INTEGRATED INFORMATION SUPPORT SYSTEM (IISS)
Volume V - Common Data Model Subsystem
Part 13 - Neutral Data Manipulation Language (NDML) Precompiler
Parse NDML Product Specification

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DATE 25 July 91

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Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.
This specification establishes the design of Function PRE3, "Parse NDML", one of the major functions of the Configuration Item "Precompiler" to be built and formally accepted by the ICAM Program Office.
FOREWORD

This technical report covers work performed under Air Force Contract F33600-87-C-0464, DAPro Project. This contract is sponsored by the Manufacturing Technology Directorate, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. It was administered under the technical direction of Mr. Bruce A. Rasmussen, Branch Chief, Integration Technology Division, Manufacturing Technology Directorate, through Mr. David L. Judson, Project Manager. The Prime Contractor was Integration Technology Services, Software Programs Division, of the Control Data Corporation, Dayton, Ohio, under the direction of Mr. W. A. Osborne. The DAPro Project Manager for Control Data Corporation was Mr. Jimmy P. Maxwell.

The DAPro project was created to continue the development, test, and demonstration of the Integrated Information Support System (IISS). The IISS technology work comprises enhancements to IISS software and the establishment and operation of IISS test bed hardware and communications for developers and users.

The following list names the Control Data Corporation subcontractors and their contributing activities:

<table>
<thead>
<tr>
<th>SUBCONTRACTOR</th>
<th>ROLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Data Corporation</td>
<td>Responsible for the overall Common Data Model design development and implementation, IISS integration and test, and technology transfer of IISS.</td>
</tr>
<tr>
<td>D. Appleton Company</td>
<td>Responsible for providing software information services for the Common Data Model and IDEFIX integration methodology.</td>
</tr>
<tr>
<td>ONTEK</td>
<td>Responsible for defining and testing a representative integrated system base in Artificial Intelligence techniques to establish fitness for use.</td>
</tr>
<tr>
<td>Simpact Corporation</td>
<td>Responsible for Communication development.</td>
</tr>
<tr>
<td>Structural Dynamics Research Corporation</td>
<td>Responsible for User Interfaces, Virtual Terminal Interface, and Network Transaction Manager design, development, implementation, and support.</td>
</tr>
<tr>
<td>Arizona State University</td>
<td>Responsible for test bed operations and support.</td>
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iii
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION 1.0</th>
<th>SCOPE</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Identification</td>
<td>1-1</td>
</tr>
<tr>
<td>1.2</td>
<td>Functional Summary</td>
<td>1-1</td>
</tr>
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<table>
<thead>
<tr>
<th>SECTION 2.0</th>
<th>DOCUMENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Reference Documents</td>
<td>2-1</td>
</tr>
<tr>
<td>2.2</td>
<td>Terms and Abbreviations</td>
<td>2-1</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>SECTION 3.0</th>
<th>REQUIREMENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Structural Description</td>
<td>3-1</td>
</tr>
<tr>
<td>3.2</td>
<td>Functional Flow</td>
<td>3-1</td>
</tr>
<tr>
<td>3.3</td>
<td>Interfaces</td>
<td>3-1</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Inputs/Outputs</td>
<td>3-2</td>
</tr>
<tr>
<td>3.4</td>
<td>Program Interrupts</td>
<td>3-2</td>
</tr>
<tr>
<td>3.5</td>
<td>Timing and Sequencing Description</td>
<td>3-2</td>
</tr>
<tr>
<td>3.6</td>
<td>Special Control Features</td>
<td>3-2</td>
</tr>
<tr>
<td>3.7</td>
<td>Storage Allocation</td>
<td>3-2</td>
</tr>
<tr>
<td>3.7.1</td>
<td>Database Definition</td>
<td>3-2</td>
</tr>
<tr>
<td>3.7.1.1</td>
<td>File Description</td>
<td>3-2</td>
</tr>
<tr>
<td>3.7.1.2</td>
<td>Table Description</td>
<td>3-2</td>
</tr>
<tr>
<td>3.8</td>
<td>Object Code Creation</td>
<td>3-2</td>
</tr>
<tr>
<td>3.9</td>
<td>Adaptation Data</td>
<td>3-3</td>
</tr>
<tr>
<td>3.10</td>
<td>Detail Design Description</td>
<td>3-3</td>
</tr>
<tr>
<td>3.10.1</td>
<td>Where Include File Used List</td>
<td>3-3</td>
</tr>
<tr>
<td>3.10.2</td>
<td>Where External Routine Used List</td>
<td>3-4</td>
</tr>
<tr>
<td>3.10.3</td>
<td>Main Program Parts List</td>
<td>3-6</td>
</tr>
<tr>
<td>3.10.4</td>
<td>Module Documentation</td>
<td>3-8</td>
</tr>
<tr>
<td>3.10.5</td>
<td>Include File Descriptions</td>
<td>3-14</td>
</tr>
<tr>
<td>3.10.6</td>
<td>Hierarchy Chart</td>
<td>3-16</td>
</tr>
<tr>
<td>3.11</td>
<td>Program Listings Comments</td>
<td>3-18</td>
</tr>
</tbody>
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<td>Introduction and Definitions</td>
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</tr>
<tr>
<td>4.2</td>
<td>Computer Programming Test and Evaluation</td>
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</tbody>
</table>
SECTION 1
SCOPE

