> Time Entries

5.6.2 Get File Status

```
stat(), Function, Implemented
fstat(), Function, Implemented
```

5.6.3 Check File Accessibility

```
access(), Function, Implemented
```

5.6.4 Change File Modes

```
chmod(), Function, Implemented
fchmod(), Function, Implemented
```

5.6.5 Change Owner and Group of a File

```
chown(), Function, Implemented
```

5.6.6 Set File Access and Modification Times

```
struct utimbuf, Type, Implemented
utime(), Function, Implemented
```

5.6.7 Truncate a File to a Specified Length

```
ftruncate(), Function, Implemented
```

5.7 Configurable Pathname Variable

5.7.1 Get Configurable Pathname Variables

```
pathconf(), Function, Implemented
fpathconf(), Function, Implemented
_PC_LINK_MAX, Constant, Implemented
_PC_MAX_CANON, Constant, Implemented
_PC_MAX_INPUT, Constant, Implemented
_PC_MAX_INPUT, Constant, Implemented
_PC_NAME_MAX, Constant, Implemented
_PC_PATH_MAX, Constant, Implemented
_PC_PIPE_BUF, Constant, Implemented
_PC_ASYNC_IO, Constant, Implemented
_PC_CHOWN_RESTRICTED, Constant, Implemented
_PC_NO_TRUNC, Constant, Implemented
_PC_PRIO_IO, Constant, Implemented
_PC_SYNC_IO, Constant, Implemented
_PC_VDISABLE, Constant, Implemented
```

NOTE: The newlib unistd.h and sys/unistd.h are installed and the include search patch is used to get the right one. There are conflicts between the newlib unistd.h and RTEMS' version.

6 Input and Output Primitives

6.1 Pipes

6.1.1 Create an Inter-Process Channel

```
pipe(), Function, Dummy Implementation
```

NOTE: pipe() returns ENOSYS.

6.2 File Descriptor Manipulation

6.2.1 Duplicate an Open File Descriptor

```
dup(), Function, Implemented
dup2(), Function, Implemented
```

6.3 File Descriptor Deassignment

6.3.1 Close a File

```
close(), Function, Implemented
```

6.4 Input and Output

6.4.1 Read from a File

```
read(), Function, Implemented
```

6.4.2 Write to a File

```
write(), Function, Implemented
```

6.5 Control Operations on Files

6.5.1 Data Definitions for File Control Operations

6.5.2 File Control

```
struct flock, Type, Implemented
fcntl(), Function, Implemented
F_DUPFD, Constant, Implemented
F_GETFD, Constant, Implemented
F_GETLK, Constant, Implemented
F_SETFD, Constant, Implemented
F_GETFL, Constant, Implemented
F_SETFL, Constant, Implemented
F_SETLK, Constant, Implemented
F_SETLKW, Constant, Implemented
FD_CLOEXEC, Constant, Implemented
F_RDLCK, Constant, Implemented
F_UNLCK, Constant, Implemented
F_WRLCK, Constant, Implemented
O_ACCMODE, Constant, Implemented
```

NOTE: A number of constants are used by both `open` and `fcntl`. `O_CREAT`, `O_EXCL`, `O_NOCTTY`, `O_TRUNC`, `O_APPEND`, `O_DSYNC`, `O_NONBLOCK`, `O_RSYNC`, `O_SYNC`, `O_RDONLY`, `O_RDWR`, and `O_WRONLY` are also included in another section. See Section 5.3.1 [Open a File], page 19.

6.5.3 Reposition Read/Write File Offset

```
lseek(), Function, Implemented
SEEK_SET, Constant, Implemented
SEEK_CUR, Constant, Implemented
SEEK_END, Constant, Implemented
```

6.6 File Synchronization

6.6.1 Synchronize the State of a File

```
fsync(), Function, Implemented
```

6.6.2 Synchronize the Data of a File

```
fdatasync(), Function, Implemented
```

6.7 Asynchronous Input and Output

6.7.1 Data Definitions for Asynchronous Input and Output

6.7.1.1 Asynchronous I/O Control Block

struct aiocb, Type, Untested Implementation

6.7.1.2 Asynchronous I/O Manifest Constants

AIO_CANCELED, Constant, Implemented
AIO_NOTCANCELED, Constant, Implemented
AIO_ALLDONE, Constant, Implemented
LIO_WAIT, Constant, Implemented
LIO_NOWAIT, Constant, Implemented
LIO_READ, Constant, Implemented
LIO_WRITE, Constant, Implemented
LIO_NOP, Constant, Implemented

