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DEVELOPMENT OF INTEGRATED PROGRAMS FOR AEROSPACE–VEHICLE DESIGN (IPAD)

P- 316

IPAD Requirements
D6-IPAD-70040-D
December 19, 1977

(Reference: Statement of Work 8.3)

Prepared under Contract No. NAS1-14700 by
Boeing Commercial Airplane Company
P.O. Box 3707
Seattle, Washington 98124

for

Langley Research Center
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

REV. B

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_____

IPAD Project Manager
IPAD Project Office (IPO)
NASA Langley Research Center

DATE 12/19/77

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AUTHORS _O. L. Anderson_   DATE _6-10-77_
          O. L. Anderson

A. L. Calvery   DATE _6-10-77_
          A. L. Calvery

H. Blair Burner for   DATE _6/10/77_
          D. A. Davis   _Don Davis_

H. Blair Burner for   DATE _6/10/77_
          L. Dickmann   _Larry Dickmann_

D. H. Folger   DATE _6-10-77_
          D. H. Folger

E. N. Jochem   DATE _6-10-77_
          E. N. Jochem

C. M. Kitto   DATE _6-10-77_
          C. M. Kitto

G. von Limbach   DATE _6-10-77_
          G. von Limbach

RESPONSIBLE MANAGER: _H. Blair Burner_ DATE _6/10/77_
          H. Blair Burner

CONCURRENCE:

Stig Wahlstrom   DATE _11/9/77_
S. O. Wahlstrom
IPAD Engineering Development Manager

D. E. Taylor   DATE _11/10/77_
D. E. Taylor
IPAD Program Support Manager

A. S. Kawaguchi   DATE _11/10/77_
A. S. Kawaguchi
Assistant IPAD Program Manager

Ralph E. Miller   DATE _11-10-77_
R. E. Miller, Jr.
IPAD Program Manager
BOEING COMMERCIAL AIRPLANE COMPANY

NASA Concurrence:

Vann V Youn, DATE 12/19/77
Document Reviewer, IPAD Project Office
NASA LANGLEY RESEARCH CENTER

ABSTRACT

The IPAD Requirements Document, is the product of the Requirements Analysis Task, WBS 1.6.2 and contains the IPAD System Design Requirements. It is based on the IPAD User Requirements Document (D6-IPAD-70013-D) and the Integrated Information Processing Requirements Document (D6-IPAD-70012-D). This document contains general information about IPAD and a list of the system design requirements that are to be satisfied by the IPAD system. The system design requirements definition contained in this document is to be considered as a baseline definition of the IPAD system design requirements.

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REVISIONS			
REV SYM	DESCRIPTION	DATE	APPROVAL
A	Add four new requirements: 1) 43.1 User Absence and Substitution 2) 57.1 Computer Program Certification and Version Control 3) 57.2 Checklist 4) 87.1 Data Set Modification Log Change requirements: 2-135, 5-329, 10-55, 16-221, 21-80, 46-337, 52-113, 60-262, 80-33, 81-340, 71-13 and 128-287 Delete requirement: 49-359 Note: All approved changes are denoted by the revision symbol.	2-6-79	Per CCR #37
B	Revise section 2.0 by: 1) Retitling 82 req. to clarify meaning 2) Adding a diagram to each third-level numbered paragraph (approx. 19) to serve as an index to the requirements therein 3) Add Appendix B, a short description of requirements 4) Add Appendix C, a keyword list 5) Delete the hyphenated part of each requirement number	11-6-79	per CCR #50

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ACRONYMS AND ABBREVIATIONS

ACT	Acceptance Criteria for Testing
AED	ALGOL Extended for Design
ANSI	American National Standards Institute
APT	Automatically Programmed Tools
ART	Average Response Time
BCD	Binary Coded Decimal
BCS	Boeing Computer Services
BPI	Bits per inch
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CDC	Control Data Corporation
CDR	Critical Design Review
CG	Center of Gravity
CL	1. Command Language 2. Center Line
CLFILE	Center Line File
CLP	Command Language Processor
COBOL	Common Business Oriented Language
COLIST	Corporate Like Organizational Lists
CPI	Characters per inch
CPU	Central Processing Unit
CRT	Cathode-ray tube
DADA	Data Area Data Administration
DEC	Digital Equipment Corporation
DBMS	Data Base Management System

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EIA	Electronic Institute of America
FDP	FORTRAN Drawing Package
FEDD	For Early Domestic Dissemintation
FORTRAN	Formula Translator
GNAME	Group Name
IBM	International Business Machines Corporation
IDMS	Integrated Data Management System (Cullinane Corp.)
IDR	Intermediate Design Review
INAME	Individual Name
INTOL/OUTTOL	Inner Tolerance/Outer Tolerance
I/O	Input/Output
IPAD	Integrated Programs for Aerospace-Vehicle Design
IPEX	IPAD Executive
IPIP	IPAD Information Processor
IPO	IPAD Project Office (NASA Langley Research Center)
ITAB	Industry Technical Advisory Board (IPAD)
JEQ	Job Execution Queue
K/B	Key Board
KRONOS	A CDC Operating System
LCGT	Low Cost Graphics Terminal
LRC	Langley Research Center (NASA)
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
NOS	Network Operating System (CDC)
N/C	Numerical Control
OM	Operational Module

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OS	Operating System
PDR	Preliminary Design Review
RFP	Request for Proposal
RJE	Remote Job Entry
RTAC	Research and Technology Advisory Committee (NASA)
SAMM	Systematic Activity Modeling Method (BCS)
SD	Short Duration
SGHS	Specialized Graphics Hardware Systems
SGS	Standard Graphics Software
SIGGRAPH	Special Interest Group—Graphics
SLRT	Standard Limiting Response Time
SM	Source Module
SOW	Statement of Work
VM/CMS	Virtual Machine/Conversational Monitor System (IBM)
WBS	Work Breakdown Structure
2-D	Two-Dimensional
3-D	Three-Dimensional

REV. B

DEFINITIONS

ACCESS CODE

A code which will authorize an IPAD user to read or modify a specific data set.

ACCEPTANCE CRITERIA

The rules, or standards that will be used during acceptance testing to determine if a requirement has been satisfied.

ACCOUNTING PROGRAM

A program which maintains statistics on computer resource utilization.

AEROELASTIC CYCLE

Consists of iterative processes which start with a stress analysis based on rigid structure loads and ends with a compatible solution between applied loads, structural sizing for strength and fatigue and mass and stiffness to meet static and dynamic criteria. Implied in the solution is a structure closely approximating minimum weight and cost.

ANSI STANDARD

A standard formulated and controlled by the American National Standards Institute (ANSI).

APERTURE CARD

A card designed to hold microfilm image film.

APPLICATION PROGRAMS

Computer programs developed for the purpose of solving a particular problem.

ARCHIVAL STORAGE

A repository for the storage of less frequently used data.

AVERAGE RESPONSE TIME

A measure of the actual response time experienced by a user. This is usually estimated by observing many transactions and is highly dependent on machine loading.

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BATCH CONTROL CARDS

Cards that contain commands directing the operation of computer programs in the batch processing mode.

BATCH PROCESSING

A mode of computer processing in which computer programs are executed with no interaction with the user during processing.

BATCH SUBMITTAL

Submitting computer program(s) to a computer for batch processing.

BINARY CODED DECIMAL (BCD)

A numeric code for representing each character of an alphabet.

BENCHMARK

A point of reference from which measurements can be made to evaluate the performance of computers or computer programs relative to each other.

CARPET PLOT

This plot is generated by intersecting a function of two variables by two families of planes and plotting the intersection curves.

CLASSIFICATION CODE

Used to identify items classified within a Uniform Classification and Coding System. The system is based on organizing data in a consistent and disciplined manner. Each code is meaningful and discrete, and is a universal index for all information bearing the same code. It is useful as a tool for storing, retrieving, sorting, analyzing, collating, and identifying data. These codes may be used as sorting criteria for the data stored in the information bank.

COMMAND LANGUAGE

A language for directing a computer in which each command corresponds to a function to be performed.

COMMAND MODE

A mode in which the IPAD System is awaiting a command from the user.

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COMMUNICATION RATES

A unit of signaling speed. The number of signal events per unit of time.

COMPUTER AIDED DESIGN (CAD)

The application of computers to assist in conducting activities needed to get design ideas and concepts defined, refined, and documented ready to transmit to manufacturing. Included are not only conception and definition of vehicles, systems, and hardware, but their evaluation through analysis.

COMPUTER AIDED DRAFTING

The adaptation of the computer for automated drafting. It provides a man-machine dialogue allowing construction and display of geometric entities using a graphics device.

COMPUTER AIDED MANUFACTURING (CAM)

The application of computers to assist in performing functions from the receipt of product definition to the completion of an acceptable hardware item, system, or vehicle.

COMPUTER PROGRAM

A series of instructions or statements, in a form acceptable to a computer, prepared in order to achieve a certain result.

COMPUTER PROGRAM CERTIFICATION

The process of confirming that a computer program has been validated.

COMPUTER PROGRAM VALIDATION

The test and evaluation of a computer program to ensure that all requirements have been satisfied and that the program is correct.

CONFIGURATION CONTROL

A procedure for controlled development and maintenance of a document, program, or other entity to ensure its integrity by carefully controlling all changes.

CONTOUR PLOT

The plot of contour lines, usually generated by intersecting a surface with parallel planes.

REV. B

CONTROL CARDS

Cards that contain control data for directing the operation
of a computer or computer program.

CRITICAL DESIGN REVIEW (CDR)

A major review of the products of an IPAD Program Task
required to obtain approval to proceed to subsequent tasks.

CRITICAL PATH

The longest time path of sequenced events and activities that
has the least positive slack. Slack is defined as the
difference between the latest allowable start time and the
expected start time of an activity. If the latest allowable
start time is greater than the expected start time, slack is
positive.

DATA AREA

An arbitrary collection of the data sets which are grouped
together for purposes of control, management, ease of use,
etc.

DATA BASE

A collection of interrelated data with as little redundancy
as possible to serve one or more applications in an optimal
fashion.

DATA BASE MANAGEMENT

The function performed by a data base management system.

DATA BASE MANAGEMENT SYSTEM (DBMS)

A generalized tool for managing data bases. It makes data
interrogation, maintenance, and analysis of data available to
users.

DATA DEFINITION

The means by which data is described through its physical and
logical characteristics.

DATA DICTIONARY

A directory containing data element name, descriptions,
security controls, physical location, etc.

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DATA ELEMENT

A named unit of data which is not defined in terms of any
other named units of data.

DATA FORMAT

Defines the information bank access method used to store and
retrieve a data set occurence.

DATA INTEGRITY

Ensuring that the data base is protected at all times against
invalid alteration or destruction.

DATA OCCURRENCE

Actual value(s) of data corresponding to a particular data
relationship.

DATA PRIMITIVES

The basic indivisible building blocks for data in the
information bank.

DATA RECORD

An ordered set of data elements.

DATA RELATIONSHIP

A data relationship is a logical grouping of one or more data
records.

DATA SET

A specific occurrence of data corresponding to a given data
format.

DATA SET HEADER

Data contained in a data set header is used to identify the
owner and source of the data set and to control access to the
values contained in the data set. Headers for may contain
additional information such as element type, coordinate
system, etc.

DATA SET QUALIFIER

A version number or alphanumeric appendage to a generic name
to make a unique name for a data set.

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DATA SURVEILLANCE

Monitoring of data processing activities for the purpose of reconstructing data which has been destroyed or modified, and informing the affected users.

DEFAULT

A system assigned value or result which will be in force unless intentionally overridden by the user.

DICTIONARY

Dictionaries contain definitions of data elements, data relationships, data formats, coding modules, operational modules, and jobs.

DIGITIZERS

A device which assigns digital numbers to analog measurements.

DISPLAY FORMAT

A special class of data formats that is used for displaying data sets.

DISPLAY LANGUAGE

The language interface between the user and a graphics device.

DISTRIBUTED COMPUTING

Computing performed within a network of distributed computing facilities. The processors for this type of system usually function with control distributed in time and space throughout the network. Associated with the distributed computing may be distributed storage facilities.

EXPLICIT INPUT/OUTPUT

Input/output action to or from a data set which is under the control of a user program.

FLATBED PLOTTER

This name is used to describe those plotting devices which draw on a horizontal flat surface, such as the Orthomat, Gerber, etc.

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GEOMETRIC DESCRIPTION

The mathematical model describing a geometric entity.

HIGHER LEVEL LANGUAGE

A computer programming language in which the instructions or commands may each result in many machine language instructions.

HOST COMPUTER

The interactive computer complex for which the IPAD System will be developed.

IMPLICIT INPUT/OUTPUT

Input/output action to and from a data set under the direct control of IPAD.

INFORMATION BANK

The collection of all data areas defined to IPAD.

INTERACTIVE GRAPHICS

A graphics capability which allows the user to communicate with the computer.

INTERACTIVE PROCESSING

Execution of a computer program which communicates directly with the user, in the sense that it displays information in response to new inputs and supports intense dialogue.

INTERACTIVE TERMINAL

A communication device which provides a hardware interface between the user and a computer for interactive processing.

INTERFACE ROUTINES

Software routines which interface hardware or software.

I-O LIST

A list of variables representing data which are to be read or written.

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IPAD COMMUNICATION NETWORK

All hardware and software furnished and maintained by the
IPAD contractor or by independent vendors which is used to
provide communications between the IPAD host computers and
any IPAD satellite computer. This shall include any
translators required to reformat data or computer programs
for transmission between computers.

IPAD COMPUTER PROGRAM LIBRARY

The collection of all user supplied computer programs
installed into IPAD.

IPAD SYSTEM

An interactive computing system being developed to support
the aerospace vehicle design process.

IPAD SYSTEM ADMINISTRATOR

A person who has authority to administer the IPAD system.
His responsibilities are to maintain the IPAD system
(hardware and software) once it is installed; to assure
system performance, integrity and security; and to interface
with the IPAD user community which he serves.

JOB

A sequence of executable operational modules.

JOB EXECUTION QUEUE

A queue containing jobs submitted by IPAD users.

JOB NETWORK

A set of logically connected jobs in the IPAD system whose
execution order is dependent upon user supplied parameters or
calculated results.

KEY WORD LIST

Part of each dictionary which allows users to search and find
existing dictionary entries to fulfill their needs. This
capability will help to limit the number of redundant entries
in the dictionary which contain the same information or have
the same mathematical definition.

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LANGUAGE SYNTAX

The structure of a language. The objects in a language and the relationships between those objects.

LINKED PROGRAMS

Separately assembled program segments which are combined together through a linkage processor to allow them to operate as a single program unit.

LOGICAL STRUCTURE

The structure of data as it is referred to by an application computer program or a user.

MENU

A list of available choices displayed to a user at an interactive terminal.

MESSAGE FILE

A file of messages for users created by the system or other IPAD users.

MICROFILM PLOTTER

A plotting device capable of producing microfilm output.

NARRATIVE TUTORIALS

Educational material displayed at a terminal which instructs the user in the use of the system capabilities.

OBJECT MODULE

A module of a computer program expressed in the language of a computer.

OPERATIONAL MODULE

An executable collection of object modules which contribute to one or more jobs.

OPERATING SYSTEM

The control program for the host computer or satellite computer under which IPAD or a subset of IPAD executes.

PASSIVE COMMAND

Such commands cause the IPAD system to inform the user of the functions which are available to pursue a particular task.

PERMISSION CODE

Constraints on the use of the IPAD command language.

PROCESS

A series of continuous actions that are defined and planned within a hierarchical system of levels divided into activities that are accomplished by executing one or more jobs. Each level has forward and feedback data flow paths defined within activities and between related activities. Data transfer between levels may be forward or feedback.

PROGRAM ITEM NUMBER (PIN)

A number which relates an item of work to the work breakdown structure. It is used as a primary index to work items and for cost collection.

PROJECT

The sequence of tasks and subtasks to be performed during an associated design and/or analysis effort.

PROJECT PLAN

The definition of all project tasks, subtasks, expected results, and the associated control in terms of schedule dependencies.

QUERY LANGUAGE

A language designed specifically for formulating data base retrieval requests.

REMOTE JOB ENTRY

Entry into the host computer of a job from a remote input device.

REMOTE SITE

Any computer processing system which is remote from and connected to the host computing system.

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RESPONSE TIME

The time interval between the operator typing the character
signifying the end of the input and the terminal typing the
first letter of the reply.

REQUIREMENTS TREE

A hierarchical structure for the IPAD requirements. The
outline of the body of the IPAD requirements document.

SATELLITE COMPUTER

Any computer remote from and in communication with an IPAD
host computer.

SECURITY CODES

Coded conventions established to meet company or governmental
rules pertaining to controlling access to data. These are a
key subset of the total set of access codes.

SOURCE MODULE

A specific collection of symbolic code that contributes to
the definition of one or more operational modules. Source
modules are the smallest division of user source code that
can be defined.

SUBTASK

A sequence of jobs which represents a step in a project.

SUBTASK DATA AREA

A data area that is associated with a user during the
execution of one subtask. Each subtask will have an
associated subtask data area. The subtask data area is a
private user working data area and all data is generated in a
subtask data area.

TASK

A sequence of subtasks accomplished by a group which
represent a milestone in the project plan.

USER IDENTIFICATION

A unique identifier associated with each user of IPAD. It is
mandatory that this ID be associated with a person and not an
activity or an organization.

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UTILITY SOFTWARE

Programs which aid systems operations. They usually perform
services frequently needed by users.

VERSION NUMBER

A special identification used to denote a specific version of
a data set or a program.

X-Y PLOTS

A two-dimensional plot of one variable against another.

SUMMARY

The principal objective of IPAD is to provide a computer software system which will aid the U.S. Aerospace Industry in the design of future vehicles. It will be an engineering information processing system for aerospace vehicle design to be installed on the computer complexes of major U.S. Aerospace companies. It shall serve as the key communication and calculation integrator for a large number of designers conducting a broad range of design tasks over significant periods of time and on a wide variety of aerospace vehicles. IPAD will increase the effectiveness of the individual designer by accelerating the computational and data management tasks of the design process. The system must respond to company needs from conceptual through detailed design and provide interfaces to computer-aided design and computer-aided manufacturing. IPAD must be readily modifiable and will change as the user's needs change.

Requirements for a user interface to IPAD cover the areas of language, tools, and access. User friendly languages will be provided for interface with the IPAD system. An assortment of user tools will be available. A variety of modes of access and different priorities of access are provided for the user's convenience. For the protection of the user and the system, user identification and classification are required.

A command language will provide access to IPAD system capabilities. The command language will allow a user, unfamiliar with the language, to get assistance on IPAD use. A query language will be provided to enable a user to access information in the IPAD data base. The IPAD languages will be constructed to accomodate users with different levels of IPAD expertise; e.g., expert, intermediate or novice.

An assortment of user tools will be available to all IPAD users—managers, engineers and supporting staff. The tools will be available interactively and in batch mode. The number and types of tools made available will change as the needs of the IPAD user evolve.

IPAD will provide tools to enable the user to:

- edit and update stored data, computer programs and text documents;

- generate reports using information from the IPAD Information Bank;

- facilitate communication between IPAD users by providing utilities to build information menus, organization lists

and mailing lists and enabling a user to transmit
messages to other IPAD users;

- maintain and query references to IPAD documents and
  procedures;

- evaluate computing system performance;

- help the user when he requests assistance;

- debug computer programs; and

- construct command sequences.

IPAD will provide a variety of modes to the user for
interfacing with the IPAD system. He may interface via an
interactive terminal, batch control cards or by initiating user
programs that issue commands or calls for IPAD capabilities.
Interactive work may be done either by textual or graphical
terminals. Batch jobs may be submitted remotely via a satellite
computer or from an interactive terminal.

Four different categories of user priority will be
recognized: standard, appointment, short duration, and emergency.
The standard user's access time and turnaround time is dependent
upon system load. The purpose of the appointment category is to
give a user an opportunity, through the use of appointments, to
run in a semiprivileged state. An appointment user has fast
access to the system and cannot be put in a wait queue when the
system gets overloaded. Short duration users are privileged in
access and response time but limited in hook-up duration and
restricted in activities. An emergency user has top priority over
all other categories of users.

IPAD will provide processing security for individual users.
This protection will be provided by employing user passwords.
These passwords must provide unique identification, must be
protected from discovery and must be easy to use and modify.

IPAD will support engineering and management in planning,
defining, modifying, controlling and integrating engineering
technical processes. Support provided includes the building and
saving of job sequences, the execution and monitoring of jobs,
process reporting and data release control to inform users of data
status. Information to be shared by more than one organization
shall be under release control.

IPAD will support managers in planning, monitoring and
reporting Design Projects. Management computer programs will be
made available for analyzing technical and management information.
An individual IPAD user will be able to assess the status of his
own subtask, data, task or the overall project status. In

response to IPAD monitoring and reporting, controls may be exerted to limit, terminate or suspend activities.

Information management within IPAD is broken down into three categories: data management, information management tools and computer program library. Data management is concerned with the organization, manipulation, control, integrity, security and administration of IPAD data. Information management tools are provided to maintain data, to perform data transformations, to compare data and to perform arithmetic and logical operations on data. The computer program library contains computer programs in source and executable forms. The programs may be supplied by the user or generated by software processes (e.g., compilation). Computer programs may be structured into jobs and executed.

The handling of data within IPAD will have many facits including organization, manipulation, control, integrity, security and administration. Data organization at the elementary level will consist of elements, formats and data relationships which will be grouped into data sets. Data sets are organized into data areas. Data manipulation includes capabilities to query, to copy data and programs and to access and retrieve archived data. Data control governs data access, data changes, purging and data retention. Backup and recovery procedures are provided to guard the integrity of all data in the IPAD data base. Proper security clearance will be required to access some data sets within IPAD. Security control of read/write access will be provided. Data administration responsibility is to be assigned to a designated person or organization who will be responsible for exercising control over the entire IPAD information bank.

IPAD capabilities shall be provided to enable the user to maintain data in the IPAD information bank and to perform data transformations. Maintenance features include data updating, data restructuring and data reformatting. File maintenance capabilities will be also provided. Files may be created from data in the IPAD information bank or data from files may be inserted into the IPAD data base. Command sequences for creating or decomposing files may be saved for subsequent execution.

The computer program library shall consist of programs in source or executable forms. The programs may be supplied by the user or generated by software processes (e.g., compilation). Insertion and deletion of programs shall be straightforward and machine independent so that a company may insert its own programs. IPAD user aids will be made available to facilitate the interfacing of existing aerospace computer programs with each other.

IPAD must be adaptable to different hardware implementation and computing facilities. IPAD must be able to share data with non-IPAD systems and to safeguard and control non-IPAD data while

in the custody of IPAD. Existing telecommunication standards will
be used to facilitate communication between computing systems.
Support software and user aids will be provided to facilitate
transfer of programs, data base, etc.

IPAD must be able to interface with the host system and with
remote systems. IPAD shall permit access to and receive data from
non-IPAD systems using existing standards whenever possible.

IPAD shall be able to communicate with existing software
systems external to IPAD and facilitate transfer of program
modules, data bases, etc., between IPAD installations. Support
software and user aids shall be provided for such purposes.

The IPAD system shall provide fail-safe security to prevent
the disclosure of information which may be detrimental to National
Security or the proprietary interests of the user company. System
failure must not result in the degradation of IPAD security
controls. The reliability and availability of the IPAD system
should not be limiting factors in the system's usefulness. IPAD
shall be designed to be flexible when adapting and interfacing
with individual installations.

Response time must be adequate. System capacity should be
hardware configuration limited rather than software limited.
Tools for performance monitoring will be provided for the System
Administrator. Various accounting programs will be provided for
project management, reporting and statistics.

Graphics standards for communicating between devices will be
established. Graphic equipment interface software will be
provided within IPAD to accommodate a prescribed assortment of
graphical equipment.

A standard graphics software package (CORE) will be provided
consisting of lower level primitive routines which will minimize
machine dependence and will be capable of supporting a wide range
of graphics devices. These basic functions will allow development
of sophisticated graphics related applications.

IPAD shall provide techniques for converting data from the
IPAD standard formats to the format required by dumb and
intelligent type terminals. Compression and explosion techniques
shall reduce the amount of data sent over communication lines.

IPAD shall provide a variety of functions to support CAD, NC
and related analyses. Tools shall be provided to construct and
display engineering designs and data plots. Standard and extended
geometry formats shall be supported. Conversion utilities shall
be provided to convert geometry formats to a standard format for
communication purposes.

Graphics related programming tools shall be provided to allow the development of sophisticated graphics capabilities from the standard graphics software primitives. An animation package shall be provided to display dynamic phenomena.

IPAD shall provide a wide variety of CAD/CAM geometric entities for the construction and display of engineering designs. A standard geometry format for communications shall be provided.

IPAD shall provide tools to define cutter paths utilizing CAD engineering design geometries and shall also provide a utility to convert the same geometry to APT geometry source format.

1.0 INTRODUCTION

The IPAD Requirements Document defines the requirements that are to be satisfied by the IPAD System. After approval, this document will be placed under configuration control. The requirements definition contained in this document is to be considered as a baseline definition of the IPAD requirements. All changes or additions to the requirements definition must be made to these documents.

The IPAD Requirements Document was produced by the Requirements Analysis Task. The sources of information are the Integration and Information Processing Requirements and the IPAD User Requirements.

The two documents were assigned to personnel on the requirements analysis team. Each person composed a list of recognized requirements from an assigned document or sections of a document. Each item in the list was composed of a requirements number, a reference to the source of the requirement (document, section, page), and a statement of the requirement. The requirements in these lists were studied by the team and divided into two groups: firm requirements and questionable requirements. These questionable requirements were presented with questions to the IPAD Program Engineering Group and to a representative of the NASA IPAD Project Office. The firm requirements were analyzed by the requirements analysis team. These questionable requirements were also analyzed when they became firm requirements.

During analysis, each requirement was evaluated against nine criteria. These criteria are: complete; correct; precise; unambiguous; clear; consistent; relevent; testable; traceable; free of design detail; and manageable.

If a requirement did not satisfy all nine criteria, it was returned to the originator for resolution. The requirements that satisfied the criteria were placed into the appropriate section of the IPAD Requirements Document. As the problems were resolved with the requirements presented to their originator for resolution, those requirements were re-analyzed and eventually placed in the document.

Acceptance test criteria were written for each requirement. These will become part of the IPAD Acceptance Test Plan. An abstract of the acceptance test criteria for each requirement is included with each requirement in this document.

The format adopted for documenting each requirement is as follows. Each requirement will start a new page and will begin with a sequence number and a title. The sequence number will have the form n-r, where n is a running sequence number 1,2,3,....,etc.,

and r is the requirement number. Next will come the requirement
source references delimited by commas. Except for Boeing and NASA
requirements rework team source reference, each source reference
will have the form: doc/sec, where doc is the document source, and
sec is the section within the document. Possible document sources
(doc) are:

> 1.3 for document D6-IPAD-70012-D;
> 1.4 for document D6-IPAD-70013-D;
> SOW for Statement of Work;
> F3 for IPAD Feasibility Study, Volume III;
> BCAC-NASA for Boeing/NASA requirements rework team.

Next comes the requirement description followed by the
acceptance criteria abstract.

1.1 IPAD OBJECTIVES

1.1.1 Purpose

Within the concept of a design data management system, IPAD
is intended to satisfy three primary objectives:

1. improved productivity;

2. fewer manufacturing changes; and

3. lower technical risks.

1.1.2 Scope of IPAD

IPAD is software to computerize, insofar as possible,
company-wide design-information processing. Its intended scope is
such that it will simultaneously support design activities of a
typical company mix of multiple development projects. It will
serve management and very large engineering staffs at all levels
of design (conceptual, preliminary, and final) and will aid in the
assembly and organization of design data for support of
manufacturing processes.

IPAD software will function on "third generation" computer
complexes typical of those in use today by large aerospace
corporations and will augment, rather than replace, existing
"system software." It is currently visualized as composed of (1)
executive software that will control user-directed processes
through "interactive" interfaces with a large number of terminals
in simultaneous use by engineering and management personnel; (2) a
large number of utility software packages for routine information
manipulation and display function; and (3) data management
software to provide a comprehensive, versatile capability for
efficiently storing, tracking, protecting, and retrieving

exceptionally large quantities of data maintained on multiple storage devices.

Note that the data base includes the technical analysis and design computer programs utilized by various disciplinary specialists. Such programs are not regarded as part of IPAD, but must be provided by the user to form the complete design-software system; they can include existing and future company-proprietary programs, as well as those in the public domain. The data base will also include all official project information defining the characteristics of current baseline and alternative designs and their performance, as well as archival "handbook" information forming the technology base for company designs. Simultaneous access to the same baseline design information by all disciplinary groups will thus be possible. Temporary libraries, for design information being actively utilized by individuals or teams, will also be provided.

It should be emphasized that IPAD is not "automated design" software and will not constrain company design methods. The characteristics and quality of aerospace designs in the future, as now, will depend on such elements as the creativity of designers, the quality of technical staffs and their analysis tools and design data, and the coordination of design and manufacturing technologies. IPAD is a tool to improve the efficiency and effectiveness of the use of these elements.

IPAD processing requirements shall be developed to incorporate the requirements for military and commercial aircraft and aerospace vehicles.

1.2 BACKGROUND INFORMATION

1.2.1 Problem Description

The Evolution of Computing in the Design Process

Large design problems require a division of tasks. Individual designers are assigned a part of a task under the direction of a task leader. The designer performs his subtask by dividing it into several manageable jobs. Tasks are organized and reported by the task leader as part of a project group responsible for the design of a product.

The result of the design process is a single product entity in which all components must function harmoniously. Hence, extensive data communication, evaluation, and iteration are required to optimize the design. Orderly methods for introducing changes in the design are necessary to ensure convergence. These methods establish a data (information) handling environment.

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This environment characteristically:

- Requires extensive record keeping for data and configuration management;

- Requires accurate and timely production and communication of data;

- Has complex informal and formal communication paths;

- Is continuous with respect to time, activities and people.

These information functional characteristics remain unchanged even though the methods and computerized tools used may change significantly.

Prior to the use of computers, all calculations were performed by hand or by using slide rules and other mechnical aids. This process required the designer to record a set of values, input these values into a mechanical device, record results and generally manage each detail of the computation by hand. The size and complexity of the calculations were limited by the manual abilities of the designer.

When computers were first introduced, they were used to relieve the manual constraint on calculations. Typically, the computer was programmed to perform the arithmetic, record intermediate values, and generally manage the computation process; hence, effectively automating the routine manual activities in performing calculations.

The computer was so effective that the designer was able to extend his computational ability by many orders of magnitude, often utilizing theories and methods previously unavailable because of their extensive arithmetic. Improvements in computing hardware, operating system software, and programming languages resulted in further extensions of this computation capability.

The continued automation of calculations, produced new constraints. While individual designers were able to produce thousands and even millions of numerical results in very short periods of time, the volume of data to be handled by people became the constraining factor. People began to be faced with unmanageable data volumes associated with data preparation, evaluation of output and communication of results. Computing hardware and software were oriented to batch processing at the physical site of the computer and gave no support to the transmission of data between individuals or between coding modules to be executed together as one job. Hence, while large volumes of calculations could now be performed, information handling was still a manual process.

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Early automation of calculations on simple tasks soon gave rise to other problems that were part of the task but manual in nature. The general question of problem solving efficiency began to emerge. Instead of seeking efficiency improvements on one isolated task element such as calculations, all task elements come into question. Studies examined this broader efficiency question of how to lower task total cost by considering both the human aspects and the computer aspects of a task. In summary, the significant findings were:

- The computing cost is approximately one-tenth of the total cost;

- The time people spend on the task is the most important cost element;

- A proper selection of computing devices and services can reduce task total cost by 25% through reducing time people spend waiting for computations.

The early successes with calculation automation on simple tasks naturally led to putting more complex tasks on the computer. These more complex tasks inevitably resulted in data handling problems, especially at technical module interfaces.

Integrated systems were developed to relieve the constraint of communicating large volumes of data across program interfaces. These systems typically included several modules, each identified with a set of calculations. Data was transferred across module interfaces by developing compatible data formats and passing the data through the computer system directly. As a result, modules were able to communicate technical data reliably, precisely and rapidly.

Executive control systems were developed giving the user control of the operation of the integrated system with language syntax familiar to him. Data management systems were also developed for automatic retrieval and storage of data by command of the individual program.

Computing hardware and software were developed to support a direct real-time interface between the user and the computer. This interface, combined with executive and data management software, gave the user control of the computer with respect to his own processing. It allowed the user, within limits, to make real-time adjustments to data and execution sequences and to interrogate output through direct access to large capacity data storage devices.

This environment introduced several advantages. Integrated systems were effectively configured to include several related disciplines, thus providing a medium for exchange of data and a

common reference system for problem solution and theory development. In parallel, later generation computing systems provided arithmetic and data transfer rates sufficient to support the data volumes to analyze total aircraft responses such as the aeroelastic cycle, the total flight control system, or the engine to airframe interface.

By coupling integrated systems with interactive graphics devices, computer-aided drafting systems were developed. These systems have been interfaced with numerical control software, thus providing a direct tie between product design and manufacturing.

The Next Steps That Need to be Taken In the Development of Computers to Support the Design Process

Early in the IPAD study, the problem solving environment typified by integrated systems was re-examined. This examination identifed some very different characteristics associated with the design process which had not been identified. These characteristics evolve from the long duration of problem solving which is characteristic of all but the simplest work and is particularly present in product design processes which span months and even years. It was found that design is a hierarchy of processes; individuals and their subtasks, tasks composed of many subtasks, and product studies composed of many tasks.

In examining the details of this process with respect to time duration, it was observed that:

- Different subtasks or different sequences are utilized as the study progresses and as new insight is gained into technology trades;

- Most subtasks are not completed in one work period; therefore, the designer must re-orient himself, the data and the subtask in order to continue at his next work period.