1.1 Identification

This specification establishes the design of Function PRE3, "Parse NDML", one of the major functions of the Configuration Item "Precompiler" to be built and formally accepted by the ICAM Program Office. This CPCI constitutes one of the subsystems of the Common Data Model Processor (CDMP).

1.2 Functional Summary

This function parses the NDML or SQL statements into tokenized form. Legal syntax is checked and syntax error messages issued.
SECTION 2

DOCUMENTS

2.1 Reference Documents


2.2 Terms and Abbreviations

Attribute Use Class: (AUC)

Conceptual Schema: (CS)

Common Data Model Processor: (CDMP)

Common Data Model: (CDM) Describes common data application process formats, form definitions, etc, of the IISS and includes conceptual schema, external, internal schemas, and schema transformation operators.

Data Field: (DF) An element of data in the external schema. It is by this name that an NDML programmer references data.

Database Management System: (DBMS)

Distributed Request Supervisor: (DRS) This IISS CDM subsystem configuration item controls the execution of distributed NDML queries and non distributed updates.

Domain: A logical definition of legal attribute class values.
Domain Constraint: Predicate that applies to a single domain.

External Schema: (ES)

Forms: Structured views which may be imposed on windows or other forms. A form is composed of fields where each field is a form, item, or window.

Forms Processor: (FP) A set of callable execution time routines available to an application program for form processing.

Internal Schema: (IS)

Integrated Information Support System: (IISS) A test computing environment used to investigate, demonstrate and test the concepts of information management and information integration in the context of Aerospace Manufacturing. The IISS addresses the problems of integration of data resident on heterogeneous databases supported by heterogeneous computers interconnected via a local Area Network.

Mapping: The correspondence of independent objects in two schemas: ES to CS or CS to IS.

Network Transaction Manager: (NTM) Performs the coordination, communication and housekeeping functions required to integrate the application processes and system services resident on the various hosts into a cohesive system.

Neutral Data Manipulation Language: (NDML) A language developed by the IISS project to provide uniform access to common data, regardless of database manager or distribution criteria. It provides distributed retrieved and single node updates.

ORACLE: Relational DBMS based on the SQL (Structured Query Language, a product of ORACLE Corp, Menlo Park, CA). The CDM is an ORACLE database.

Parcel: A sequential file containing sections source code of the input application program.

Request Processor: (RP) A COBOL program that will satisfy a retrieval or update NDML subtransaction against a particular Database Management System.

User Interface: (UI) Controls the user's terminal and interfaces with the rest of the system.

Virtual Terminal Interface: (VTI) Performs the interfacing between different terminals and the UI. This is done by defining a specific set of terminal features and protocols which must be supported by UI software which constitutes the Virtual Terminal Definition. Specific terminals are then mapped against the Virtual Terminal software by specific software modules written for each type of real terminal supported.
3.1 **Structural Description**

A graphic portrayal of this Computer Program Configuration Item (CPCI) is included in Section 3.10. This chart shows the hierarchical relationship of each module making up this CPCI. This module is accessed for each NDML or SQL command identified by PRE2. The routine is generated by the UNIX tools YACC and LEX. YACC generates a parser given the syntax rules as input. LEX generates the lexical analyzer for the language given the definitions of the lexical units of the language. The parser generated by YACC is named YYPARSE and the lexical analyzer is named YYLEX. PRE2 controls the call to YYPARSE. Whenever YYPARSE (the parser) needs another token or unit of command input, YYLEX is called. Whenever YYLEX needs another character of the user command, YYINPUT is called. In this application, YYINPUT has been modified to record the next character from the file containing NDML or SQL commands. The parsed tokens are stored in global data structures accessible by "C" primitives. PRE2 then uses these primitives to access the "C" data structures, storing them in COBOL tables and checking command semantics.