6.7.2 Asynchronous Read

aio_read(), Function, Dummy Implementation

6.7.3 Asynchronous Write

aio_write(), Function, Dummy Implementation

6.7.4 List Directed I/O

lio_listio(), Function, Dummy Implementation

6.7.5 Retrieve Error Status of Asynchronous I/O Operation

aio_error(), Function, Dummy Implementation

6.7.6 Retrieve Return Status of Asynchronous I/O Operation

aio_return(), Function, Dummy Implementation

6.7.7 Cancel Asynchronous I/O Request

aio_cancel(), Function, Dummy Implementation

6.7.8 Wait for Asynchronous I/O Request

aio_suspend(), Function, Dummy Implementation

6.7.9 Asynchronous File Synchronization

`aio_fsync(), Function, Dummy Implementation`

7 Device- and Class-Specific Functions

7.1 General Terminal Interface

7.1.1 Interface Characteristics

7.1.1.1 Opening a Terminal Device File

7.1.1.2 Process Groups (TTY)

7.1.1.3 The Controlling Terminal

7.1.1.4 Terminal Access Control

7.1.1.5 Input Processing and Reading Data

7.1.1.6 Canonical Mode Input Processing

7.1.1.7 Noncanonical Mode Input Processing

Case A - MIN > 0 and TIME > 0

Case B - MIN > 0 and TIME = 0

Case C - MIN = 0 and TIME > 0

Case D - MIN = 0 and TIME = 0

7.1.1.8 Writing Data and Output Processing

7.1.1.9 Special Characters

```
INTR, Constant, Implemented
QUIT, Constant, Implemented
ERASE, Constant, Implemented
KILL, Constant, Implemented
EOF, Constant, Implemented
NL, Constant, Implemented
EOL, Constant, Implemented
SUSP, Constant, Implemented
STOP, Constant, Implemented
START, Constant, Implemented
CR, Constant, Implemented
```

7.1.1.10 Modem Disconnect

7.1.1.11 Closing a Terminal Device File

7.1.2 Parameters That Can Be Set

7.1.2.1 termios Structure

```
tcflag_t, Type, Implemented
cc_t, Type, Implemented
struct termios, Type, Implemented
```

7.1.2.2 Input Modes

```
BRKINT, Constant, Implemented
ICRNL, Constant, Implemented
IGNBREAK, Constant, Unimplemented
IGNCR, Constant, Implemented
IGNPAR, Constant, Implemented
INLCR, Constant, Implemented
INPCK, Constant, Implemented
ISTRIP, Constant, Implemented
IXOFF, Constant, Implemented
IXON, Constant, Implemented
PARMRK, Constant, Implemented
```

7.1.2.3 Output Modes

```
OPOST, Constant, Implemented
```

7.1.2.4 Control Modes

```
CLOCAL, Constant, Implemented
CREAD, Constant, Implemented
CSIZE, Constant, Implemented
CS5, Constant, Implemented
CS6, Constant, Implemented
CS7, Constant, Implemented
CS8, Constant, Implemented
CSTOPB, Constant, Implemented
HUPCL, Constant, Implemented
PARENB, Constant, Implemented
PARODD, Constant, Implemented
```

7.1.2.5 Local Modes

```
ECHO, Constant, Implemented
ECHOE, Constant, Implemented
ECHOK, Constant, Implemented
ECHONL, Constant, Implemented
ICANON, Constant, Implemented
IEXTEN, Constant, Implemented
ISIG, Constant, Implemented
NOFLSH, Constant, Implemented
TOSTOP, Constant, Implemented
```

7.1.2.6 Special Control Characters

```
VEOF, Constant, Implemented
VEOL, Constant, Implemented
VERASE, Constant, Implemented
VINTR, Constant, Implemented
VKILL, Constant, Implemented
VQUIT, Constant, Implemented
VSUSP, Constant, Implemented
VSTART, Constant, Implemented
VSTOP, Constant, Implemented
VMIN, Constant, Implemented
VTIME, Constant, Implemented
```

7.1.3 Baud Rate Values

```
B0, Constant, Implemented
B50, Constant, Implemented
B75, Constant, Implemented
B110, Constant, Implemented
```

```
B134, Constant, Implemented
B150, Constant, Implemented
B200, Constant, Implemented
B300, Constant, Implemented
B600, Constant, Implemented
B1200, Constant, Implemented
B1800, Constant, Implemented
B2400, Constant, Implemented
B4800, Constant, Implemented
B9600, Constant, Implemented
B19200, Constant, Implemented
B38400, Constant, Implemented
```

7.1.3.1 Baud Rate Functions

```
cfgetospeed(), Function, Implemented
cfsetospeed(), Function, Implemented
cfgetispeed(), Function, Implemented
cfsetispeed(), Function, Implemented
TCIFLUSH, Constant, Implemented
TCOFLUSH, Constant, Implemented
TCIOFLUSH, Constant, Implemented
TCOOFF, Constant, Implemented
TCOON, Constant, Implemented
TCIOOFF, Constant, Implemented
TCIOON, Constant, Implemented
```

