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SURFACE PREPARATION AND COATINGS  
DESIGN/PRODUCTION INTEGRATION  
HUMAN RESOURCE INNOVATION  
MARINE INDUSTRY STANDARDS  
WELDING  
INDUSTRIAL ENGINEERING  
EDUCATION AND TRAINING

October 1980  
NSRP 0007

# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

## **Proceedings of the REAPS Technical Symposium**

### **Paper No. 6: The IPD System for Interactive Part Coding and Nesting**

U.S. DEPARTMENT OF THE NAVY  
CARDEROCK DIVISION,  
NAVAL SURFACE WARFARE CENTER

# Report Documentation Page

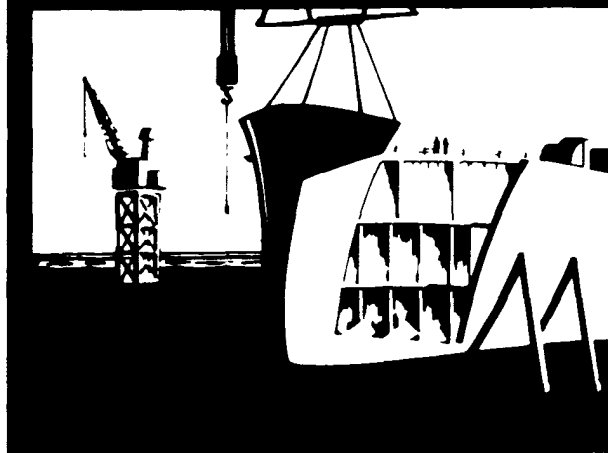
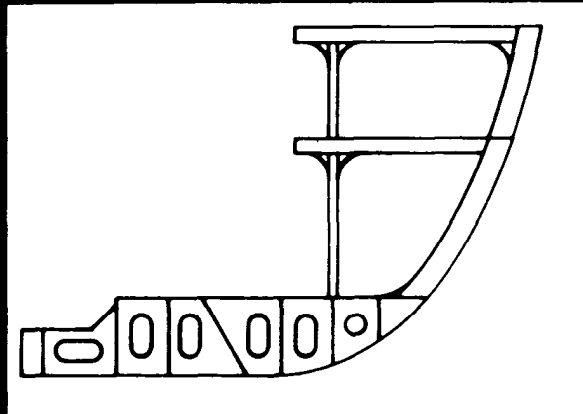
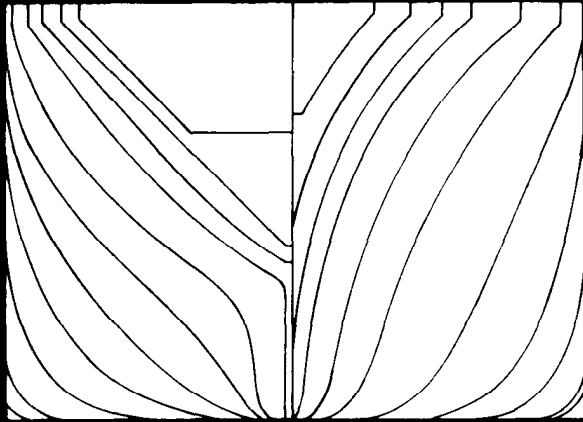
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**R**  
**E**  
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**RESEARCH  
AND  
ENGINEERING  
FOR  
AUTOMATION  
AND  
PRODUCTIVITY  
IN  
HIPBUILDING**