Large design problems are divided into management, technical, and support tasks. These tasks are further subdivided into manageable work packages. During the performance of these work packages there is a need for communication between the groups involved. To support this communication, a computing system should be available with the following key features:

1. Is readily accessible by personnel in engineering, manufacturing, management, and support functions;

2. Is easy to use without the need for long training periods;

3. Provides timely responses that encourage a continuous thought process for a large number of users;

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4. Can be installed in various computing environments without extensive modification to itself and little or no modification to the host computing environment;

5. Provides secure, private, and reliable storage for programs and data;

6. Provides for the interrogation of storage and the sharing of information among people, among programs, and among people and programs;

7. Provides for the incorporation of existing programs;

8. Provides for the dynamic specification and control of sequences in which programs are to be executed.

9. Is extendable in scope to cope with new methods of solving existing problems;

10. Allows a computing task to be suspended and resumed at a later time;

11. Keeps a record of users, activities, data storage accesses, data transfers, data creations, etc.

12. Provides for information continuity over long periods of time;

13. Provides for information continuity over many different task sequences.

The Problem Definition

There are no universally available computing systems that satisfy all of the needs of a computing system to support the engineering process as described. IPAD development must consider the existing computing environments and the computing environments expected in the future. The difference between these computing environments and the computing system needed to support the design process is the problem that is to be solved. That problem definition must be measured against the time and resources that are available to determine what part can be solved by specified dates. IPAD development must proceed in such a way that the evolving system keeps pace with the changing needs of potential users and the changing state-of-the-art of computing systems.

1.2.2 Events Leading to the Requirements

IPAD has evolved over the past ten years beginning with discussions at Boeing in 1967 and continuing with a study and critique process that has included extensive aerospace industry involvement. Two in-depth studies of the feasibility and possible

forms of an IPAD system were carried out by The Boeing Company and General Dynamics/Convair. The total cost of these studies over a 17-month period was $611,000. Each study contractor undertook a careful dissection of the vehicle design process to delineate those functions and tasks that can be beneficially supported by computer hardware and software and then defined the format and elements of a software system that could substantially improve the design process. They assessed the impact of this IPAD system on company computer hardware requirements and on the performance of company staffs and evaluated its cost and benefit potential.

One company examined these questions in the context of design of three kinds of vehicles - a large subsonic transport, a supersonic transport, and a hydrofoil - and developed a comprehensive, detailed picture of the design process as a multilayered network of functions. The other examined intensively the tasks and interfaces of individual designers and groups and analyzed carefully the information flow in design. They used a combination of bottom-up counting of the effects of the constituent parts of the design process and extrapolation of experience with existing small software systems to arrive at computer requirements, costs, and benefits of IPAD software. Both concluded IPAD is feasible and will fit on existing computers. They arrived at software systems that differed in detail, but exhibited the same general characteristics and order-of-magnitude costs. Projected benefits included 25-90 percent time and 20-60 percent cost savings in design, better management visibility, and reduced product risk and cost resulting from greater depth in early trade-offs, on-time designs, and fewer design changes during production.

Results of these studies were aired in four oral reports that were heavily attended by representatives of industry; for example, 83 industry representatives attended the final oral presentations. Following completion of the studies, the results were critiqued by teams from McDonnell Aircraft Co.; Lockheed-Georgia Co.; Grumman Aerospace Corp.; Rockwell International Corp., Los Angeles, Aircraft Div.; Control Data Corp.; IBM Corp.; and Sperry Univac. These firms examined such questions as completeness of the studies, credibility of the proposed systems and projected development parameters, user acceptance, and government and industry roles. They expended significant effort over four months, employing 31 team members and about 100 part-time consultants. The critique reports reveal a wide spectrum of views, but stong consensus that IPAD development should proceed, should not include disciplinary module development which should remain largely the prerogative of industry, and should provide early delivery of software and user involvement. Because of the inevitable budget limitations, it was recommended that NASA limit its specific objective to production of a truncated, but "working," system.

Other evaluations of IPAD include an Army-funded study by McDonnell Douglas Astronautics Co. of its benefit potential for missile design and a small NASA-funded study by Battelle Columbus Laboratories of its potential for non-aerospace application. In addition, the NASA Research and Technology Advisory Committee (RTAC) on Materials and Structures sponsored a colloquium of high-level aerospace managers at MIT on January 30-31, 1974, at which IPAD was examined and discussed. As a result, the NASA RTAC on Materials and Structures recommended pursuit of the IPAD development by NASA.

In February through April, 1975, an IPAD Prospectus, prepared by NASA, was reviewed and commented by aerospace executives whose firms were anticipated to be interested in membership on the IPAD advisory board, evaluation of IPAD software, and involvement in IPAD support and maintenance in the future.

An RFP for IPAD development was released in May, 1975. Proposals were received from the Boeing Commercial Airplane Company, McDonnell-Douglas, and a Computer Science Corporation-Grumman team. In December, 1975, the Boeing commercial Airplane Company was selected as the IPAD System developer. The development contract covers a five-year period involving approximately 100 man years of development effort.

Contractor work on IPAD development began in April 1976.

2.0 IPAD REQUIREMENTS

The principal objective of IPAD is to provide a computer software system which will aid the U.S. Aerospace Industry in the design of future vehicles. IPAD's computer based capability will substantially reduce design time and costs and will afford improved vehicle performance.

IPAD is an engineering information processing system for aerospace vehicle design and is to be installed on the computer complexes of major U.S. Aerospace companies. It shall serve as the key communication and calculation integrator for a large number of designers conducting a broad range of design tasks over significant periods of time and on a wide variety of aerospace vehicles. IPAD will increase the effectiveness of the individual designer by accelerating the computational and data management tasks of the design process. The system must respond to company needs from conceptual through detailed design and provide interfaces to computer-aided design and computer-aided manufacturing. IPAD must be readily modifiable and will change as the user's needs change. (See figure 2.0-1.)

2.1 USER INTERFACE

Requirements concerning the user interface cover the areas of user language, user tools, and user access. User friendly languages will be provided for interface with the IPAD system. An assortment of user tools will be available. A variety of modes of access and different priorities of access are provided for the user's convenience. For the protection of the user and the system, user identification and classification are required.

2.1.1 User Language

User friendly languages will be provided for interface with the IPAD system. A command language will provide access to IPAD system capabilities. The command language will allow a user, unfamiliar with the language, to get assistance on how to use IPAD. A query language will be provided to enable a user to access information in the IPAD data base. The IPAD languages will be constructed to accomodate users with different levels of IPAD expertise; i.e., expert, intermediate or novice. (See figure 2.1.1-1.)
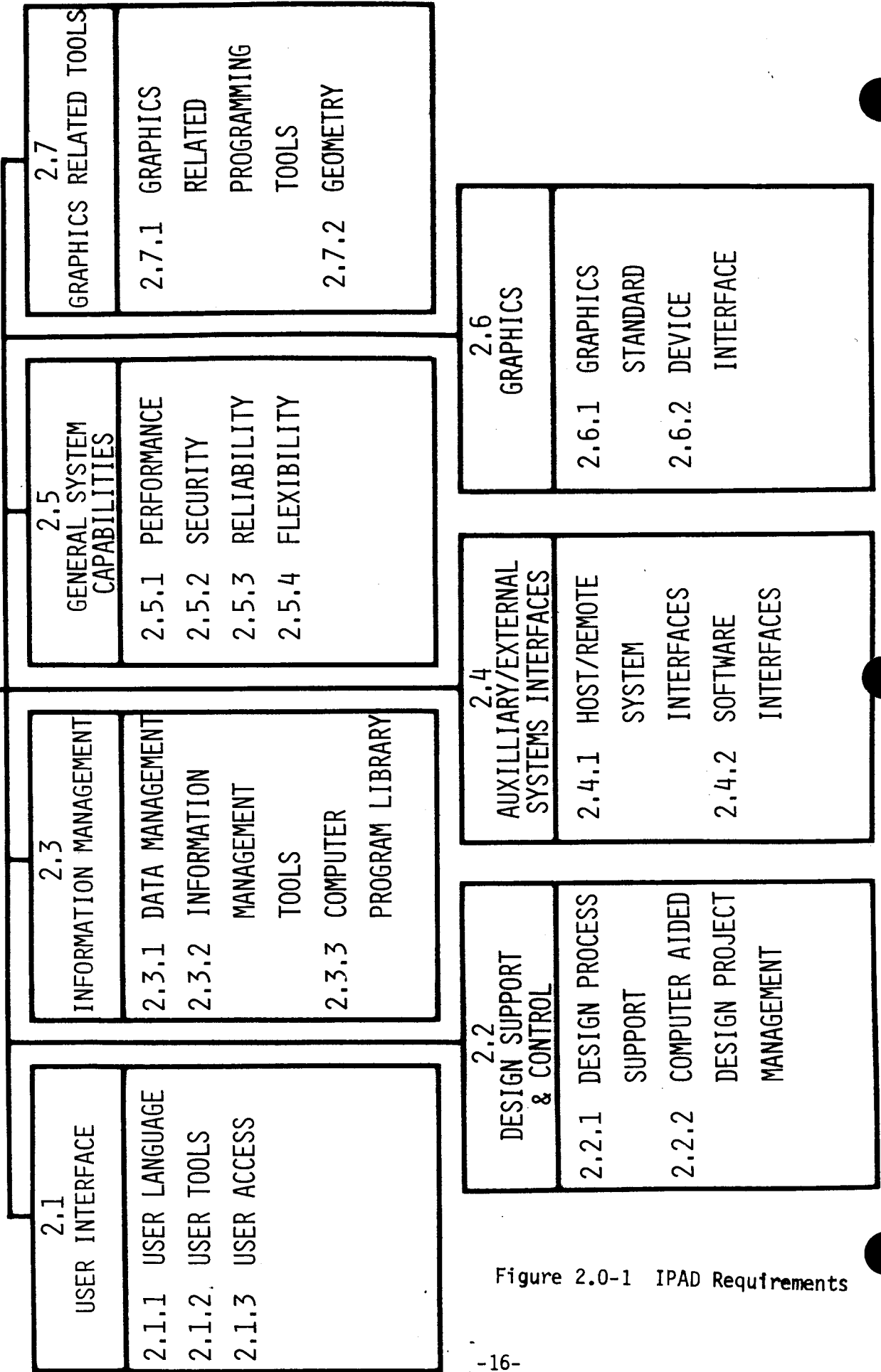
REV. B

Figure 2.0-1   IPAD Requirements

2.0 FULL IPAD REQUIREMENTS

1. USER LANGUAGE
2. USER SKILL LEVELS
3. ERROR DIAGNOSTICS
4. COMMAND LANGUAGE FUNCTIONS
5. USER AIDS
6. COMMAND LANGUAGE
7. ACCESS TO HOST O/S FUNCTIONS
8. COMMAND PROMPTS
9. USER ACCESS CONTROL
10. EXIT REPORTS
11. QUERY LANGUAGE
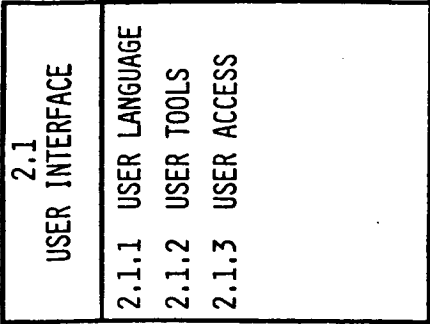12. HEADER DATA QUERY
13. MANAGEMENT QUERY LANGUAGE

2.1 USER INTERFACE

2.1.1 USER LANGUAGE
2.1.2 USER TOOLS
2.1.3 USER ACCESS

Figure 2.1.1-1 User Language Requirements

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REQUIREMENT   1   USER LANGUAGE

SOURCE   1.4/2.1.1

DESCRIPTION

     The IPAD user languages (e.g., command, query, edit, etc.)
are user oriented and consistent in vocabulary, and syntax.
Defaults are employed when practical and are directed towards the
experienced user.

ABSTRACT OF THE ACCEPTANCE CRITERIA

     A user opinion survey will be used to evaluate the IPAD user
languages for all modes of operation during acceptance testing.
The evaluation criteria will include: consistency in vocabulary,
syntax and format, ease of changing from one user language to
another, and ease of use. These criteria will first be evaluated
during the user language design phase and subsequently tested
concurrently with most of the other requirements, with each user
completing a check list for each mode of the user language that is
tested.

     In addition, tests must be conducted to verify that the
defaults in the user language are operational, and that they are
directed to the experienced user.

REV. B

REQUIREMENT   2   USER SKILL LEVELS

SOURCE   SOW/5.2.2, 1.4/2.1.1

DESCRIPTION

IPAD shall address the problem of variation in expertise in
the use of computers and IPAD itself.

The system shall direct by virtue of the user inputs, the
level of response required and make dynamic adjustments based on
the detected skill of the user. It is intended that IPAD minimize
frustrations at all user skill levels by optimizing guidance in
the use of IPAD commands and supplying explanations of
diagnostics, prompts, defaults as indicated by the user input.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The system capability to detect the skill level of users and
make appropriate responses will be checked for all user functions.

A user opinion survey will be used to evaluate the "help"
provided for all uses of IPAD. The criteria considered will be
utility, clarity, ease of use, adequacy, and appropriateness for
skill level.

REV. B

SOURCE   SOW/5.2.2, 1.4/3.3.1, 1.4/2.4.3

DESCRIPTION

All user input to IPAD or its utilities (excluding user
supplied utilities and application programs) shall be checked for
errors. IPAD error diagnostics shall

a. Be complete, clear, concise, courteous, and spelled
correctly.

b. Explain the error and how to rectify the problem.

c. Be specifically identified as to source.

d. Be fully explained in both the user's manual and through
HELP mode.

e. Include warnings for semantically suspicious commands.

f. Include a brief mode which at the user's option will
eliminate all but the most essential portions of
diagnostic messages.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A user opinion survey will be used to evaluate all IPAD error
diagnostics based upon the user's ability to quickly correct
errors through the use of the diagnostics. The diagnostics will
be evaluated for completeness, clarity, courtesy, adequacy of
explanation, and ease of error detection.

The user option to request "brief" diagnostics will be
checked. The ability to return to the detailed error diagnostics
should also be tested.

This requirement will be tested concurrently with other
requirements throughout acceptance testing.

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2.1.1.1 IPAD Command Language

The IPAD command language is composed of active and passive command types. Active commands enable the IPAD user to initiate IPAD system capabilities. Passive commands help the user to understand IPAD and how to use the active commands.

The command language is to be user friendly; that is, abbreviated commands will be accepted, default parameters will be provided where needed and useful error and warning diagnostics will be returned whenever necessary. Host operating system capabilities will be accessible from IPAD but the corresponding command language will be independent of the host computer.

Managers or persons in authority will be able to restrict the set of commands available to each individual user. Status, resource and message reporting will be available upon request.

Active command functions may be part of subordinate user languages but will be accessible through the IPAD command language.

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SOURCE   1.4/2.5.2.1, 1.4/2.5.2.4

DESCRIPTION

IPAD must provide a user command language to perform certain functions, examples of which are given below. These functions include two types: those that are part of the executive level of the IPAD command language and those that are incorporated in subordinate user languages.

Executive-level IPAD command language functions shall include the following capabilities:

- Initiate execution of a job.

- Request loading of SMs/OMs/jobs previously saved by the user.

- Initiate saving of SMs/OMs/jobs for subsequent usage.

- Interrupt execution of a job with or without automatic data saving.

- Restart an interrupted job.

- Initiate printing of data or programs.

- Submit a batch job for execution.

- Query the status of a job.

- Send a message to other IPAD users.

- Request help.

- Request display of information on use of IPAD (overview, key word, procedures, menus, command structure, etc.).

- Access IPAD utilities.

- Access host operating system capabilities.

- Exit IPAD.

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Command functions that may be part of subordinate user languages, but which must be accessible through the IPAD command language include:

- Display an explanation of the current operation that the user is performing.

- Find desired information (data, programs, data definitions, etc.)

- Generate printed reports.

- Compare two data sets or programs.

- Display graphical information.

- Define new data elements/formats/relationships

- Purge entries from a data base.

- Review/update data or data element dictionaries.

- Review/update information about tasks, sub-tasks, or jobs.

- Review/update schedule/budget/overall information about a project.

- Enter new data or programs.

- Edit contents of a data base.

- Transfer data, SMs/OMs from one area to another.

- Link OMs together for execution.

In addition to the command functions described in this requirement, IPAD shall provide a set of "prompting" displays that are callable from the IPAD command language. (See requirement 5.)

ABSTRACT OF THE ACCEPTANCE CRITERIA

These commands will be tested with the passive commands (requirement 5) in conjunction with other tests. A test procedure will be developed to assure that all commands (executive level and subordinate language) are tested.

Considerations for testing include:

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a)   Commands function properly.

b)   Mnemonics are suitable.

c)   Abbreviations are suitable.

d)   Language is consistent.

e)   Defaults are most commonly used cases.

f)   Parameters are easy to use & remember.

g)   Language usage is consistent with documentation.

REV. B

REQUIREMENT 5 USER AIDS

SOURCE 1.4/2.4.1.1

DESCRIPTION

IPAD will provide a number of aids to assist the user in the use of IPAD to accomplish his product design task. The user shall be able to request help to receive an overview of the capabilities available to him in the IPAD system. At any time, the user shall be able to request an overview of the IPAD commands currently available. The overviews will include a textual description of the capabilities of each command and a menu of choices to permit the user to request additional information. The user shall also be able to request an explanation of any command currently available to him to receive a textual description of the function of the command and an explanation of the syntax of that command. The user will also be prompted by IPAD in the entry of his requests.

The engineering user shall be able to use these user aids to be guided to the correct procedure, data, and programs which he needs to perform the design function.

When a command is changed, deleted, or added, notification will be sent to the systems administrator if the required accompanying explanation has not been updated.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The user aids will be tested throughout the testing period in conjunction with other requirement testing. All user aid capabilities will be tested.

The considerations that will be tested are:

a)   User acceptability

b)   Command explanations and overviews can be created by the system administrator and can be acessed by all IPAD users

c)   Command explanations or overviews for a user program can be created and requested by users of that task

REV. B

d)   Command explanations and overviews function correctly.

REQUIREMENT   6   COMMAND LANGUAGE

SOURCE   SOW/5.2.2

DESCRIPTION

The command language shall be easy for the engineering user
to understand and use. The commands shall appear to the user to
be independent of the host computer, except in those cases where
it may be necessary or desirable to allow an IPAD user to have
direct access to host commands.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A user opinion survey will be used to evaluate all active and
passive commands considering usefulness, clarity, ease of use and
adequacy. Test parameters will include a variety of user skill
levels and batch and interactive modes on more than one host
computer to verify host independence.

REV. B

REQUIREMENT   7   ACCESS TO HOST O/S FUNCTIONS

SOURCE   SOW/5.2.2, 1.4/3.5.2, 1.4/3.3.1

DESCRIPTION

The host operating system capabilities shall be accessible from IPAD.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A subset of functions of the host operating system will be selected and used from within IPAD. It will be established that the functions are available and operate correctly and that they can be intermixed with the IPAD functions. Furthermore, a subjective user opinion will be established as to the ease of use of host operating system features.

REV. B

REQUIREMENT   8   COMMAND PROMPTS

SOURCE   SOW/5.2.2, 1.4/3.3.1

DESCRIPTION

    IPAD shall interpret or translate commands into appropriate
operating system functions, possibly initiating other IPAD
software.

    IPAD shall provide command decoding, provide error
diagnostics for syntactically ill-formed commands, provide warning
messages for semantically suspicious commands, accept abbreviated
commands, supply default parameters, and provide lists of
alternate parameters and their descriptions on request from the
user.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    The IPAD command language decoding and display capability
will be tested in conjunction with other acceptance tests and
should verify that:

    a)   IPAD commands function correctly;

    b)   Abbreviated commands are accepted;

    c)   Warning messages are appropriate;

    d)   IPAD will provide lists of alternate parameters and
        their descriptions upon request;

    e)   Default parameters are provided for each command.

    User acceptance and operational correctness will be the
principal evaluation criteria.

REQUIREMENT   9   USER ACCESS CONTROL

SOURCE   1.4/2.8.2

DESCRIPTION

　　IPAD shall provide a manager or person in authority the
ability to restrict the set of commands available to an individual
user. The default shall be that all commands except those
reserved for the system administrator are permitted.

ABSTRACT OF THE ACCEPTANCE CRITERIA

　　The capability to restrict a set of commands available to an
individual user will be tested with the following procedure:

a)　The set of commands to be restricted will be tested both
　　as restricted and unrestricted.

b)　The default will be tested to verify that all commands
　　are available to the individual except those reserved
　　for the system administrator.

c)　Verify that the system administrator can access reserved
　　system commands but that the unprivileged user cannot
　　access these commands.

A user opinion survey will evaluate this capability based
upon user acceptance and operational correctness.

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REQUIREMENT   10   EXIT REPORTS

SOURCE   1.4/2.6

DESCRIPTION

The command "EXIT" will cause the user to log-off the system
preceded by a resources report on the current session. Two
reports are available:

EXIT alone will invoke a summary report on the resources used
during the current session and will consist of total resouces
used (CU's and dollars), total budgeted to the user and total
remaining.

EXIT, R will invoke a more detailed resources summary as
described in Requirement 52, type 1.

ABSTRACT OF THE ACCEPTANCE CRITERIA

During the execution of other acceptance tests users will use
EXIT and EXIT, R. The appropriate resource reports will be
checked for accuracy, completeness and acceptability to the users.

REV. B

2.1.1.2 Query Language(s)

A special query language shall be provided for accessing information in the IPAD data bases. Queries may be initiated by engineers, managers or supporting staff.

REV. B

REQUIREMENT   11   QUERY LANGUAGE

SOURCE   SOW/5.2.1.3, 1.3/4.5.1

DESCRIPTION

Access to data element values shall be through an interactive query language. The query language shall support logical requests which include arithmetic operations and refer to any data element. The result of a query may be a single value or a list of values of one or more elements. Results of one query may be referenced in another query. Queries may be restricted to user designated data areas on data sets. The query language shall also be usable from within an operational module running either in batch or interactive mode.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A user opinion survey will evaluate the interactive query language based upon user acceptability and operational correctness. Users will request data elements, both directly and in batch or interactive user programs.

The tests should include arithmetic operations on data elements and queries which result in single values or lists of values. There should be a test in which the results of one query are referenced in another query. It should also be verified that queries can be restricted to a specific data set or a specific data area.

REV. B

REQUIREMENT   12   HEADER DATA QUERY

SOURCE   1.3/3.2.2.1, 1.4/2.5.2

DESCRIPTION

    IPAD shall provide the capability to query data set header on
any information contained in the data set header.   (See
requirements 60.)

ABSTRACT OF THE ACCEPTANCE CRITERIA

    Users will test the capability to query header data by
requesting status information about data sets and by requesting
lists of data sets based upon different elements of the header
information such as owner, data set, type, location, etc.
Requests should include queries on user supplied header
information.   Evaluation will be based upon user acceptance and
operational correctness.

REQUIREMENT   13   MANAGEMENT QUERY LANGUAGE

SOURCE   BCAC-NASA

DESCRIPTION

A management query language, which may be part of the IPAD query language, shall permit interrogation of official project data.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A standard project will be defined. Each of 4 testors will develop individual questions and actions to do and then use the query language to carry out tnese on their own version of the project data. Three out of four of the persons who conduct the test must classify both the language capabilities and ease of use as acceptable.

2.1.2 User Tools

An assortment of user tools will be available to all IPAD users—managers, engineers and supporting staff. The tools will be available interactively and in batch mode. The number and types of tools made available will change as the needs of the IPAD user evolves. (See figure 2.1.2-1.)

IPAD will provide tools to enable the user to:

- edit and update stored data, computer programs and text documents;

- generate reports using information from the IPAD Information Bank;

- facilitate communication between IPAD users by providing utilities to build information menus, organization lists and mailing lists and enabling a user to transmit messages to other IPAD users;

- maintain and query references to IPAD documents and procedures;

- evaluate computing system performance;

- help the user when he requests assistance;

- debug computer programs; and

- construct command sequences

REV. B

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│  2.0  FULL IPAD REQUIREMENTS  │
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         │
         │
         │
    ┌────────────────────┐
    │         2.1        │
    │   USER INTERFACE   │
    ├────────────────────┤
    │ 2.1.1  USER LANGUAGE │
    │ 2.1.2  USER TOOLS    │
    │ 2.1.3  USER ACCESS   │
    └────────────────────┘
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14. UTILITY PROGRAMS
15. EDIT UTILITY
16. DOCUMENT UTILITY
17. REPORTING UTILITY
18. MENU BUILDING UTILITY
19. ORGANIZATION LIST UTILITY
20. MAIL LIST UTILITY
21. MESSAGE UTILITY
22. DOCUMENT REFERENCE UTILITY
23. PROGRAM PERFORMANCE MONITORING UTILITY
24. LEARNING UTILITY
25. ON-LINE INSTRUCTION UTILITY
26. USER ASSISTANCE UTILITY
27. USER INTERFACE DESCRIPTION UTILITY
28. PROGRAM DEBUGGING UTILITY
29. COMMAND SEQUENCE INTERPRETATION UTILITY
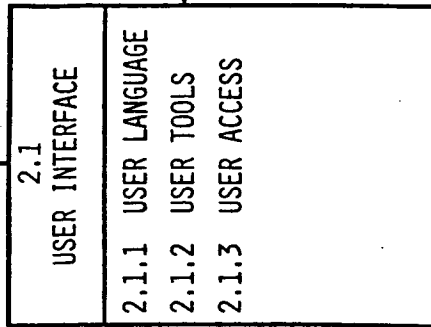
Figure 2.1.2-1   User Tool Requirements

REV.B

SOURCE   1.4/3.3, SOW/5.2.3

DESCRIPTION

Utilities must provide a machine independent interface and shall be accessible from both interactive and batch modes of operation. The set of IPAD utility functions must be open ended.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Utilities will be used in both batch and interactive modes to check their availability. The user will provide a new utility to check the open ended requirement. Both of these features will be checked with the same utility.

REV. B

SOURCE   SOW/5.2.3, 1.4/3.3.4, SOW/5.1.8

DESCRIPTION

General text editing and update capabilities shall be provided to perform the following functions:

a) The editor shall permit on-line development of programs or data by entering alphanumeric text from the interactive console.

b) The editor shall permit changes to source modules (SM) or data by adding, altering or deleting statements. A chronological record of changes shall be kept automatically at the user's option.

c) The editor should allow the user to selectively display part or all of the current data set as well as data identified by the editor in response to the current command.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The text editor will be checked by several users of the various skill levels. This can be accomplished in conjunction with other tests.

The capability will be checked by:

a) Entering alphanumeric text at the terminal;

b) Revision of the text (change, add, delete) at the terminal;

c) Display the current data or other data in the data set at the user's option; and

d) Maintain a chronological record of the changes made to the data (this option will be selected).

REV. B

These will be tested for accuracy, responsiveness and ease of operation.

REV. B

SOURCE   1.4/2.5.4, 1.4/2.7.4

DESCRIPTION

1PAD shall provide a complete capability to enter, maintain and print documents. The following features are minimum requirements:

1.   Source data entry online at terminal.

2.   Data available immediately arter input for review and update (additions, deletions, revisions).

3.   Support of rough drafts and finished documents with page headings, formatting, footnotes, page numbering and right-margin control.

4.   Automatic table of contents preparation through use of section and paragraph headings.

5.   Provision to create a document in subsections and combine the subsections to create the total document.

6.   Search for portion(s) of a document based on a search argument.

7.   Provision for operator developed dictionary to be used for automatic spelling check.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The document preparation and update capability will be tested by having expert operators develop, update and manipulate documents and by having novice operators use the on-line learning capability. The full range of facilities will be tested for correctness, and ease of use.

REV. B

SOURCE   SOW/5.2.3, SOW/5.1.4, 1.4/3.3.8, 1.4/2.5.4

DESCRIPTION

A report generation capability shall be provided for use in user requested, and automatic reporting. This shall include an English-like display language processor to be used by non-programmers to format visual displays, identify, save, and retrieve a standard report format both for on-line and batch use.

The report generation capability shall interface with the IPAD data retrieval capability and with utilities such as the arithmetic/logical operation utility (see requirement 95), unit transformation (see requirement 93), and other applicable utilities.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The Report Generation Utility will be tested by several users by creating a report and having it printed both on-line and batch. During testing, other utilities will be interfaced including data retrieval, arithmetic/logical operations and unit transformation. Testing will be for ease of operation and accuracy.

REV. B

REQUIREMENT   18 MENU BUILDING UTILITY

SOURCE   SOW/5.2.3, 1.4/3.3.5

DESCRIPTION

IPAD shall provide aids for building menus. Menus are
established during the planning and preparation phases and provide
lists of IPAD commands, computer programs, execution sequences,
data sets, etc. from which the user may select.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capability to allow users to build menus will be checked
by building menus that will be used for other aspects of the
acceptance tests. These menus must be easy to build and function
correctly in the other acceptance tests.

REV. B

SOURCE   1.4/3.3.18

DESCRIPTION

IPAD shall provide the means to produce Corporate Like Organizational Lists (COLIST). These lists shall consist of Group Names (GNAME), dependent group names (down to any level) and terminating with Individual Named (INAME) members of a group. Each individual member may have descriptors assigned such as, Supervisor, Social Security No., Security Classification, Mail Stop, Phone No., etc.

In addition to using COLIST for organizational display, it may also be used functionally. It shall be possible to use COLIST as a means of indicating the receivers of messages or creating a mailing list.

The use of any group name when using COLIST functionally implies that all the individuals in all the subordinate groups are included. At least the following list of functions shall apply to COLIST.

Given a GNAME or an INAME and a DESCRIPTOR NAME, IPAD shall be able to:

a)   Display the INAME and the assigned DESCRIPTOR value or list the INAMES (Defined by GNAME) and their assigned descriptor values. e.g., If DESCRIPTOR(S) = MAIL STOP ORGANIZATION NO., a mailing list will be produced for everyone in group GNAME.

b)   Compare the DESCRIPTOR value(s) assigned to INAMES with a list of similar descriptors assigned to data to establish a key-lock relationship.

This can be used for access permission to classified data when GNAME(S) and/ or INAME(S) are assigned to data to denote access authorization.

c)   Search and display the INAME(s) within the GNAME(s) which have any of the descriptor names assigned.

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REV. B

ABSTRACT OF THE ACCEPTANCE CRITERIA

The organization list capability will be tested by producing the Corporate Like Organizational Lists (CULISTS). The procedure will follow the description of this requirement and will test the security access relationship. Messages will be sent to insure proper functioning (see requirement 20). The test will be for ease of operation and accuracy.

REV. B

REQUIREMENT   20 MAILING LIST UTILITY

SOURCE   1.4/2.7

DESCRIPTION

   IPAD shall provide the means to construct mailing lists.
Such lists can be input directly by a user or constructed by IPAD
from recorded data such as those who have accessed a given data
set, own overdue data, used a specified IPAD utility belonging to
a given organization, etc.

ABSTRACT OF THE ACCEPTANCE CRITERIA

   The capability to allow the user to construct mailing lists
by direct input, system construction using recorded data and in
conjunction with the organization lists will be tested. Several
sources for mailing lists will be accessed, such as users of data
sets on record, owners of overdue data, etc. The tests will be
for ease of operation and accuracy.

REV. B

REQUIREMENT   21 MESSAGE UTILITY

SOURCE   1.4/2.7.2, 1.4/3.3.9, SOW/5.1.6

DESCRIPTION

There are two basic message types within IPAD.

1.   System to User messages

2.   User to User messages.

1.0   System to User Messages

There are two categories of system messages:

- Messages which originate with the operator or System Administrator

- Messages which are sent automatically and are triggered by certain user activity.

1.1   System Administrator Messages

These messages are assigned the following display priorities:

- "Authorized User" priority messages. This priority is available to the System Administrators and operators and any user who is authorized. These messages will be automatically displayed during the time IPAD is awaiting input from the recipient in CLP mode.

- "System Administrator/Operator" priority messages. These messages are automatically displayed during the time IPAD is awaiting input from the recipient in any user function or the CLP mode.

- System Administrator/Operator emergency messages. These messages display immediately, interrupting the recipient.

1.2   Messages Transmitted automatically

These messages are triggered by special user activity which impacts other users and informs them of a change in status. These messages are stored in the recipient's message file in the same manner as user to user messages described in Section 2.0.

2.0   User to User Messages

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2.1 Message Storage

Messages sent from one user to another are stored in the recipient's message file. There are no limitations on the size of this file.

2.2 "Messages Waiting" Notification

When a message is stored but not yet displayed, a prompt (or indicator) will display that messages are waiting. The prompt will become increasingly annoying as the number of waiting messages increases but not to the level that it will disrupt the continuity of work if the user elects to view his messages later.

2.3 Message Display and Save

When a user elects to display his messages he may save any or all of the displayed messages. Messages not saved are deleted at the termination of that session.

2.4 Message Read Confirmation

The "sending" user will be able to request automatic confirmation that his message has been displayed. An automatic confirmation message will be sent to him when the recipient has displayed the message.

2.5 Message Accumulation Control

The automatic printing and mailing of users messages after a specific time interval (installation parameter) will be the means of controlling the accumulation of unread user messages. After unread user messages have been printed a certain number of times (installation parameter) they will be deleted. IPAD will not archive user messages.

2.6 Message Priorities

IPAD will provide a user message priority scheme. IPAD will provide a fixed number of message priority categories and a using installation will be able to select its priority message categories as an installation parameter.

The message priority levels which IPAD will recognize include:

- Standard User Messages: as described in Section 2.2 with the constraint that the "messages waiting" prompt occurs only when the recipient is in the CLP mode.

- Priority User Messages: as described in Section 2.2 but the "messages waiting" prompt will be different from the

Standard User message prompt but occurs only when the recipient is in the CLP mode.

- Emergency User Messages: as described in Section 2.2 but the "messages waiting" prompt will be different from the Standard and Priority prompts and will be displayed when the recipient is in any user function.

ABSTRACT OF ACCEPTANCE CRITERIA

The message processing capability shall be checked by inputting the following message types to a specific user.

- from another user with varying message priorities

- from the system administrator with varying message priorities

- from the automatic system message capability resulting from user activity triggered messages.

REV. B

REQUIREMENT   22   DOCUMENT REFERENCE UTILITY

SOURCE   1.4/2.4.4

DESCRIPTION

IPAD shall provide the capability to create, update and query
(by keyword) references to documents on standard design and
processing procedures. These references must be identified and
accessible by revision date.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capability for the user to create, revise and access
lists of references to documents on standard design and processing
procedures will be tested. The procedure will be to create and
revise such lists and then access them by keywords and by revision
date. Ease of operation and accuracy will be tested.

REV. B

REQUIREMENT   23   PROGRAM PERFORMANCE MONITORING UTILITY

SOURCE   1.4/3.3.17

DESCRIPTION

For any IPAD application program, a facility shall be
available which can be used to evaluate the program performance.
This facility will monitor the execution of such a program and
identify computer resources that are used in selected subsets of
the program.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The application program performance facility will be tested
on at least two application programs with known program
performance. The results of the IPAD monitor will be compared
with the known results.