7.2 General Terminal Interface Control Functions

7.2.1 Get and Set State

```
tcgetattr(), Function, Implemented
tcsetattr(), Function, Implemented
```

7.2.2 Line Control Functions

```
tcsendbreak(), Function, Dummy Implementation
tcdrain(), Function, Implemented
tcflush(), Function, Dummy Implementation
tcflow(), Function, Dummy Implementation
```

7.2.3 Get Foreground Process Group ID

```
tcgetprgrp(), Function, Implemented, SUSP
```

7.2.4 Set Foreground Process Group ID

`tcsetprgrp(), Function, Dummy Implementation`

8 Language-Specific Services for the C Programming Language

8.1 Referenced C Language Routines

ANSI C Section 4.2 — Diagnostics

```
assert(), Function, Implemented
```

ANSI C Section 4.3 — Character Handling

```
isalnum(), Function, Implemented
isalpha(), Function, Implemented
iscntrl(), Function, Implemented
isdigit(), Function, Implemented
isgraph(), Function, Implemented
islower(), Function, Implemented
isprint(), Function, Implemented
ispunct(), Function, Implemented
isspace(), Function, Implemented
isupper(), Function, Implemented
isxdigit(), Function, Implemented
tolower(), Function, Implemented
toupper(), Function, Implemented
```

ANSI C Section 4.4 — Localization

```
setlocale(), Function, Implemented
```

ANSI C Section 4.5 — Mathematics

```
acos(), Function, Implemented
asin(), Function, Implemented
atan(), Function, Implemented
atan2(), Function, Implemented
cos(), Function, Implemented
sin(), Function, Implemented
tan(), Function, Implemented
cosh(), Function, Implemented
sinh(), Function, Implemented
tanh(), Function, Implemented
exp(), Function, Implemented
frexp(), Function, Implemented
ldexp(), Function, Implemented
log(), Function, Implemented
log10(), Function, Implemented
modf(), Function, Implemented
pow(), Function, Implemented
sqrt(), Function, Implemented
ceil(), Function, Implemented
```

```
fabs(), Function, Implemented
floor(), Function, Implemented
fmod(), Function, Implemented
```

ANSI C Section 4.6 — Non-Local Jumps

```
setjmp(), Function, Implemented
longjmp(), Function, Implemented
```

ANSI C Section 4.9 — Input/Output

```
FILE, Type, Implemented
clearerr(), Function, Implemented
fclose(), Function, Implemented
feof(), Function, Implemented
ferror(), Function, Implemented
fflush(), Function, Implemented
fgetc(), Function, Implemented
fgets(), Function, Implemented
fopen(), Function, Implemented
fputc(), Function, Implemented
fputs(), Function, Implemented
fread(), Function, Implemented
freopen(), Function, Implemented
fseek(), Function, Implemented
ftell(), Function, Implemented
fwrite(), Function, Implemented
getc(), Function, Implemented
getchar(), Function, Implemented
gets(), Function, Implemented
perror(), Function, Implemented
printf(), Function, Implemented
fprintf(), Function, Implemented
sprintf(), Function, Implemented
putc(), Function, Implemented
putchar(), Function, Implemented
puts(), Function, Implemented
remove(), Function, Implemented
rewind(), Function, Implemented
scanf(), Function, Implemented
fscanf(), Function, Implemented
sscanf(), Function, Implemented
setbuf(), Function, Implemented
tmpfile(), Function, Implemented
tmpnam(), Function, Implemented
ungetc(), Function, Implemented
```

NOTE: `rename` is also included in another section. Section 5.5.3 [Rename a File], page 20.

ANSI C Section 4.10 — General Utilities

```
abs(), Function, Implemented
atof(), Function, Implemented
atoi(), Function, Implemented
atol(), Function, Implemented
rand(), Function, Implemented
srand(), Function, Implemented
calloc(), Function, Implemented
free(), Function, Implemented
malloc(), Function, Implemented
realloc(), Function, Implemented
abort(), Function, Implemented
exit(), Function, Implemented
bsearch(), Function, Implemented
qsort(), Function, Implemented
```

NOTE: `getenv` is also included in another section. Section 4.6.1 [Environment Access], page 16.