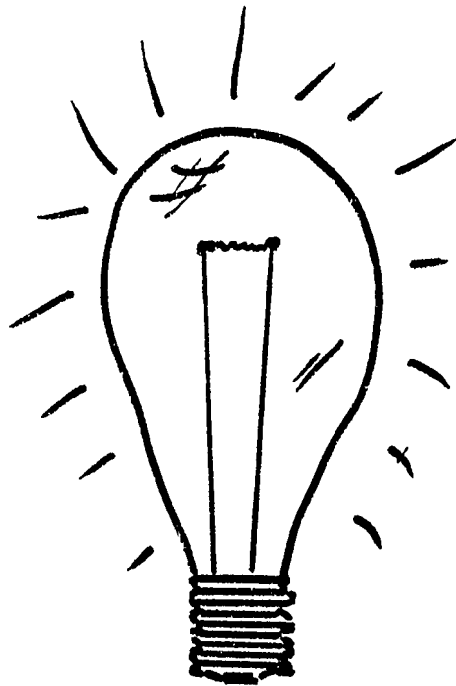
**Proceedings of the  
REAPS Technical Symposium  
October 14-16, 1980  
Philadelphia, Pennsylvania**

## THE IPD SYSTEM FOR INTERACTIVE PART CODING AND NESTING

Richard C. Moore  
Manager, Computer Design Department  
Newport News Shipbuilding and Dry Dock Company  
Newport News, Virginia

Mr. Moore is responsible for development and implementation of computer aided design techniques. Primary areas of interest are structural and piping design where computer aided manufacturing systems are already in operation. He is also IPD project manager.

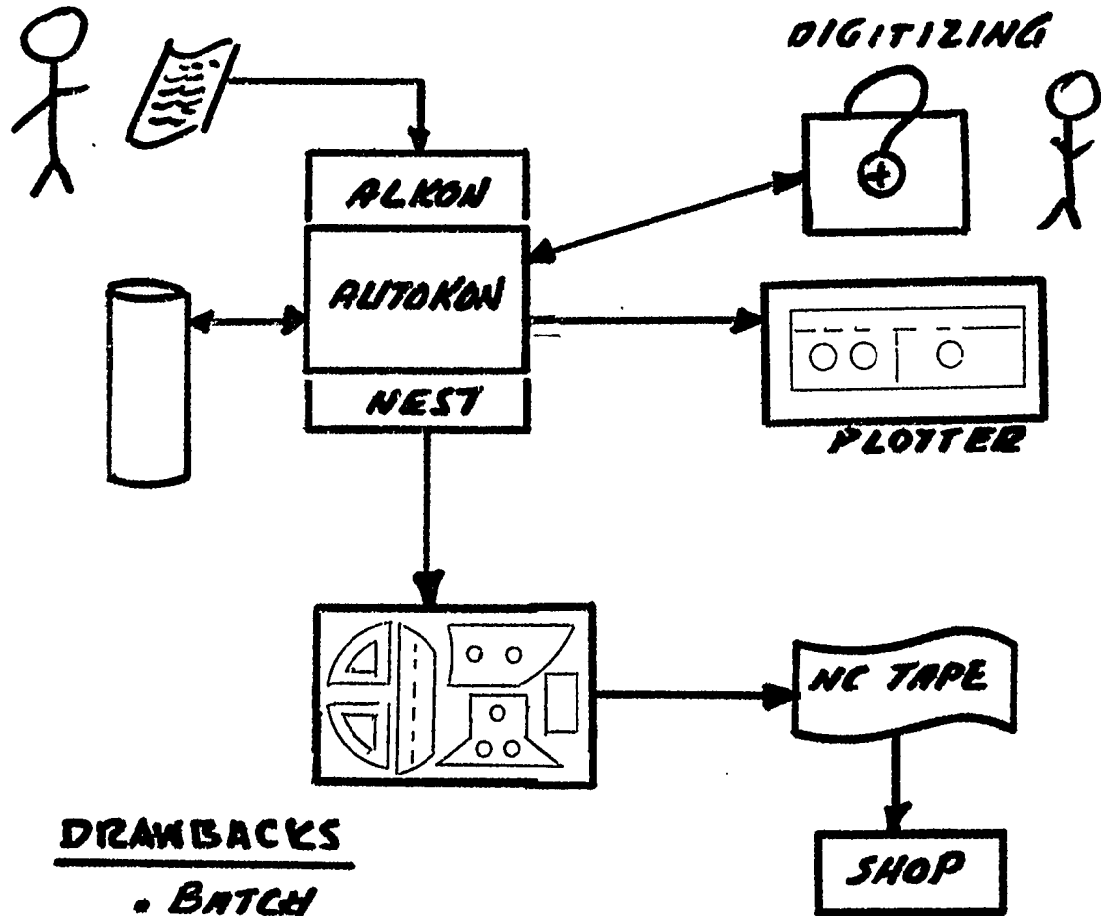
Mr. Moore holds degrees in naval architecture and marine engineering from the University of Michigan. He has 15 years of experience in structural production work including management responsibility in mold loft, fabrication, and assembly areas. Also implementation of computer systems for numerical control lofting/cutting, structural work packages.