SOURCE   1.4/3.3.16

DESCRIPTION

IPAD shall support a computer based learning utility. This utility shall comprise the following:

a)   A language which permits an author to prepare, maintain and improve courseware;

b)   A means for the student to progress through the course material at a self controlled pace by means of branching and immediate error feedback;

c)   A means for a teacher to maintain appropriate surveillance of the community of users of a given course. The capability to control the use of this utility shall be provided. The mistakes which the learner makes while working the sample problems created to teach IPAD will be recorded. The content and format of the record will be installation selectable and will probably contain items such as: course, student, organization, date, question, and incorrect response. The format of this record shall be compatible with the IPAD query facility.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Computer based learning and monitoring of learning activities will be tested by developing and using a complete course package. The author will test the ability to enter material and make changes to it. Users of various levels of expertise will act as students to check the tutorial features of the utility. Finally a teacher of the course will check the capability to maintain surveillance over the students to analyze their progress. During the test, the provision to control access to the utility will be checked. The capabilities will be tested for correct functioning, completeness and ease of use.

REV. B

<u>REQUIREMENT</u>   25   ON-LINE INSTRUCTION UTILITY

<u>SOURCE</u>   1.4/2.2.2, 1.4/2.2.3, 1.4/2.2.1

<u>DESCRIPTION</u>

When the user is in the learning mode, he shall have a choice
of available options open to him. The user shall be able to
select from short texts, programmed learning and example problems
available on-line in IPAD.

<u>ABSTRACT OF THE ACCEPTANCE CRITERIA</u>

The tutorial aids will be tested by several users of various
skill levels at the terminal. The options of short texts
(describing IPAD features), programmed learning and example
problems will be utilized during the tests. A user opinion survey
will be conducted to insure the aids are responsive to the users
satisfaction and successfully teach IPAD.

REV. B

SOURCE   1.4/2.3.3

DESCRIPTION

For the novice user the IPAD System shall present a message at log-on asking if direction is needed. An affirmative response should result in the activation of user aids to provide an overview of IPAD capabilities.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A user designated as "NOVICE" will log-on to IPAD and reply that direction is required. The user aids will be evaluated for providing the user with effective instructions for using IPAD.

REV. B

REQUIREMENT   27 USER INTERFACE DESCRIPTION UTILITY

SOURCE   BCAC-NASA

DESCRIPTION

A utility will be provided for creating and interrogating
data sets of text that describe the user command interface to IPAD
and to selected user supplied modules and data.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The utility to create and interrogate user commands data sets
will be tested by several users by creating the text for some of
the commands during the acceptance testing and by interrogating
those and existing data sets. The user commands will include IPAD
and some user supplied modules. Testing will be for ease of
operation, responsiveness and accuracy.

REV. B

SOURCE   1.4/2.5.2, 1.4/3.3.17

DESCRIPTION

IPAD shall provide on-line debugging aids such as:

- The ability to stop the action and then proceed;

- The ability to execute stepwise;

- The ability to determine or change the value of any program variable in any subroutine while the action is stopped;

- The ability to query and update the information bank (e.g., values of elements) while the action is stopped.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The debugging aids will be tested by several users in conjunction with other acceptance tests while running programs on-line. The procedure will follow the steps outlined:

a)   Stop the action;

b)   Execute the program stepwise;

c)   Determine the value of any program variable;

d)   Update values of elements;

e)   Proceed with the program.

REV. B

SOURCE   SOW/5.2.2, 1.4/2.4.1.2

DESCRIPTION

IPAD shall provide means for automatic interpretation of sequences of operations to be performed using IPAD. The user shall have the ability to construct command sequence files either through the normal text editing features of the system or by requesting IPAD to save a sequence of commands from a work session. The command sequences shall be "macro-like" in the user's ability to allow for operand substitution by run time parameters. IPAD shall have the capability to interrupt a sequence to alert the user to unexpected conditions, e.g., input file not available, abnormal termination of a program, etc. IPAD shall have the capability to supply automatically the default intermediate requests to IPIP for retrieving or saving files to permit continuity of a user defined command sequence.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Command sequences will be created, executed and the results checked according to the following procedure.

a)   Create and execute command sequence data by saving user commands.

b)   Modify and execute command sequence data created in a).

c)   Create and execute command sequence data identical to a) by use of the text editor.

d)   Modify and execute command sequence data created in c) to make it identical to b).

Both parametric and non-parametric commands will be tested and must work correctly.

REV. B

2.1.3 User Access

This section presents the requirements that concern the user access in the areas of mode of access, priority of access, and user security and identification.

Specified under mode of access are the type of access of interactive (interactive batch, etc), the type of terminals, job interrupt, checkpoint/restart, and real time message capabilities.

Four different capabilities of user priority are recognized. The purpose of the different categories is to keep an adequate access and response time for the majority of the users.

Security is provided for the individual user by the use of password identification and user classification. (See figure 2.1.3-1.)

2.1.3.1 Mode

There are a variety of modes available to the IPAD user for interfacing with the IPAD system. He may interface via an interactive terminal, batch control cards or by initiating user programs that issue commands or calls for IPAD capabilities. Interactive work may be done either by textual or graphical terminals. Batch jobs may be submitted remotely via a satellite computer.

Batch or interactive jobs may be interrupted to review intermediate results or obtain help. Execution may then be resumed or aborted. Batch jobs may be submitted from interactive terminals.

A checkpoint/restart capability may be applied to any job running under IPAD. Parameters, for controlling when checkpoints are taken, will be controlled by the user.

The user may elect to have real time messages sent to all interactive terminals or to have data viewed by multiple terminals simultaneously.

REV. B

2.0 FULL IPAD REQUIREMENTS

2.1 USER INTERFACE

2.1.1 USER LANGUAGE
2.1.2 USER TOOLS
2.1.3 USER ACCESS

30. INTERACTIVE, BATCH, AND PROGRAM COMMANDS
31. INTERACTIVE TERMINALS
32. SATELLITE COMPUTER SUPPORT
33. INTERRUPT AND RESUME CAPABILITY
34. BATCH JOB PROCESSING
35. CHECKPOINT AND RESTART CAPABILITY
36. CONFERENCE VIEWING OF DATA
37. USER PRIORITIES
38. STANDARD LIMITING RESPONSE TIME
39. USER IDENTIFICATION
40. UNACCEPTABLE USER ID
41. PASSWORD PROTECTION
42. PASSWORD CONTROL
43. USER CLASSIFICATION DISPLAY
43.1 USER ABSENCE AND REASSIGNMENT CONTROL
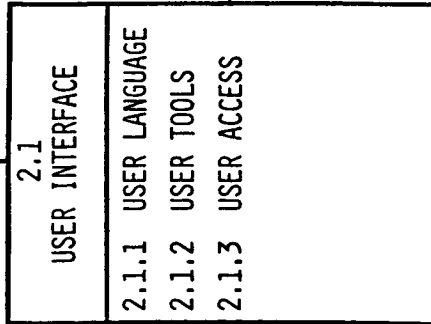
Figure 2.1.3-1   User Access Requirements

REV. B

SOURCE   SOW/5.2.2

DESCRIPTION

The user shall have the ability to communicate with IPAD
through interactive terminal commands, batch control cards, or
commands or calls from user programs in execution under IPAD
control. The format of the commands shall be compatible in these
three modes wherever possible.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A set of three tests will be used to evaluate the three modes
of IPAD communication for all IPAD commands. The commands must be
available and operational in all three modes of communication, and
will be evaluated for format compatibility between the three
modes:

a)   All IPAD commands will be tested using an interactive
     terminal;

b)   All IPAD commands will be tested using batch control
     cards (submitted over the counter and RJE);

c)   All IPAD commands will be tested using calls in programs
     executing under IPAD control.

REV. B

REQUIREMENT   31   INTERACTIVE TERMINALS

SOURCE   SOW/5.1.1, 1.3/3.3.6, 1.4/3.5.3

DESCRIPTION

IPAD shall accommodate interactive terminals as primary user
interface. Communication rates shall be limited only by hardware
factors unless stated as a part of the system design. The design
shall not preclude advances in terminal technology.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The ability of the IPAD system to facilitate textual and
graphic (storage and refreshed) interactive terminals as the
primary user interface will be tested for ease of use by systems
programmers while building software interfaces for the devices
listed in requirement 122.

Communication rates on these devices will also be tested to
ensure that the only limitations are due to hardware. If
limitations are discovered, the system design must so state.

REV. B

SOURCE   1.3/3.3.2

DESCRIPTION

IPAD jobs may be executed in whole or in part on a satellite computer (a remote system).   These jobs must be recognized and supported by the IPAD System.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Test the capability of IPAD to support a distributed computing network in the following tests:

Run jobs on the IPAD host which are executed in part on a satellite computer;

Run jobs on a satellite computer IPAD which are executed in part on the IPAD host.

REV. B

REQUIREMENT   33   INTERRUPT AND RESUME CAPABILITY

SOURCE   SOW/5.1.11, SOW/5.3.1, 1.4/2.1.3, 1.4/2.4.2

DESCRIPTION

The user must have the capability to interrupt his
interactive terminal session at any point for the following
reasons:

a)   Quit and cancel results of current session;

b)   Interrupt and resume at a later time;

c)   Interrupt execution and review results to that time;

d)   Interrupt execution and obtain HELP.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The interrupt, termination, and restart capabilities of IPAD
will be tested in an interactive terminal session. A special
sample of input data will be specified.   Tests should include:

1.   Quit and cancel results of current session.

a)   The user will interrupt and purge all data sets
     generated in the current work session.

b)   The user will interrupt and purge at least one data set
     generated in the current work session.

2.   Interrupt and resume at a later time.

3.   Interrupt execution and review results to that point.

4.   Interrupt execution and request HELP then restart execution.

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REV. B

SOURCE   SOW/5.1.12, SOW/5.3.1, 1.4/2.4.3, 1.4/2.5.3, 1.4/3.5.3,
           1.4/3.3.6, 1.3/3.3.6

DESCRIPTION

IPAD shall permit submittal of a computing job for batch
processing from an interactive terminal, or through normal batch
submittal. It shall be possible to monitor progress and to
interrupt a batch execution for the following reasons:

a)   Review intermediate results, and

b)   Abort the job.

When an interactive job is switched to batch processing, the
system will suspend the job when it is complete or when user input
is required. The user will be able to restart the job at the
point of suspension.

The user shall also have the capability to transfer a batch
job to interactive processing.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Tests of batch submittal in IPAD will be conducted to verify
the following:

- A batch job may be submitted from an interactive
  terminal;

- A batch job may be submitted using "over the counter" or
  RJE procedures;

- A batch job in execution may be transferred to
  interactive processing;

- A batch job in execution may be interrupted;

- A suspended batch job may be restarted at the point of
  suspension.

REV. B

The tests will include a mix of batch jobs, requiring data from various sources as defined in the sample test input data.

REV. B

SOURCE   BCAC-NASA

DESCRIPTION

A checkpoint/restart capability shall be available for jobs running under IPAD control. Checkpoints shall be user selectable in terms of elapsed time, resources consumed or events.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Test the checkpoint/restart capability for operational correctness in both batch and interactive modes. A special sample of test input data will be supplied. The capability to establish a checkpoint and to restart a job successfully from the specified checkpoint will be tested under each of the following conditions:

1.   A user established checkpoint based on elapsed time;

2.   A user established checkpoint based on computer resources consumed, including memory, number of data accesses, etc. for each resource parameter which may be controlled by users;

3.   A user established checkpoint based on a specific "event", for example, completion of a sequence of operations, or excessive use of a resource.

REV. B

REQUIREMENT   36 CONFERENCE VIEWING OF DATA

SOURCE   1.4/2.7.3

DESCRIPTION

IPAD shall provide the means for multiple or conference viewing of data. This requires concurrent display of data at more than one terminal. In addition, IPAD shall provide the means to send real time messages and to edit the data being viewed by all the members of the conference.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The following three "conference mode" capabilities of IPAD will be tested using two, five, and ten terminals:

The tests should verify that both alphanumeric and graphical data will display concurrently on all terminals in conference mode.

There will be a test to ensure that users at any terminal in conference mode are able to edit data. It must be verified that no two terminal users can simultaneously edit the data being viewed.

A test will verify that a message input from any terminal is displayed correctly on all terminals in conference mode.

REV. B

2.1.3.2 Priority

Four different categories of user priority will be recognized: standard, appointment, short duration, and emergency. The standard user's access time and turnaround time is dependent upon system load. The purpose of the appointment category is to give a user an opportunity, through the use of appointments, to run in a semiprivileged state. An appointment user has fast access to the system and cannot be put in a wait queue when the system gets overloaded. Short duration users are privileged in access and response time but limited in hook-up duration and restricted in activities. An emergency user has top priority over all other categories of users.

A quantity called the Standard Limiting Response Time (SLRT) will be used to insure that system response time for all users including the emergency, short duration and appointment use is always within the prescribed limits.

REV. B

REQUIREMENT   37 USER PRIORITIES

SOURCE   1.4/2.3.1

DESCRIPTION

The IPAD System shall recognize the following categories of
user:

- Emergency

- Short Duration

- Appointment

- Standard

The Emergency User shall be recognized by the IPAD System to
have the following capabilities:

a) He will have immediate access to the system.

b) The control procedures for obtaining an emergency
priority will be left to the IPAD system administrator.

c) He will have top priority over all other categories of
user during job execution.

d) He will be penalized with a premium charge.

The Short Duration (SD) user will be recognized by the system
to have the following capabilities and restrictions:

a) He shall be able to access the computer with a minimum
frustration from communication overload. The following
criteria shall apply: 95% of the SD users' attempts to
establish a communication link with IPAD shall be
successful within 10 seconds of completing the mechanics
of establishing communication, i.e., finish dialing.
The system design should consider the following
possibilities:

(1) Some hardwired terminals with direct communication
to IPAD; these terminals would be dedicated SD user
terminals; or

REV. B

(2)   If normal telephone lines are used some kind of hold device which will accept user calls and process them in the order received, but with sufficient lines to meet the 95%-10 seconds criteria specified above.

b)   The SD user shall be restricted to a fixed hook up duration.   This duration shall be adjustable to suit individual company needs.   The range should address 0-30 minutes if system design requires the range to be set.

The SD user shall be restricted in activity so that he may not perform functions which would affect the integrity of information in the information bank in the event that the time limit was reached before the user had completed his task (e.g., any kind of editing task).

c)   The system administrator shall be able to establish the functions available to an SD user.   For example:

(1)   Determine the status of things:

- System load (holding queue status)
- Check on job status or resources
- Review and query data in information bank

(2)   Make, change or cancel an appointment

(3)   Receive and send messages

(4)   Abort a batch job

d)   In the event that the SD user reaches his time limit he shall be unconditionally logged off.

The Appointment user shall be recognized by the IPAD System to have the following capabilities and restrictions.

a)   The Appointment user is defined as a user who has requested and been granted, by the IPAD System, a specified work period or periods in IPAD for a defined date.

b)   The IPAD System shall be designed to recognize a daily cycle of appointments.   The cycle shall consist of an appointment starting time (S) and a given number of appointment periods (N) each having a duration time of T minutes, where S, N and T may be selected by the company using the system and should have the following range of values, $0 \le S \le 1440$ minutes, $3 \le N \le 288$, and $5 \le T$ minutes ≤ 480 (where T is in increments of 5 minutes). The condition that $T*N \ge (1440-S)$ must also be satisfied.

REV. B

c) The system shall be designed so that a company can remove the appointment capability if it so desires.

d) The IPAD System shall be designed to limit the number of users who can make appointments in an appointment period.

e) A user may make appointments for himself or others from the COMMAND mode. When making or changing an appointment the user may enter the date for which he requires the appointment and the system will display to him the appointment periods (in hours and minutes) still available to him. He then selects an appointment period.

f) Each IPAD user (as defined by the permission codes) shall be limited in the number of appointment periods he may use in any four week period. The number of appointment periods and the specific four week cycle dates are flexible and may be selected to suit individual company requirements.

g) A user can request an appointment up to D days ahead of the appointment date and may change or cancel that appointment up to H hours ahead of the appointment time without forfeit of his allotted appointment periods. Where $0 \leq D \leq 28$ and $0 \leq H \leq 48$ may be selected by the using company.

h) An appointment user must use his appointment during the time the appointment period is in force or his appointment will be dropped from the system and he will forfeit his allotted appointment period.

i) An appointment user is not restricted in the manner in which he elects to make his allotted appointment periods. He may make them singly or any number in series up to the maximum allowed. He must designate the number of periods he requires when he makes his appointment.

j) The appointment user shall be able to access the computer subject to the following criteria.

95% of the attempts to communicate with IPAD by an appointment user shall be successful within 10 seconds of dialing. The system design should consider the following possibilities:

(1) Some hardwired terminals with direct communication to IPAD. These terminals would be dedicated (appointment user terminals).

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(2) If normal telephone lines are used the system shall be designed to reserve sufficient lines during each appointment period to accommodate the number of appointment reservations.

k) If the appointment user has not completed his task by the end of the requested appointment period(s) the system will take the following steps.

(1) The system will enforce a normal INTERRUPT.

(2) The system will check and list the appointment periods available for the rest of that day and inform the user. The user may then elect to:

• Take a new appointment, and if it runs concurrently, continue with his work.

• If he has a job in execution he may transfer to a batch job.

• Request standard user category if resources are available.

• Log-off the system.

The Standard user shall be recognized by the IPAD System to have the following capabilities and restrictions.

a) The Standard user has no special privileges. If all the communication lines are occupied he has no recourse but to keep dialing. He can check on the system load through SD capability and decide on his next course of action.

b) In the event of system overload he will be unable to commence his task even though he is able to communicate with the system. He will be held in a waiting queue until the system response level permits him to use the system.

c) During the period in which a Standard user is held in the waiting queue he will be informed on a regular basis of his position in the queue and will be able to make an appointment or log-off.

ABSTRACT OF THE ACCEPTANCE CRITERIA

REV. B

The IPAD user categories -- access considerations will be tested with the procedures summarized below:

General

A user in each of the four categories will attempt to access IPAD. The results and the IPAD responses will be compared to verify that IPAD recognizes the four categories of user. A user opinion survey will evaluate IPAD access for each category.

Emergency Users

The emergency user's access to IPAD should be tested and evaluated:

- Verify that the emergency user has "immediate" access to the system.

- Check the accounting for the session to demonstrate that the emergency user pays a premium charge.

- Test that the system administrator can assign emergency status.

- Compare a mix of jobs from different user categories to verify that the emergency job has priority.

Short Duration

The Short Duration user's access to IPAD should be tested and evaluated:

- 1,000 attempts to access IPAD as a short duration user should be made. At least 950 attempts must be successful within 10 seconds after completing the mechanics of establishing communication.

- An SD user should exceed his duration to verify that he will be unconditionally logged off.

- Check that the short duration parameter may be varied by company installation. Test several different values, including the range boundaries of 0. and 30. Also, test invalid values.

- An SD user should attempt to edit and update datasets, to execute a job, and to perform other functions which might affect the information bank. These operations should not be allowed.

- Verify that the SD user is able to perform the functions specified for him in this requirement.

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REV. B

- Test that the system administrator is able to establish or restrict the functions available to the SD user.

Appointment Users

The appointment user's access to IPAD should be tested and evaluated:

- Several appointments should be made for defined dates. It should be verified that this user is able to access IPAD during these appointments, and that other users are not able to use these appointments.

- Check that all appointment parameters specified in this requirement may be set or modified by each company. Verify that these parameters must satisfy conditions in the requirements.

- Test the IPAD access scheme without the optional appointment capability.

- Specify a limit of 5 users for each appointment period, and verify that the sixth user will be unsuccessful in making an appointment.

- Users should test the following:

  a) Change the time and/or date of an appointment.

  b) Cancel an appointment.

  c) Make appointments for other users.

  d) Change/cancel appointments for other users.

  e) Specify date and select appointments from displayed choices.

- Specify a "company" limit of 20 appointments per user for a four week period, and verify that a user cannot exceed this number.

- Verify that a user can cancel or change an appointment if the number of hours notice limitation is met.

- Verify that a user forfeits his appointment if he attempts to change or cancel it after the "H" limit is passed.

- Check that the user cannot make an appointment insufficiently far in advance.

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REV. B

- A user should make an appointment and fail to keep it without cancelling. The appointment should be dropped from the system.

- 500 attempts snould be made to access IPAD with an appointment. Of these, at least 475 attempts should be successful to meet the 95% requirement.

- Continue to use IPAD beyond the allocated appointment time to evaluate the options under IPAD. Test the following:

  a. With a light appointment load, verify that the user may make an immediate appointment and continue his work.

  b. With a "capacity" appointment load, the user's attempt to make an immediate appointment should fail.

  c. Make an appointment for later in the day.

  d. When a user's job is executing at the time his appointment runs out, transfer the job to a batch job.

  e. When sufficient resources are available to permit standard users, verify that the user can continue as a "standard" user.

  f. When sufficient resources are not available to permit standard users, verify that the user cannot continue as a standard user. Check that the user can log off.

Standard Users

The standard user's access to IPAD shall be tested and evaluated:

- Verify that the standard user has no special privileges and that in a competition for resources, other users have priority over the standard user.

- In a test to simulate system overload, verify that the standard user can communicate with IPAD as he is held in a wait queue. Verify that the user is informed of queue position and that he can make an appointment or log off.

  Verify that the standard user can use IPAD once the system load is reduced.

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SOURCE   1.4/2.3.1, 1.3/3.3.5.3

DESCRIPTION

The system shall recognize a quantity called STANDARD
LIMITING RESPONSE TIME (SLRT). The value and means for computing
the value of SLRT shall be variable and controlled by each
individual company using the system.

The system shall compute the actual response time (ART) based
on installation parameters and take the following action:

a)   If ART > SLRT the system will block Standard users from
       performing their task in IPAD and place them in a
       waiting queue.

b)   If ART ≤ SLRT the system will not block Standard users
       from performing their tasks in IPAD and will process
       users in order from the waiting queue. If the queue is
       vacant, Standard users may be processed directly.

Privileged users (Emergency, Short Duration and Appointment)
are not affected by SLRT and will be permitted to access the
system without constraint.

The SLRT shall apply to only the interactive user and shall
have no effect on IPAD jobs that are submitted for batch
processing.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The Standard Limiting Response Time (SLRT) will be tested by
defining parameters for measuring response time and loading the
system so that ART > SLRT. A check will be made that standard
users are blocked from performing their task and are placed in a
wait queue. There will be users of the other category to insure
they are not affected by ART and SLRT.

REV. B

2.1.3.3 User Security and Identification

IPAD must provide security for individual users. This protection will be provided by employing user passwords. These passwords must provide unique identification, must be protected from discovery and must be easy to use and modify.

Access to IPAD data will be controlled by user classification. Data manipulation will likewise be controlled. User classifications will be available upon request.

REV. B

SOURCE   1.4/2.3.2

DESCRIPTION

The IPAD system shall determine the authority of a user to access IPAD through the use of an identification sequence which shall include user identification, password, security classification, and project identification.

Identification in this context establishes user personal identification and the discipline or group to which the user is assigned. A password or other means of verification is required to protect the person being identified from impersonation.

ABSTRACT OF THE ACCEPTANCE CRITERIA

User access to IPAD will be tested to identify satisfactory operation for both interactive and batch modes. Tests will include both valid and invalid user identification. User access to IPAD will be tested for user acceptance. Users with various levels of computing skills will access the IPAD system and remote IPAD system and will input unique ID and applicable user ID verification. A user survey will be conducted for ease of use and adequacy.

REV. B

REQUIREMENT   40   UNACCEPTABLE USER IDENTIFICATION

SOURCE   1.4/2.3.2

DESCRIPTION

The system shall recognize unacceptable identification and indicate to the user the source of the inaccuracy and subsequently permit him to re-enter the identification data. After x such attempts (where x is an installation parameter) without successful acceptance of the identification data, the user will be terminated from IPAD after being forewarned prior to the last attempt. Any termination immediately following an unsuccessful access attempt shall be recorded and made available to the system administrator.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Users will attempt to log on with improper user IDs and passwords. A check will be made that users are allowed 3 attempts; that users are forewarned after two attempts and that records of unsuccessful access attempts are only available to the system administrator.

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REV. B

REQUIREMENT   41   PASSWORD PROTECTION

SOURCE   1.4/2.3.2

DESCRIPTION

The password shall be protected from discovery as a result of its normal use.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Checks will be made to insure the password will not be disclosed through its normal use. These will include a check to make sure the password is not displayed on the terminal or on batch printout. A check will also be made to insure that a non-authorized user cannot access any records of user passwords.

REV. B

REQUIREMENT   42   PASSWORD CONTROL

SOURCE   1.4/2.3.2

DESCRIPTION

The establishment and subsequent changes to the password shall be accomplished with a minimum of user inconvenience. Changes may be accomplished by the user.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Check the IPAD capability to assign and change user passwords. A password will be defined for a set of typical users. Each of these users will change their assigned password a minimum of 5 times while testing other features of IPAD. Attempts will be made to illegally access password data.

REV. B

REQUIREMENT   43   USER CLASSIFICATION DISPLAY

SOURCE   1.4/2.5.4,   1.4/2.5.2

DESCRIPTION

The IPAD System shall provide the user on request with a display of his classifications for accessing and manipulating data.

ABSTRACT OF THE ACCEPTANCE CRITERIA

For various users with a distribution of authorized functions and data access classifications, a check will be made to insure correct reporting of these classifications. A check will also be made to insure that users may use authorized functions and data accesses while they are prevented from unauthorized activity. Tests will be for correctness and useability.

REV. B

REQUIREMENT   43.1   USER ABSENCE AND REASSIGNMENT CONTROL

SOURCE   6.3.8

DESCRIPTION

It shall be possible to convey to IPAD that a user will be absent from active participation on the system as follows:

a)   User initiated--between defined dates (vacation, trips)

b)   Management initiated--after a specified date, for an indefinite period, for any reason (transfer, termination, etc.). The manager who will reallocate the work shall be identified.

Notification of absence a) above, shall result in protection of the user's working area including automatic deletion capabilitites such as deletion of messages not read within an allowed time. Messages will be accepted during this period and sending users will be notified of the intended recipient's absence.

The time period allowed between the starting and finishing date for category a) is a system parameter.

Notification of absence b) to the system results in offline warning messages being sent to the manager responsible for the absent user's work. The message will remind the manager of the user's termination date and will list the tasks, subtasks, suspended jobs, data sets and programs for which the terminating user is responsible in order that the manager may reassign them. The messages will be sent periodically until everything has been reassigned.

Users who have accessed data or programs owned by the replaced user will receive automatic messages informing them of the change in data ownership.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capability of IPAD to track the absence of users and make appropriate notification of the absence will be tested by simulating a series of absences.

REV. B

2.2 DESIGN SUPPORT AND CONTROLS

A design process is a complex network of engineering, computational and management activities. IPAD will support the planning, defining, modifying and reporting of the design process. Management monitoring of projects will also be supported.

2.2.1 Design Process Support

IPAD will support engineering and management in planning, defining, modifying, controlling and integrating engineering technical processes. Support provided includes the building and saving of job sequences, the execution and monitoring of jobs, process reporting and data release control to inform users of data status. Information to be shared by more than one organization shall be under release control. (See figure 2.2.1-1.)

2.2.1.1 Definition

The ability to plan, define and modify an integrated engineering technical process shall be supported by IPAD. The design process shall serve as the basis for data identification, control of information flow, etc. The processes in turn will be associated with a specific design project.

The building block of a process shall be a job. A job will involve user input data, execution of user computer programs or IPAD utilities and a choice of outputs. A job may be processed in batch, interactive or mixed mode. Data flow occurs between and within jobs.

Jobs may be grouped into hierarchial levels. The highest grouping is defined as a process. The number and designation of these levels is defined by the user. IPAD shall be able to recognize an unlimited number of processes.

REV. B

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┌──────────────────────────┐
│  2.0  FULL IPAD REQUIREMENTS │
└──────────────────────────┘
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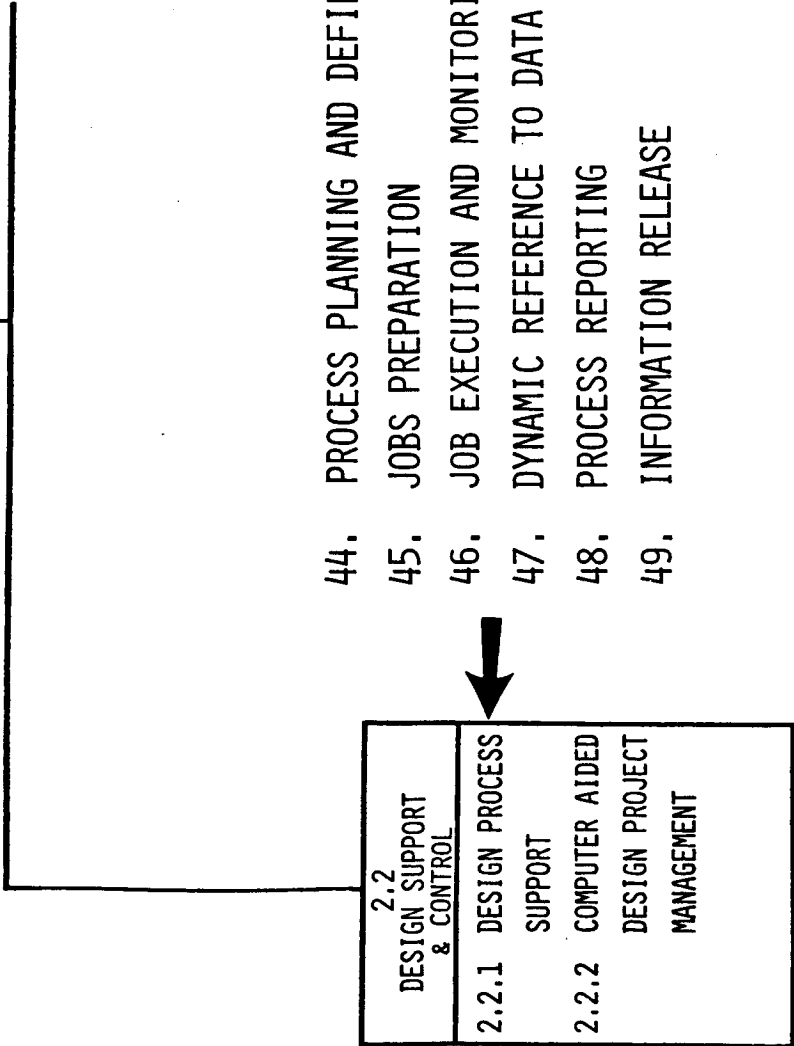
┌─────────────────────────────┐
│ 2.2   │
│ DESIGN SUPPORT   │
│ & CONTROL   │
│   │
│ 2.2.1 DESIGN PROCESS   │
│   SUPPORT   │
│ 2.2.2 COMPUTER AIDED   │
│   DESIGN PROJECT   │
│   MANAGEMENT   │
└─────────────────────────────┘

44. PROCESS PLANNING AND DEFINITION

45. JOBS PREPARATION

46. JOB EXECUTION AND MONITORING

47. DYNAMIC REFERENCE TO DATA

48. PROCESS REPORTING

49. INFORMATION RELEASE

Figure 2.2.1-1   Design Process Support Requirements

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SOURCE   1.3/3.3.1, 1.3/3.3.6, 1.3/3.3.2, 1.3/3.3

DESCRIPTION

The capability to plan, define and modify an integrated engineering technical process such as the reference design process described in D6-IPAD-70010-D and its associated data interfaces as described by the data flow model in section 2.0 of D6-IPAD-70012-D shall be supported by IPAD. The information contained in such a process definition shall be used by IPAD for data identification, control of information flow and activities, etc., when such a process has been made part of a specific design project.

The building block of a process shall be a job. A job may involve user input of data, execution of one or more computer programs as well as execution of one or more IPAD utilities or system functions. A job may be processed in a batch, interactive or mixed mode. Data flow occurs between and within jobs.

Jobs may be grouped and such groups of jobs grouped further in an hierarchical fashion to any level. The highest group is defined as the process. The number of levels in this hierarchy and the designation of these levels shall be definable by the user.

IPAD shall be able to recognize an unlimited number of processes.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The process planning and definition capabilities of IPAD will be tested for adequacy and ease of use by defining to IPAD a subset of one or more levels of the reference design process including the data flow. A test should verify that the data flow model shall result in an accurate data transfer between two jobs or between a job and the information bank.

The capability to identify changes to the process and data flow definitions will be tested to verify that IPAD will distinguish between each process or data flow version.

REV. B

An arbitrary number of processes and data flows will be defined until hardware capacity is reached and then tested in a simulated production environment. Accuracy must not be affected by the quantity of defined processes.

REV. B

2.2.1.2 Preparation of Jobs

IPAD will support the building and saving of job sequences.
In connection with job sequences, IPAD will provide the means for
collecting data, preparing and verifying input, and setting up and
checking data flow between programs.

REV. B

<u>REQUIREMENT</u>   45 JOBS PREPARATION

<u>SOURCE</u>   SOW/5.1.9, 1.4/2.5.2, 1.3/5.1.3

<u>DESCRIPTION</u>

IPAD snall provide means for preparing for a job or a group
ot jobs:

This involves:

    a)   Collecting computer programs;

    b)   Assembling programs into a job sequence;

    c)   Setting up and checking consistent and compatible data
        flow among the programs in the job sequence;

    d)   Collecting data;

    e)   Preparing and verifying input;

    f)   Storing job sequence for future use.

These sequences may be defined in terms of previously defined
sequences.

<u>ABSTRACT OF THE ACCEPTANCE CRITERIA</u>

All the IPAD system aids described in this requirement for
preparing jobs or groups of jobs will be tested by several users
to determine if they are operationally correct. The tests will
include defining job sequences in terms ot previously defined job
sequences. A user survey will evaluate these aids for ease of
operation, accuracy, and efficiency.

REV. B

2.2.1.3 Execution and Monitoring of Jobs

The system shall provide the means to assist a user in running a job or sequence of jobs within IPAD. Computer program reference to data sets, input and output, is controlled by the user and may be specified by the user on a computer program at execution time. Information to identify these data sets may be supplied by the user or by a computer program.

REV. B

REQUIREMENT   46   JOB EXECUTION AND MONITORING

SOURCE   1.4/2.5.3

DESCRIPTION

The system shall provide the means to assist a user in running a job. In this context, a job may involve more than one computer program linked in sequence. The following activities are examples of activities which shall be available while running a job:

- Reviewing selected intermediate results

- Reviewing selected final results

ABSTRACT OF THE ACCEPTANCE CRITERIA

Several users will test the IPAD system capabilities to assist a user in running a job, including:

a)   Reviewing selected intermediate results;

b)   Reviewing selected final results;

A user survey will evaluate these capabilities based on operational correctness and ease of use.