3.2 **Functional Flow**

This CPCI implements the logic defined in the Development Specification for this CPCI. Details of inputs/outputs and relationships between modules are to be found in Section 3.10.

This CPCI has been designated to operate in a batch or interactive mode. It must use the ORACLE DBMS installed on a DEC VAX computer.

3.3 **Interfaces**

The following diagram depicts the interface of PRE3 with other CPCI's in the system.
3.3.1 Inputs/Outputs

The following table depicts the inputs and outputs of this CPCI. A detailed description for each item can be found in the DS for this CPCI.

**FUNCTION: PRE3**

<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input File Pointer</td>
<td>Command Number</td>
</tr>
<tr>
<td>Parcel 4 File Pointer</td>
<td>Module Status</td>
</tr>
<tr>
<td>Error File Pointer</td>
<td></td>
</tr>
</tbody>
</table>

3.4 Program Interrupts

Not applicable to this CPCI.

3.5 Timing and Sequencing Description

PRE3 is called once for every NDML or SQL statement encountered in the user's input program.

3.6 Special Control Features

Not applicable to this CPCI.

3.7 Storage Allocation

3.7.1 Database Definition

No databases are used by this CPCI.

3.7.1.1 File Description

No permanent files have been defined for this CPCI. It may use temporary scratch files for such things as generated program source code or temporary query results.

3.7.1.2 Table Description

All tables used by this CPCI have been defined by the Development Specification for this CPCI.

3.7.1.3 Item Description

Not applicable to this CPCI.

3.8 Object Code Creation

The object code for this CPCI will be created by the system integration test team by using defined IISS Software Configuration Management procedures. This CPCI will use the COBOL and "C" language compilers. In addition, source code generated by the YACC and LEX tools must be compiled to become objects in the final, executable software package.
3.9 Adaptation Data

This CPCI has been coded using ANSI COBOL and a "standard" subset of the "C" languages. The intent was to provide a transportable system. Any system environment supporting these languages, a virtual memory management scheme, and the ORACLE Database Management System should be able to support this CPCI. Every possible attempt has been made to localize and identify any machine or environment dependent modules through the original design of the IISS and application of Configuration Management Procedures.

3.10 Detail Design Description

The following sections have been computer generated for this CPCI.

3.10.1 Where Include File Used List

The following lists each include file in the documentation group and all the modules documented in this specification which include them. The purpose of each module is listed as well.

DOCGROUP PS41213 Where-include-file-used List

<table>
<thead>
<tr>
<th>Include File</th>
<th>Module Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHKCDM</td>
<td>CDTRANS</td>
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<td>ERRCDM</td>
<td>CDTRANS</td>
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<td>ESQUAL</td>
<td>CDTRANS</td>
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<td>CDTRANS</td>
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<tr>
<td>STDIO</td>
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<td>YYERROR</td>
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<td></td>
<td>YYPARSE</td>
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<td>YYWRAP</td>
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<td>NDMLPAR</td>
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<tr>
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<td>LINFIL</td>
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</table>
### DOCGROUP PS41213 Where-include-file-used List

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<thead>
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<th>Module Name</th>
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<td>CMDID</td>
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<td>YYWRAP</td>
<td></td>
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<tr>
<td>LINFIL</td>
<td>LISTID</td>
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<td>YYWRAP</td>
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### 3.10.2 Where External Routine Used List

The following lists each external function or routine in the documentation group and all the documented modules which call it. The purpose of each module is listed as well.
<table>
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### System Module Name

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<td>MEMCPY</td>
<td>YYPARSE</td>
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<td>EXIT_SCOPE</td>
<td>YYPARSE</td>
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<tr>
<td>YYLEX</td>
<td>YYPARSE</td>
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</tbody>
</table>

#### 3.10.3 Main Program Parts List

The following lists each Main Program in the documentation group and all the modules which are called either by that module itself or by any of the documented modules which it calls. It is possible for a non-main module to be listed more than once if it is called by multiple modules. The called modules, in this case known as program parts, are marked as to whether they are documented here. If so, the phrase "well-defined module" appears by the module name, if not it is an "external "routine". The Purpose of the Main Program module is listed as well.
## DOCGROUP PS41213 Main Program Parts List