ANSI C Section 4.11 — String Handling

```
strcpy(), Function, Implemented
strncpy(), Function, Implemented
strcat(), Function, Implemented
strncat(), Function, Implemented
strcmp(), Function, Implemented
strncmp(), Function, Implemented
strchr(), Function, Implemented
strcspn(), Function, Implemented
strpbrk(), Function, Implemented
strrchr(), Function, Implemented
strspn(), Function, Implemented
strstr(), Function, Implemented
strtok(), Function, Implemented
strlen(), Function, Implemented
```

ANSI C Section 4.12 — Date and Time Handling

```
asctime(), Function, Implemented
ctime(), Function, Implemented
gmtime(), Function, Implemented
localtime(), Function, Implemented
mktime(), Function, Implemented
strftime(), Function, Implemented
```

NOTE: RTEMS has no notion of time zones.

NOTE: `time` is also included in another section. Section 4.5.1 [Get System Time], page 16.

From Surrounding Text

```
EXIT_SUCCESS, Constant, Implemented
```

```
EXIT_FAILURE, Constant, Implemented
```

8.1.1 Extensions to Time Functions

8.1.2 Extensions to setlocale Function

```
LC_CTYPE, Constant, Implemented
LC_COLLATE, Constant, Implemented
LC_TIME, Constant, Implemented
LC_NUMERIC, Constant, Implemented
LC_MONETARY, Constant, Implemented
LC_ALL, Constant, Implemented
```

8.2 C Language Input/Output Functions

8.2.1 Map a Stream Pointer to a File Descriptor

```
fileno(), Function, Implemented
STDIN_FILENO, Constant, Implemented
STDOUT_FILENO, Constant, Implemented
STDERR_FILENO, Constant, Implemented
```

8.2.2 Open a Stream on a File Descriptor

```
fdopen(), Function, Implemented
```

8.2.3 Interactions of Other FILE-Type C Functions

8.2.4 Operations on Files - the remove Function

8.2.5 Temporary File Name - the tmpnam Function

8.2.6 Stdio Locking Functions

```
flockfile(), Function, Unimplemented
ftrylockfile(), Function, Unimplemented
funlockfile(), Function, Unimplemented
```

8.2.7 Stdio With Explicit Client Locking

```
getc_unlocked(), Function, Unimplemented
getchar_unlocked(), Function, Unimplemented
putc_unlocked(), Function, Unimplemented
putchar_unlocked(), Function, Unimplemented
```

8.3 Other C Language Functions

8.3.1 Nonlocal Jumps

```
sigjmp_buf, Type, Implemented
sigsetjmp(), Function, Implemented
siglongjmp(), Function, Implemented
```

8.3.2 Set Time Zone

```
tzset(), Function, Unimplemented
```

8.3.3 Find String Token

```
strtok_r(), Function, Implemented
```

8.3.4 ASCII Time Representation

```
asctime_r(), Function, Implemented
```

8.3.5 Current Time Representation

```
ctime_r(), Function, Implemented
```

8.3.6 Coordinated Universal Time

```
gmtime_r(), Function, Implemented
```

8.3.7 Local Time

```
localtime_r(), Function, Implemented
```

8.3.8 Pseudo-Random Sequence Generation Functions

```
rand_r(), Function, Implemented
```

9 System Databases

9.1 System Databases Section

9.2 Database Access

9.2.1 Group Database Access

```
struct group, Type, Implemented
getgrgid(), Function, Implemented
getgrgid_r(), Function, Implemented
getgrname(), Function, Implemented
getgrnam_r(), Function, Implemented
```

NOTE: Creates /etc/group if none exists.

9.2.2 User Database Access

```
struct passwd, Type, Implemented
getpwuid(), Function, Implemented
getpwuid_r(), Function, Implemented
getpwnam(), Function, Implemented
getpwnam_r(), Function, Implemented
```

NOTE: Creates /etc/passwd if none exists.

10 Data Interchange Format

10.1 Archive/Interchange File Format

10.1.1 Extended tar Format

```
tar format, Type, Unimplemented
TMAGIC, Constant, Unimplemented
TMAGLEN, Constant, Unimplemented
TVERSION, Constant, Unimplemented
TVERSLEN, Constant, Unimplemented
REGTYPE, Constant, Unimplemented
AREGTYPE, Constant, Unimplemented
LNKTYPE, Constant, Unimplemented
SYMTYPE, Constant, Unimplemented
CHRTYPE, Constant, Unimplemented
BLKTYPE, Constant, Unimplemented
DIRTYPE, Constant, Unimplemented
FIFOTYPE, Constant, Unimplemented
CONTTYPE, Constant, Unimplemented
TSUID, Constant, Unimplemented
TSGID, Constant, Unimplemented
TSVTX, Constant, Unimplemented
TUREAD, Constant, Unimplemented
TUWRITE, Constant, Unimplemented
TUEXEC, Constant, Unimplemented
TGREAD, Constant, Unimplemented
TGWRITE, Constant, Unimplemented
TGEXEC, Constant, Unimplemented
TOREAD, Constant, Unimplemented
TOWRITE, Constant, Unimplemented
TOEXEC, Constant, Unimplemented
```

NOTE: Requires <tar.h> which is not in newlib.