REV. B

REQUIREMENT   47   DYNAMIC REFERENCE TO DATA

SOURCE   1.3/4.5.2

DESCRIPTION

IPAD shall permit computer programs to reference data sets in specific data areas with the user identifying the input and output data sets to the job or group of jobs at execution time. These data sets may be identified by information supplied either by the user or the program.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capability to dynamically reference input and output data sets at execution time will be tested by several users concurrently. The tests will include data set identification supplied by both the user and user programs. The capability will be evaluated for ease of use and accuracy.

REV. B

2.2.1.4 Reporting

Design process reports shall be available either through routine reporting or upon specific request. These reports may relate information about the design process model, data flow or technical status of data.

REV. B

REQUIREMENT   48   PROCESS REPORTS

SOURCE   BCAC-NASA

DESCRIPTION

IPAD shall provide for design process reports. These reports
include a display of the design process model or parts thereof
including data flow as well as technical status of the data. It
shall be possible to define these reports as part of the process
itself but they shall also be available to the user at his
specific request.

ABSTRACT OF THE ACCEPTANCE CRITERIA

This test will be in two parts. First the ability of IPAD to
display in graphical form the design process definitions will be
tested by defining a multi-level fairly complex design process and
displaying all and selected parts of the model.

Secondly, a test will be made of IPAD's ability to report in
graphical or textual form on status of data when the process has
been made part of a project. Two design processes will be defined
and made part of a project. Simulated progress will be created.
Automatic, user requested, problem, and technical status reports
will be evaluated for correctness.

REV. B

2.2.1.5 Control of Information

Information to be shared by more than one job or by more than one organization shall be under release control. Jobs may use non-released data for generating preliminary results, but resultant data based on non-released information shall be non-releasable unless the data is approved by the system administrator.

REV. B

The intent of this requirement is covered by the revised requirement 81.

REV. B

2.2.2 Computer Aided Design Project Management

IPAD will support managers in planning, monitoring and reporting Design Projects. Management computer programs will be made available for analyzing technical and management information. An individual IPAD user will be able to assess the status of his own subtask, data, task or the overall project status. In response to IPAD monitoring and reporting, controls may be exerted to limit, terminate or suspend activities. (See figure 2.2.2-1.)

2.2.2.1 Planning

IPAD will support management planning of design project by assisting a manager in identifying tasks and subtasks, in scheduling manpower and resource assignment and in relating the dependency between tasks. IPAD shall support management computer programs and in the retrieval and display of project technical and management information.

REV. B

2.0 FULL IPAD REQUIREMENTS

2.2
DESIGN SUPPORT
& CONTROL
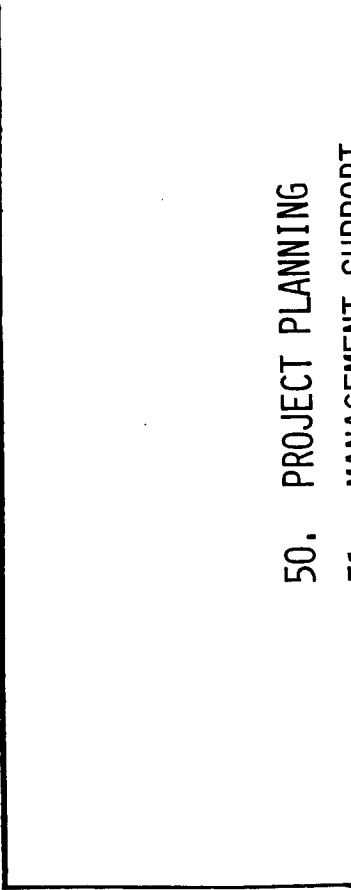
2.2.1 DESIGN PROCESS
SUPPORT

2.2.2 COMPUTER AIDED
DESIGN PROJECT
MANAGEMENT

50. PROJECT PLANNING

51. MANAGEMENT SUPPORT

52. RESOURCE REPORTS

53. SUBTASK MONITORING

54. SUBTASK MODIFICATION

55. PROJECT RESOURCE MONITORING

56. PROJECT SCHEDULE MONITORING AND CONTROL

57. OPTIONAL AUTOMATIC REPORTING

57.1 APPLICATION PROGRAM CERTIFICATION

57.2 USER ACTIVITY CHECKLIST

Figure 2.2.2-1   Computer-Aided Design Project Management

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REV. B

REQUIREMENT   50   PROJECT PLANNING

SOURCE   1.4/2.5.1, 1.4/2.5.4, 1.3/3.3.3

DESCRIPTION

IPAD shall provide the means whereby managers can plan a
design project using one or more design processes.

"Plan" in this sense includes grouping of jobs or groups of
jobs into subtasks and subtasks into tasks as well as scheduling,
manpower and computer resources assignment to these tasks and
subtasks. The technical dependency of tasks to each other is
indicated in the design process. To this end the following
requirements apply:

- The planner shall be able to define tasks and subtasks
  from the selected process(es)

- The planner shall be able to schedule, by project, tasks
  and subtasks and assign names and commit schedule dates
  to them.

- The system will provide the means to name subtasks and
  tasks by project to address various levels of planning
  and enable the planner to assign task and subtask
  dependency.

- The means to assign manpower and computer resource
  constraints to named tasks and subtasks shall be
  available.

- Review of information on scheduling, manpower and
  computer resources shall be available at the terminal or
  off-line by display or hardcopy. The input shall
  consist of project task or subtask name and a selection
  of any combination of schedule, manpower, computer
  resources and dependency. The means to select bar chart
  or tabular display of information shall be available.

- Bar chart display will have available a standard set of
  symbols to denote key activities. The set of symbols
  shall be open ended and will have the purpose of
  denoting such activities as:

  Start/Complete Project

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REV. B

Complete Key Tasks
Decision Milestone
Begin Milestone
End Milestone

ABSTRACT OF THE ACCEPTANCE CRITERIA

The project planning capability of the IPAD system will be
tested by developing a design project with all the attributes
cited in this requirement. The procedure will basically follow
these steps:

a) Define tasks and subtasks;

b) Schedule the tasks and subtasks;

c) Assign manpower and computer resources to tasks and
subtasks;

d) Display scheduling, manpower and computer resources at
the terminal or off-line selecting bar chart or tabular
displays;

e) Use a standard set of symbols for bar chart display.

REV. B

SOURCE   1.3/3.3.4, 1.3/3.3.5, 1.4/3.3.6, SOW/5.1.14

DESCRIPTION

IPAD shall support management in storage and utilization of management computer programs such as critical path determination or cumulative cost distribution, and IPAD shall facilitate retrieval and display of project technical and management information for reviews of task assignments, work progress, schedules, and resources expended and available.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The ability of the IPAD System to store and utilize management computer programs will be tested by running a computer program such as critical path determination or cumulative cost distribution. The IPAD System must facilitate the execution of the program and the retrieval and display of management information from the program.

2.2.2.2 Monitoring Control and Reporting

Several levels of monitoring and reporting are available within IPAD. This capability may be used by the IPAD user to assess the status of his own subtasks, to assess the status of data, tasks or subtasks within a project or to assess the overall status of a project. This capability may be used to monitor resources used versus resources planned or budgeted. In response to IPAD reporting, controls may be exerted to limit, terminate or suspend activities. Reports may be generated on a routine basis or by specific request.

REV. B

REQUIREMENT   52   RESOURCE REPORTS

SOURCE   1.4/2.9.4, 1.4/2.5.4, 1.3/3.3.5.2

DESCRIPTION

At anytime in the command mode a user shall be able to request a report on resources, both computer and manpower by entering a suitable command such as RESOURCES, p. In addition, when a user requests EXIT an automatic short report of total CU's for session will be generated prior to log-off. (See requirement 10.) EXIT, R will present report type 1 described below.

There are two types of reports required:

Type 1   Computing resources used during the current session and the budget/used/remaining for each subtask worked on.

Type 2   Cumulative summation of both computing resources and manpower (extracted from the payroll accounting system). Reporting basis shall include:

a.   Organization

b.   Program Item Number

c.   Person

d.   Project

Reporting period shall include:

a.   Latest Week

b.   Latest Month

c.   Year to Date

d.   Project Start to Date

e.   Any arbitrary period based on specified start and ending dates

The two types of reports are discussed in more detail in the following sections.

REV. B

Report Type 1, Work done during current session:

User in session report consists of a work item oriented report relative to the work done during the current session at the terminal. Only computer resources are required.

Figure 2.2.2.2-1 gives an example of the type 1 automatic report on resources used following the "EXIT, R" or "RESOURCES" command.

Report Type 2, Summation Based Reports:

Summation based reports consist of both manpower and computer resources relative to individuals and groups of individuals defined by a project manpower oganization. Figure 2.2.2.2-2 gives an example of the type 2 automatic report following the "RESOURCES, S" command. The following describes source of data for the reporting basis.

The manpower organization will be defined to IPAD through the "COLIST" capability (see requirement 19).

The work item organization will be defined to IPAD through a WBS (Work Breakdown Structure) which may be done using "COLIST" and will also be used to define the type of report needed.

Work Item based reports consist of resources, both manpower and computer resources, relative to tasks and subtasks within a given project.

Work item based on an individual's name for a specific assignment or total assignments.

REV. B

Input

        Command=Resources or Exit, R

Output

CURRENT SESSION RESOURCES REPORT

Work Done by: _____Time _____Date _____

WORK DONE				COMPUTER	TOTAL COMPUTER RESOURCES		
PROJECT	SUB TASK	JOB	STATUS	RESOURCES USED THIS SESSION CU'S $	USED TO DATE CU'S $	BUDGETED CU'S $	REMAINING CU'S $
PR1			IN-WORK				
	ST11		IN-WORK				
		J111	IN-WORK				
		J112	INTER.				
PR2			IN-WORK				
	ST21		COMP.				
		J211	COMP.				
	TOTAL						

Figure 2.2.2.2-1, Current Session Resources Report

Input
  Command = Resources P_1, P_2, P_3, P_4, P_5 P_3 = Level of Detail

    P_1 = S (Summary Report)   1
                                                                2
                                                                3
    P_2 = Reporting Basis   4

        1 - Organization (Colist No.) P_4 = Reporting Period
        2 - Program Item Number
        3 - Person   1 - Latest Week
        4 - Project   2 - Latest Month
                                                 3 - Year to Date
Output   4 - Project Start to Date
                                                 5 - Arbitrary Period
        Resources Reporting Basis_____   Start Date
                                                       End Date
        Time Period_____to _____

        Request by_____

Level of Detail	Item	Units	RESOURCES		
			Used	Budgetted	Remaining
AAAA (Level 4 Subtotal)	Manpower	M/Hrs $	————	————	————
	Computing	CU's $			
	Total	$			
AAAB (Level 4 Subtotal)	Manpower	M/Hrs $	————	————	————
	Computing	CU's $			
	Total	$			
AAA (Level 3 Subtotal)	Manpower	M/Hrs $	————	————	————
	Computing	CU's $			
	Total	$			
AAB (Level 3 Subtotal)	Manpower	M/Hrs $	————	————	————
	Computing	CU's $			
	Total	$			
AA (Level 2 Subtotal)	Manpower	M/Hrs S	————	————	————
	Computing	CU's $			
	Total	$			
A (Level 1 Total)	Manpower	M/Hrs $	————	————	————
	Computing	CU's $			
	Total	$			

Figure 2.2.2.2-2 Summation Resources Report

REV. B

ABSTRACT OF THE ACCEPTANCE CRITERIA

During IPAD system testing, reports will be requested on
individual computer resources account for current status during
terminal sessions. These will include all the overall accounting
level reports defined in the requirement. In addition periodic
reports will be requested and compared to the individual reports.
The status of accounts will be checked independently of terminal
sessions.

REV. B

REQUIREMENT   53 SUBTASK MONITORING

SOURCE   1.3/3.3.6

DESCRIPTION

IPAD shall provide the capability to monitor subtask status
or subtasks which have been suspended. Status needs include
schedule, number and status of suspended and active jobs, and
resource information.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The subtask monitoring capability will be tested in
conjunction with Req. 55 "Budget Status" and Req. 54 "Revised Task
Status". Several subtasks in various stages of activity will be
suspended and reports requested. IPAD should accurately supply
the following:

a)   Job Status

   • Jobs completed prior to suspension and resources
     used for each batch step.

   • Jobs in progress at the time of suspension,
     resources for job steps completed.

   • Cause or source of suspension.

b)   Subtask resource reporting

   • Schedule constraints

   • Data Sets Created

   • Budget/Actual/Remaining

REV. B

REQUIREMENT   54   SUBTASK MODIFICATIONS

SOURCE   1.3/3.3.5.2, 1.4/2.9.1.1, 1.4/3.3.7

DESCRIPTION

IPAD shall provide facilities to perform the following functions:

a)   Input current status of tasks in progress;

b)   Add, delete or alter tasks and subtasks at any time during working phases of the task;

c)   Stop a task in progress to be resumed at some time in the future without loss of work continuity. This may be accomplished by closing off resources for the task and issuing a message.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The project reporting capability for task and subtask status will be tested in conjunction with requirement 55 "Budget Status Report" and requirement 53 "Subtask Monitoring". A project with a series of subtasks will be set up and run. The ability to input current status of tasks, add, delete or alter tasks or subtasks during working phases of the task will be tested and checked by requesting reports. A task will be stopped by closing off resources. An appropriate message should be issued. At a later date the task will be restarted.

REV. B

SOURCE   1.3/3.3.5.2, 1.3/3.3.5.1

DESCRIPTION

IPAD must produce a report that compares project resources used to those budgeted. The report will identify subtasks and collect accounting information for each specified category, such as program item number (PIN), which relates to Work Breakdown Structure (WBS). IPAD will monitor resources and report all uses of unplanned resources. Resources consumed by each job will be the responsibility of the user, who will also establish the appropriate time and resource limits. When the limits are exceeded, any currently running jobs will be completed and the system will suspend the subtask, which will be held for review by the user. At the appropriate manager's discretion, the subtask will be able to restart from the point of suspension.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A WBS structure with associated PINs will be created. Several subtasks will be created and run to various stages of completion. Accounting information reports will be requested by subtask, PIN and job. A subtask will use unplanned resources to check IPAD's ability to report this use. Low resource limits will be set on a job to check subtask suspension. (See requirement 107-Subtask Monitoring.) Subtask restart will be attempted with and without the appropriate manager, permission. IPAD must perform correctly throughout these tests,and the reports will be checked for ease of use as well.

REV. B

REQUIREMENT   56   PROJECT SCHEDULE MONITORING AND CONTROL

SOURCE   1.3/3.3.4.2, 1.4/2.9.1.11, 1.3/3.3.3.3

DESCRIPTION

Projects may be placed under optional schedule control. IPAD would monitor project planning data and provide reports of status and impending problems. For example, IPAD would provide the capability to limit job execution when a job is part of a subtask not yet scheduled or or one that has already been completed. IPAD could also monitor project data set occurrences to determine if a project milestone has been met. When a milestone is missed, IPAD will report the exception to each affected organization.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Schedule monitoring and the ability of the system to control schedules will be tested in conjunction with the sample project plan developed for requirement 50, ACT 1. Using the optional schedule control, IPAD will:

a)   Report status and impending problems;

b)   When a milestone is missed, analyze impact and print report, which is to be distributed to each affected organization;

c)   Stop job execution if subtask has not been scheduled or has been completed.

REV. B

SOURCE   1.3/3.3.7.4, 1.4/2.5.4, 1.4/2.1.4

DESCRIPTION

IPAD shall provide the capability for optional automatic reporting such as automatic reporting of data which is due in the data base to meet a schedule date, all data which is overdue in the data base, and notification of a data set change to all users who had accessed the data set.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The following automatic reports will be generated and checked for accuracy and reliability.

a)   A report to list data which is due in the data base to meet a schedule date.

b)   A report to list data which is overdue in the data base.

c)   Revise a data set and initiate the notification of the revision to all users who have accessed the data set.

REV. B

REQUIREMENT   57.1 APPLICATION PROGRAM CERTIFICATION

SOURCE   1.3/5.2.2, 1.3/5.2.3

DESCRIPTION

In order to document the integrity of a given job execution, its component operational modules must somehow be certified. Certification implies that a judgment has been made about the trustworthiness of the computer code to perform its intended function. As an example, an operational module may have one of the following certifications:

a)   In checkout

b)   Research use only

c)   Staff use

d)   Airplane program/model use

e)   FAA certification use (legally certified)

The certification of a job is the same as the "lowest" certification operational module contained in the job.

Since many changes may be made to a computer program, a mechanism is needed to automatically record program versions. This applies to coding modules, operational modules and jobs. The certification data must accompany the program module in the program library.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capability of IPAD to correctly assign version numbers and identify certification of programs in the program library will be tested.

REV. B

SOURCE   1.4/2.6

DESCRIPTION

Occasionally during his work session (at anytime in the
COMMAND MODE) a user needs the capability to request a summary of
his activities in order to confirm that he has in fact done what
he intended to do up to that point. Two types of report are
needed, one to check specific items and one to check all user
activities.

The entities needing verification during the user's current
work session are: data names, coding module names, operating
module names, subtask names, job names and their respective
headers, where appropriate.

The user also must verify the activities which he has
performed (or which have been performed by a job) on these
entities. These activities are: accessed; copied and given a new
name; created; modified and given a new version name; deleted;
interrupted (in the case of a job) and suspended; in-work, and
completed (in the case of a subtask).

In the case of headers the item(s) in the header that are
affected should be identified with appropriate comments such as
"DATA SET XYZ, READ PERMISSION GRANTED TO JOHN BROWN AND ALL
MEMBERS ASSIGNED TO THE AERODYNAMICS DATA AREA."

The report should include the date and time when the activity
was completed and be broken down by Subtask.

The user must be able to enable or disable this checklist
capability using a command.

Report Format Examples

Session Date: 5/10/77 User I/D:

Subtask XXX Completed at 10:45 a.m.
        Data Set XYZ (Data Area=Stress) accessed at 10:15 a.m.
        Data Set ABC (Data Area=Wing Project) copied at 10:20 a.m.
                  to Data Area=Stress and renamed CBA
        Job Joe (Data Area=Stress) Run commenced at 10:30 a.m.;
                  completed at 10:45 a.m. with normal exit

            Data Sets Accessed:
            1. XYZ (Data Area=Stress)
            2. CBA (Data Area=Stress)

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Data Sets Produced:
        1. PQR (Data Area=Stress)
Subtask YYY suspended at 10:52 a.m.

Operating module EFG version changed at 10:47 a.m. Execute permission granted to John Brown and all members assigned to the Aerodynamics Data Area.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Typical work session scenarios will be performed and the checklist reports displayed and checked for accuracy and completion.

REV. B

2.3 INFORMATION MANAGEMENT

Information management is broken down into three categories - data management, information management tools and computer program library. Data management is concerned with the organization, manipulation, control, integrity, security and administration of IPAD data. Information management tools are provided to maintain data, to perform data transformations, to compare data and to perform arithmetic and logical operations on data. The computer program library contains computer programs in source and executable forms. The programs may be supplied by the user or generated by software processes (e.g., compilation). Computer programs may be structured into jobs and executed. Information about programs is available to the user.

2.3.1 Data Management

The handling of data within IPAD has many facets including organization, manipulation, control, integrity, security and administration. Data organization at the elementary level consists of elements, formats and data relationships which will be grouped into data sets. Data sets are organized into data areas. Data manipulation includes capabilities to query, to copy data and programs and to access and retrieve archived data. Data control governs data access, data changes, purging and data retention. Backup and recovery procedures are provided to guard the integrity of all data in the IPAD data base. Proper security clearance is required to access some data sets within IPAD. Security control of read/write access is available. Data administration responsibility is assigned to a designated person or organization who will be responsible for exercising control over the entire IPAD information bank. (See figure 2.3.1-1 and 2.3.1-2.)

2.3.1.1 Data Organization

At the elementary level IPAD data will consist of data elements, data formats and data relationships. These elementary items may be grouped and organized into data sets which may be logically related to other data sets. Data sets will be logically organized into data areas. A data set may belong to more than one data area. Header data will be associated with each data set to enable the user to query and retrieve data.

Each data area will contain a dictionary or index that lists the data sets within each area and also describes the contents of each data set. Each IPAD user will have his own private working data space.

Data areas may be combined into a single data area. Data dictionaries for the data areas will also be combined. Data

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definition ambiguities and redundancies will be reported to the user.

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2.0 FULL IPAD REQUIREMENTS

58. INFORMATION BANK STRUCTURE
59. DATA SET ASSOCIATION
60. DATA SET HEADERS
61. DATA AREA CONTENTS
62. PRIVATE DATA SPACE
63. DATA ELEMENT TYPES
64. DATA GROWTH
65. ENGINEERING STANDARDS
66. REORGANIZING DATA AREAS
67. DATA STRUCTURES
68. DATA ELEMENTS AND RELATIONSHIPS
69. OPERATIONS ON DATA RELATIONSHIPS
70. DATA ELEMENT NAMES
71. DATA QUANTIFICATION
72. DATA SET COPYING
73. ARCHIVED DATA
74. PROGRAM DATA ACCESS
75. USER DATA ACCESS
76. DATA SET ACCESS RECORDS

2.3 INFORMATION MANAGEMENT
2.3.1 DATA MANAGEMENT
2.3.2 INFORMATION MANAGEMENT TOOLS
2.3.3 COMPUTER PROGRAM LIBRARY
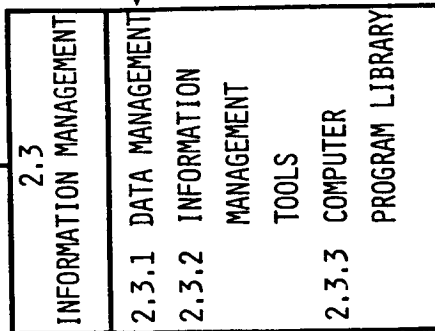
Figure 2.3.1-1

Data Management Requirements

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2.0 FULL IPAD REQUIREMENTS

2.3 INFORMATION MANAGEMENT
2.3.1 DATA MANAGEMENT
2.3.2 INFORMATION MANAGEMENT TOOLS
2.3.3 COMPUTER PROGRAM LIBRARY

77. DATA SET IDENTIFICATION CONTROL

78. DATA PURGE PERMISSION

79. DATA RETENTION CLASSIFICATION

80. DATA VERSION NOTIFICATION

81. DATA RELEASE MECHANISM

82. SHARED AND PRIVATE DATA SETS

83. DATA DISTRIBUTION CONTROL

84. RECOVERY AND BACKUP

85. MODIFICATION OR LOSS OF DATA

86. DATA TRANSACTION HISTORY

87. DATA VALIDATION

87.1 DATA SET MODIFICATION LOG

88. USER READ AND WRITE SECURITY

89. PROGRAM READ AND WRITE SECURITY

90. CLASSIFIED DATA ACCESS

91. SYSTEM ADMINISTRATION
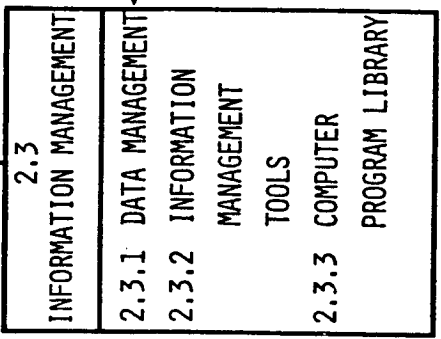
Figure 2.3.1-2

Data Management Requirements
(Cont'd)

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SOURCE   1.3/3.1.3.1,   1.3/3.1.3.2

DESCRIPTION

The capability must be provided for groups of IPAD data sets
to be logically organized into data areas for convenience of
handling, reporting requirements, program input/output, frequency
of access, etc.   There should be no restriction on the number of
data areas that a given data set may belong to. Separate user
action shall be required to make a data set or data area a member
of another date area.

A data area may be contained in part or all within another
data area. The totality of all data areas (sets) constitutes the
information bank which is a single source non redundant
computerized data resource of a company.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A number of data sets will be created, as will a number of
data areas. The ability to make a data area, in whole or in part,
a member of another area will be tested. One data set will be
made a member of all data areas. Queries and data accesses will
be made to determine correct assignment of data areas and data
sets.

In addition the capability of IPAD to control and manage data
as a company resource will be evaluated. An information bank
equivalent to figure 3.1.3.2-1 through 3.1.3.2-6 of D6-IPAD-70012-
D will be defined. The data model constructed for requirement 44,
ACT 2, will be interfaced to the information bank. Several
related projects will be defined and executed.

REV. B

REQUIREMENT   59   DATA SET ASSOCIATION

SOURCE   1.3/3.2.1

DESCRIPTION

IPAD shall provide the capability to logically associate data
sets with a given data set. If a data set is accessed for the
purpose of reading, its associates (and associates of these to
whatever depth defined) are also accessed.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A chain of logically associated data sets will be created.
The first will be accessed and queries performed to insure the
rest of the chain is also accessed. Chains of length 2 and length
10 will be used.

REV. B

<u>REQUIREMENT</u>   60   DATA SET HEADERS

<u>SOURCE</u>   1.3/3.1.4.3, 1.3/3.2.2, 1.3/3.3.7.1, 1.3/3.1.1

<u>DESCRIPTION</u>

    IPAD shall provide the capability to logically associate
header data with each data set. Header data may be classified
into three categories:

1.   IPAD System Data - This data is required by IPAD to maintain
    data set integrity:

    a)   Unique Data Set Name

    b)   Creation Date

    c)   Creation Time

    d)   Storage Relationship

    e)   Storage Format

    f)   Other

2.   Installation Control Data - This data is used by an
    installation to control data access and retention.

    a)   Security - National, Company, Project and/or User
        Security Information.

    b)   Owner I.D. - Creator of data set.

    c)   Retention Classification - How long should data set be
        retained (see requirement 79).

    d)   Version I.D. - The information is used if multiple
        versions of a data set are stored (see requirement 77).

3.   Project/User Controlled Data - This data is used to determine
    how the data is to be applied.

    a)   User Qualifier - For Example: Airplane Model, Case No.,
        etc.

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b)   Approval Category - Prepared, Checked or Approved (see
      requirement 81).

c)   Quality Categories - Preliminary or Final

d)   Classification Code.

e)   Project I.D.

f)   Process I.D.

g)   Other (such as date due).

ABSTRACT OF THE ACCEPTANCE CRITERIA

The IPAD capability to store, retrieve, and modify header
data associated with data sets will be tested. Data definitions
will be entered specifying the installation control header data,
including planned date and last possible date. Several data sets
will then be created, and the capability of IPAD to successfully
retrieve the header information for these data sets will be
tested, as well as the user's capability to modify the header
information.

In an additional test, a data set will be created under IPAD,
archived, and later retrieved. The header information will be
checked for accuracy.

REV. B

SOURCE   1.3/3.1.2

DESCRIPTION

A data area shall consist of two general items: a dictionary or index or equivalent concept describing what the area contains, and the data sets, data definitions, etc., that it actually contains.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A data area will be created which contains a variety of data sets and data definitions. Queries will be made to determine the correctness of the dictionary/index and to access the data sets, etc., to insure that the contents of the data area is correct.

REV. B

REQUIREMENT   62   PRIVATE DATA SPACE

SOURCE   1.3/3.1.2, 1.4/2.5.5

DESCRIPTION

Each active subtask in IPAD shall have a special subtask data area which will function as its private working data space. All data generated by the subtask is automatically placed in the subtask area. Data contained in subtask area is unreleased data. (See requirement 81.)

ABSTRACT OF THE ACCEPTANCE CRITERIA

Three separate subtasks will be defined and will generate data sets to insure the existence of the private working data area. A check will be made to insure these areas are private and cannot be accessed from another subtask.

REV. B

2.3.1.1.1 Data Definition Contents

IPAD will support an expandable list of data element types.
An orderly growth of data set definitions and occurrences of data
corresponding to the definition will also be supported.
Capabilities for a company to insert into the information bank,
for query, definitions, and sets of values for engineering
standards will be provided. A user program will be allowed to
access data sets or data elements within any number of specified
data areas.

Data areas may be combined into a single data area. Data
dictionaries for the data areas will also be combined. Data
definition ambiguities and redundancies will be reported to the
user.

REV. B

REQUIREMENT   63 DATA ELEMENT TYPES

SOURCE   1.3/4.2.4

DESCRIPTION

IPAD shall support an expandable list of data element types such as text, scalars, vectors, matrices, tables, and lists. Data elements may be populated with characters, integers, real, complex, or multiple precision values.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Data formats will be defined using all the mentioned data element types with integers, reals, complex and multiple precision values. Data will be loaded and used to test accuracy. New data types will be defined and used. A user opinion survey will be made to check useability of element type definition.

REV. B

REQUIREMENT   64   DATA GROWTH

SOURCE   1.3/4.0

DESCRIPTION

   IPAD shall support an orderly growth of data set (elements,
relationship formats) definitions within an IPAD information bank
without impacting the availability of the existing information.
In addition, IPAD shall support an orderly growth of occurrences
of data corresponding to the definitions.

ABSTRACT OF THE ACCEPTANCE CRITERIA

   A set of definitions of elements, relationships and formats
will be used to simulate data definition growth to system storage
capacity in several simulated system loadings. There shall be no
evidence of software limitations on the number of data definitions
supported by IPAD.

REV. B

REQUIREMENT   65   ENGINEERING STANDARDS

SOURCE   SOW/5.1.2, 1.4/2.4.5

DESCRIPTION

The IPAD System must provide the capability for a using
company to insert into the information bank, definitions and sets
of values for engineering standards. IPAD will provide a default
set of engineering standards, to include material property lists,
universal constants, etc. These engineering standards shall be
available for query.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Definitions and sets of values will be entered into the
information bank for engineering standards. Query will be done
against that information to guarantee its accuracy. In addition a
complete query and print out of the default information will be
performed to check its accuracy.

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REQUIREMENT   66   REORGANIZING DATA AREAS

SOURCE   BCAC-NASA

DESCRIPTION

The capability shall be provided to organize the information
bank by combining individual data areas into one composite data
area or moving one nested data area into another data area thus
creating a new combination. the data dictionaries for the
individual areas shall also be combined and the user will be
notified of any ambiguities and/or redundancies resulting from
duplicate data definitions. The result of this operation shall be
a reorganized information bank with correct data dictionaries for
the restructured areas.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capability to combine individual data areas into one data
area will be tested. Several users will test this requirement by
combining data areas that have been used in other tests. There
will be ambiguities and redundancies and the user must be notified
of these and provided an easy means of resolving them. After
successfullyl combining data areas, only one data area and data
dictionary must exist. Ease of use is the prime consideration of
this test.

REV. B

2.3.1.1.2 Data Structure

Data structures used by a company shall be provided and supported by IPAD. Logical structure independent of physical structure will be provided so that an alteration to the physical structure will not affect the user or his program. A capability for defining data relationships will be provided to the user. The format in which the data is to be presented to the user may also be specified. Logical relationships of data elements may be established, recorded, viewed, located, and modified. Data element names are to be unique within a data area. There may be data areas in which data element definitions are not allowed.

REV. B

SOURCE   SOW/5.2.1.1, SOW/5.2.1.2, 1.3/4.4, 1.3/4.3.4

DESCRIPTION

IPAD shall provide and support those data structures used by Engineering. The capability to have logical structure independent of physical structure shall be provided. In this case, alteration to the physical structure must not affect the user or his programs.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A set of structures will be developed which test the full spectrum of IPAD logical structures. To test independence of physical and logical structures, the physical structure will be modified several times and query's run to insure no user impact. The user (engineering) acceptance of the logical structures will be evaluated by means of a user survey.

REV. B

SOURCE   SOW/5.2.1.1, 1.3/4.1.2, 1.3/4.3.2

DESCRIPTION

IPAD shall provide the user with the capability to define data elements and to introduce relationships between them.

Data element definitions shall include such attributes as name, type (integer, real, character, vector, matrix, tensor, etc.) , synonyms, textual definition, engineering use description, unit(s) , default value,external representation format, etc.

A data relationsnip is a logical grouping of data elements, possibly expressed in terms of other relationships. The user shall have the capability of expressing relationships for the purpose of storing and retrieving data. Relationships will in general be expressed at the time of use, but it shall be possible for the user to define and store relationships for future usage.

Accompanying the data relationship shall be the ability for a user or a user's program to specify the format in which the data is to be delivered from IPAD or presented to IPAD. A format shall define sucn things as: display format (e.g., FORTRAN format capability) , external media type, and external units (which if different from units defined with an element will cause unit conversion). Formats may be expressed at time of usage and may also be stored for future use. One format may be used in conjunction with several relationships.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Users will define data elements and data relationships both at the time of usage and to be stored for later use. All attributes for data element definition described in the requirement will be tested.

Another test should verify that the relationships and data element definitions can be used to store and access data successfully.

REV. B

The capability to define the I/O format for data will be tested both from within a user program and as a direct user request. Specific items defined will include those identified in the requirement.

A user opinion survey will evaluate these capabilities based upon correctness and user acceptability.

REQUIREMENT   69   OPERATIONS ON DATA RELATIONSHIPS

SOURCE   SOW/5.1.18, 1.3/4.3, 1.4/2.5.2

DESCRIPTION

    IPAD shall provide means for establishing, recording,
viewing, locating, and modifying the logical relationships of data
elements stored in a data area.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    User will define to IPAD sample logical relationships of data
elements stored in a data area.   Users other than those who
originally defined the logical relationships will then attempt to
locate and view these logical relationships.   Several
modifications should then be made and the resulting logical
relationships viewed to verify that the modifications were
correctly performed.

REV. B

REQUIREMENT   70   DATA ELEMENT NAMES

SOURCE   1.3/4.2.1, 1.3/4.4.1.1, 1.3/4.2.2

DESCRIPTION

Data element names shall be unique within the data area in which the elements are defined and in any of its dependent data areas. It shall be possible to designate data areas for which data element definitions are not allowed.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A sample of data element names will be defined for a specific data area. It should be verified that these data element names are available to the data area and any of its dependent data areas. Attempts should be made to define duplicate data element names for this data area and these attempts should be unsuccessful.

A data area should be designated for which data element definitions are not allowed. It should then be verified that data element names cannot be defined for this data area.