<table>
<thead>
<tr>
<th>Main Pgm Name</th>
<th>Module Name</th>
<th>Type</th>
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<tr>
<td>CDTRANS</td>
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<td>PRINTF</td>
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<td>YYERROR</td>
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<td></td>
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<td>NEW_SCOPE</td>
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### DOCGROUP PS41213 Main Program Parts List

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<td>PUT_SYM</td>
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<tr>
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<td>YYLEX</td>
<td>External routine</td>
</tr>
</tbody>
</table>

#### 3.10.4 Module Documentation

The following documentation describes information which is specific to each individual module in the documentation group being documented in this specification. It provides a compact way of getting information that would be otherwise buried within each module's source code.

The specific items in this module documentation have the following meanings:

- **NAME:** Name of program Module.
- **PURPOSE:** Purpose of Module as detailed in the source code.
- **LANGUAGE:** Programming language source code is written in. The choices are:
  - VAX-11 FORTRAN
  - C (I/S-1 Workbench 'C')
  - VAX-11 COBOL
- **MODULE TYPE:** Whether a Program, Subroutine, or Function.
- **SOURCE FILE:** Name of Source File from file specification.
- **SOURCE FILE TYPE:** Source File Extension from file specification.
- **HOST:** Whether this is a host-dependent routine (VAX or IBM) or blank if host-independent.
- **SUBSYSTEM:** IISS sub-system this file resides in.
NAME:  CDTRANS
PURPOSE:  TRANSLATE EXCLUSIVE OR (XOR) AND NOT OPERATORS.
LANGUAGE:  VAX-11 COBOL
SOURCE FILE:  CDTRANS
SOURCE FILE TYPE:  COB
HOST:  SUBSYSTEM:  CDM
SUBDIRECTORY:  NDML

DESCRIPTION:
-------------
- THIS FUNCTION WILL TRANSLATE THE "XOR" AND "NOT" OPERATORS IN THE WHERE CLAUSE OF THE NDML STATEMENT. IT WILL UPDATE BOTH THE ES-QUALIFY-LIST AND BOOLEAN-LIST TO REFLECT THE TRANSLATION OF "XOR" AND "NOT" TO ALL "AND" AND "OR" OPERATORS.
-
ARGUMENTS:
------------------
ES-QUALIFY-LIST           RECRD
BOOLEAN-LIST             RECRD
RET-STATUS                DSPLY[X(5)]

INCLUDE FILES:
------------------
CHKCDM
ERRCDM
ESQUAL
BOOLST
ERRPRO

ROUTINES CALLED:
------------------
ERRPRO

ARGUMENTS:
------------------
FCB_IN                      FCB **
FCB_ERROR                   FCB **
FCB_4                       FCB **
COM_NO                      INT *
STATUS                      INT *

INCLUDE FILES:
------------------
STDIO
CSTDYP
FCBSTRC

ROUTINES CALLED:
------------------
NDMLPAS
YYINPUT
PUTC
NAME: YYWRAP
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

INCLUDE FILES:
--------------
NDMLYAC.INP
STDO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

NAME: LINFIL
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

INCLUDE FILES:
--------------
NDMLYAC.INP
STDO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:
-----------------
GETC
FPUTC
FPRTNTF
UNGETC
NAME: YYERROR
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

ARGUMENTS:

---
S           CHAR *
---

INCLUDE FILES:

NDMLYAC.INP"
STDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:

INPUT
OUTPUT
PRINTF
STRLN
WRTERR
FREE_SYMTAB

NAME: UNSUPPORTED
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

ARGUMENTS:

---
S           CHAR *
---
INCLUDE FILES:

NDMLYAC.INP
STUDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:

PRINTF
STRLRN
WRITERR
INPUT
OUTPUT
FREE_SYMTAB

DOCGROUP PS41213 Module Documentation

NAME: YYPARSE
PURPOSE:
LANGUAGE: C
SOURCE FILE: NDMLYTB
SOURCE FILE TYPE: C
HOST:
SUBSYSTEM: CDM
SUBDIRECTORY: NDML

INCLUDE FILES:

NDMLYAC.INP
STUDIO
ATTRID
CMDID
LISTID
NDMLSTB
NDMLEXY

ROUTINES CALLED:

PRINTF
YYERROR
MEMCPY
NEW_SCOPE
EXIT_SCOPE
LINFIL
CHAIN_SYMB
PUT_SYMB
STRNCPY
STRCPY
UNSUPPORTED
YYLEX

3-13
3.10.5 Include File Descriptions

The following list contains a purpose and description of each include file in the documentation group as specified in the source code. The language it is written in is also given.