10.1.2 Extended cpio Format

```
cpio format, Type, Unimplemented
C_IRUSER, Constant, Unimplemented
C_IWUSER, Constant, Unimplemented
C_IXUSER, Constant, Unimplemented
C_IRGRP, Constant, Unimplemented
C_IWGRP, Constant, Unimplemented
C_IXGRP, Constant, Unimplemented
```

```
C_IROTH, Constant, Unimplemented
C_IWOTH, Constant, Unimplemented
C_IXOTH, Constant, Unimplemented
C_ISUID, Constant, Unimplemented
C_ISGID, Constant, Unimplemented
C_ISVTX, Constant, Unimplemented
```

NOTE: POSIX does not require a header file or structure. RedHat Linux 5.0 does not have a <cpio.h> although Solaris 2.6 does.

10.1.3 Multiple Volumes

11 Synchronization

11.1 Semaphore Characteristics

NOTE: Semaphores are implemented but only unnamed semaphores are currently tested.

```
sem_t, Type, Implemented
```

11.2 Semaphore Functions

11.2.1 Initialize an Unnamed Semaphore

```
sem_init(), Function, Implemented
SEM_FAILED, Constant, Implemented
```

11.2.2 Destroy an Unnamed Semaphore

```
sem_destroy(), Function, Implemented
```

11.2.3 Initialize/Open a Named Semaphore

```
sem_open(), Function, Implemented
```

11.2.4 Close a Named Semaphore

```
sem_close(), Function, Implemented
```

11.2.5 Remove a Named Semaphore

```
sem_unlink(), Function, Implemented
```

11.2.6 Lock a Semaphore

```
sem_wait(), Function, Implemented
sem_trywait(), Function, Implemented
```

11.2.7 Unlock a Semaphore

```
sem_post(), Function, Implemented
```

11.2.8 Get the Value of a Semaphore

```
sem_getvalue(), Function, Implemented
```

11.3 Mutexes

11.3.1 Mutex Initialization Attributes

pthread_mutexattr_init(), Function, Implemented
pthread_mutexattr_destroy(), Function, Implemented
pthread_mutexattr_getpshared(), Function, Implemented
pthread_mutexattr_setpshared(), Function, Implemented
PTHREAD_PROCESS_SHARED, Constant, Implemented
PTHREAD_PROCESS_PRIVATE, Constant, Implemented

11.3.2 Initializing and Destroying a Mutex

pthread_mutex_init(), Function, Implemented
pthread_mutex_destroy(), Function, Implemented
PTHREAD_MUTEX_INITIALIZER, Constant, Implemented

11.3.3 Locking and Unlocking a Mutex

pthread_mutex_lock(), Function, Implemented
pthread_mutex_trylock(), Function, Implemented
pthread_mutex_unlock(), Function, Implemented

11.4 Condition Variables

11.4.1 Condition Variable Initialization Attributes

pthread_condattr_init(), Function, Implemented
pthread_condattr_destroy(), Function, Implemented
pthread_condattr_getpshared(), Function, Implemented
pthread_condattr_setpshared(), Function, Implemented

11.4.2 Initialization and Destroying Condition Variables

pthread_cond_init(), Function, Implemented
pthread_cond_destroy(), Function, Implemented
PTHREAD_COND_INITIALIZER, Constant, Implemented

11.4.3 Broadcasting and Signaling a Condition

pthread_cond_signal(), Function, Implemented
pthread_cond_broadcast(), Function, Implemented

11.4.4 Waiting on a Condition

```
pthread_cond_wait(), Function, Implemented
pthread_cond_timedwait(), Function, Implemented
```

12 Memory Management

12.1 Memory Locking Functions

12.1.1 Lock/Unlock the Address Space of a Process

```
mlockall(), Function, Unimplemented
munlockall(), Function, Unimplemented
MCL_CURRENT, Constant, Unimplemented
MCL_FUTURE, Constant,  Unimplemented
```

12.1.2 Lock/Unlock a Rand of Process Address Space

```
mlock(), Function, Unimplemented
munlock(), Function, Unimplemented
```

12.2 Memory Mapping Functions

12.2.1 Map Process Addresses to a Memory Object

```
mmap(), Function, Unimplemented
PROT_READ, Constant,  Unimplemented
PROT_WRITE, Constant,  Unimplemented
PROT_EXEC, Constant,  Unimplemented
PROT_NONE, Constant,  Unimplemented
MAP_SHARED, Constant,  Unimplemented
MAP_PRIVATE, Constant,  Unimplemented
MAP_FIXED, Constant,  Unimplemented
```