REV. B

2.3.1.1.3 Quantifiers

The data volumes and data processing activities that IPAD must support vary from company to company. Bounds on volumes of storing and retrieving activities are estimated from the Data Flow Model in document D6-IPAD-70012-D.

REV. B

REQUIREMENT   71   DATA QUANTIFICATION

SOURCE   SOW/5.2.1, 1.3/2.2, 1.3/2.3

DESCRIPTION

The data volumes and data processing activities that IPAD must support vary from company to company. The following guidelines establish the upper bound of data volumes.

Two product development processes through detail design are in progress at any given time. The data storage required is:

Immediate access - 150 billion bits

Archive (10 min. access) - 190 billion bits

Archive (24 hr. access) - 360 billion bits

Ten products are undergoing sustaining design. For this activity, it is assumed that 20% of the total sustaining design data is required for current work and requires immediate access; 40% consists of archived drawings which must be available within 10 minutes; and the remaining 40% is also archived and must be available within 24 hours. The data storage required is:

Immediate access - 470 billion bits

Archive (10 min. access) - 940 billion bits

Archive (24 hr. access) - 940 billion bits

Preliminary design, of exploratory nature of 10 products per year. Data storage required:

Immediate access - 100 billion bits

Archive (24 hr. access) - 620 billion bits

For archival purposes, it is assumed that there is a continued increase of data volume that corresponds to one product description (detailed design) every two years and 10% of the information developed during exploratory preliminary design. The annual increase in data storage is:

Archive (24 hr. access) - 310 billion bits

The bounds of data storage required are as follows (the lower bound is assumed to be approximately 10% of the upper bound):

REV. B

	Lower Bound	Upper Bound	Annual Growth
Immediate access (billion bits)	70	720	
Archive - 10 min. access (billion bits)	110	1130	
Archive - 24 hr. access (billion bits)	190	1920	310

The above volumes were estimated from the data flow model in document D6-IPAD-70012-D. Table 2.3.1.1.3-1 contains a summary of the output data from each design level. A factor was used to account for iterations estimated for each level and the distribution of on-line data and archival data. This data storage, representing the development of one aerospace vehicle, was further factored to represent the total engineering data storage required for one large aerospace company and is shown in table 2.3.1.1.3-2.

REV. B

Table 2.3.1.1.3-1 Data Storage Estimate - IPAD Project 1
Subsonic Transport (Ref. D6-IPAD-70010-D)
(Data Expressed as Millions of 60 Bit Words)

Data Output by Design Level (Ref: D6-IPAD-70012-D) Data Model	Data Output	Data Output Single Pass Through Levels	Storage Factor Based on Estimated Iterations of Levels On-Line	Archival 10-min Access	Archival 24-hour Access	DATA STORAGE On-Line	Archival 10-min Access	Archival 24-hour Access
ABA	.35							
Subtotal Level II		.35	10	--	20	3.5	--	7.0
ABB	.12							
ABBA	.01							
ABBB	..32							
Subtotal Level III		.45	10	--	90	4.5	--	40
ABC	.61							
ABCA	5.22							
ABCB	1.02							
ABCC	11.52							
ABCD	13.01							
ABCF	6.68							
Subtotal Level IV		38.1	4	--	26	152	--	991
Total Levels II-IV Exploratory Preliminary Design						160	--	1038
ABDA	618							
ABDB	248							
ABDC	437							
Subtotal Level V		1304	2	1.2	4.8	2608	1565	6260
Total Levels II-V Preliminary Design						2768	1565	7298
ACAA	648							
ACAB	593							
ACAC	2649							
ACAD	7							
Total Level VI Detail Design		3897	.2	.4	.4	779	1559	1559

REV. B

Table 2.3.1.1.3-2 Data Storage Estimate
Large Aerospace Company
IPAD Distributed Environment
(Data Storage Expressed as Billions of Bits)

Activities Assumed for Data Volume Estimate of an Aerospace Company	Storage Factor Based on Table 2.3.1.1.3-1 (Converted to Billion Bits)	DATA STORAGE		
		On-Line	Archival	
			10-min Access	24-hour Access
2 Product Development Processes in Progress at Any Given Time				
•Preliminary Design	.5(Lev. II-V)	80	50	220
•Detail Design	1.5 (Lev. VI)	70	140	140
Sub-Total		150	190	360
10 Products in Sustaining Design				
Sub-Total	10 (Lev. VI)	470	940	940
Preliminary Design of Exploratory Nature (EPD) 10 Products per Year				
Sub-Total	10 (Lev. II-IV)	100	--	620
Total Data Storage		720	1130	1920
Archival Growth				
•One Product per Year	1.0 (Lev. VI)	--		230
•10% Exploratory Preliminary Design	.1 (EPD)	--	--	70
Total Archival Growth		--		310

REV. B

ABSTRACT OF THE ACCEPTANCE CRITERIA

In order to test the data volumes and data processing activities that can be supported by IPAD, a computer simulation model will be developed based on the Data Flow Model in document D6-IPAD-70012-D. IPAD must function correctly and within response constraints at both the upper and lower bounds given.

REV. B

2.3.1.2 Data Manipulation

IPAD data manipulation capabilities include the ability to query specific data areas, to copy data and programs from other data area into a user's own data area, to access and retrieve data from archive files.

REQUIREMENT   72   DATA SET COPYING

SOURCE   1.4/2.5.2

DESCRIPTION

    The system shall provide the user with a means to copy data
and programs into his own subtask or data area from other data
areas.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    The software to copy data and programs into a user data area
will be tested. The accuracy of before and after images will be
verified.

REV. B

REQUIREMENT   73 ARCHIVAL DATA

SOURCE   SOW/5.1.22, 1.3/3.1.3.2

DESCRIPTION

     IPAD shall provide appropriate aids for access to engineering
project data after it has been archived. These aids include, for
example, an interactive query of data area catalogs to determine
the existence of data sets that have been archived. Users shall
not be aware of archival storage media. Queries of archived data
sets shall cause the archived data sets to be returned to online
status for immediate access. Data sets containing geometry of
parts shall be available online within 10 minutes from any
terminal in an IPAD installation having terminals distributed
across both global and local networks. All other archived data
sets shall be available within 24 hours. (See requirement 71 for
the quantities of archived data expected in an IPAD installation.)

ABSTRACT OF THE ACCEPTANCE CRITERIA

     The existence of software to retrieve archived data to on-
line storage will be verified. The efficiency and accuracy of the
software to identify and move data to on-line storage will be
tested.

REV. B

REQUIREMENT   74   PROGRAM DATA ACCESS

SOURCE   SOW/5.2.1.1, 1.3/4.4.2

DESCRIPTION

    IPAD shall provide the ability for user programs to work
within a subset of a data area or with data from more than one
data area.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    Multiple data areas will be created. User programs will be
written which will utilize data from a subset of a specified data
area and from several specified data areas.

REV. B

75   USER DATA ACCESS

SOURCE   1.3/3.2.2.1, 1.3/4.5.1

DESCRIPTION

The user shall be able to limit a query to a specific data
area or to any subset of the information bank identified in a
previous query.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Queries will be made to check that they may be limited to a
selected data area or areas. The carry over from previous queries
feature will also be tested. The tests will be for accuracy and
responsiveness.

REV. B

2.3.1.3 Data Control

Data control is instigated to insure the validity and accuracy of IPAD. All accesses to IPAD data sets are recorded and are available for examination. Any change to a data set must be accompanied by a corresponding change in the data set name. A data set that has other data sets dependent upon it can only be purged with special permission. Data set retention classifications establish how long a data set will be retained and whether the data set is to be archived or not. IPAD data can be qualified as for information only, preliminary or final. IPAD users using unreleased data will be notified when released data becomes available. Data sets may be shared or private. IPAD will permit automatic and manual distribution of data and programs throughout the IPAD computer network.

REV. B

REQUIREMENT   76 DATA SET ACCESS RECORDS

SOURCE   SOW/5.1.15, SOW/5.2.1.6, 1.3/3.3.7.4, F3/3.1,
          1.3/3.3.7.2, 1.4/2.1.4

DESCRIPTION

      IPAD shall keep a record of all accesses to a data set. The
information kept in this record shall be open ended and may
include user identification, date, time, job, and type of access.
The record is for the purpose of notification and will be
maintained for the life of the data set or until it is no longer
useful (program parameter).

ABSTRACT OF THE ACCEPTANCE CRITERIA

      A set of data to be kept for each access will be defined
including user id, date, time, job, and type of access. A random
mix of users will access data sets by user query, system data
manipulation utilities under user control, and user jobs. A
planned set of activities will guide these tests and will be used
to establish operational correctness. Exact agreement between the
user mix and the records kept by the system is required.

REV. B

SOURCE   1.3/3.1.4.2

DESCRIPTION

The system must guarantee that data set content changes cause
a change in data set identification. This will be accomplished by
the user inserting a new name, or a system supplied version
identification to the existing name by a version number, (default
procedure).

ABSTRACT OF THE ACCEPTANCE CRITERIA

Check that the access of data sets in write mode causes the
IPAD system to either

a)   request the user to specify a new name for the data set
     or

b)   assign a version number to the old name by default of
     a).

REV. B

REQUIREMENT   78   DATA PURGE PERMISSION

SOURCE   1.3/3.3.7.5

DESCRIPTION

Special permission shall be required to purge any data set
which has a dependent data set while these data sets are under
project control.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The data set purge permission requirement will be tested by
attempting to purge data sets which have dependent data sets both
with permission and without permission.

REV. B

SOURCE   1.3/3.3.7.5

DESCRIPTION

IPAD shall provide for data set retention classifications such as permanent, program life, project life, number of years, etc. Project life should be the archival default rating and the system shall have provisions to selectively purge or archive data set occurrences which are determined by retention classification to be no longer required.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The retention classification of data sets to control archiving and purging will be tested. The procedure will be as follows:

a.   Several data sets will be classified for retention in the various categories cited in this requirement.

b.   Establish artificial times for project life, etc.

c.   Check that retention classifications have been correctly labelled for each data set.

d.   Test automatic purges and archivals.

e.   Test defaults.

REV. B

REQUIREMENT   80   DATA VERSTION NOTIFICATION

SOURCE   1.3/3.1.4, 1.4/2.9.2, 1.4/2.5.5

DESCRIPTION

A procedure is required to notify users when they access data
that a later version of the data is available (see requiement 81).

ABSTRACT OF THE ACCEPTANCE CRITERIA

The approved data identification will be tested by several
users each of whom accesses preliminary information for which
released information is available. The notification must be
issued.

REV. B

REQUIREMENT   81   DATA RELEASE MECHANISM

SOURCE   1.3/3.1.4, 1.4/2.5.5

DESCRIPTION

1. IPAD shall provide a data release mechanism equivalent to
    signing a drawing. Approval categories such as the following
    shall be possible:

CODE	LABEL	DEFINITION
R1	Prepared	Creator is satisfied with data
R2	Checked	Checker is satisfied with data
R3	Approved	Responsible manager is satisfied with data

2. The release mechanism shall also make provisions to identify
    the quality of the data and permit release of intermediate
    information. Quality categories such as the following shall
    be possible for all released data.

CODE	LABEL	DEFINITION
Q1	Preliminary	Data likely to change
Q2	Final	Data unlikely to change

3. Released data is subject to version control and qualification
    in accordance with Requirement 77-32.

4. Subsequent release of new versions of previously released
    data shall result in the following:

    • Notify those users that have accessed the previous
      version that a new version exists. (See requirement
      57.)

    • New use of the data shall always be the latest version
      (unless user specifies a particular version).

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- Continued use of previous versions shall be possible but an automatic warning or message is required. (See requirement 80.)

5. The appropriate release and quality labels shall be shown on each page of data printed or displayed.

6. The user should be able to request a list of release and quality labels on the input which was used to produce the current output.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A basic set of data approval and quality categories will be defined to IPAD. Data release will be simulated and will include optional abbreviations. A check will be made to insure that only authorized people may assign data release and quality categories to data.

SOURCE   SOW/5.2.1.1

DESCRIPTION

IPAD shall accommodate both shared and private data sets. Users witn a need to read a private data set shall be given "read only" permission by the owner/creator of the private data. There shall be no restriction on the number of users who may be permitted to read a shared data set concurrently.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The ability to use either private or shared data sets will be tested by several users. The procedure will include:

a.   Use a private data set and prove that other users cannot access it;

b.   Snare a data set by several users simultaneously (read only).

REV. B

REQUIREMENT   83   DATA DISTRIBUTION CONTROL

SOURCE   BCAC-NASA

DESCRIPTION

IPAD shall permit both automatic (IPAD initiated and controlled) and manual (IPAD user initiated and controlled) distribution of data and programs throughout the IPAD computer complex. IPAD shall retain knowledge of the location of and access control to all data and programs within the IPAD system.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The data distribution control feature of IPAD will be tested for both automatic (system initiated) and manual (user initiated) modes. The procedure will include the following steps.

a)   Several users at various locations will create data sets and/or programs and check that the system automatically distributes them to the correct source.

b)   Several users will create data sets and/or programs and tell the system where to distribute them and then check that they are distributed properly.

c)   Check the accuracy of the systems records of location of data and programs by query.

REV. B

2.3.1.4 Data Integrity

IPAD must guard the integrity of all data in the IPAD data base. This requires that proper backup and recovery procedures be provided. These procedures shall be sufficient to guard against system failure, or accidental or intentional destruction of the IPAD data base.

Loss or modification of IPAD data other than through normal use shall be identified and reported to the owner(s) of the data. Further unauthorized use of the data shall be blocked by IPAD.

As part of system backup and recovery, a history of transactions and data will be maintained to permit the recreation of required data. History transactions may be archived if the required data is archived.

Provisions will be available within IPAD to validate user data. Validation will be performed on values when entered or on selected contents of a data set at the user's request. The set of validation available from IPAD will be extendable and user derinable.

REV. B

REQUIREMENT   84   RECOVERY AND BACKUP

SOURCE   SOW/5.1.24,   SOW/5.2.1.6,   1.3/3.5,   1.4/2.8.2

DESCRIPTION

Recovery and backup procedures shall be provided to ensure
data integrity in case of system failure or accidental or
intentional destruction of the data bases.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The backup and recovery capabilities will be evaluated. A
planned set of failures will be simulated. These simulations
shall include all known types of system failures and accidental or
intentional destruction of the information bank. The backup and
recovery capabilities will be judged on adequacy, computing
resources required, time required to recover and user involvement
required.

REV. B

SOURCE   1.4/2.8.2, SOW/5.2.1.6

DESCRIPTION

In the event that the IPAD system, or any agent other than
the user in the normal course of using the system, causes loss or
modification of data in the IPAD information bank, the system
shall be designed to identify the affected data.

The system will immediately report the identity of the
affected data and the nature of the problem to the owners of the
data, and shall block further use of that data.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A simulation of both lost and modified data will be made.
This data will be both programs and data in several different data
areas. Correct identification and reporting of the lost or
damaged data will be checked for accuracy and timeliness.
Attempts to use damaged data will be made to insure IPAD correctly
blocks that use.

REV. B

SOURCE   SOW/5.1.15, SOW/5.2.1.4, 1.3/3.1.4.2, 1.3/3.1.4.3,
           1.3/3.3.7 1.4/3.3.11, 1.4/2.8.2

DESCRIPTION

The system shall record a history of transactions and data
needed to recreate data which has been willfully or inadvertently
destroyed or modified. This includes date, creator (owner),
creating job, and input sets to creating job, etc. There shall be
a mechanism to make it optional for specified data sets.

This history must be maintained as long as the data is
maintained. It may be archived if the data is archived.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Data sets will be created to check that the history
information exists as long as the data set exists, the data sets
will be transferred to remote IPAD and back, to archival and back
and between data areas. The data will be destroyed and the
ability of IPAD to recreate it will be checked. A deliberate
attempt to delete history information while it exists will be made
in addition to checking that authorized purging of the data set
causes deletion of the history data.

REV. B

SOURCE   1.3/3.0, 1.3/3.3.6.2

DESCRIPTION

IPAD shall provide for validation of user data including a range of values check. The set of validation operations will be extendable and user definable. Validation will be performed on values when entered and on selected contents of a data set at user request.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A data definition will be created with several user defined validation checks. Both good and bad data will be entered to insure IPAD accepts good data and rejects bad data. After some data has been entered a new validation check will be defined which rejects some of the previously entered data. The user will request this check be run against a subset of the already entered data to insure IPAD detects the bad data. The tests will be for ease of use and accuracy.

REV. B

REQUIREMENT   87.1   DATA SET MODIFICATION LOG

SOURCE   1.3/3.3.7.3

DESCRIPTION

The following information shall be available in a data set modification log to clarify the history of data set versions: (see requirement 77):

1.   Reason for change

2.   Description of change

Note: This information is in addition to the data set headers (see requirement 60).

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capability for IPAD to maintain a data set modification log will be tested. Users notified of data set changes (see requiement 80) will access the data set modifiction log to determine the general nature of the change. This test will be conducted in conjunction with ACT 80-33/1.

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2.3.1.5 Data Security

Read access to classified and proprietary data including headers shall require proper security clearance. Read access to other data may require need-to-know security clearance but access to the corresponding headers is unrestricted. Only the data owner(s) may have write access to data.

User access to specific data sets may be controlled by a designated authority. Under this control, a user must establish "need to know" rights before access is permitted.

Computer programs are subject to the same access restrictions as individuals (noted above). The security classification of the person executing the programs is used to establish computer program accessibility.

IPAD shall have the ability to report unauthorized attempts to access IPAD data. The reports will be submitted to the system administrator for further action.

REV. B

SOURCE   SOW/5.1.21, SOW/5.2.1.6, 1.3/3.2.1, 1.4/2.8.2,
            1.3/3.2.3.1

DESCRIPTION

    Read (query) access to classified and proprietary data
(including headers) shall require proper clearance and be subject
to "need to know." Read access to all other data shall be subject
to "need to know," except that headers of such data shall not be
subject to any read (query) control.

    The IPAD system must provide a means to enable a designated
authority to establish a user's "need to know" rights relative to
specific sets of data.

    Write access to all data shall be possible by the owner(s)
only.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    Access to data by users other than the owner will be tested
by having users try to access data labelled classified and
proprietary for reading. Only those with proper clearance and a
need to know should be able to access this data (even the header
information is protected). For other data, users must have a need
to know, but the headers are accessible. The means of determining
the need to know authority and controlling user clearance will be
tested as well as the data protection. The owner of the data must
have access to write for updating, etc. This aspect will also be
checked.

REV. B

SOURCE   1.3/3.2.3.2, 1.3/3.2.2.2

DESCRIPTION

Computer program access to a data set, including header, shall be subject to the same control as a user access based on the access restrictions of the person executing the computer program.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The access of data by a computer program will be tested similarly to or in conjunction with the test of requirement 88 "READ AND WRITE ACCESS". The user of the computer program and the user's classification (authority to access data) have the same restrictions as a user directly accessing the data and the protection of the data will be tested by having both authorized and unauthorized users run the programs that will request the data. The owner will also access the data through a computer program to read and write in the data set.

REV. B

REQUIREMENT   90   CLASSIFIED DATA ACCESS

SOURCE   1.4/2.8.2

DESCRIPTION

Access to classified and proprietary data shall require stringent user identification.

Any unauthorized attempts to access this data shall be reported to the system administrator by the IPAD system.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The unauthorized access security feature of IPAD will be tested by attempting to access classified and proprietary data without authorization. Check that the system reports these attempts to the system administrator.

REV. B

2.3.1.6 System Administration

The system administrator is a designated person or organization recognizable by IPAD who is responsible for exercising control over the IPAD information bank. The system administrator will have special privileges. He will be permitted quick and easy access to the IPAD system and be capable of performing tasks available to no other users. Written IPAD procedures will fully describe the functions and authority of the system administrator.

The system administrator may delegate control of selected functions to other persons or organizations. These delegated persons may likewise delegate protions of their control to other persons or organizations.

REV. B

REQUIREMENT   91   SYSTEM ADMINISTRATION

SOURCE   1.4/2.7.1, 1.3/3.1.4.1, SOW/5.2.1.2

DESCRIPTION

The IPAD system must accommodate the special requirements of system administration. The IPAD System Administrator is a person or organization responsible for exercising control over the IPAD system and information bank. This control includes system parameters, distribution of functions, data structures, and security. The system must recognize the authority of the IPAD System Administrator(s) as he accesses the system and allow him to perform his functions.

It shall be possible for the IPAD System Administrator to delegate control of selected functions to persons or organizations designated by him. Such delegated control shall permit the further delegation of control.

The IPAD System Administrator(s) must be able to access the IPAD system quickly and easily--more so than the normal user. The system must recognize his authority and allow him to perform tasks that other users cannot. Written procedures must fully describe the functions and authority of the IPAD System Administrator(s).

ABSTRACT OF THE ACCEPTANCE CRITERIA

In two parallel tests, the System Administrator and a regular user should each access IPAD and attempt to perform the system administration commands. The System Administrator should obtain access to the system more quickly and should be able to perform all commands. The other user will be tested to ensure that he is restricted from the use of System Administrator commands. The test should verify that the System Administrator is able to authorize the use of selected system administration commands for another user who can successfully use these commands. This user should then authorize the use of a subset of these commands to still another user or organization.

Note: Commands tested will include assignment of permission and access codes and assignment of data set approval status.

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2.3.2 Information Management Tools

IPAD capabilities shall be provided to enable the user to maintain data in the IPAD information bank and to perform data transformations. Maintenance features include data updating, data restructuring and data reformatting. File maintenance capabilities are also provided. Files may be created from data in the IPAD information bank or data from files may be inserted into the IPAD data base. Command sequences for creating or decomposing files may be saved for subsequent execution.

A capability will be provided to enable a user to compare two data sets, to find out the difference between them and to get meaningful diagnostics in return.

Utility programs shall be provided to perform arithmetic and logical operations on selected data. Functions available shall include conversions of data, scaling, summing, Boolean operations, linear algebra, numerical differentiation and integration of data. IPAD will provide for mapping IPAD element names to variable names used in user programs. (See figure 2.3.2-1.)
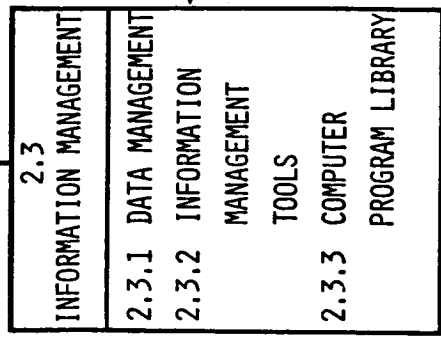
REV. B

Figure 2.3.2-1   Information Management Tools Requirement

REV. B

SOURCE   SOW/5.2.1.4

DESCRIPTION

The following update and transformation capabilities shall be provided:

a)   Altering existing values and data structures, adding new data structures and values, and deleting old values and data structures.

b)   Restructuring existing data by means of special commands, without loss of existing content.

c)   Creating a file from information in the data base with data format specification by the user extending to the bit level.

d)   Decomposing a file and inserting information into the data base with data format extending to the bit level.

e)   Saving command sequences used to create or decompose files for subsequent execution.

f)   Creating files for transfer to an external medium in any national standard, e.g., binary, BCD.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The data update and transformation capabilities will be tested by the following procedure:

a)   A data set will be constructed containing data structures and data values. The appropriate utility will be exercised to add, delete and modify existing data values and structures. The data will be displayed for purposes of verification.

b)   The IPAD special commands for restructuring existing data will be applied to the data set in a to restructure it. Again, data will be displayed for verification.

REV. B

c)   Define a file to the bit level and create it from the
     data set in a) using the appropriate IPAD utility.

d)   Reverse the process in c) to create another data set.

e)   Save the command sequence from c) and use it to create
     another file. Compare for verification.

f)   Create a file in each National Standard supported by
     IPAD using techniques of c) Successfully transfer the
     file to an external medium.

REV. B

REQUIREMENT   93   DATA TRANSFORMATION

SOURCE   1.3/4.4.3, 1.3/4.4.2

DESCRIPTION

IPAD shall provide the means to automatically present data in the correct form expected by the calling program or user. Some examples are: unit conversions, coordinate transformations and user supplied transformations.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The following will be checked to test the transformation capabilities:

a)   IPAD's ability to perform unit transformations.

b)   The ability to perform coordinate transformations between rectangular or oblique cartesian, polar and cylindrical coordinates.

c)   The ability to perform transformations on 1, 2 or 3 order tensors.

d)   The ability to perform transformations according to a user specified formula.

(e)   The ability to perform transformations defined by user supplied code (analogous to a Fortran function or subroutine).

REV. B

REQUIREMENT   94 PROGRAMS AND DATA SET COMPARISON

SOURCE   F3/3.1, SOW/5.2.3, SOW/5.1.13, 1.4/2.5.3

DESCRIPTION

    IPAD will compare two or more programs or data sets for
physical differences and inform the user of differences with
meaningful diagnostic messages. The comparison shall cover:

a)   Data that was inserted (or deleted) in one data set or
      program and not in the other

b)   Taking a) into account, the remaining data items taken
      in sequence are checked for those items that are
      different.

c)   Verification that two data sets are identical. When two
      items differ, it shall be ascertained whether or not
      they are real numbers (in single or multiple precision.)
      If they can be interpreted as real numbers, they shall
      be considered identical if the absolute values of both
      numbers are less than a user specified value or if the
      relative difference of the two numbers is less than a
      second user supplied value.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    The compare utility will be subject to the following tests:

a)   Compare two known identical programs using the compare
      utility.

b)   After changing part of one of the programs used in a),
      test the ability of the compare utility to recognize and
      report the changes accurately.

c)   Check that the user interface to the compare utility is
      acceptable by means of a user survey.

d)   Compare two sequential binary files of mixed data (real
      numbers, integers, text, packed integers), in which all
      information except the real numbers is identical in the

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two files but the real numbers differ to varying degrees in value.

e)   Same as d)except for two BCD files.

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SOURCE   SOW/5.2.3, 1.4/3.3.15, 1.3/4.5.1

DESCRIPTION

A set of utility programs shall be provided to perform arithmetic and logical operations on selected data. Functions such as unit conversions of data, scaling, summing, Boolean operations, and linear algebra operations shall be included. Other functions such as numerical differentiation and integration of data arranged in tabular form are frequently performed by engineers. In general, these operations can be described as arithmetic operations on columns of a table.The set of operations shall be open ended.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The system data manipulation capabilities; unit conversion, scaling, summing, sorting, boolean operations, linear algebra, numerical differentiation and integration and table or array operations will be tested for accuracy and user acceptance. This will be done by building a set of test data and problems and having a range of users use them to evaluate the data manipulation capabilities.

REV. B

2.3.3 Computer Program Library

The computer program library shall consist of programs in source or executable forms. The programs may be supplied by the user or generated by software processes (e.g., compilation). Program inputs and outputs may be IPAD controlled, i.e., I/O content below data set level is controlled by the user program.

Insertion and deletion of programs shall be straightforward and machine independent so that a company may insert its own programs. IPAD user aids will be made available to facilitate the interfacing of existing aerospace computer programs with each other.

Program descriptions and keyword lists may be entered and made available for subsequent query. (See figure 2.3.3-1.)

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2.0 FULL IPAD REQUIREMENTS

2.3
INFORMATION MANAGEMENT

2.3.1 DATA MANAGEMENT

2.3.2 INFORMATION
MANAGEMENT
TOOLS

2.3.3 COMPUTER
PROGRAM LIBRARY

96. PROGRAM LIBRARY

97. EXPLICIT AND IMPLICIT I/O

98. PROGRAM IDENTIFICATION AND DESCRIPTION

99. PROGRAM INTERFACES

100. PROGRAM INSERTION AND DELETION

Figure 2.3.3-1   Computer Program Library Requirements

REV. B

SOURCE   1.3/5.1, SOW/5.2.1.1

DESCRIPTION

IPAD shall provide for a single application program library
which shall consist of programs in either source or executable
form and which have been directly supplied by the user or
generated by software processes.

Standards for program integration, data handling, and program
catalog procedures shall be developed. The IPAD system shall
check programs for conformity to these standards and shall not
allow insertion of programs which do not meet these standards.
The IPAD computer program library shall be subject to the
same requirements for security, integrity, version control, and
access control as generally applied to the IPAD information bank.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The IPAD program library will be utilized and tested
throughout the test period. A procedure to test the library will
include loading and accessing programs by the user and by the
system. The security and integrity requirements and access
control will be tested in conjunction with those general
requirements for the IPAD information bank. The test procedure
will include accessing programs from libraries other than IPAD.

REV. B

REQUIREMENT   97 EXPLICIT AND IMPLICIT I/O

SOURCE   1.3/5.3, SOW/5.2.1, SOW/5.2.1.5

DESCRIPTION

It is required that IPAD support several modes of program interfaces with the information bank. The primary purpose is to make provisions which allow simple installation of existing application programs into IPAD.

IPAD must provide for installation of the following types of application computer program:

- Programs for which the contents of all input and output data sets are defined to IPAD and for which all data management is "implicit" (IPAD controlled).

- Programs for which the contents of some input and output data sets are defined to IPAD, and for which IPAD I/O is both "implicit" (IPAD controlled) and "explicit" (user program controlled). If data reformatting is needed for "explicit" I/O, IPAD shall support preparation of a data translation program.

- Programs for which the contents of input and output data sets are undefined to IPAD, and for which all data management is "explicit" (user program controlled).

The use of the terms implicit and explicit I/O should be interpreted as follows:

- IMPLICIT input/output action to and from a data set is totally under the direct control of IPAD. Note, query is possible at the level of data elements.

- EXPLICIT input/output action to and from a data set is under control of the user program. IPAD is responsible only for the data set as a unit. Query is possible at the level of data set and in general, IPAD is not capable of interpreting the content of any data set handled in this way.

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ABSTRACT OF THE ACCEPTANCE CRITERIA

The ability of IPAD to support the various modes of program input and output will be tested in conjunction with other tests and with standalone tests as required.

The procedure will include the installation of application programs with implicit I/O, explicit I/O and a combination of implicit and explicit I/O. For implicit data, queries will be made at the element level. Tests will be for user acceptance and correct operation.

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REV. B

SOURCE   F3/2.2, SOW/5.2.1.1

DESCRIPTION

IPAD shall provide the means for users to enter keywords and standardized descriptions of their programs. These descriptions shall be available for subsequent query.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Users will test the capability to enter keywords and descriptions of their programs in both batch and interactive modes. Users other than those who input the information will then query the information by entering the keywords. The feature must operate correctly and it most be responsive to the users' satisfaction in interactive mode.

REV. B

REQUIREMENT   99 PROGRAM INTERFACE

SOURCE   SOW/5.1.27, 1.4/3.3.19

DESCRIPTION

IPAD software shall include features and user aids to
facilitate interfacing existing computer programs with each other.
Such features shall make use of IPAD data transformation
facilities (requirement 93). IPAD shall also supply user aids to
facilitate integration of existing programs into IPAD. Such aids
may include automatic identification of I/O statements in source
programs and assistance in converting them to an IPAD compatable
form.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Existing Boeing and ITAB member companies' design programs
will be used to test the features and user aids for facilitating
the interfacing of existing programs with each other and
integrating them into IPAD. The functional capabilities such as
detection of I/O statements of these user aids will be verified
and user evaluation of these features for ease of operation and
adequacy of support will be established.

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REQUIREMENT   100 PROGRAM INSERTION AND DELETION

SOURCE   SOW/5.2.1, SOW/5.1.23, 1.4/2.1.5

DESCRIPTION

     Insertion and deletion of programs in the program library shall be straightforward and essentially machine independent so that a company may insert its own proprietary programs.

ABSTRACT OF THE ACCEPTANCE CRITERIA

     A group of ITAB users will insert and delete programs from their companies in the IPAD program library. User opinion will evaluate this capability for ease of use, operational correctness, and machine independence.

REV. B

2.4 AUXILIARY/EXTERNAL SYSTEM INTERFACES

IPAD must be flexible in regard to hardware implementation and computing facility. IPAD must be able to share data with non-IPAD systems and to safeguard and control non-IPAD data while in the custody of IPAD. Existing telecommunication standards will be used to facilitate communication between computing systems. Support software and user aids will be provided to facilitate transfer of programs, data base, etc.

2.4.1 Host/Remote System Interfaces

The requirements regarding IPAD's interface with the host system and IPAD's interface with remote systems are specified in this section. IPAD is to be flexible in regard to hardware implementation and computing facility. IPAD shall permit access to and receive data from non-IPAD systems using existing standards whenever possible. (See figure 2.4.1-1.)

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2.0 FULL IPAD REQUIREMENTS

2.4
AUXILLIARY/EXTERNAL
SYSTEMS INTERFACES

2.4.1 HOST/REMOTE
SYSTEM
INTERFACES

2.4.2 SOFTWARE
INTERFACES

101. HOST COMPUTER(S)

102. COMMUNICATION STANDARDS

103. ACCESS BY OTHER SYSTEMS
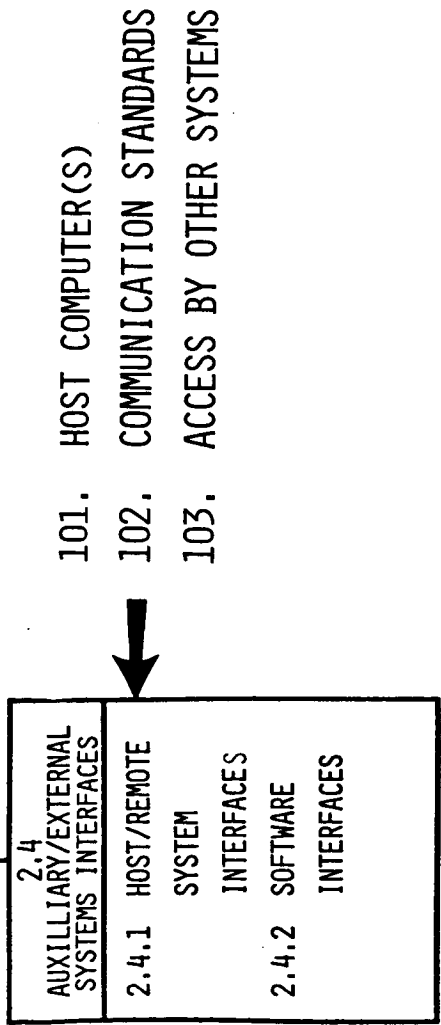
Figure 2.4.1-1   Host/Remote System Interface Requirements

SOURCE   SOW/5.3, SOW/5.3.2, 1.4/3.5.2, 1.3/3.4.2

DESCRIPTION

IPAD must be able to operate on either a single computer or on a distributed computer complex. The computing facility may be dedicated solely to IPAD use or IPAD may execute as part of a job mix. A computer complex may consist of CPU's with shared data storage units processing under single or multiple control and may include remotely connected computer facilities. The user interface to IPAD must be independent of the computing complex configuration although it may be restricted at some parts of the complex.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A user opinion survey of the ITAB members will be used to evaluate the design of IPAD with respect to the ability of IPAD to operate on a single computer or to be distributed on a computer complex.