1975 IDEA

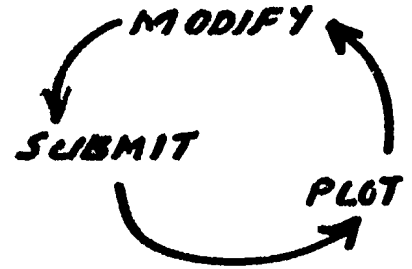
*INTERACTIVE PARTS  
DEFINITION*

# MOLD LOFT CURRENT TECHNIQUES



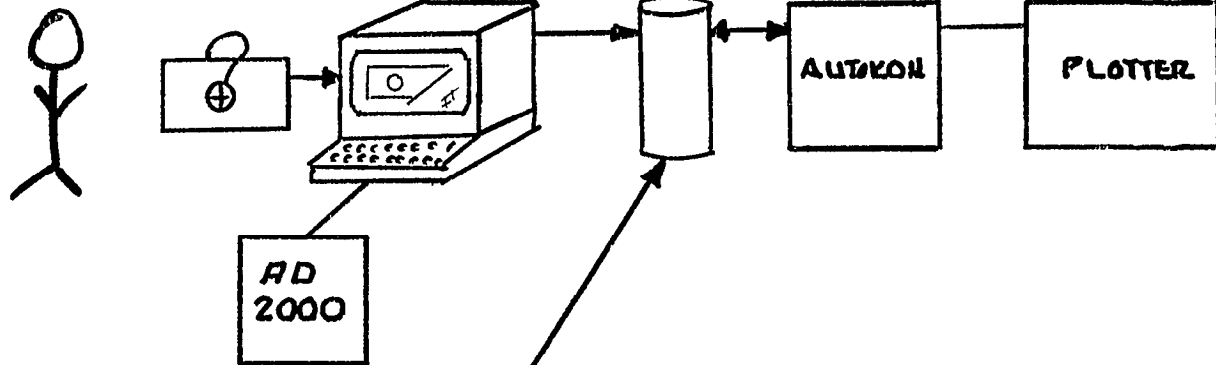
## DRAWBACKS

- BATCH
- CORRECTION CYCLE
- TRAINING
- HUMAN ENGINEERING

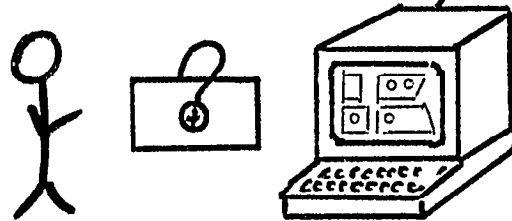


# MOLD LOFT PROPOSAL

**PART  
GENERATION**



**NESTING**



## BENEFITS

- NO ERROR CYCLE
- ON-LINE RESPONSE
- HUMAN ENGINEERING

**INTERACTIVE GRAPHICS PART DEFINITION  
PROJECT**

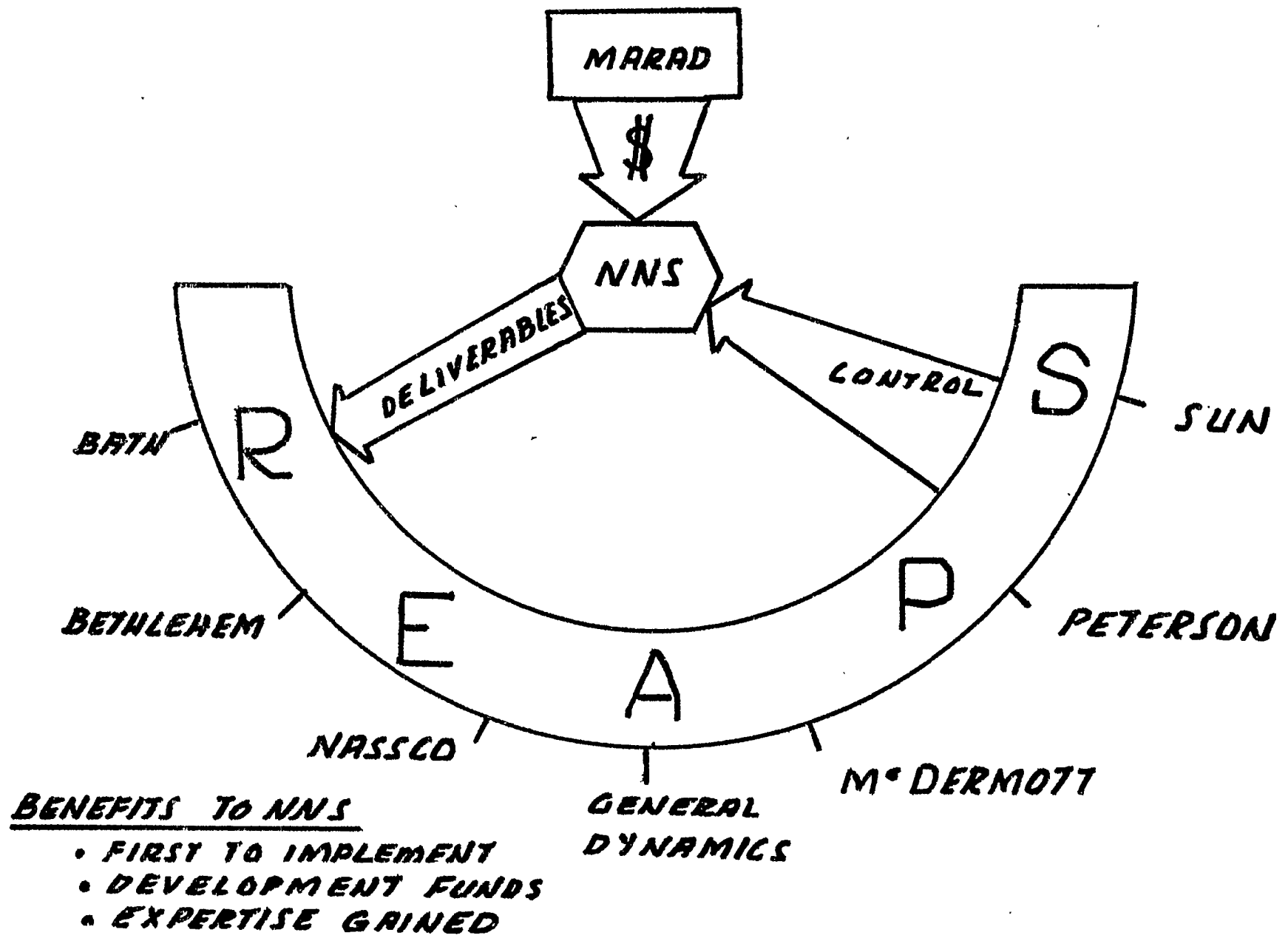
**MAIN REQUIREMENTS OF IPD AS DEFINED BY NNS AND REAPS  
TECH REPS,**

- **HARDWARE/SOFTWARE PACKAGE TO ALLOW USERS TO PERFORM REAL TIME DEFINITION OF THEIR APPLICATION WITH VISUAL (GRAPHIC) OUTPUT AND BUILD UP A DIGITAL MODEL OF THE DEFINITION AT THE SAME TIME,**
- **MUST BE PORTABLE AND CAPABLE OF BEING UPDATED AND EXPANDED INDEPENDENTLY OF THE VENDOR,**
- **PROVIDE A GENERAL TOOL TO BE AVAILABLE FOR FUTURE GRAPHICS PROJECTS WITHIN U, S, SHIPBUILDING, -**
- **DEDICATED COMPUTER, HARDWARE TO PROVIDE RESPONSE TO SUPPORT INTERACTIVE GRAPHICS,**
- **CAPABLE OF DIRECT INTERFACE TO AUTOKON/ SPADES/STEERBEAR SYSTEMS,**