DOCGROUP PS41213 Include File Description

FILE NAME: BOOLST
PURPOSE: BOOLEAN LIST
LANGUAGE: VAX-11 COBOL
DESCRIPTION:

----------
CONTAINS THE BOOLEAN OPERATORS, PARENTHESES, AND POINTERS TO THE TYPE 2 CONDITIONS FOR AN NDML TRANSACTION

DOCGROUP PS41213 Include File Description

FILE NAME: CHKCDM
PURPOSE: IISS CDMP CHECK STATUS CODES
LANGUAGE: VAX-11 COBOL
DESCRIPTION:

----------
CONTAINS ALL STATUS CODES FOR THE CDMP MODULES

DOCGROUP PS41213 Include File Description

FILE NAME: ERRCDM
PURPOSE: IISS ERROR STATUS CODES FOR CDMP MODULES
LANGUAGE: VAX-11 COBOL
DESCRIPTION:

----------
CONTAINS ALL ERROR CODES USED BY CDMP MODULES FOR ERROR HANDLING
DOCGROUP PS41213 Include File Description

FILE NAME: ERRPRO
PURPOSE: PROCESS ERROR INCLUDE FILE
LANGUAGE: VAX-11 COBOL

DESCRIPTION:
______________

DOCGROUP PS41213 Include File Description

FILE NAME: ESQUAL
PURPOSE: EXTERNAL SCHEMA QUALIFY LIST
LANGUAGE: VAX-11 COBOL

DESCRIPTION:
______________

CONTAINS EXTERNAL SCHEMA INFORMATION FOR THE NDML QUALIFICATION

THE EXTERNAL SCHEMA QUALIFY LIST

DOCGROUP PS41213 Include File Description

FILE NAME: LISTID
PURPOSE: PROVIDES LIST OF PARSED OBJECTS
LANGUAGE: C

DESCRIPTION:
______________

DESCRIPTION

DOCGROUP PS41213 Include File Description

FILE NAME: NDMLEXY
PURPOSE: LEX GENERATED INCLUDE FILE
LANGUAGE: C

DESCRIPTION:
______________

DESCRIPTION
3.10.6  Hierarchy Chart

```
+-----------+-------+-------+-------+-------+-------+-------+
| CDTRANS  | YYPARSE|       |       |       |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| ERRPRO    | NDMLPAS| YYINPUT| PUTC   |       |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| YYPARSE   |       |       |       |       |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| PRINTF    | YYERROR| MEMCPY | NEW_SCOPE | (CONT) |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| YYERROR   |       |       |       |       |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| INPUT     | OUTPUT | SPRINTF| STRLEN | (CONT) |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| YYPARSE   |       |       |       |       |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| (CONT)    | EXIT_SCOPE | LINFIL | (CONT) |       |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
| GETC      | FPUTC  | FPRINTF| UNGETC |       |       |       |
+-----------+-------+-------+-------+-------+-------+-------+
```

3-16
3.11 Program Listings Comments

This information is contained in the Module Descriptions in section 3.10.
SECTION 4
QUALITY ASSURANCE PROVISIONS

4.1 Introduction and Definitions

"Testing" is a systematic process that may be preplanned and explicitly stated. Test techniques and procedures may be defined in advance, and a sequence of test steps may be specified. "Debugging" is the process of isolation and correction of the cause of an error.

"Antibugging" is defined as the philosophy of writing programs in such a way as to make bugs less likely to occur and when they do occur, to make them more noticeable to the programmer and the user. In other words, as much error checking as is practical and possible in each routine should be performed.

4.2 Computer Programming Test and Evaluation

The quality assurance provisions for test consists of the normal testing techniques that are accomplished during the construction process. They consist of design and code walk-throughs, unit testing, and integration testing. These tests are performed by the design team. Structured design, design walk-through and the incorporation of "antibugging" facilitate this testing by exposing and addressing problem areas before they become coded "buds."