The independence of IPAD with respect to job mix or dedicated facility will be tested by randomly selecting three functional tests for requirements to be rerun in a different environment. (If they were run on a dedicated IPAD facility, they will be run as part of a job mix and vice versa). The results will be compared with the original tests.

The user interface will be tested on all available hardware, including remote access, evaluated on the basis of invariance over hardware. All deviations will be noted and the IPAD engineering team will decide which are acceptable.

REV. B

REQUIREMENT 102 COMMUNICATION STANDARDS

SOURCE 1.3/3.4.3.1

DESCRIPTION

Communications standards should be selected to facilitate IPAD's communication between computing systems and between aerospace companies. Existing standards should be used whenever possible.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A user opinion survey will be conducted for the ITAB members to evaluate the IPAD communications standards. The standards must be judged acceptable by a majority of ITAB members.

REV. B

SOURCE   1.3/3.4.1, 1.3/3.4.3

DESCRIPTION

IPAD shall permit access to all design data under IPAD
control from non-IPAD systems. Data produced on non-IPAD systems
shall be received into any IPAD system. Such data shall have
appropriate safeguards and controls while in the custody of IPAD.
Communications with non-IPAD systems will be through standard
formats and subject to IPAD security control.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A special sample or test input data will be entered at a
remote site. The data will have security provisions. Legitimate
attempts to access this data will be made to ensure that IPAD
permits data access from a remote site. Attempts must also be
made to illegally access and change this data to test IPAD's
capability to safeguard data in its custody.

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2.4.2 Software Interfaces

IPAD shall be able to communicate with existing software systems external to IPAD and facilitate transfer of program modules, data bases, etc., between IPAD installations. Support software and user aids shall be provided for such purposes. (See figure 2.4.2-1.)
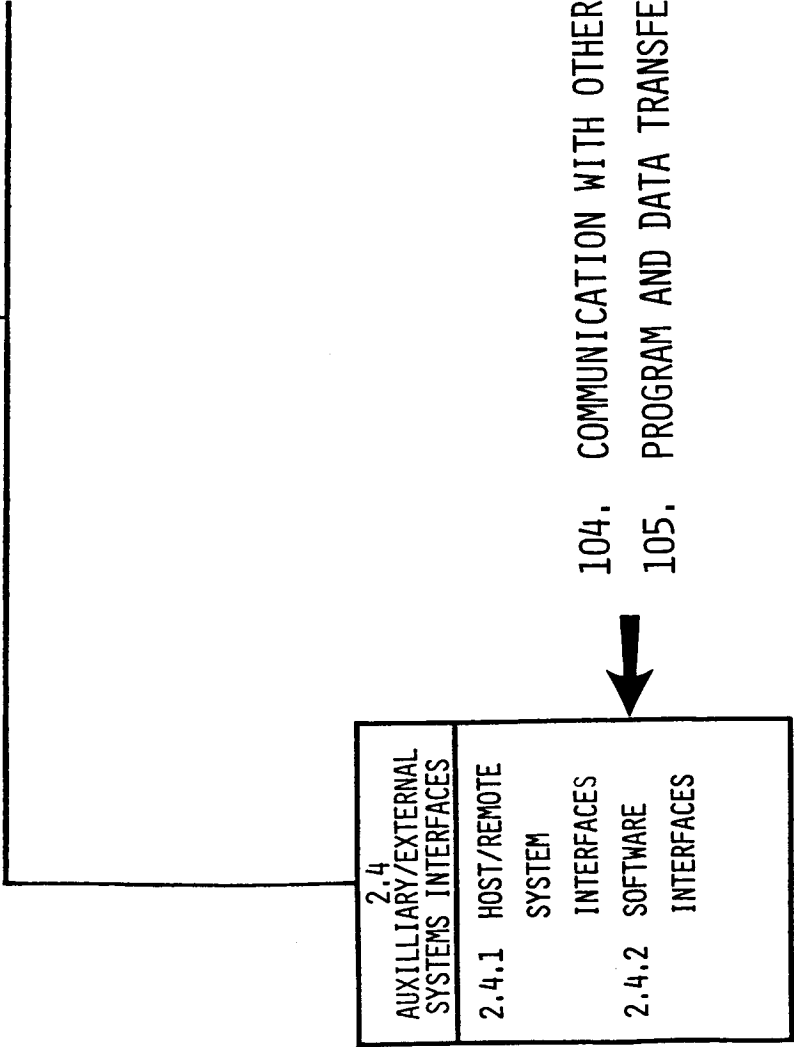
Figure 2.4.2-1　Software Interfaces Requirements

REV. B

REQUIREMENT   104 COMMUNICATION WITH OTHER SYSTEMS

SOURCE   1.4/4.4.3

DESCRIPTION

IPAD must have the ability to communicate with existing software systems external to IPAD in data forms sufficiently accurate to preserve the useability and accuracy requirement specified in requirement 110.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Data generated on an external system will be extracted and inserted into the IPAD information bank. This data will then be extracted from IPAD and returned to the external system and compared with the original data. The original accuracy must be preserved. In addition, the communication must be direct and non-cumbersome in the opinion of the testers.

REV. B

SOURCE   SOW/5.1.26, 1.4/3.3.10

DESCRIPTION

IPAD shall facilitate transfer of program modules, data, etc., between IPAD installations. Support software and user aids shall be provided to perform such data transfers and to account for differences in computer word sizes.

ABSTRACT OF THE ACCEPTANCE CRITERIA

To test this capability the following procedure will be followed:

a) Programs will be transferred from one installation to another, then back to the first, and verified to be identical using the IPAD compare utility.

b) When the programs are transfered to the second installation, test data (defined data sets) will also be transfered and the programs executed and checked to verify that execution was performed correctly.

REV. B

2.5   GENERAL SYSTEM CAPABILITIES

The general system capabilities in the area of performance, security, reliability and flexibility are discussed in this section. Regarding performance, response time must be adequate, system capabilities are only limited by the hardware configuration and adequate accuracy in storing and manipulating numeric data must be provided. Performance monitoring tools are provided to aid the system administrator.

The IPAD system shall provide fail-safe security to prevent the disclosure of information which may be detrimental to National Security or the proprietary interests of the user company. The reliability and availability of the IPAD system are important considerations but should not be limiting factors in the system's usefulness. IPAD shall be designed to be flexible when adapting and interfacing with individual installations.

2.5.1   Performance

The performance capabilities of the IPAD system are given in this section. System capacity is to be hardware configuration limited rather than software limited. Very large capacities are envisioned. Tools for performance monitoring are to be provided for the System Administrator. The ability to store numerical data with at least ten significant digits will be provided. Various accounting programs will be provided for project management, reporting and statistics. (See figure 2.5.1-1.)
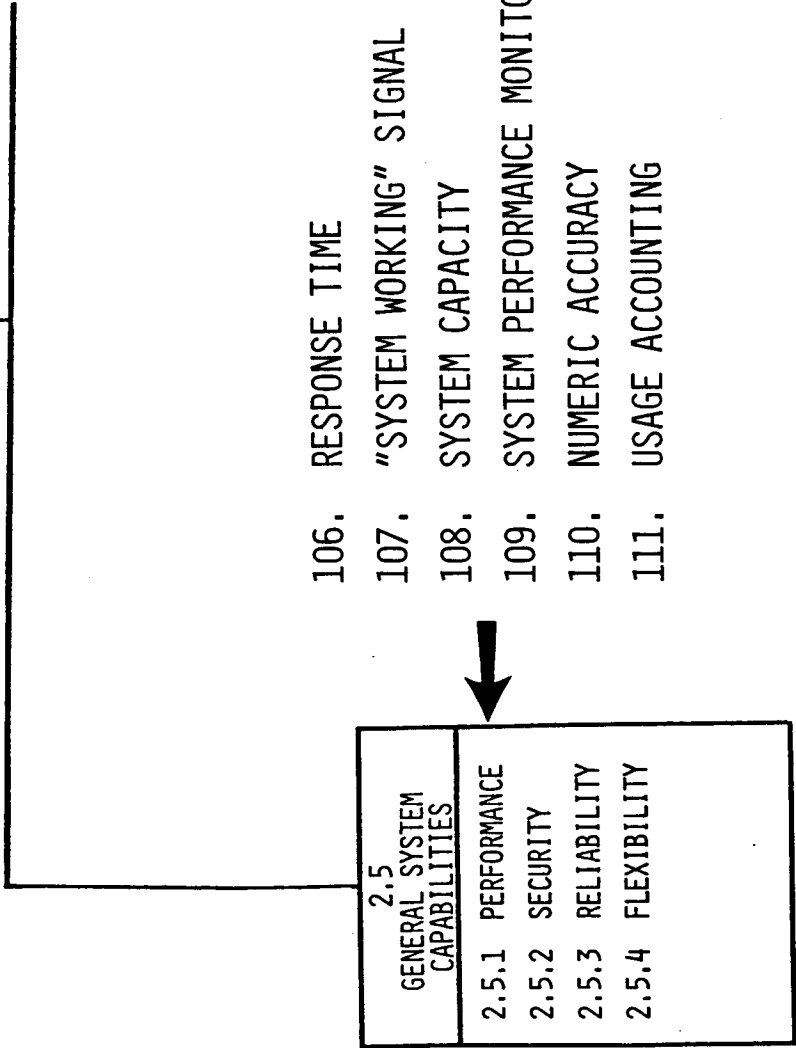
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2.0 FULL IPAD REQUIREMENTS

2.5
GENERAL SYSTEM
CAPABILITIES

2.5.1 PERFORMANCE
2.5.2 SECURITY
2.5.3 RELIABILITY
2.5.4 FLEXIBILITY

106. RESPONSE TIME
107. "SYSTEM WORKING" SIGNAL
108. SYSTEM CAPACITY
109. SYSTEM PERFORMANCE MONITORING UTILITY
110. NUMERIC ACCURACY
111. USAGE ACCOUNTING

Figure 2.5.1-1   Performance Requirements

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REQUIREMENT   106 RESPONSE TIME

SOURCE   1.4/3.1.2, SOW/5.1.1

DESCRIPTION

    IPAD shall provide for adequate response time. Guidelines
for desirable response times which should be sought are as
follows.

    Response time is defined as the time elapsed between the last
input by the user and the first character displayed by the
computer.

    The response times given are those for which the user will be
comfortable and continue to utilize the terminal for his purposes.

    (15 to 60 seconds)

        Some log-on/log-off functions where the user is familiar
        with the delay.

        Single enquiries where the user is familiar with the
        delay, preferably cued by a messaged from the computer
        within two seconds acknowledging the command.

        System failures and recoveries, preferably cued, where
        possible, by a message from the computer within two
        seconds warning of the delay.

        Loading of programs and data for execution and
        processing, preferably cued by a message within two
        seconds acknowledging the command.

        Restart from a prior session.

    (4 to 15 seconds)

        Low key enquiry dialogue possible but awkward.

        Intense creative dialogue not possible.

    (2 to 4 seconds)

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Complex enquiries where continuity of thought is necessary.

Initial acknowledgment by the system that it is "listening."

Error messages.

(Less than 2 seconds)

Intense creative dialog.

Acknowledgment by the system that a command has been received.

Response to a paging request through a keyboard.

(Less than 1 second)

Response to a paging request using a light pen.

Development of geometric entities.

(Less than 0.1 seconds)

Brightening of characters from a light pen selection.

Appearance of a line when using the light pen as a drawing stylus.

Appearance of a character on a CRT keyboard.

The critical threshold for effective creative dialogue is two seconds. Beyond two seconds mental efficiency degrades rapidly. Delays beyond fifteen seconds should be structured to relieve the user of both mental and physical captivity. Experienced users will prefer faster response times.

Deviations - permissible deviations in response times depend upon the activity. Response times less than two seconds should not vary by more than 100%.

ABSTRACT OF THE ACCEPTANCE CRITERIA

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The response times in the interactive mode will be monitored and recorded by activity throughout the test period. Acceptance will be based on user satisfaction and the response times that are recorded. User opinion will be solicited.

REV. B

REQUIREMENT   107 "SYSTEM WORKING" SIGNAL

SOURCE   1.4/4.1, SOW/5.1.1

DESCRIPTION

If an IPAD command, or application program execution requires
more than x seconds of time, the system shall display a signal
every x seconds (flashing) to indicate to the user that the
computer is working. The user may specify x but the default value
shall be 5 seconds.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The "system working" signal will be tested in conjunction
with other tests both for user specified ("X") seconds response
and the default (5 seconds).

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REV. B

REQUIREMENT   108 SYSTEM CAPACITY

SOURCE   SOW/5.1.1, 1.4/4.6.1, 1.4/2.1.2

DESCRIPTION

The IPAD System capacity shall be considered to be "hardware configuration limited" with no actual restriction placed on the IPAD System.

Capacity here refers to computer memory capacity, size of information bank, the number of interactive terminals simultaneously in use, etc.

Explanation: The capacities envisioned are very large. For example, the number of interactive terminals simultaneously in use is expected to be very much greater than 100, likely to exceed 400, and may grow to several thousand.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The capacity of the IPAD system must be proven to be limited only by hardware configuration. In addition to saturating the acceptance test hardware configuration, simulation techniques will be used to test this aspect of the system. Procedures for developing the simulation models must be prepared and approved for each aspect of system loading prior to testing this requirement.

REV. B

SOURCE   SOW/5.2.1.7, 1.4/4.3.1, 1.4/2.9.2, 1.4/4.3.2,
           1.3/3.3.5.3

DESCRIPTION

A complete set of software tools shall be provided for performance monitoring by the System Administrator. The tools shall include a software probe capable of gathering a complete set of performance parameters over the entire spectrum of IPAD activities so that fundamental software and hardware activities (data transfers, disc accesses, etc.) can be related to user level actions (e.g., specific commands and operands). The probe shall:

a) Be operational in a production environment and shall not seriously perturb system resource utilization by more than 5%.

b) Be capable of producing statistical summaries as well as a complete chronological trace of all or any part of the measured IPAD performance parameters.

c) Have a "mode;" e.g., inactive, summary, or complete trace, that is dynamically selectable by the System Administrator.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The System Administrator shall demonstrate the software tools for system performance monitoring throughout the acceptance testing. It must be shown that the features described in this requirement are available and that the software probe fulfills the monitoring functions described. The testing procedures must be developed for the monitoring aspects once they have been defined. Several hardware and software conditions will be simulated to test as broad a spectrum of the IPAD system operation as practical.

REV. B

REQUIREMENT   110 NUMERIC ACCURACY

SOURCE   1.4/4.4.1

DESCRIPTION

The system shall have the ability to store numerical data
with at least 10 significant digits and to perform arithmetic
operations with no additional loss of accuracy other than that
imposed by purely mathematical considerations.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The significant digit accuracy (at least 10 significant
digits) will be tested by several users by comparing computational
results with known accurate results (from other computer programs
outside of IPAD or calculator computations).

REV. B

SOURCE   1.4/3.3.14, 1.4/3.3.11, 1.3/3.3.7, SOW/5.1.15,
           SOW/5.2.1.6

DESCRIPTION

IPAD shall provide the capability of determining how data and
system resources are used. This shall be in the form of a data
base audit facility and a system resource accounting facility.
The following capabilities shall be included in the data base
audit facility:

- Determine the origin of data: Originator I.D., date of
  creation, trace of antecedents for data sets.

- Most recent date of reference to data.

- I.D. of all recent users within installation specified
  time.

- Count of the number of accesses to data.

- Count of unauthorized attempts to access data.

The system resource accounting facility shall include:

- Processor time for all jobs.

- Memory utilization for program memory and secondary
  storage (disks, tapes, etc.)

- Permanent file utilization.

These facilities will be used in support of utilities such as
project management aids, usage statistics reports and report
generators.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The data base audit facility will be tested by requesting
reports on data set accesses to include:

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a) Origin of data (originator I.D., etc.)

b) Most recent date of access

c) I.D. of most recent user

d) Count of number of accesses to data

e) Count of number of unauthorized attempts to access data.

In addition the system resource accounting facility will be tested by requesting reports to include:

a) Processor times for jobs.

b) Utilization of program memory and secondary storage.

c) Permanent file utilization.

The reports will be generated in conjunction with other acceptance tests and compared to known information where possible. Reports must be accurate to within ±5% when compared to known operation.

2.5.2 Security

The IPAD system is to be fail-safe in security. Means will be provided to prevent the disclosure of information which would be detrimental to National Security or the proprietary interests of the user company. System failure must not result in the degradation of IPAD security controls. (See figure 2.5.2-1.)

REV. B

2.0 FULL IPAD REQUIREMENTS

2.5
GENERAL SYSTEM
CAPABILITIES

2.5.1 PERFORMANCE
2.5.2 SECURITY
2.5.3 RELIABILITY
2.5.4 FLEXIBILITY

112. PROPRIETARY INFORMATION PROTECTION
113. FAIL-SAFE SECURITY
114. NATIONAL SECURITY
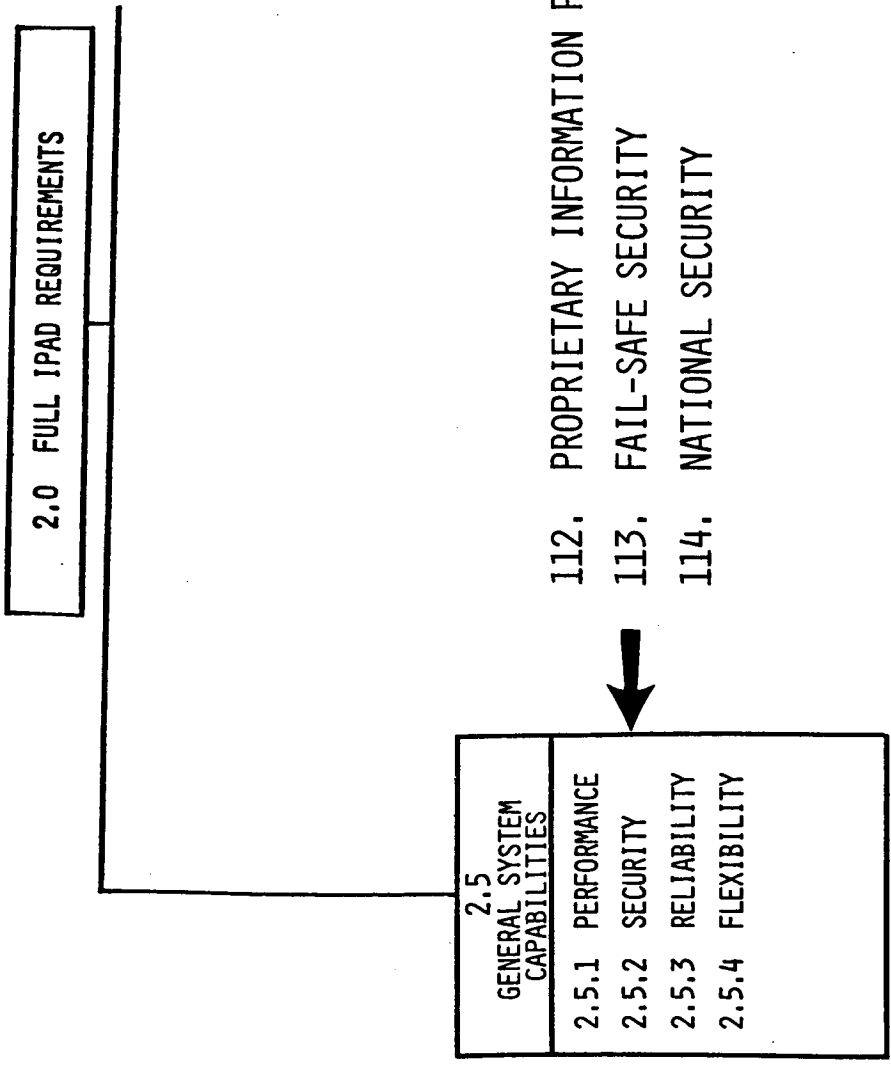
Figure 2.5.2-1   Security Requirements

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SOURCE   1.4/2.8.2

DESCRIPTION

IPAD shall provide the means to prevent the disclosure of information which would be detrimental to the proprietary interests of the company.

This may be achieved through security codes assigned to individual users. These codes will address the various levels of sensitivity of protection required of different information. The number and character of the protection levels may be optional to satisfy individual company requirements.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Test the IPAD system provisions to prevent disclosure of proprietary information. A group of users for a typical company will be identified having the following types of data access control: 1) Unclassified data only; 2) Company limited data; 3) Company proprietary data; 4) joint venture proprietary data; and 5) third party proprietary data. Both valid and invalid attempts to access data sets with corresponding security will be made to test the proprietary information security of IPAD.

REV. B

REQUIREMENT   113 FAIL-SAFE SECURITY

SOURCE   1.4/2.8.2

DESCRIPTION

Failure of the IPAD System shall not result in a degradation of the security controls provided by the system. The system will be fail-safe from the security viewpoint.

ABSTRACT OF THE ACCEPTANCE CRITERIA

A number (determined in testing) of deliberate failures will be effected without warning when data sets or data areas designated as "classified" are in the IPAD system. Separate tests of failures involving the IPAD system, the host operating system, and the hardware components will be conducted. The security controls for classified and unclassified data will be checked by both authorized and unauthorized users immediately after failure, and again, after normal operation is restored. The security controls must be maintained during and after system failure.

REV. B

SOURCE   1.4/2.8.2

DESCRIPTION

IPAD shall not preclude operating in accordance with the current Industry Security Manual For Safeguarding Classified Information (DOD5220.22-M).

ABSTRACT OF THE ACCEPTANCE CRITERIA

The IPAD system must be checked to verify that it can operate in accordance with the current DOD security manual for industry. The host operating system and the IPAD system (including the distributed processing area) will be secured in order to enter and process data sets and data areas classified by national security regulations as confidential, secret, and top secret. Authorized and unauthorized users will then attempt to access the data.

REV. B

2.5.3 Reliability

The reliability and availability of the IPAD system are important considerations. They should not be limiting factors in the system's usefulness. (See figure 2.5.3-1.)

REV. B

2.0 FULL IPAD REQUIREMENTS

2.5
GENERAL SYSTEM
CAPABILITIES

2.5.1 PERFORMANCE

2.5.2 SECURITY

2.5.3 RELIABILITY

2.5.4 FLEXIBILITY

115. SYSTEM RELIABILITY

116. SYSTEM AVAILABILITY

Figure 2.5.3-1   Reliability Requirements

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REV. B

REQUIREMENT   **115 SYSTEM RELIABILITY**

SOURCE   1.4/3.1.3

DESCRIPTION

The reliability of the IPAD System, hardware, and operating system will be such that system reliability need not be a specific planning consideration for IPAD users or the system administrator.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The reliability of the IPAD system, hardware and operating system shall be monitored for a 4 week period aligned with the test of requirement 116--IPAD System Availability. The system shall function properly. Any error detected in calculations, data management or any function of the IPAD system, hardware or operating system shall be considered a failure to meet the reliability requirement.

REV. B

REQUIREMENT   116 SYSTEM AVAILABILITY

SOURCE   1.4/4.2.2

DESCRIPTION

During any consecutive four week period, the minimum average user availability for the IPAD system shall be 97.5% of the total available host computing time allocated to IPAD. The IPAD system is considered available when a user is able to productively perform his desired objectives.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The IPAD System scheduled availability will be monitored for a 4 week period. This test will be conducted concurrently with all acceptance testing. The system availability shall not be less than 97.5% of the scheduled availability. During this test, the scheduled availability will not be less than 8 hours per day.

REV. B

2.5.4 Flexibility

IPAD is designed to be flexible in adapting to and interfacing with individual installation. Modular functional capabilities, specialized interfacing capabilities, and variable parameters are provided to aid flexibility. (See figure 2.5.4-1.)

REV. B

2.0 FULL IPAD REQUIREMENTS

2.5
GENERAL SYSTEM
CAPABILITIES

2.5.1 PERFORMANCE
2.5.2 SECURITY
2.5.3 RELIABILITY
2.5.4 FLEXIBILITY

117. MODULAR DESIGN
118. SYSTEM PARAMETERS

Figure 2.5.4-1   Flexibility Requirements

REQUIREMENT   117 MODULAR DESIGN

SOURCE   1.4/3.5.4, 1.4/2.1.5

DESCRIPTION

IPAD shall be designed so that the functional capabilities
are modular, allowing a company to gradually adopt IPAD to their
needs. Specialized interfacing facilities shall be provided by
IPAD to aid users in designing interfaces to systems outside IPAD.

ABSTRACT OF THE ACCEPTANCE CRITERIA

An initial version of IPAD will be brought up, including only
the minimum IPAD functions and data set management. A test must
show that this software configuration is operational.

Additional functional capabilities will be added one at a
time, with complete system testing after each addition. Functions
added and tested will include process definition, data element
management, project definition, and schedule control.

The IPAD facilities to aid design of interfaces to systems
outside of IPAD will be tested for two external systems: 1) IPAD
geometry data sets to be interfaced to a remote release system and
2) IPAD cost data interfaced to an external management system.
The facilities to support interface design will be evaluated for
ease of use and adequacy.

REV. B

SOURCE   1.4/2.1.6, 1.3/3.3.5.3

DESCRIPTION

Parameters are directly or indirectly associated with many requirements. Such parameters would include the period of time for messages to be automatically erased, the arrangement for user appointments, etc. Values for these parameters shall be easily set by an individual installation.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Tests shall be made to ensure that an individual installation has the ability to specify all variable IPAD system parameters and verify that these parameters operate correctly. Tests shall also be made to determine that the installation is able to easily change these parameters. Where a parameter is limited to a range of values, it must be verified that an invalid value may not be specified, but that the upper and lower bounds to the range are acceptable.

All variable IPAD system parameters are tested and initialized to valid default values if unspecified by the installation, and that the parameters so set are tested to ensure that they operate correctly.

REV. B

2.6 GRAPHICS

Graphics standards for communicating between devices will be established. Graphic equipment interface software will be provided within IPAD to accommodate a prescribed assortment of graphical equipment.

2.6.1 Graphics Standard

A standard graphics software package will be provided consisting of lower level primitive routines which will minimize machine dependence and will be capable of supporting a wide range of graphics devices. These basic functions will allow development of sophisticated graphics related applications.

IPAD shall provide both data explosion and data compression techniques for converting data from the IPAD standard formats to the format required by dumb and intelligent type terminals, respectively. Compression techniques shall also reduce the amount of data sent over communication lines. (See figure 2.6.1-1.)

REV. B

2.0 FULL IPAD REQUIREMENTS

2.6 GRAPHICS

2.6.1 GRAPHICS STANDARD

2.6.2 DEVICE INTERFACE

119. GRAPHICS PRIMITIVES
120. COMMUNICATION STANDARD FOR NON-INTELLIGENT GRAPHICS TERMINALS
121. COMMUNICATION STANDARD FOR INTELLIGENT GRAPHICS TERMINALS

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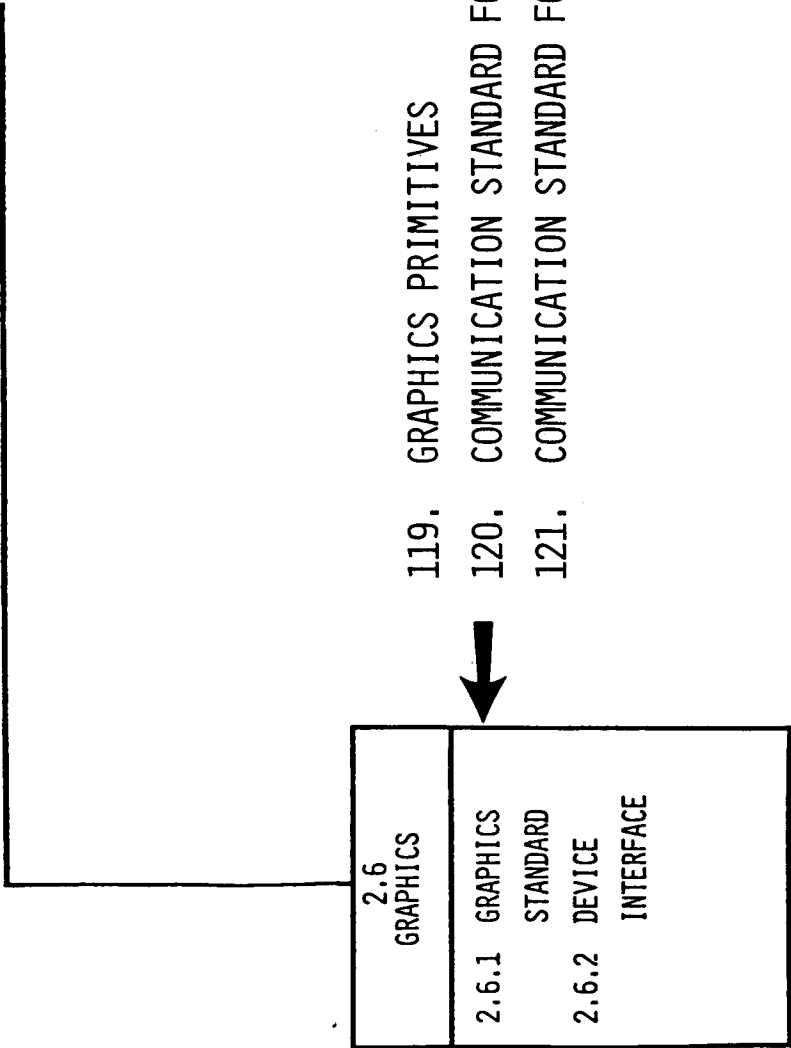
Figure 2.6.1-1   Graphics Standard Requirements

REQUIREMENT   119 GRAPHICS PRIMITIVES

SOURCE   BCAC-NASA

DESCRIPTION

A standard graphics software package consisting of primitives
which embody the concept of device independence will be provided
in IPAD (similar to subroutine package being defined by SIGGRAPH).
Examples of functions to be provided include:

1. Line drawing

2. Text drawing

3. Segments

4. View transformation

5. Attributes

6. Control

7. Input

ABSTRACT OF THE ACCEPTANCE CRITERIA

An application program which uses the graphics software
primitives will be written and tested using a variety of devices
to verify that the graphics software package functions correctly.

A user opinion survey will be used to determine if the
systems design meets the organizational specifications of the
requirement. The efficiency of the graphics primitives will also
be evaluated by the users.

REV. B

SOURCE   BCAC-NASA

DESCRIPTION

IPAD shall establish standards for communication with dumb
graphics terminals, which recognize coordinate data only, and
provide for conversion of geometry data stored in IPAD's standard
geometry format prior to transmitting them to such terminals.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The IPAD standards for communication with dumb graphics
terminals will be evaluated during system design by a group of
users.

In testing, a data set containing geometric data in the IPAD
standard geometry format will be created. This data will then be
converted to the standard communication interface format and then
transmitted to each type of dumb graphics terminal supported by
IPAD to test the functionality and efficiency of the IPAD
conversion and transmission software.

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REQUIREMENT   121 COMMUNICATION STANDARD WITH
                   INTELLIGENT GRAPHICS TERMINALS

SOURCE   BCAC-NASA

DESCRIPTION

    IPAD shall establish standards for communication with
intelligent graphics terminals. Such standards shall be intended
to improve response time. If required, IPAD shall provide for
conversion of geometry data stored in IPAD's standard geometry
format prior to transmitting them to such terminals.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    During systems design, users will evaluate the IPAD standards
for communication with intelligent graphics terminals,
particularly in respect to the goal of reducing response time.

    In testing, the data set containing geometry data which was
created for requirement 120, ACT 1 will be converted to the
standard communications interface format for intelligent graphics
terminals. This data will then be transmitted to each type of
intelligent graphics terminal supported by IPAD to test the
functionality and efficiency of the IPAD conversion and
transmission software.

2.6.2 Device Interface

IPAD shall provide interface software for a prescribed assortment of graphical equipment. (See figure 2.6.2-1.)

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2.0 FULL IPAD REQUIREMENTS

2.6 GRAPHICS

2.6.1 GRAPHICS STANDARD

2.6.2 DEVICE INTERFACE

122. GRAPHICS INTERFACE SOFTWARE

Figure 2.6.2-1 Device Interface Requirements

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<u>SOURCE</u>   1.4/3.1.1

<u>DESCRIPTION</u>

IPAD shall provide interface software for the following graphics devices:

Tektronics
VG3300
SC 4020
IBM 2250
763 Calcomp
Flatbed plotter
Scanning units
Digitizer
Microfilm plotter
Projection devices

This interface software shall provide the transformations and other capabilities required to make the graphics software independent of the graphics devices.

<u>ABSTRACT OF THE ACCEPTANCE CRITERIA</u>

Interface software for all devices listed below will be tested either on-line or off-line as appropriate. Specific models must be specified for those devices listed as general types.

Tektronics
VG 3300
SC 4020
IBM 2250
763 Calcomp
Flatbed Plotter
Scanning Units
Digitizer
Microfilm Plotter
Projection devices

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2.7 GRAPHICS RELATED TOOLS

IPAD shall provide a variety of functions to support CAD, NC and related analyses. Tools shall be provided to construct and display engineering designs and data plots. Animation techniques shall be provided for display of dynamic phenomena. Standard and extended geometry formats shall be supported. Conversion utilities shall be provided to convert geometry formats to a standard format for communication purposes.

2.7.1 Graphics Related Programming Tools

Graphics related programming tools shall be provided to allow the development of sophisticated graphics capabilities from the standard graphics software primitives. An animation package shall be provided to display dynamic phenomena. (See figure 2.7.1-1.)