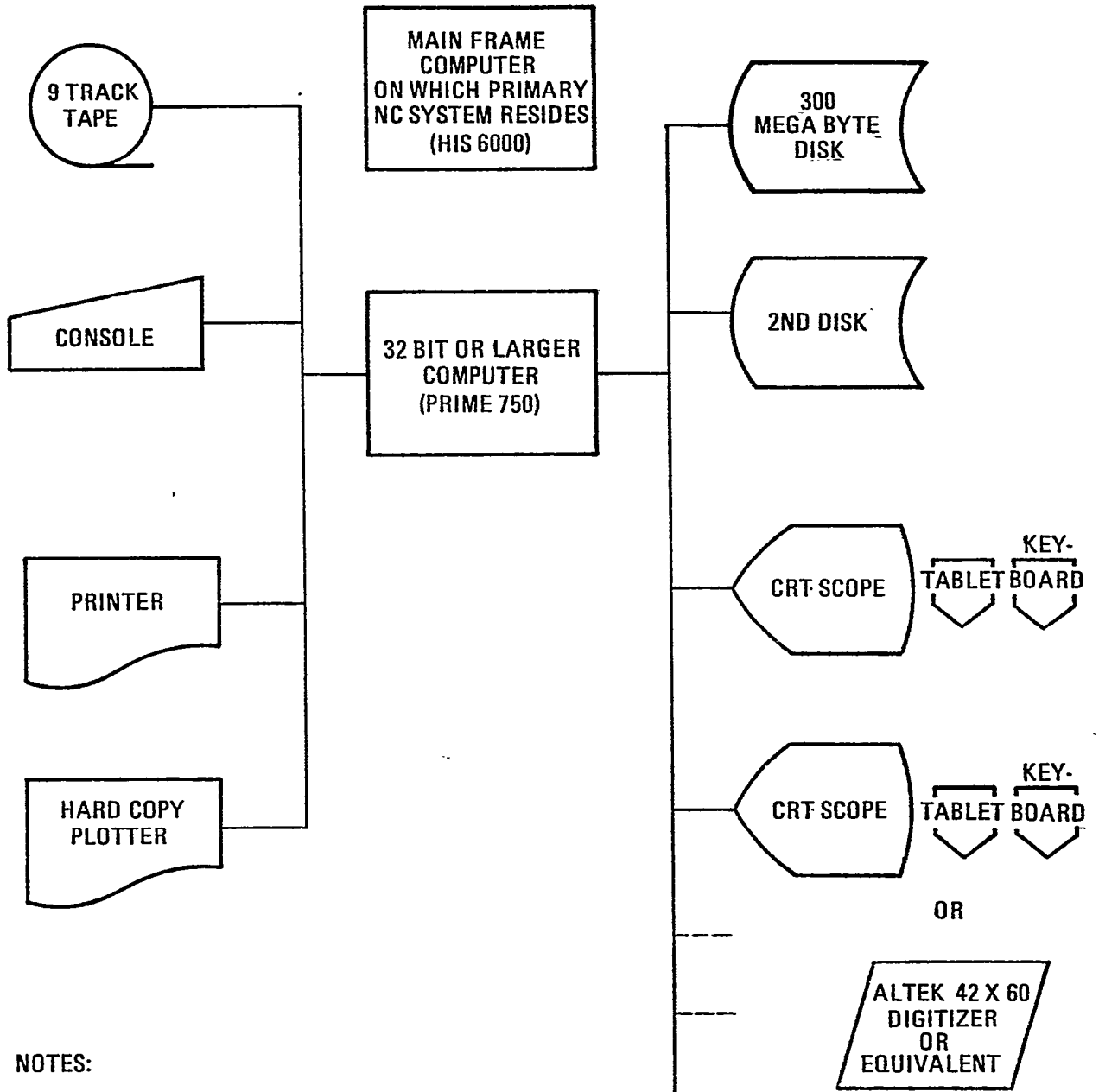
**FUNCTIONAL AREAS ADDRESSED  
BY IPD**

- **STRUCTURAL PART DEFINITION (CURRENT LOFTING)**
- **NESTING**
- **STRUCTURAL SHOP DRAWINGS**
- **NC MACHINING (APT)**
- **DESIGN USE**

