

Table of Contents

PREFACE	1
1. BASIC ANNA CONCEPTS	5
1.1 VIRTUAL ADA TEXT	5
1.2 ANNOTATIONS	7
1.3 SEMANTICS OF ANNOTATIONS	8
1.3.1 Program States	8
1.3.2 Assertions and the Anna Kernel	9
1.3.3 Consistency of Anna Programs	9
1.3.4 Definedness of Annotations	10
1.4 CONSISTENCY CHECKING	11
1.5 STRUCTURE OF THE MANUAL	12
1.6 CLASSIFICATION OF ERRORS	13
2. LEXICAL ELEMENTS	15
2.1 CHARACTER SET	15
2.2 LEXICAL ELEMENTS, SEPARATORS, AND DELIMITERS	15
2.7 FORMAL COMMENTS	16
2.9 RESERVED WORDS	16
2.10 ALLOWED REPLACEMENTS OF CHARACTERS	17
3. ANNOTATIONS OF DECLARATIONS AND TYPES	19
3.1 DECLARATIVE ANNOTATIONS	19
3.2 ANNOTATIONS OF OBJECTS	20
3.2.1 Transformation of Object Constraints	23
3.3 ANNOTATIONS OF TYPE AND SUBTYPE DECLARATIONS	24
3.3.3 Operations on All Types	27
3.4 ANNOTATIONS OF DERIVED TYPES	28
3.5 OPERATIONS OF SCALAR TYPES	28
3.6 ANNOTATIONS OF ARRAY TYPES	29
3.6.2 Operations of Array Types	29
3.6.4 Array States	30
3.7 ANNOTATIONS OF RECORD TYPES	31
3.7.4 Operations of Record Types	31
3.7.5 Record States	32
3.8 ANNOTATIONS OF ACCESS TYPES	34
3.8.2 Operations of Access Types	34
3.8.3 Constraints on Access Types	35
3.8.4 Collection States	36
3.9 DECLARATIVE PARTS	39
4. NAMES AND EXPRESSIONS IN ANNOTATIONS	41
4.1 NAMES IN ANNOTATIONS	41
4.1.4 Attributes	41
4.4 EXPRESSIONS IN ANNOTATIONS	41
4.5 OPERATORS AND EXPRESSION EVALUATION	42

4.5.1 Logical Operators	43
4.5.2 Relational Operators and Membership Tests	43
4.6 TYPE CONVERSIONS	44
4.7 QUALIFIED EXPRESSIONS	45
4.11 QUANTIFIED EXPRESSIONS	45
4.11.1 Transformation of Quantified Expressions into the Anna Kernel	47
4.12 CONDITIONAL EXPRESSIONS	48
4.13 MODIFIERS	49
4.14 DEFINEDNESS OF EXPRESSIONS	51
5. STATEMENT ANNOTATIONS	55
5.1 ANNOTATIONS OF SIMPLE AND COMPOUND STATEMENTS	55
5.5 ANNOTATIONS OF LOOP STATEMENTS	57
5.8 ANNOTATIONS OF RETURN STATEMENTS	58
6. ANNOTATION OF SUBPROGRAMS	59
6.1 ANNOTATIONS OF SUBPROGRAM DECLARATIONS	59
6.2 ANNOTATION OF FORMAL PARAMETERS	61
6.3 ANNOTATIONS OF SUBPROGRAM BODIES	62
6.4 ANNOTATIONS OF SUBPROGRAM CALLS	62
6.5 RESULT ANNOTATIONS OF FUNCTION SUBPROGRAMS	63
6.6 OVERLOADING OF SUBPROGRAMS IN ANNOTATIONS	64
6.7 OVERLOADING OF OPERATORS	64
6.8 ATTRIBUTES OF SUBPROGRAMS	64
7. PACKAGE ANNOTATIONS	67
7.1 PACKAGE STRUCTURE	67
7.2 VISIBLE ANNOTATIONS IN PACKAGE SPECIFICATIONS	68
7.2.1 Annotations of a Visible Type	69
7.3 HIDDEN PACKAGE ANNOTATIONS	70
7.4 ANNOTATIONS ON PRIVATE TYPES	72
7.4.1 Use of Private Types in Annotations	74
7.4.2 Operations of a Private Type	74
7.4.4 Redefinition of Equality for Limited Types	75
7.7 PACKAGE STATES	76
7.7.1 State Types	77
7.7.2 Initial and Current States	79
7.7.3 Successor Package States	81
7.7.4 Function Calls Relative to Package States	82
7.7.5 Annotations on State Types	83
7.8 AXIOMATIC ANNOTATIONS	85
7.8.1 Simplified Notation for Axioms	88
7.8.2 Implicit Axioms for Equality	89
7.9 CONSISTENCY OF ANNA PACKAGES	90
7.9.1 Consistency of the Package Body	90
7.9.2 Consistency of Visible Annotations with the Package Body	91
7.10 EXAMPLE OF A PACKAGE WITH ANNOTATIONS	95

8. VISIBILITY RULES IN ANNOTATIONS	99
8.2 SCOPE OF DECLARATIONS AND DECLARATIVE ANNOTATIONS	99
8.3 VISIBILITY	99
8.5 RENAMING DECLARATIONS	100
8.7 THE CONTEXT OF OVERLOAD RESOLUTION	101
9. TASK ANNOTATIONS	103
10. PROGRAM STRUCTURE	105
10.1 ANNOTATIONS OF COMPILATION UNITS	105
10.1.1 Virtual Context Clauses	105
10.1.3 Context Annotations	105
10.2 ANNOTATIONS OF SUBUNITS	107
11. EXCEPTION ANNOTATIONS	109
11.2 ANNOTATION OF EXCEPTION HANDLERS	109
11.3 ANNOTATION OF RAISE STATEMENTS	109
11.4 PROPAGATION ANNOTATIONS	110
11.7 SUPPRESSING CHECKS OF ANNOTATIONS	112
12. ANNOTATION OF GENERIC UNITS	113
12.1 ANNOTATIONS OF GENERIC DECLARATIONS	113
12.1.1 Annotation of Generic Formal Objects	115
12.1.2 Annotation of Generic Formal Types	115
12.1.3 Annotation of Generic Formal Subprograms	116
12.3 INSTANTIATION OF GENERIC ANNOTATIONS	117
12.4 EXAMPLE OF A GENERIC PACKAGE WITH ANNOTATIONS	118
12.5 CONSISTENCY OF GENERIC UNITS	119
13. ANNOTATION OF IMPLEMENTATION-DEPENDENT FEATURES	121
13.8 ANNOTATIONS FOR MACHINE CODE INSERTIONS	121
13.9 ANNOTATIONS OF INTERFACES TO OTHER LANGUAGES	121
13.10 ANNOTATIONS OF UNCHECKED PROGRAMMING	122
13.10.1 Annotations of Unchecked Storage Deallocation	122
13.10.2 Annotations of Unchecked Type Conversions	122
A. PREDEFINED ANNA ATTRIBUTES	123
C. PREDEFINED ANNA ENVIRONMENT	125
E. ANNA SYNTAX SUMMARY	127
H. EXAMPLES OF ANNA PROGRAMS	133
1. A SYMBOL TABLE PACKAGE	133
2. DIJKSTRA'S DUTCH NATIONAL FLAG PROGRAM	136
References	139
Index	141