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2.0 FULL IPAD REQUIREMENTS
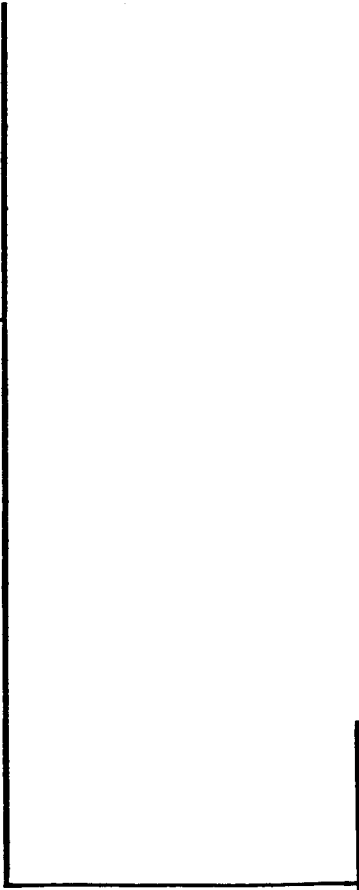
2.7 GRAPHICS RELATED TOOLS

2.7.1 GRAPHICS RELATED PROGRAMMING TOOLS

2.7.2 GEOMETRY

123. GRAPHIC DISPLAY OF NUMERICAL DATA

124. ANIMATION PACKAGE

125. GRAPHIC PROGRAMMING TOOLS

Figure 2.7.1-1   Graphics Related Programming Tools
Requirements

REQUIREMENT   123 GRAPHIC DISPLAY OF NUMERICAL DATA

SOURCE   1.4/2.5.4, SOW/5.1.4

DESCRIPTION

IPAD shall include comprehensive capability for conversion of
numerical data into graphical format such as: multiple x-y plots,
bar charts, contour plots and carpet plots.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The IPAD capability to convert numerical data into graphical
format will be tested in conjunction with other graphics
requirements as well as by a seperate operation. The primary
considerations are the user's ease of conversion and the accuracy
of the conversion. All graphic formats available in IPAD will be
tested.

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SOURCE   1.4/3.4.3, SOW/5.2.4.2

DESCRIPTION

IPAD shall provide an animation package to help display dynamic phenomena flicker free. The result will be either viewed directly on a scope, or generated on a movie film for later display.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The animation package will be tested by developing an animated sequence and viewing it on a scope and then generating it on a movie film to be viewed off-line. Accuracy and quality of the animation both on scope and on film will be the acceptance criteria.

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SOURCE   1.4/3.4.2, SOW/5.2.4.1

DESCRIPTION

Graphic programming tools shall be provided through support routines. These routines will allow development of a sophisticated graphics capability from simplified building blocks. The following functions shall be provided:

- Superposition of text horizontally, vertically, or at an angle.

- Menu and message display.

- Decoding of integer and floating point variables for graphic textual display.

- Numerical data display with editing capability.

- Change of drawing scale, two- and three-dimensional windowing and clipping.

- Shading, hidden surface and line removal.

- Dynamic write protection for any part of the screen.

- Ability to obtain hardcopy of screen contents (e.g., on plotter or hardcopy unit attached to graphical display device).

- Grid and graph generation, including labels and titles.

- Graphic INPUT (e.g., keyboard, lightpen, function button, digitizer)

- Variety of dashes for vector plotting.

- Variable plot intensity, including blinking.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The graphic programming tools listed in this requirement will be called from a selected pre-existing graphics program which uses these options extensively. The results of running the program using IPAD should agree with the results under non-IPAD usage. The ease of conversion will also be a test criteria. Program efficiency in the IPAD environment should at least equal its non-IPAD efficiency.

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2.7.2 Geometry

IPAD shall provide a wide variety of CAD/CAM geometric entities for the construction and display of engineering designs. A standard geometry format for communications shall be provided.

IPAD shall provide tools to define cutter paths utilization CAD engineering design geometries and shall also provide a utility to convert the same geometry to APT geometry source format. (See figure 2.7.2-1.)

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│  2.0  FULL IPAD REQUIREMENTS │
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                │
    ┌───────────┴──────────────┐
    │      2.7                  │
    │ GRAPHICS RELATED TOOLS    │
    ├──────────────────────────┤
    │ 2.7.1 GRAPHICS            │
    │       RELATED             │
    │       PROGRAMMING         │
    │       TOOLS               │
    │                           │
    │ 2.7.2 GEOMETRY            │
    └──────────────────────────┘
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126.   DESIGN DRAFTING CAPABILITIES

127.   GEOMETRY CONVERSION TO APT FORMAT

128.   STANDARD GEOMETRY FORMAT

129.   NUMERICAL CONTROL CAPABILITIES
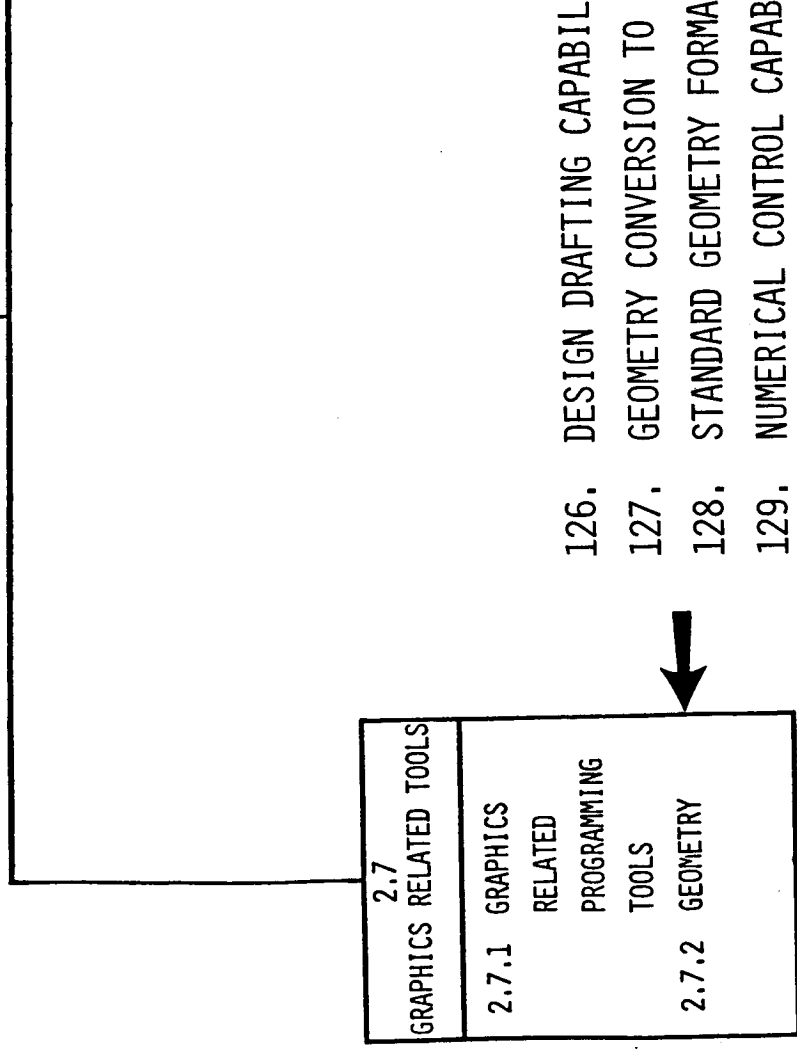
Figure 2.7.2-1   Geometry Requirements

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SOURCE   1.4/3.4

DESCRIPTION

IPAD shall provide the following CAD entities:

PLAN FORMS IN ANY PLANE OF SPACE

- Point

- Line

- Circle or circular arc

- Fillet

- Ellipse

- Hyperbola

- Parabola

- General conic

- Cubic spline

- Rectangle

- Triangle

- Hexagon

- Entity string

NON-PLANAR FORMS

- Cubic spline

- Surface of revolution

- Ruled surface

- Developed surface (flat pattern)

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- Curve mesh surface

- Fillet surface

- Surface intersection curve

- Draft curve

- Surface edge curve

IPAD shall further provide the following CAD functions:

FUNCTIONS SUPPORTING GRAPHIC DEVELOPMENT

- Break away lines

- Generate array of entities

- Entity group

- Pattern of entities

- General notes

- Labels

- True position symbols

- Dimensioning (manual and automatic)

- Balloon labels

- 2D section properties

- 3D analysis

- Mirror entities

- Variable line fonts

- English/metric conversion

- Blank/unblank

- Delete

- Detail magnification

- z clipping/peeling

- View/depth modification

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- Variable view point location (orthographic, auxiliary)

- Automatic scaling

- Plotter output

- Composite surfaces with the option for surface blending.

- Cross-sectioning island techniques.

- Interactive hidden line removal or truncation for "cleaned up" views.

- Display and allow modification of the definition (canonical) form of all entities.

- Entity selection for all functions by cursor position, sequence number, pointer or "all within diagonal points."

- Provide macro capability for capturing and naming a sequence of construction operations allowing that sequence to be invoked by name.

- Provide capability where any solid can be sliced by any plane or surface. The resultant cross-section can be used for the following functions: dimensions, analysis, cross-hatching, and further construction.

- Both 2D and 3D non-montonic splines.

- Data plot system including generation, naming, filing and recall of graphs and histograms.

- Provide capability to construct normal areas with trim options.

- Chamfer line with trim options.

- Auto chamfer/fillet capability for open and closed figures.

- Translate, rotate, duplicate with following facilities: 1) "Repeat" n times, 2) Include scaling, 3) Tool paths are included, 4) Depth is added to translation.

- Provide the means to define and display up to 32 simultaneous view areas controlled by user with auto rescale.

- Provide for "remembering" entities selected for a series of operations without forcing a reselection.

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- User defined symbol or character set.

- Provide capability to go directly to point, line or arc from anywhere using K/B commands.

- Allow user to change display tolerance (for curves) to speed display generation.

- Lockout rejected entity until another entity has been selected.

- Provide FORTRAN COMMON to expand with added system capabilities without obsoleting old drawings.

- Provide extended spline analysis via line printer or CRT output (e.g., slope at each point).

- Provide calculator like capabilities including the use of named variables, evaluating expressions and functions to be input where numeric input only is now permitted.

- Provide extended analytic function including: CG, AREA, CURVE LENGTH, distance between entities, etc.

- Provide loft conic.

- Allow a BASIC DIMENSION or REFERENCE BLOCK to be placed around any drafting LABEL or DIMENSION.

- Provide automatic text arrow control for linear dimension based on origin selection.

- Treat a set of contiguous curves as a single curve for purposes of surface definition, machining applications and construction.

- Associative graphics geometry data base which include the following relationships: inclusion, causality, and connectivity.

- Character recognition to input system commands with "teach" mode.

- Provide for data unit having the attribute which when changed causes the change to be reflected throughout the data base for all instances where it is used.

- Within a macro, provide FORTRAN capabilities such as GOTO, IF, and statement labelling.

- Provide batch mode capability.

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- Provide capability for working in different coordinate systems, e.g., wing to body.

- Find slope and curvature of any curve at a specified point.

- For any 3D curve, given 2 coordinates, find the 3rd coordinate nearest the cursor position.

- Provide chord-neight-tolerance point matrix for any curve.

- Allow any curve to be generated from coefficient inputs.

- Provide annullment of curves, surfaces, and volumes (resultant curves must be continuous) e.g., a window "subtracted" from a surface.

- Define a 3D curve as 2 2D curves in different views.

- Provide the capability to label entities as they are created, e.g., P35 = X Y Z.

- Provide both function button and mnemonic input modes.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The computer aided design (CAD) entities and functions listed in this requirement will be tested in conjunction with requirement 125, ACT 1. The procedure will include the development of geometric packages that will incorporate all of the entity features and can be operated on to use all of the listed functions. The entities and functions can be tested in any combination and sequence as determined by the users; each entity and function will be tested by several users and in several contexts. The criteria for this test will be accuracy, efficiency and ease of operation.

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SOURCE   BCAC-NASA

DESCRIPTION

    IPAD shall provide a utility to convert geometry data from
the IPAD communication format to APT geometry source format. For
this purpose a specific APT format shall be selected.

ABSTRACT OF THE ACCEPTANCE CRITERIA

    The specific APT format to be used for testing will be
selected with the assistance of ITAB members. The utility to
convert geometry data to the APT geometry source format will be
tested with a geometry package already developed and used in an
APT program. The CL data will be developed for a zero diameter
cutter and plotted full size on mylar off-line on a flat bed
plotter. The plot will be compared to results achieved outside of
IPAD. Plots developed with APT geometry must agree with
previously developed geometry within .001". Efficiency to be
specified.

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SOURCE   1.3/3.4.3.2

DESCRIPTION

IPAD shall provide a standard geometry format. The entities supported by IPAD will include those recommended by ANSI Y14.26.1. IPAD shall include ways to generate elements and shall allow a nonassociative coefficient format. The IPAD standard format should adhere to the following:

a)   Be restricted to bounded geometry in parametric form;

b)   Accommodate new element types and geometry techniques as they are developed;

c)   Operate in multiple dimensions (e.g., 2D or 3D) according to the needs of the user;

d)   Include a hierarchical structure for relating data.

IPAD shall include the ability to transform between its standard geometry format and the Y14.26.1 standard for communication. IPAD will allow the representation of entities in nonparametric form but will not support transformation between parametric and nonparametric representations.

ABSTRACT OF THE ACCEPTANCE CRITERIA

The IPAD standard geometry format will be evaluated as follows:

Geometry data types shall be as follows: engineering drawings, idealization of major aircraft components for analysis and aircraft structure in sufficient detail for detail design and manufacture by a subcontractor.

Data in the coefficient format will be transmitted to the IPAD standard format and back to the coefficient format.

Data in the IPAD standard format will be transmitted to the ANSI Y14.26.1 communications standard and back.

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The acceptance criteria is that IPAD allow the above function to be performed with no change in the accuracy of the geometric data.

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129 NUMERICAL CONTROL CAPABILITIES

SOURCE   1.4/3.4

DESCRIPTION

    The system shall provide the following NC capabilities.

    • Constrain CL output to the configuration supplied by the
      MULTAX APT statement in support of 4 and 5-axes
      machining.

    • Allow any postprocessor command to be inserted, for
      inclusion in the CLFILE, after each complete tool path.

    • Display approximate machining time on demand for every
      complete tool path, or all tool paths generated.

    • Provide CLFILE editor.

    • Provide circular interpolation, if applicable, for any
      Pocket/Profile or /Lathe finish paths in which lines and
      arcs are the only entity types.

    • Provide separate path generation with optional separate
      tool for 3-axis and 5-axis contouring to allow fewer
      paths and larger tolerance.

    • Buffer Pocket/Profile/Lathe data so that the number of
      approximating segments is limited only by disk size.

    • Allow user to enter a secondary feedrate statement when
      cornering. (This will override any automatic system
      generated feed rate).

    • Provide for machining around bosses while in the lace
      mode of 3-axis and 5-axis end cutting.

    • Allow a rough distance to be kept while in the 3-axis or
      5-axis end cutting modes.

    • Allow machining the resultant of any curve projected to
      any surface in either the 3-axis or 5-axis end cutting
      modes.

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- Provide continuous check of cutter interferring with walls while machining a region bounded by surfaces in the 5-axis end cutting mode.

- Provide graphic lathes module with the following major functions: TURN, FACE, BORE, CONTOUR, GROOVE, TAPER, THREAD, TOOL.

- Provide dynamic tool display and positioning for cut vector insertion/modification or LATHE check surface creation.

- Place direction arrowhead on tool path display.

- Allow accessing individual cut vectors in order to modify, delete, or insert cut vectors.

- Provide a choice of tangent, secant, or chordal approximation for all curves used in pocket, profile, or lathe path generation.

- Provide INTOL and/or OUTTOL approximation for all surface used in 3-axis and 5-axis contouring.

- Incorporate the APT MACRO capability.

- Surface display control including number of paths, fineness and direction of path.

- Provide 10 standard APT vector definitions and display same with an arrowhead indicating direction.

- Provide the 7 standard APT plane definitions, planes are displayed as infinite entities.

- Provide standard APT definitions for surface and solids including: sphere, cylinder, core, torus, hexahedron, spheroid, ellipsoid, circular rod and toroid.

- The means to define the intersection of a curve and a surface (point x,y,z) also the direction cosines of the normal at that point.

- Provides deep hole chip removal sequence; user defined drill cycle; piercing operation; G80 drill cycle output; 3,4,5 axis point-to-point operations.

- Provides user choice of simple or complex analysis; handles pockets of any depth and any planar bottom; provides cornering feedrate control.

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- Provide option to specify number of paths for display, allow for a pause to insert tool path motion, continue or quit and save.

ABSTRACT OF THE ACCEPTANCE CRITERIA

Utilize APT numerical control programmers of various skill levels to test the NC capabilities listed in this requirement. The capabilities are not sequential in nature. Each NC programmer can select those capabilities to be tested but several should test each capability for final evaluation. The parameters to be checked include ease of command, response time accuracy and usability of CL output. A test part (or parts) should be machined for a complete evaluation. The geometry that is used for the CAM functions should be generated using CAD functions (requirement 126).

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APPENDIX A

Cross reference listing of requirements
by number then by title.

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IPAD REQUIREMENTS

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APPENDIX B

BRIEF REQUIREMENT DESCRIPTION

2.1   USER INTERFACE

2.1.1   USER LANGUAGE

1. **User Language**

   IPAD user languages shall be user-
   oriented, consistent in vocabulary
   and syntax.

2. **User Skill Levels**

   IPAD shall address the problem of
   variation in expertise.

3. **Error Diagnostics**

   IPAD shall provide flexible error
   diagnostic capabilities which are
   helpful, complete, user-friendly, etc.

4. **Command Language Functions**

   IPAD shall provide a user command
   language comprised of IPAD executive
   level commands and commands in sub-
   ordinate user languages.

5. **User Aides**

   IPAD shall assist the user in accomplish-
   ing his design task by providing a
   description and overview of capabilities
   available in the IPAD system.

6. **Command Language**

   IPAD command language shall be engineer-
   ing-user oriented.

7. **Access to Host O/S Functions**

   IPAD shall allow access to the host
   operating system capabilities.

8. **Command Prompts**

   IPAD shall interpret commands into
   appropriate operating system functions
   supplying defaults, accepting abbre-
   viated commands, etc.

9. **User Access Control**

   IPAD shall provide the capability for a
   manager to control the set of commands
   available to an individual IPAD user.

10. **Exit Reports**

    IPAD shall provide reports of the status
    of data sets affected by the current
    IPAD work session, resources used,
    messages on file, etc.

11. **Query Language**

    IPAD shall provide an interactive query
    language supporting logical requests
    which may include arithmetic operations
    and refer to any data element.

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| 12. | Header Data Query | IPAD shall provide the capability to query header data. |
| 13. | Management Query | IPAD shall provide the capability to interrogate the official project data. |

2.1.2   USER TOOLS

14.	Utility Programs	IPAD shall provide an open-ended set of machine-independent interface utilities.
15.	Edit Utility	IPAD shall provide a general text-editing and update capability permitting on-line development of programs, changes to source modules, and selective display of the current data set and data in response to the current command.
16.	Document Utility	IPAD shall provide a complete capability to enter, maintain, and print documents.
17.	Reporting Utility	IPAD shall provide means for user-requested and automatic reporting.
18.	Menu Building Utility	IPAD shall provide aids for planning-and-preparation phase usage in establishing individual user command menus.
19.	Organization Lists Utility	IPAD shall provide the means to produce corporate-like organizational lists down to individual named members and associated descriptors.
20.	Mail List Utility	IPAD shall provide a flexible means of constructing/accessing data for mailing lists.
21.	Message Utility	IPAD shall provide a means for one user to send a message (either displayed interactively or hard copied in batch) to designated users.
22.	Document Reference Utility	IPAD shall provide the capability to create, update, and query references to documents on standard design and processing procedures.
23.	Program Performance Monitoring Utility	IPAD shall provide a facility to monitor execution of a program and provide computer resource indicators.
24.	Learning Utility	IPAD shall support a computer-based learning

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tool allowing an instructor-student relationship, including monitoring of progress.

25.	On-Line Instruction Utility	IPAD shall support on-line instruction with selection from short lists, programmed learning, and example problems.
26.	User Assistance Utility	IPAD shall provide conditional activation of enhanced user-aids for giving novice users a better view of IPAD capabilities.
27.	User Interface Description Utility	IPAD shall provide a utility for creating and interogating data sets of text describing the IPAD user-command interface.
28.	Program Debugging Utility	IPAD shall provide advanced on-line debugging aids for observing and controlling executive programs.
29.	Command Sequence Interpretation Utility	IPAD shall provide means for interpretation of macro-like command sequence files.

2.1.3   USER ACCESS

30.	Interactive, Batch, and Program Commands	IPAD shall addressible thru interactive terminal commands, batch control cards, or calls from user programs running under IPAD control.
31.	Interactive Terminals	IPAD shall use textual and graphical interactive terminals (both storage and refreshed) as the primary user interface.
32.	Satellite Computer Support	IPAD shall be able to run jobs, in whole or in part, on a remote computer system.
33.	Interrupt and Resume Capability	IPAD shall allow the user to interupt his interactive terminal session at any point.
34.	Batch Job Processing	IPAD shall permit submittal of batch processing jobs from interactive terminals or through normal batch submittal.
35.	Checkpoint and Restart Capability	IPAD shall allow a checkpoint/restart capability for jobs running under the control of IPAD.
36.	Conference Viewing of Data	IPAD shall provide the means for multiple and conference viewing of IPAD data and generated displays.

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37.	User Priorities	IPAD shall recognize the emergency, short-duration, appointment, and standard user categories for priority control.
38.	Standard Limiting Response Time	IPAD shall provide user response by using the concept of standard limiting response time (SLRT).
39.	User Identification	IPAD shall determine the authority of a potential user to access the IPAD system by checking passwords, user ID, etc.
40.	Unacceptable User ID	IPAD shall provide diagnostic aids to unacceptable identification which allow for the re-entering of ID data.
41.	Password Protection	IPAD shall protect the user password from discovery thru normal usage.
42.	Password Control	IPAD shall permit the user to easily change his own password.
43.	User Classification Display	IPAD shall allow the user to request a display of the classifications assigned to the user for accessing and manipulating data.
43.1	User Absence and Reassignment Control	IPAD shall protect an absent users working area and warn the user's manager of messages, tasks, subtasks involved.

2.2   DESIGN SUPPORT AND CONTROLS

2.2.1   DESIGN PROCESS SUPPORT

44.	Process Planning and Definition	IPAD shall be able to support an un-limited number of design-team processes.
45.	Job Preparation	IPAD shall provide the means for job preparation including collecting programs and data, assembling into job sequence, etc.
46.	Job Execution and Monitoring	IPAD shall provide mechanisms for monitoring and providing executive authority over running jobs.

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47. **Dynamic Reference To Data** IPAD shall permit programs to reference data sets in specific data areas with the user identifying the input/output data sets to the job or group of jobs at execution time.

48. **Process Reporting** IPAD shall provide for design process reports which may include both graphical and textual data.

49. **Information Release** This requirement now covered by reqmt 81

2.2.2 COMPUTER AIDED DESIGN PROJECT MANAGEMENT

50. **Project Planning** IPAD shall provide the means whereby managers can plan a design project using one or more design processes.

51. **Management Support** IPAD shall support design management by storage and utilization of management tools such as critical path, work progress, etc.

52. **Resource Reports** IPAD shall provide individual reports on the status of computer resource and manpower accounts.

53. **Subtask Monitoring** IPAD shall provide the means to monitor subtask status or subtasks which have been suspended.

54. **Subtask Modification** IPAD shall allow for input of task status, add/delete/alter tasks and subtasks, or suspend a task in progress.

55. **Project Resource Monitoring** IPAD shall prepare a report comparing the computer resources budgeted versus actual usage.

56. **Project Schedule Monitoring and Control** IPAD shall permit projects to be driven by schedule control.

57. **Optional Automatic Reporting** IPAD shall permit optional automatic reporting of such iems as schedule deliquencies, notice of data changes to users having accessed particular data sets, etc.

57.1 **Application Program Certification** IPAD shall document the integrity of a given job execution by certifying the component operational modules.

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57.2	User Activity Checklist	IPAD shall provide the capability for the user to request a summary of his activities.

2.3 INFORMATION MANAGEMENT

2.3.1 DATA MANAGEMENT

58.	Information Bank Structure	IPAD shall permit groups of IPAD data sets to be logically grouped into data areas for user convenience.
59.	Data Set Association	IPAD shall provide the capability to logically associate data sets with a given data set.
60.	Data Set Headers	IPAD shall permit the logical association of header data with each data set.
61.	Data Area Contents	IPAD shall provide data areas consisting of both a data dictionary and the actual data sets.
62.	Private Data Space	IPAD shall provide a special subtask area as the private data area for each subtask.
63.	Data Element Types	IPAD shall support an expandable list of data element types such as text, scalars, vectors, matrices, tables, lists, etc.
64.	Data Growth	IPAD shall support an orderly growth of data set definitions within an IPAD information bank without inpacting information availability.
65.	Engineering Standards	IPAD shall provide means for the installing definitions, sets of values for engineering standards, etc. in the information bank.
66.	Reorganizing Data Areas	IPAD shall provide the capability of combining individual data areas into one resulting data area.
67.	Data Structures	IPAD shall provide and support those data structures commonly used by engineering disciplines.
68.	Data Elements and Relationships	IPAD shall provide the user with a capability to define data elements and to introduce relationships between them.

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69.	Operations on Data Relationships	IPAD shall allow establishing, recording, viewing, locating, and modifying the logical relationships of data elements.
70.	Data Element Names	IPAD shall expect unique element names within the data areas in which the elements are defined.
71.	Data Quantification	IPAD shall support extensive data volumes with upper and lower data volumes defined to support at least ten IPAD-design products.
72.	Data Set Copying	IPAD shall provide the means to the user for copying data and programs into subtask or private data areas from other data areas.
73.	Archived Data	IPAD shall provide for access to archived project data.
74.	Program Data Access	IPAD shall allow user programs to work within a subset of a data area or with data from multiple data areas.
75.	User Data Access	IPAD shall allow the user to limit a query to a specific data area or to a subset of the information data bank.
76.	Data Set Access Records	IPAD shall keep a record of all accesses to a data set.
77.	Data Set Identification	IPAD shall guarantee that data set content changes cause changes in data set identification.
78.	Data Purge Permission	IPAD shall require special permission to purge any data set which has a dependent data set while these data sets are under project control.
79.	Data Retention Classification	IPAD shall provide for data set retention classifications to include permanent, program life, project life, etc.
80.	Data Version Notification	IPAD shall notify users accessing preliminary data that a later version of the data is available.
81.	Data Release Mechanism	IPAD shall provide for the creator or modifier of data to release it and qualify the data set for the benefit of other users

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82.	Shared and Private Data Sets	IPAD shall accomodate both shared and private data sets.
83.	Data Distribution Control	IPAD shall permit both automatic and manual distribution of data and programs throughout the IPAD Computer Complex.
84.	Recovery and Backup	IPAD shall provide for recovery and backup in case of system failure or descruction of data bases.
85.	Modification or Loss of Data	IPAD shall automatically identify any data areas affected by losses or modifications to the data base.
86.	Data Transaction History	IPAD shall record a transaction history with data needed to recreate data destroyed or modified.
87.	Data Validation	IPAD shall provide for validation of user data including a range of values check.
87.1	Data Set Modification Log	IPAD shall log data set modification history for each version.
88.	User Read and Write Security	IPAD shall control the users ability to read and write data as per the need-to-know and other security consideration.
89.	Program Read and Write Security	IPAD shall control computer program access to data in a similar manner to the interactive user query.
90.	Classified Data Access	IPAD shall require stringent user identification to access classified and/or proprietary data.
91.	System Administration	IPAD shall accomodate the special managerial requirements of the data administrator.

2.3.2 INFORMATION MANAGEMENT TOOLS

92.	Data Update and Transformation	IPAD shall provide update and transformation capabilities for a wide range of requirements.
93.	Data transformation	IPAD shall provide automated means for unit conversions, data transformations.

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94. Program and Data
    Set Comparison

IPAD shall compare two or more data sets
or programs for physical differences and
report those differences.

95. Mathmatical Operations

IPAD shall provide utilities for per-
forming arithmetic and logical operations
on selected data.

2.3.3   COMPUTER PROGRAM LIBRARY

96. Program Library

IPAD shall support a program library
consisting of programs in either source
or executable form for use in the design
process.

97. Explicit and Implicit
    I/O

IPAD shall support several modes of
program interfaces with the information
data bank.

98. Program Identification
    and Description

IPAD shall allow users to enter keywords
and standard descriptions of their programs

99. Program Interfaces

IPAD shall include tools for interfacing
existing design computer programs with
each other.

100. Program Insertion and
     Deletion

IPAD shall provide for the easy insert-
ion of programs from the library.

2.4   AUXILIARY/EXTERNAL SYSTEM INTERFACES

2.4.1   HOST/REMOTE SYSTEM INTERFACES

101. Host Computers

IPAD shall be capable of operating on
either a single computer or on a dis-
tributed computer complex.

102. Communication
     Standards

IPAD shall utilize communications
standards between computing systems and
aerospace companies.

103. Access By Other
     Systems

IPAD shall permit access to all design
data under IPAD control obtained from
non-IPAD systems.

2.4.2   SOFTWARE INTERFACES

104. Communication With
     Other Systems

IPAD shall have the ability to commun-
icate with existing software systems
external to IPAD.

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| 105. Program and Data Transfer | IPAD shall facilitate transfer of program modules, data bases, etc. between installations, accounting for differences in computer word sizes. |

2.5   GENERAL SYSTEM CAPABILITIES

2.5.1   PERFORMANCE

| 106. Response Time | IPAD shall provide for adequate response time for varying functions. |

| 107. "System Working" Signal | IPAD shall display a signal to the user to indicate the system is working (used if response time is long). |

| 108. System Capacity | IPAD shall have no restrictions imposed other than the physical limitations of the hardware configuration used to support IPAD. |

| 109. System Performance Monitoring Utility | IPAD shall provide a complete set of tools for the system administrator to monitor system performance. |

| 110. Numeric Accuracy | IPAD shall be able to store numerical data with at least 10 significant digits. |

| 111. Usage Accounting | IPAD shall be able to determine how data and system resources are used. |

2.5.2   SECURITY

| 112. Proprietary Information Protection | IPAD shall prevent the disclosure of information to proprietary interests of the user-company. |

| 113. Fail-Safe Security | IPAD shall not compromise security considerations even in the event of a system failure. |

| 114. National Security | IPAD shall not preclude the operation in accordance with standards for the safeguarding of classified information. |

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2.5.3 RELIABILITY

115. System Reliability

IPAD shall be reliable to the point that system reliability need not be a planning consideration for IPAD users.

116. System Availability

IPAD shall be available more than 97.5% of the available time allocated to IPAD use on the host computer.

2.5.4 FLEXIBILITY

117. Modular Design

IPAD shall be designed for modular functional capabilities, allowing a gradual adoptation of IPAD within a company.

118. System Parameters

IPAD shall have installation parameters available for tuning the IPAD system to the needs and capabilities of the installation.

2.6 GRAPHICS

2.6.1 GRAPHICS STANDARDS

119. Graphics Primitives

IPAD shall utilize a standard graphics software package consisting of defined, standard graphics primitives.

120. Communication Standard for Non-Intelligent Graphics Terminals

IPAD shall establish standards for communication with non-intelligent graphics terminals.

121. Communication Standard for Intelligent Graphics Terminals

IPAD shall establish standards for communication with intelligent graphics terminals.

2.6.2 DEVICE INTERFACE

122. Graphics Interface Software

IPAD shall provide interface software for most common graphics devices.

2.7 GRAPHICS RELATED TOOLS

2.7.1 GRAPHICS RELATED PROGRAMMING TOOLS

123. Graphic Display of Numerical Data

IPAD shall include comprehensive capabilities for conversion of numerical data into graphical format.

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124.	Animation Package	IPAD shall provide an animation package to help display dynamic phenomena in a flicker-free form.
125.	Graphic Programming Tools	IPAD shall provide comprehensive graphic programming tools allowing development from simplified building blocks.

2.7.2 GEOMETRY

126.	Design Drafting Capabilities	IPAD shall provide CAD entities such as point, line, circle, fillet, ellipse, rectangle, ruled surface, curve mesh surface, etc.
127.	Geometry Conversion To APT Format	IPAD shall provide a utility to convert from geometry data in the IPAD communication format into a form suitable for APT usage.
128.	Standard Geometry Format	IPAD shall be capable of allowing a geometry format which is an extension of the ANSI Y14.26 proposed standards.
129.	Numerical Control Capabilities	IPAD shall provide a wide range of N.C. capabilities.