12.2.2 Unmap Previously Mapped Addresses

```
munmap(), Function, Unimplemented
```

12.2.3 Change Memory Protection

```
mprotect(), Function, Unimplemented
```

12.2.4 Memory Object Synchronization

```
msync(), Function, Unimplemented, Unimplemented
MS_ASYNC, Constant, Unimplemented
```

```
MS_SYNC, Constant,  Unimplemented
MS_INVALIDATE, Constant,  Unimplemented
```

12.3 Shared Memory Functions

12.3.1 Open a Shared Memory Object

```
shm_open(), Function, Unimplemented
```

12.3.2 Remove a Shared Memory Object

```
shm_unlink(), Function, Unimplemented
```

13 Execution Scheduling

13.1 Scheduling Parameters

```
struct sched_param, Type, Implemented
```

13.2 Scheduling Policies

```
SCHED_FIFO, Constant, Implemented
SCHED_RR, Constant, Implemented
SCHED_OTHER, Constant, Implemented
```

NOTE: RTEMS adds SCHED_SPORADIC.

13.2.1 SCHED_FIFO

13.2.2 SCHED_RR

13.2.3 SCHED_OTHER

13.3 Process Scheduling Functions

13.3.1 Set Scheduling Parameters

```
sched_setparam(), Function, Dummy Implementation
```

13.3.2 Get Scheduling Parameters

```
sched_getparam(), Function, Dummy Implementation
```

13.3.3 Set Scheduling Policy and Scheduling Parameters

```
sched_setscheduler(), Function, Dummy Implementation
```

13.3.4 Get Scheduling Policy

```
sched_getscheduler(), Function, Dummy Implementation
```

13.3.5 Yield Processor

sched_yield(), Function, Implemented

13.3.6 Get Scheduling Parameter Limits

sched_get_priority_max(), Function, Implemented
sched_get_priority_min(), Function, Implemented
sched_get_priority_rr_get_interval(), Function, Implemented

13.4 Thread Scheduling

13.4.1 Thread Scheduling Attributes

PTHREAD_SCOPE_PROCESS, Constant, Implemented
PTHREAD_SCOPE_SYSTEM, Constant, Implemented

13.4.2 Scheduling Contention Scope

13.4.3 Scheduling Allocation Domain

13.4.4 Scheduling Documentation

13.5 Thread Scheduling Functions

13.5.1 Thread Creation Scheduling Attributes

pthread_attr_setscope(), Function, Implemented
pthread_attr_getscope(), Function, Implemented
pthread_attr_setinheritsched(), Function, Implemented
pthread_attr_getinheritsched(), Function, Implemented
pthread_attr_setschedpolicy(), Function, Implemented
pthread_attr_getschedpolicy(), Function, Implemented
pthread_attr_setschedparam(), Function, Implemented
pthread_attr_getschedparam(), Function, Implemented
PTHREAD_INHERIT_SCHED, Constant, Implemented
PTHREAD_EXPLICIT_SCHED, Constant, Implemented

13.5.2 Dynamic Thread Scheduling Parameters Access

```
pthread_setschedparam(), Function, Implemented
pthread_getschedparam(), Function, Implemented
```

13.6 Synchronization Scheduling

13.6.1 Mutex Initialization Scheduling Attributes

```
pthread_mutexattr_setprotocol(), Function, Implemented
pthread_mutexattr_getprotocol(), Function, Implemented
pthread_mutexattr_setprioceiling(), Function, Implemented
pthread_mutexattr_getprioceiling(), Function, Implemented
PTHREAD_PRIO_NONE, Constant, Implemented
PTHREAD_PRIO_INHERIT, Constant, Implemented
PTHREAD_PRIO_PROTECT, Constant, Implemented
```

13.6.2 Change the Priority Ceiling of a Mutex

```
pthread_mutex_setprioceiling(), Function, Implemented
pthread_mutex_getprioceiling(), Function, Implemented
```

14 Clocks and Timers

14.1 Data Definitions for Clocks and Timers

14.1.1 Time Value Specification Structures

```
struct timespec, Type, Implemented
struct itimerspec, Type, Implemented
```

14.1.2 Timer Event Notification Control Block

14.1.3 Type Definitions

```
clockid_t, Type, Implemented
timerid_t, Type, Implemented
```

14.1.4 Timer Event Notification Manifest Constants

```
CLOCK_REALTIME, Constant, Implemented
TIMER_ABSTIME, Constant, Implemented
```

14.2 Clock and Timer Functions

14.2.1 Clocks

```
clock_settime(), Function, Partial Implementation
clock_gettime(), Function, Partial Implementation
clock_getres(), Function, Implemented
```