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APPENDIX C

KEYWORD LIST

REV. B

REQ	KEYWORD
6.0	ABBREVIATED COMMANDS
2.0	ABBREVIATION
34.0	ABORT
111.0	ACCESSES
7.0	ACCESSIBLE HOST OPERATING SYSTEM
43.0	ACCESSING DATA
103.0	ACCESS BY OTHER SYSTEMS
9.0	ACCESS CONTROL
60.0	ACCESS CONTROL
96.0	ACCESS CONTROL
74.0	ACCESS DATA AREA SUBSET
4.0	ACCESS HOST OPERATING SYSTEM CAPABILITIES
4.0	ACCESS IPAD UTILITYS
76.0	ACCESS LOG
74.0	ACCESS MULTIPLE DATA AREAS
76.0	ACCESS RECORDS
57.2	ACCESS SUMMARY
7.0	ACCESS TO HOST O/S FUNCTIONS
96.0	ACCESS TO JOBS
96.0	ACCESS TO PROGRAMS
96.0	ACCESS TO SOURCE MODULES
11.0	ACCESS
91.0	ACCESS
55.0	ACCOUNTING INFORMATION
111.0	ACCOUNTING
110.0	ACCURACY
46.0	ACTIVITIES
57.2	ACTIVITY DATE
57.2	ACTIVITY SUMMARY
38.0	ACTUAL RESPONSE TIME
64.0	ADD DATA
54.0	ADD
5.0	AIDS
8.0	ALTERNATE PARAMETERS
92.0	ALTER VALUES
54.0	ALTER
124.0	ANIMATION
124.0	ANIMATION PACKAGE
128.0	ANSI Y14.26
57.1	APPLICATION PROGRAM CERTIFICATION
37.0	APPOINTMENT
37.0	APPOINTMENT PERIOD
37.0	APPOINTMENT RESERVATIONS
37.0	APPOINTMENT USER
37.0	APPOINTMENT USER TERMINALS
127.0	APT FORMAT
73.0	ARCHIVAL DATA
71.0	ARCHIVE DATA

REQ	KEYWORD
79.0	ARCHIVE DATA
95.0	ARITHMETIC OPERATIONS
38.0	ART
51.0	ASSIGNMENTS
50.0	ASSIGN NAMES
59.0	ASSOCIATIVE DATA RELATIONSHIP
110.0	ATTRIBUTES
93.0	AUTOMATIC UNIT CONVERSION
116.0	AVAILABILITY
84.0	BACKUP
50.0	BAR CHART
30.0	BATCH COMMANDS
34.0	BATCH JOB PROCESSING
4.0	BATCH JOB
44.0	BATCH MODE
34.0	BATCH PROCESSING
38.0	BATCH PROCESSING
11.0	BATCH QUERY LANGUAGE
34.0	BATCH SUBMITTAL
30.0	BATCH
50.0	BEGIN MILESTONE
102.0	BETWEEN AEROSPACE COMPANIES
95.0	BOOLEAN OPERATIONS
3.0	BRIEF ERROR DIAGNOSTIC
52.0	BUDGETED RESOURCE REPORT
55.0	BUDGET STATUS REPORT
52.0	BUDGET
55.0	BUDGET
18.0	BUILD MENU
126.0	CAD
122.0	CALCOMP 763
33.0	CANCEL RESULTS
129.0	CAPABILITIES
108.0	CAPACITY OF IPAD
57.1	CERTIFICATION
57.1	CERTIFIED OPERATIONAL MODULES
42.0	CHANGES TO PASSWORD
28.0	CHANGE DATA
87.1	CHANGE DESCRIPTION
87.1	CHANGE HISTORY
28.0	CHANGE PROGRAM
87.1	CHANGE REASON
35.0	CHECKPOINT
35.0	CHECKPOINT RESTART
35.0	CHECKPOINT AND RESTART CAPLABILITY
90.0	CLASSIFIED DATA
90.0	CLASSIFIED DATA ACCESS
19.0	COLIST

REQ	KEYWORD
66.0	COMBINE DATA AREAS
27.0	COMMANDS
30.0	COMMANDS
5.0	COMMANDS
9.0	COMMAND AVAILABILITY
5.0	COMMAND CATEGORIES
27.0	COMMAND DESCRIPTION
8.0	COMMAND DECODING
8.0	COMMAND DECODING AND DISPLAY
4.0	COMMAND FUNCTIONS
5.0	COMMAND FUNCTIONS
29.0	COMMAND INTERPRETATION
1.0	COMMAND LANGUAGE
4.0	COMMAND LANGUAGE FUNCTIONS
6.0	COMMAND LANGUAGE
37.0	COMMAND MODE
5.0	COMMAND OVERVIEW
8.0	COMMAND PROMPTS
9.0	COMMAND RESTRICTION
29.0	COMMAND SEQUENCES
29.0	COMMAND SEQUENCE INTERPRETATION UTILITY
50.0	COMMIT SCHEDULE DATES
102.0	COMMUNICATION
102.0	COMMUNICATION STANDARDS
103.0	COMMUNICATION WITH
104.0	COMMUNICATION WITH
121.0	COMMUNICATION WITH INTELLIGENT TERMINALS
4.0	COMPARE DATA
19.0	COMPARE DESCRIPTOR
19.0	COMPARE DESCRIPTOR TO INAME
19.0	COMPARE INAME TO DESCRIPTOR
4.0	COMPARE PROGRAMS
19.0	COMPARE
4.0	COMPARE
50.0	COMPLETE KEY TASKS
50.0	COMPLETE PROJECT
46.0	COMPUTER PROGRAM
99.0	COMPUTER PROGRAM
50.0	COMPUTER RESOURCES
52.0	COMPUTER RESOURCE REPORT
52.0	COMPUTER RESOURCES
55.0	COMPUTER RESOURCES
24.0	COMPUTOR COURSES
24.0	COMPUTOR LEARNING
120.0	COMUNICATION WITH NON-INTELLIGENT TERMINALS
36.0	CONFERENCE VEIWING
50.0	CONSTRAINTS
20.0	CONSTRUCT

REQ	KEYWORD
20.0	CONSTRUCT MAIL LIST
91.0	CONTENT
60.0	CONTROLLED DATA
119.0	CONTROL
129.0	CONTROL
123.0	CONVERSION TO
127.0	CONVERT
93.0	COORDINATE TRANSFORMATION
72.0	COPY DATA
72.0	COPY PROGRAMS
57.2	COPY SUMMARY
19.0	CORPORATE LIKE LIST
19.0	CORPORATE LIKE ORGANIZATIONAL LIST
28.0	CORRECTION
19.0	CREATE MAILING LIST
18.0	CREATE MENU
19.0	CREATE ORGANIZATION LIST
57.2	CREATION SUMMARY
111.0	CREATION
51.0	CRITICAL PATH
51.0	CUMULATIVE COST DISTRIBUTION
52.0	CUMULATIVE RESOURCE REPORTS
52.0	CURRENT STATUS
126.0	CURVES
60.0	DATA ACCESS
75.0	DATA ACCESS
91.0	DATA ADMINISTRATION
81.0	DATA APPROVAL CATEGORIES
47.0	DATA AREAS
74.0	DATA AREAS
58.0	DATA AREA
70.0	DATA AREA
63.0	DATA CHARACTERISTICS
94.0	DATA COMPARISON
61.0	DATA CONTENT
83.0	DATA CONTROL
93.0	DATA CONVERSION
44.0	DATA DEFINITION
61.0	DATA DEFINITION
64.0	DATA DEFINITION
65.0	DATA DEFINITION
63.0	DATA ELEMENT TYPE
68.0	DATA ELEMENT TYPE
70.0	DATA ELEMENT NAME
44.0	DATA FLOW
45.0	DATA FLOW
48.0	DATA FLOW
71.0	DATA FLOW

C.5

REQ	KEYWORD
68.0	DATA FORMAT
64.0	DATA GROWTH
96.0	DATA HANDLING
86.0	DATA HISTORY
44.0	DATA IDENTIFICATION
67.0	DATA INDEPENDENCE
60.0	DATA INSTALLATION CONTROL
84.0	DATA INTEGRITY
44.0	DATA INTERFACES
92.0	DATA MANIPULATION
93.0	DATA MANIPULATION
95.0	DATA MANIPULATIONS
54.0	DATA OCCURENCE
92.0	DATA OPERATIONS
43.1	DATA OWNERSHIP CHANGE
63.0	DATA PRIMITIVES
78.0	DATA PUARGE
81.0	DATA QUALIFICATION
71.0	DATA QUANTIFICATION
68.0	DATA RELATIONSHIP
69.0	DATA RELATIONSHIP OPERATIONS
81.0	DATA RELEASE MECHANISM
58.0	DATA RESOURCE
60.0	DATA RETENTION
79.0	DATA RETENTION
47.0	DATA SETS
58.0	DATA SETS
59.0	DATA SET ASSOCIATION
76.0	DATA SET ACCESS
57.0	DATA SET CHANGE
72.0	DATA SET COPYING
94.0	DATA SET COMPARISON
12.0	DATA SET HEADER
60.0	DATA SET HEADER
77.0	DATA SET IDENTIFICATION CONTROL
87.1	DATA SET MODIFICATION LOG
77.0	DATA SET QUALIFICATION
77.0	DATA SET VERSION
57.0	DATA SET
76.0	DATA SET
62.0	DATA SPACE
71.0	DATA STORAGE
67.0	DATA STRUCTURE
68.0	DATA STRUCTURE
91.0	DATA STRUCTURE
74.0	DATA SUBSET
86.0	DATA TRANSACTION HISTORY
92.0	DATA TRANSFORMATION

C.6

REQ	KEYWORD
93.0	DATA TRANSFORMATION
105.0	DATA TRANSFER
92.0	DATA UPDATE
87.0	DATA VALIDATION
80.0	DATA VERSION
81.0	DATA VERSION
71.0	DATA VOLUME
45.0	DATA
111.0	DATA
28.0	DEBUGGING
50.0	DECISION MILESTONE
8.0	DECODING
8.0	DEFAULT PARAMETERS
4.0	DEFINE DATA
4.0	DEFINE DATA ELEMENTS
4.0	DEFINE DATA FORMATS
4.0	DEFINE DATA RELATIONSHIPS
4.0	DEFINE FORMATS
4.0	DEFINE RELATIONSHIPS
4.0	DEFINE
44.0	DEFINITION OF PROCESSES
91.0	DEFINITION
54.0	DELETE
100.0	DELETE
57.2	DELETION SUMMARY
50.0	DEPENDANCY OF TASKS
19.0	DEPENDANT GROUP NAME
78.0	DEPENDENT DATA SET
59.0	DEPENDENT DATA SETS
27.0	DESCRIBE COMMAND
27.0	DESCRIPTIONS OF THE USER INTERFACE
19.0	DESCRIPTOR
19.0	DESCRIPTOR NAME
126.0	DESIGN DRAFTING
44.0	DESIGN PROJECT
48.0	DESIGN PROCESS
48.0	DESIGN PROCESS REPORTS
50.0	DESIGN PROCESSES
50.0	DESIGN PROJECT
117.0	DESIGN
61.0	DICTIONARY
64.0	DICTIONARY
65.0	DICTIONARY
68.0	DICTIONARY
122.0	DIGITIZER
4.0	DISPLAY CURRENT OPERATION
15.0	DISPLAY DATA
4.0	DISPLAY GRAPHICS

C.7

REQ	KEYWORD
21.0	DISPLAY MESSAGE
4.0	DISPLAY
43.0	DISPLAY
48.0	DISPLAY
50.0	DISPLAY
83.0	DISTRIBUTED COMPUTING
16.0	DOCMENT MAINTENANCE
16.0	DOCUMENTATION UTILITY
16.0	DOCUMENTATION
22.0	DOCUMENT CONTENTS
22.0	DOCUMENT INFORMATION
22.0	DOCUMENT INFORMATION RETRIEVAL
22.0	DOCUMENT INFORMATION STORAGE
16.0	DOCUMENT PREPARATION
16.0	DOCUMENT PREPARATION AND MAINTENANCE
22.0	DOCUMENT REFERENCES
22.0	DOCUMENT REFERENCE UTILITY
22.0	DOCUMENT SUBJECTS
16.0	DOCUMENT
125.0	DRAWING SCALE
120.0	DUMB
124.0	DYNAMIC GRAPHICS
47.0	DYNAMIC REFERENCE TO DATA
124.0	DYNAMIC
6.0	EASY COMMAND LANGUAGE
15.0	EDIT/UPDATE LANGUAGE
4.0	EDIT DATA BASE
36.0	EDIT DATA
4.0	EDIT DICTIONARIES
4.0	EDIT MANAGEMENT INFORMATION
15.0	EDIT UTILITY
4.0	EDIT
15.0	EDIT
35.0	ELAPSED TIME
37.0	EMERGENCY
37.0	EMERGENCY USER
50.0	END MILESTONE
6.0	ENGINEERING LANGUAGE
4.0	ENTER DATA
4.0	ENTER DATA BASE
28.0	ERROR CORRECTION
28.0	ERROR DIAGNOSIS
28.0	ERROR DIAGNOSIS AND CORRECTION
3.0	ERROR DIAGNOSTIC
8.0	ERROR DIAGNOSTICS
3.0	ERROR SOURCE
28.0	ERROR
3.0	ERROR

REQ	KEYWORD
42.0	ESTABLISHMENT OF PASSWORD
23.0	EVALUATE PERFORMANCE
35.0	EVENTS
25.0	EXAMPLE PROBLEMS
96.0	EXECUTABLE
4.0	EXECUTE
23.0	EXECUTION MONITORING
33.0	EXECUTION
97.0	EXISTING PROGRAMS
4.0	EXIT IPAD
10.0	EXIT REPORTS
4.0	EXIT
10.0	EXIT
10.0	EXIT,R
52.0	EXIT,R
63.0	EXPANDABLE LIST
2.0	EXPERTISE
2.0	EXPERT
97.0	EXPLICIT I/O
128.0	EXTEND
113.0	FAILURE
113.0	FAIL-SAFE
113.0	FAIL-SAFE SECURITY
46.0	FINAL RESULTS
4.0	FIND INFORMATION
4.0	FIND
122.0	FLATBED PLOTTER
117.0	FUNCTIONAL CAPABILITIES
126.0	FUNCTIONS
65.0	GATHER INFORMATION
5.0	GENERAL PASSISVE COMMANDS
17.0	GENERATE REPORT
4.0	GENERATE REPORTS
4.0	GENERATE
127.0	GEOMETRY CONVERSION
127.0	GEOMETRY DATA
128.0	GEOMETRY FORMAT DEFINITION
126.0	GEOMETRY
19.0	GNAME
31.0	GRAPHICAL TERMINALS
119.0	GRAPHICS PRIMATIVES
119.0	GRAPHICS
120.0	GRAPHICS
121.0	GRAPHICS
122.0	GRAPHICS
123.0	GRAPHICS
124.0	GRAPHICS
125.0	GRAPHICS

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REQ	KEYWORD
19.0	GROUP NAME
45.0	GROUP OF JOBS
47.0	GROUP OF JOBS
50.0	GROUP OF JOBS
106.0	GUIDE LINES
101.0	HARDWARE CONFIGURATION
37.0	HARDWIRED TERMINALS
50.0	HARD COPY
12.0	HEADER DATA QUERY
12.0	HEADER DATA
3.0	HELP
4.0	HELP
5.0	HELP
37.0	HOLD SERVICE
6.0	HOST COMMAND LANGUAGE
101.0	HOST COMPUTER
7.0	HOST OPERATING SYSTEM
7.0	HOST O/S
122.0	IBM 2250
39.0	IDENTIFICATION
39.0	IDENTIFICATION SEQUENCE
77.0	IDENTIFICATION
37.0	IMMEDIATE ACCESS
56.0	IMPENDING PROBLEM REPORTS
97.0	IMPLICIT I/O
19.0	INAME
6.0	INDEPENDANT OF HOST COMPUTER
101.0	INDEPENDENT
61.0	INDEX
64.0	INDEX
65.0	INDEX
68.0	INDEX
19.0	INDIVIDUAL NAME
9.0	INDIVIDUAL USER COMMANDS
37.0	INFORMATION BANK
44.0	INFORMATION CONTROL
44.0	INFORMATION FLOW
51.0	INFORMATION DISPLAY
51.0	INFORMATION RETRIEVAL
58.0	INFORMATION BANK STRUCTURE
58.0	INFORMATION BANK
66.0	INFORMATION BANK
81.0	INFORMATION RELEASE
91.0	INFORMATION BANK CONTROL
97.0	INFORMATION BANK
112.0	INFORMATION
47.0	INPUT DATA SETS
45.0	INPUT

C.10

REV. B

REQ	KEYWORD
54.0	INPUT
119.0	INPUT
100.0	INSERT
97.0	INSTALLATION
118.0	INSTALLATION
25.0	INSTRUCTION
60.0	INTEGRITY
91.0	INTEGRITY
96.0	INTEGRITY
121.0	INTELLIGENT TERMINALS
121.0	INTELLIGENT GRAPHICS TERMINALS
121.0	INTELLIGENT
30.0	INTERACTIVE
30.0	INTERACTIVE COMMANDS
31.0	INTERACTIVE TERMINALS
33.0	INTERACTIVE TERMINAL SESSION
34.0	INTERACTIVE JOB
11.0	INTERACTIVE QUERY LANGUAGE
15.0	INTERACTIVE PROGRAM DEVELOPMENT
38.0	INTERACTIVE USER
44.0	INTERACTIVE MODE
97.0	INTERFACES
99.0	INTERFACES
27.0	INTERFACE
99.0	INTERFACE
103.0	INTERFACE WITH
122.0	INTERFACE
34.0	INTERMEDIATE RESULTS
46.0	INTERMEDIATE RESULTS
29.0	INTERPRETATION
29.0	INTERPRETATION OF COMMAND SEQUENCES
8.0	INTERPRET
8.0	INTERPRET COMMAND
57.2	INTERRUPTION SUMMARY
33.0	INTERRUPT
33.0	INTERRUPT AND RESUME
33.0	INTERRUPT AND RESUME CAPABILITY
33.0	INTERRUPT EXCUTION
34.0	INTERRUPT
4.0	INTERRUPT
4.0	INTERRUPT JOB
37.0	INTERRUPT
57.2	IN-WORK SUMMARY
5.0	IPAD COMMANDS
35.0	IPAD CONTROL
37.0	IPAD SYSTEM ADMINISTRATOR
43.0	IPAD SYSTEM
103.0	IPAD SYSTEM

C.11

REQ	KEYWORD
103.0	IPAD SYSTEMS
104.0	IPAD SYSTEM
104.0	IPAD SYSTEMS
113.0	IPAD SYSTEM
115.0	IPAD SYSTEM
116.0	IPAD SYSTEM
44.0	IPAD UTILITIES
127.0	IPAD
34.0	JOB CONTROL
4.0	JOB EXECUTION
46.0	JOB EXECUTION
46.0	JOB EXECUTION AND MONITORING
56.0	JOB EXECUTION
57.1	JOB INTEGRITY
4.0	JOB LOADING
46.0	JOB MONITORING
45.0	JOB PREPARATION
4.0	JOB SAVING
45.0	JOB SEQUENCE
4.0	JOB STATUS
10.0	JOB STATUS
34.0	JOB SUBMITTAL
44.0	JOB
45.0	JOB
47.0	JOB
50.0	JOB
98.0	KEYWORDS
50.0	KEY ACTIVITIES
24.0	LEARNING COMPUTER
24.0	LEARNING UTILITY
24.0	LEARNING
25.0	LEARNING
24.0	LEARN
73.0	LIBRARY CATALOG
55.0	LIMITS
9.0	LIMIT ACCESS
9.0	LIMIT COMMANDS
95.0	LINEAR ALGEBRA
126.0	LINES
125.0	LINE DENSITY
119.0	LINE DRAWING
46.0	LINKED PROGRAMS
4.0	LINK PROGRAMS
19.0	LIST
4.0	LOAD MODULES
4.0	LOAD
5.0	LOCAL COMMANDS
58.0	LOGICAL DATA MODEL

C.12

REV. B

REQ	KEYWORD
66.0	LOGICAL DATA MODEL
95.0	LOGICAL OPERATIONS
67.0	LOGICAL STRUCTURE
37.0	LOG OFF
85.0	LOSS OF DATA
19.0	MAILING LIST
20.0	MAILING LIST
20.0	MAILING LIST UTILITY
20.0	MAIL LIST
69.0	MAINTAIN DATA RELATIONSHIPS
13.0	MANAGEMENT DATA
13.0	MANAGEMENT QUERY LANGUAGE
51.0	MANAGEMENT
51.0	MANAGEMENT SUPPORT
50.0	MANAGER
43.0	MANIPULATING DATA
50.0	MANPOWER RESOURCES
52.0	MANPOWER RESOURCE REPORTS
52.0	MANPOWER RESOURCES
95.0	MATHMATICAL OPERATIONS
18.0	MENU BUILDING
18.0	MENU BUILDING UTILITY
18.0	MENU
21.0	MESSAGES TO OTHER USERS
43.1	MESSAGES
21.0	MESSAGE DISPLAY
21.0	MESSAGE FILE
19.0	MESSAGE RECEIVER
21.0	MESSAGE RECEIVER
21.0	MESSAGE TO DESIGNATED USER
21.0	MESSAGE UTILITY
21.0	MESSAGE
4.0	MESSAGE
54.0	MESSAGE
122.0	MICROFILM PLOTTER
44.0	MIXED MODE
44.0	MODIFICATION OF PROCESSES
87.1	MODIFICATION LOG
87.1	MODIFICATION HISTORY
92.0	MODIFY DATA STRUCTURE
54.0	MODIFY SUBTASK STATUS
117.0	MODULAR DESIGN
117.0	MODULAR
53.0	MONITORING
109.0	MONITORING
23.0	MONITOR PROGRAM
34.0	MONITOR PROGRESS
55.0	MONITOR RESOURCES

REQ	KEYWORD
23.0	MONITOR
66.0	MOVE DATA AREAS
36.0	MULTIPLE VIEWING
19.0	NAME
114.0	NATIONAL SECURITY
114.0	NATIONAL
88.0	NEED TO KNOW
69.0	NEED TO KNOW
66.0	NESTED DATA AREA
120.0	NON-INTELLIGENT GRAPHICS TERMINALS
103.0	NON-IPAD SYSTEM
104.0	NON-IPAD SYSTEM
104.0	NON-IPAD SYSTEMS
58.0	NON REDUNDANT
43.1	NOTIFICATION OF USER'S ABSENCE
80.0	NOTIFICATION
26.0	NOVICE
2.0	NOVICE
53.0	NUMBER OF ACTIVE JOBS
53.0	NUMBER OF SUSPENDED JOBS
95.0	NUMERICAL DIFFERENTIATION
110.0	NUMERICAL
110.0	NUMERICAL ACCURACY
123.0	NUMERICAL DATA
129.0	NUMERICAL CONTROL
129.0	NUMERICAL
123.0	NUMERIC TO GRAPHICS
129.0	N.C. CAPABILITES
33.0	OBTAIN HELP
13.0	OFFICIAL PROJECT DATA
50.0	OFFLINE
15.0	ON-LINE DATA DEVELOPMENT
25.0	ON-LINE INSTRUCTION
25.0	ON-LINE INSTRUCTION UTILITY
15.0	ON-LINE PROGRAM DEVELOPMENT
73.0	ON-LINE STORAGE
29.0	OPERATING SEQUENCE
69.0	OPERATIONS ON DATA RELATIONSHIPS
57.0	OPTIONAL AUTOMATIC REPORTING
19.0	ORGANIZATION
19.0	ORGANIZATION DISPLAY
19.0	ORGANIZATION LIST DISPLAY
19.0	ORGANIZATION LIST
47.0	OUTPUT DATA SETS
5.0	OVERVIEW
118.0	PARAMETERS
42.0	PASSWORDS
42.0	PASSWORD CONTROL

C.14

REV. B

REQ	KEYWORD
41.0	PASSWORD PROTECTION
39.0	PASSWORD
41.0	PASSWORD
23.0	PERFORMANCE
23.0	PERFORMANCE MONITORING
109.0	PERFORMANCE
109.0	PERFORMANCE MONITORING
52.0	PERIODIC REPORT
37.0	PERMISSION CODES
21.0	PERSONAL MESSAGES
67.0	PHYSICAL STRUCTURE
44.0	PLANNING PROCESSES
50.0	PLANNING
123.0	PLOTS
126.0	PLOTTER
55.0	POINT OF SUSPENSION
80.0	PRELIMINARY DATA
81.0	PRELIMINARY DAT
37.0	PREMIUM CHARGE
31.0	PRIMARY USER INTERFACE
119.0	PRIMATIVES
4.0	PRINT
82.0	PRIVATE DATA SETS
62.0	PRIVATE
44.0	PROCESS DEFINITION
44.0	PROCESS PLANNING
44.0	PROCESS PLANNING AND DEFINITION
48.0	PROCESS REPORTS
44.0	PROCESS
25.0	PROGRAMMED LEARNING
125.0	PROGRAMMING
89.0	PROGRAM ACCESS
57.1	PROGRAM CERTIFICATION
30.0	PROGRAM COMMANDS
74.0	PROGRAM DATA ACCESS
28.0	PROGRAM DEBUGGING UTILITY
98.0	PROGRAM DESCRIPTION
100.0	PROGRAM DELETION
23.0	PROGRAM EXECUTION MONITORING
98.0	PROGRAM IDENTIFICATION
96.0	PROGRAM INTEGRATION
99.0	PROGRAM INTERFACE
100.0	PROGRAM INSERTION
55.0	PROGRAM ITEM NUMBER
96.0	PROGRAM LIBRARY
100.0	PROGRAM LIBRARY
23.0	PROGRAM MONITORING
105.0	PROGRAM MODULES

C.15

REV. B

REQ	KEYWORD
23.0	PROGRAM PERFORMANCE MONITORING
23.0	PROGRAM PERFORMANCE MONITORING UTILITY
23.0	PROGRAM RESOURCES MONITORING
89.0	PROGRAM READ SECURITY
105.0	PROGRAM TRANSFER
57.1	PROGRAM VERSIONS
89.0	PROGRAM WRITE SECURITY
23.0	PROGRAM
30.0	PROGRAM
47.0	PROGRAM
97.0	PROGRAM
100.0	PROGRAM
122.0	PROJECTION DEVICES
56.0	PROJECTS
78.0	PROJECT CONTROL
13.0	PROJECT DATA
39.0	PROJECT IDENTIFICATION
56.0	PROJECT MILESTONE
50.0	PROJECT PLANNING
56.0	PROJECT PLANNING
55.0	PROJECT RESOURCE MONITORING
56.0	PROJECT SCHEDULE MONITORING
56.0	PROJECT SCHEDULE CONTROL
50.0	PROJECT
8.0	PROMPTS
90.0	PROPRIETARY DATA
112.0	PROPRIETORY INFORMATION PROTECTION
112.0	PROPRIETORY
112.0	PROTECTION
78.0	PURGE PERMISSION
88.0	QUERY ACCESS
12.0	QUERY DATA
12.0	QUERY HEADER DATA
75.0	QUERY INFORMATION BANK SUBSET
4.0	QUERY JOB STATUS
11.0	QUERY LANGUAGE
28.0	QUERY PROGRAM
75.0	QUERY SPECIFIED DATA AREA
11.0	QUERY
12.0	QUERY
13.0	QUERY
65.0	QUERY
33.0	QUIT AND CANCEL RESULTS
33.0	QUIT
87.0	RANGE CHECK
36.0	REAL TIME MESSAGES
84.0	RECOVERY
3.0	RECTIFY ERROR

C.16

REQ	KEYWORD
128.0	REDUCE
22.0	REFERENCES
47.0	REFERENCE TO DATA
31.0	REFRESHED GRAPHICS TERMINALS
80.0	RELEASED DATA
81.0	RELEASED DATA
115.0	RELIABILITY
52.0	REMAINING RESOURCE REPORT
32.0	REMOTE COMPUTER
32.0	REMOTE
66.0	REORGANIZE DATA AREAS
17.0	REPORTING UTILITY
48.0	REPORTS
111.0	REPORTS
17.0	REPORT GENERATION UTILITY
17.0	REPORT
52.0	REPORT
55.0	REPORT
4.0	REQUEST HELP
10.0	REQUEST RESOURCES
10.0	REQUEST STATUS
4.0	REQUEST TUTORIALS
35.0	RESOURCES CONSUMED
10.0	RESOURCES USED
10.0	RESOURCES REMAINING
10.0	RESOURCES
51.0	RESOURCES AVAILABLE
51.0	RESOURCES EXPENDED
52.0	RESOURCES USED
52.0	RESOURCES REMAINING
111.0	RESOURCES
52.0	RESOURCE CONTROL
53.0	RESOURCE INFORMATION
23.0	RESOURCE MONITORING
52.0	RESOURCE REPORTS
23.0	RESOURCE
38.0	RESPONSE TIME
106.0	RESPONSE TIME
106.0	RESPONSE
28.0	RESTART EXECUTION
4.0	RESTART JOB
28.0	RESTART
34.0	RESTART
4.0	RESTART
55.0	RESTART
9.0	RESTRICT COMMANDS
66.0	RESTRUCTURE DATA AREAS
54.0	RESUME A TASK

C.17

REV. B

REQ	KEYWORD
33.0	RESUME
79.0	RETENTION CLASSIFICATION
73.0	RETRIEVE ARCHIVED DATA
46.0	REVIEWING FINAL RESULTS
46.0	REVIEWING INTERMEDIATE RESULTS
51.0	REVIEWS
34.0	REVIEW INTERMEDIATE RESULTS
33.0	REVIEW RESULTS
24.0	SAMPLE PROBLEMS
25.0	SAMPLE PROBLEMS
32.0	SATELLITE
32.0	SATELLITE COMPUTER
32.0	SATELLITE COMPUTER SUPPORT
4.0	SAVE
95.0	SCALING
122.0	SCANNING UNITS
51.0	SCHEDULES
56.0	SCHEDULE CONTROL
57.0	SCHEDULE DATE
56.0	SCHEDULE MONITORING
53.0	SCHEDULE
56.0	SCHEDULE
50.0	SCHEDULING
122.0	SC4020
37.0	SD USER
16.0	SEARCH
39.0	SECURITY CLASSIFICATION
88.0	SECURITY CONTROL
89.0	SECURITY CONTROL
91.0	SECURITY CONTROL
96.0	SECURITY CONTROL
113.0	SECURITY
114.0	SECURITY
119.0	SEGMENTS
15.0	SELECTIVE DATA DISPLAY
79.0	SELECTIVE PURGE
24.0	SELF-TEACH
24.0	SELF-TEACH COMPUTER
4.0	SEND MESSAGE
29.0	SEQUENCE CONTINUITY
29.0	SEQUENCE INTERPRETATION
29.0	SEQUENCE
52.0	SESSION RESOURCE REPORT
50.0	SET OF SYMBOLS
126.0	SHAPES
82.0	SHARED DATA SETS
37.0	SHORT DURATION
37.0	SHORT DURATION USER

C.18

REV. B

REQ	KEYWORD
110.0	SIGNIFICANT DIGIT
108.0	SIZE OF IPAD
2.0	SKILL LEVEL
2.0	SKILL
38.0	SLRT
122.0	SOFTWARE
60.0	SOURCE AND QUALITY
15.0	SOURCE MODULE CHANGES
96.0	SOURCE
37.0	SPECIFIED WORK PERIOD
16.0	SPELLING CHECK
65.0	STANDARDS
96.0	STANDARDS
128.0	STANDARD GEOMETRY
38.0	STANDARD LIMITING RESPONCE TIME
38.0	STANDARD RESPONCE
37.0	STANDARD USER
65.0	STANDARD VALUE
37.0	STANDARD
128.0	STANDARD
43.1	START-FINISH PERIOD
4.0	START JOB
50.C	START PROJECT
4.0	START
111.0	STATISTICS
53.0	STATUS OF ACTIVE JOBS
53.0	STATUS OF SUSPENDED JOBS
56.0	STATUS REPORTS
10.0	STATUS
48.0	STATUS
53.0	STATUS
54.0	STATUS
55.0	STATUS
91.0	STATUS
28.0	STEP-BY-STEP EXECUTION
54.0	STOP A TASK
28.0	STOP EXECUTION
28.0	STOP
91.0	STORAGE
4.0	SUBMIT BATCH JOB
55.0	SUBTASKS
72.0	SUBTASK DATA AREA
53.0	SUBTASK MONITORING
50.0	SUBTASK
53.0	SUBTASK
54.0	SUBTASK
56.0	SUBTASK
54.0	SUB TASK MODIFICATION

REV. B

KEYWORD LIST

REQ	KEYWORD
57.2	SUMMARY
95.0	SUMMING
125.0	SUPER POSITION
51.0	SUPPORT
55.0	SUSPEND
1.0	SYNTAX
103.0	SYSTEM ACCESS
40.0	SYSTEM ADMINISTRATOR
91.0	SYSTEM ADMINISTRATION
109.0	SYSTEM ADMINISTRATOR
116.0	SYSTEM AVAILABILITY
108.0	SYSTEM CAPACITY
91.0	SYSTEM CONTROL
60.0	SYSTEM DATA
60.0	SYSTEM DATA IDENTIFICATION
37.0	SYSTEM LOAD
21.0	SYSTEM MESSAGES
37.0	SYSTEM OVERLOAD
118.0	SYSTEM PARAMETERS
115.0	SYSTEM RELIABILITY
107.0	SYSTEM WORKING SIGNAL
16.0	TABLE OF CONTENTS
50.0	TABULAR DISPLAY
50.0	TASK
54.0	TASK
24.0	TEACHING COMPUTER
24.0	TEACHING SURVEILLANCE
24.0	TEACH
44.0	TECHNICAL PROCESS
122.0	TEKTRONICS
31.0	TERMINALS
120.0	TERMINALS
121.0	TERMINALS
33.0	TERMINAL SESSION
50.0	TERMINAL
40.0	TERMINATED
43.1	TERMINATED USER'S TASK
31.0	TEXTUAL/GRAPHICAL INTERACTIVE TERMINALS
31.0	TEXTUAL TERMINALS
15.0	TEXT EDIT
119.0	TEXT
106.0	TIME
125.0	TOOLS
37.0	TOP PRIORITY
86.0	TRACE OF ANTECEDENTS
4.0	TRANSFER DATA
34.0	TRANSFER
105.0	TRANSFER

C.20

REV. B

REQ	KEYWORD
8.0	TRANSLATE
8.0	TRANSLATE COMMAND
21.0	TRANSMIT MESSAGE
25.0	TUTORIALS
5.0	TUTORIAL AIDS
40.0	UNACCEPTABLE IDENTIFICATION
40.0	UNACCEPTABLE USER ID
40.0	UNACCEPTABLE USER IDENTIFICATION
90.0	UNAUTHORIZED ACCESS
111.0	UNAUTHORIZED
70.0	UNIQUE NAME
70.0	UNIQUE
93.0	UNIT CONVERSION
95.0	UNIT CONVERSION
85.0	UNPLANNED DATA MODIFICATION
40.0	UNSUCCESSFUL ACCESS ATTEMPT
111.0	USAGE ACCOUNTING
111.0	USAGE
43.1	USER ABSENCE AND REASSIGNMENT CONTROL
43.1	USER ABSENCE CONTROL
9.0	USER ACCESS CONTROL
88.0	USER ACCESS
57.2	USER ACTIVITY CHECK LIST
26.0	USER AIDS
5.0	USER AIDS
26.0	USER ASSISTANCE
26.0	USER ASSISTANCE UTILITY
46.0	USER ASSIST
37.0	USER CATEGORIES
43.0	USER CLASSIFICATION DISPLAY
43.0	USER CLASSIFICATION
27.0	USER COMMANDS
75.0	USER DATA ACCESS
39.0	USER IDENTIFICATION
26.0	USER INSTRUCTION
27.0	USER INTERFACE DESCRIPTION UTILITY
27.0	USER INTERFACE
101.0	USER INTERFACE
1.0	USER LANGUAGES
21.0	USER MESSAGES
37.0	USER PRIORITIES
88.0	USER READ SECURITY
43.1	USER REASSIGNMENT
2.0	USER SKILL LEVEL
43.1	USER TERMINATION
88.0	USER WRITE SECURITY
47.0	USER
48.0	USER

REO	KEYWORD
14.0	UTILITY FUNCTIONS
14.0	UTILITY PROGRAMS
87.0	VALIDATION
118.0	VARIABLE PARAMETERS
94.0	VERIFICATION
122.0	VG3300
119.0	VIEW TRANSFORMATION
1.0	VOCABULARY
37.0	WAITING QUEUE
3.0	WARNINGS
8.0	WARNING MESSAGES
43.1	WARNING
55.0	WBS
54.0	WORKING PHASES OF TASK
62.0	WORKING
55.0	WORK BREAKDOWN STRUCTURE
51.0	WORK PROGRESS
57.2	WORK SUMMARY