14.2.2 Create a Per-Process Timer

```
timer_create(), Function, Implemented
```

14.2.3 Delete a Per-Process Timer

```
timer_delete(), Function, Implemented
```

14.2.4 Per-Process Timers

```
timer_settime(), Function, Implemented
timer_gettime(), Function, Implemented
timer_getoverrun(), Function, Implemented
```

14.2.5 High Resolution Sleep

```
nanosleep(), Function, Implemented
```

15 Message Passing

15.1 Data Definitions for Message Queues

15.1.1 Data Structures

NOTE: Semaphores are implemented but only unnamed semaphores are currently tested.

```
mqd_t, Type, Implemented
struct mq_attr, Type, Implemented
```

15.2 Message Passing Functions

15.2.1 Open a Message Queue

```
mq_open(), Function, Implemented
```

15.2.2 Close a Message Queue

```
mq_close(), Function, Implemented
```

15.2.3 Remove a Message Queue

```
mq_unlink(), Function, Implemented
```

15.2.4 Send a Message to a Message Queue

```
mq_send(), Function, Implemented
```

15.2.5 Receive a Message From a Message Queue

```
mq_receive(), Function, Implemented
```

15.2.6 Notify Process That a Message is Available on a Queue

```
mq_notify(), Function, Implemented
```

15.2.7 Set Message Queue Attributes

```
mq_setattr(), Function, Implemented
```

15.2.8 Get Message Queue Attributes

`mq_getattr(), Function, Implemented`

16 Thread Management

16.1 Threads

16.2 Thread Functions

16.2.1 Thread Creation Attributes

```
pthread_attr_init(), Function, Implemented
pthread_attr_destroy(), Function, Implemented
pthread_attr_setstacksize(), Function, Implemented
pthread_attr_getstacksize(), Function, Implemented
pthread_attr_setstackaddr(), Function, Implemented
pthread_attr_getstackaddr(), Function, Implemented
pthread_attr_setdetachstate(), Function, Implemented
pthread_attr_getdetachstate(), Function, Implemented
PTHREAD_CREATE_JOINABLE, Constant, Implemented
PTHREAD_CREATE_DETACHED, Constant, Implemented
```

16.2.2 Thread Creation

```
pthread_create(), Function, Implemented
```

16.2.3 Wait for Thread Termination

```
pthread_join(), Function, Implemented
```

16.2.4 Detaching a Thread

```
pthread_detach(), Function, Implemented
```

16.2.5 Thread Termination

```
pthread_exit(), Function, Implemented
```

16.2.6 Get Thread ID

```
pthread_self(), Function, Implemented
```

16.2.7 Compare Thread IDs

```
pthread_equal(), Function, Implemented
```

16.2.8 Dynamic Package Initialization

```
pthread_once(), Function, Implemented
PTHREAD_ONCE_INIT, Constant, Implemented
```

17 Thread-Specific Data

17.1 Thread-Specific Data Functions

17.1.1 Thread-Specific Data Key Creation

pthread_key_create(), Function, Implemented

17.1.2 Thread-Specific Data Management

pthread_key_setspecific(), Function, Implemented
pthread_key_getspecific(), Function, Implemented

17.1.3 Thread-Specific Data Key Deletion

pthread_key_delete(), Function, Implemented

18 Thread Cancellation

18.1 Thread Cancellation Overview

18.1.1 Cancelability States

PTHREAD_CANCEL_DISABLE, Constant, Implemented
PTHREAD_CANCEL_ENABLE, Constant, Implemented
PTHREAD_CANCEL_ASYNCHRONOUS, Constant, Implemented
PTHREAD_CANCEL_DEFERRED, Constant, Implemented

18.1.2 Cancellation Points

18.1.3 Thread Cancellation Cleanup Handlers

PTHREAD_CANCELED, Constant, Unimplemented

18.1.4 Async-Cancel Safety

18.2 Thread Cancellation Functions

18.2.1 Canceling Execution of a Thread

pthread_cancel(), Function, Implemented

18.2.2 Setting Cancelability State

pthread_setcancelstate(), Function, Implemented
pthread_setcanceltype(), Function, Implemented
pthread_testcancel(), Function, Implemented

18.2.3 Establishing Cancellation Handlers

pthread_cleanup_push(), Function, Implemented
pthread_cleanup_pop(), Function, Implemented

18.3 Language-Independent Cancellation Functionality

18.3.1 Requesting Cancellation

18.3.2 Associating Cleanup Code With Scopes

18.3.3 Controlling Cancellation Within Scopes

18.3.4 Defined Cancellation Sequence

18.3.5 List of Cancellation Points

19 Compliance Summary

19.1 General Chapter

```
Functions:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :      21
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

FEATURE FLAG COUNTS DO NOT ADD UP!!

```
Constants:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.2 Terminology and General Requirements Chapter

```
Functions:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :      19
    Implemented     :      19
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :      32
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

FEATURE FLAG COUNTS DO NOT ADD UP!!

```
Constants:
    Total Number    :     126
    Implemented     :     124
    Unimplemented   :       2
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.3 Process Primitives Chapter

```
Functions:
    Total Number    :      36
    Implemented     :      20
    Unimplemented   :       0
    Unimplementable :      16
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       5
    Implemented     :       5
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      40
    Implemented     :      32
    Unimplemented   :       6
    Unimplementable :       2
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.4 Process Environment Chapter

```
Functions:
    Total Number    :      23
    Implemented     :      21
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       2
    Untested        :       0

Data Types:
    Total Number    :       2
    Implemented     :       2
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      53
    Implemented     :      51
    Unimplemented   :       2
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.5 Files and Directories Chapter

```
Functions:
    Total Number    :      35
    Implemented     :      30
    Unimplemented   :       3
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       1
```

FUNCTION COUNTS DO NOT ADD UP!!

```
Data Types:
    Total Number    :       3
    Implemented     :       3
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      39
    Implemented     :      37
    Unimplemented   :       2
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.6 Input and Output Primitives Chapter

```
Functions:
    Total Number    :      19
    Implemented     :       9
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       9
    Untested        :       0
```

FUNCTION COUNTS DO NOT ADD UP!!

```
Data Types:
    Total Number    :       2
    Implemented     :       1
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       1

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      24
    Implemented     :      24
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.7 Device- and Class-Specific Functions Chapter

```
Functions:
    Total Number    :      12
    Implemented     :       8
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       4
    Untested        :       0

Data Types:
    Total Number    :       3
    Implemented     :       3
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      77
    Implemented     :      76
    Unimplemented   :       1
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.8 Language-Specific Services for the C Programming Language Chapter

```
Functions:
    Total Number    :     125
    Implemented     :     117
    Unimplemented   :       8
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       2
    Implemented     :       2
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      11
    Implemented     :      11
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.9 System Databases Chapter

```
Functions:
    Total Number    :       8
    Implemented     :       8
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       2
    Implemented     :       2
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.10 Data Interchange Format Chapter

```
Functions:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       2
    Implemented     :       0
    Unimplemented   :       2
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      37
    Implemented     :       0
    Unimplemented   :      37
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.11 Synchronization Chapter

```
Functions:
    Total Number    :      28
    Implemented     :      28
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       1
    Implemented     :       1
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :       5
    Implemented     :       5
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.12 Memory Management Chapter

```
Functions:
    Total Number    :      10
    Implemented     :       0
    Unimplemented   :      10
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      12
    Implemented     :       0
    Unimplemented   :      12
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.13 Execution Scheduling Chapter

```
Functions:
    Total Number    :      24
    Implemented     :      20
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       4
    Untested        :       0

Data Types:
    Total Number    :       1
    Implemented     :       1
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :      10
    Implemented     :      10
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.14 Clocks and Timers Chapter

```
Functions:
    Total Number    :       9
    Implemented     :       7
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       2
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       4
    Implemented     :       4
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :       2
    Implemented     :       2
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.15 Message Passing Chapter

```
Functions:
    Total Number    :       8
    Implemented     :       8
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       2
    Implemented     :       2
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.16 Thread Management Chapter

```
Functions:
    Total Number    :      15
    Implemented     :      15
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :       3
    Implemented     :       3
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.17 Thread-Specific Data Chapter

```
Functions:
    Total Number    :       4
    Implemented     :       4
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.18 Thread Cancellation Chapter

```
Functions:
    Total Number    :       6
    Implemented     :       6
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Data Types:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Feature Flags:
    Total Number    :       0
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0

Constants:
    Total Number    :       5
    Implemented     :       4
    Unimplemented   :       1
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

19.19 Overall Summary

```
Functions:
    Total Number    :     362
    Implemented     :     301
    Unimplemented   :      21
    Unimplementable :      16
    Partial         :       2
    Dummy           :      19
    Untested        :       1
```

FUNCTION COUNTS DO NOT ADD UP!!

```
Data Types:
    Total Number    :      48
    Implemented     :      45
    Unimplemented   :       2
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       1
Feature Flags:
    Total Number    :      53
    Implemented     :       0
    Unimplemented   :       0
    Unimplementable :       0
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

FEATURE FLAG COUNTS DO NOT ADD UP!!

```
Constants:
    Total Number    :     444
    Implemented     :     379
    Unimplemented   :      63
    Unimplementable :       2
    Partial         :       0
    Dummy           :       0
    Untested        :       0
```

Command and Variable Index

There are currently no Command and Variable Index entries.

Concept Index

There are currently no Concept Index entries.