**SECONDARY- EVENTS  
AT NNS**



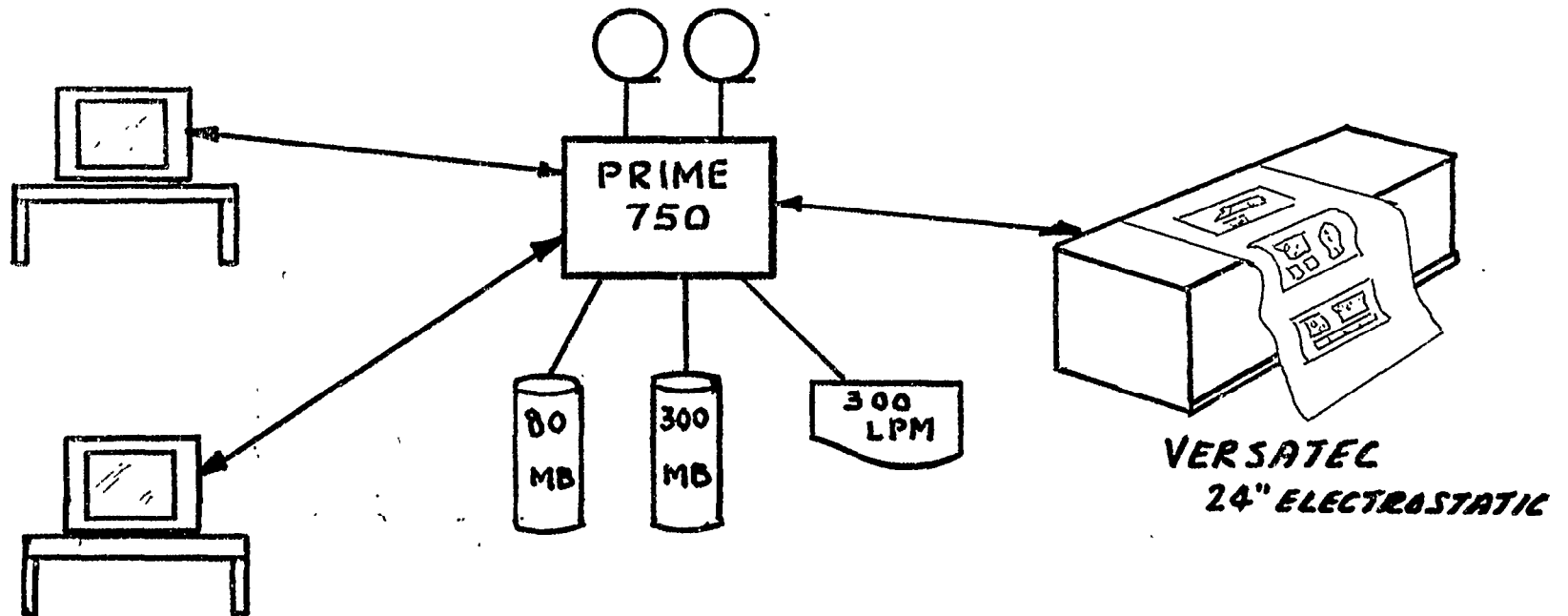
# HARDWARE CONFIGURATION



**NOTES:**

CRT WILL BE SEMI-REFRESH TO ACCOMPLISH NESTING AT A PRODUCTIVE RATE.  
 POSSIBLE PAPER TAPE READER/PUNCH REQUIREMENT.

# IPD HARDWARE MODULES



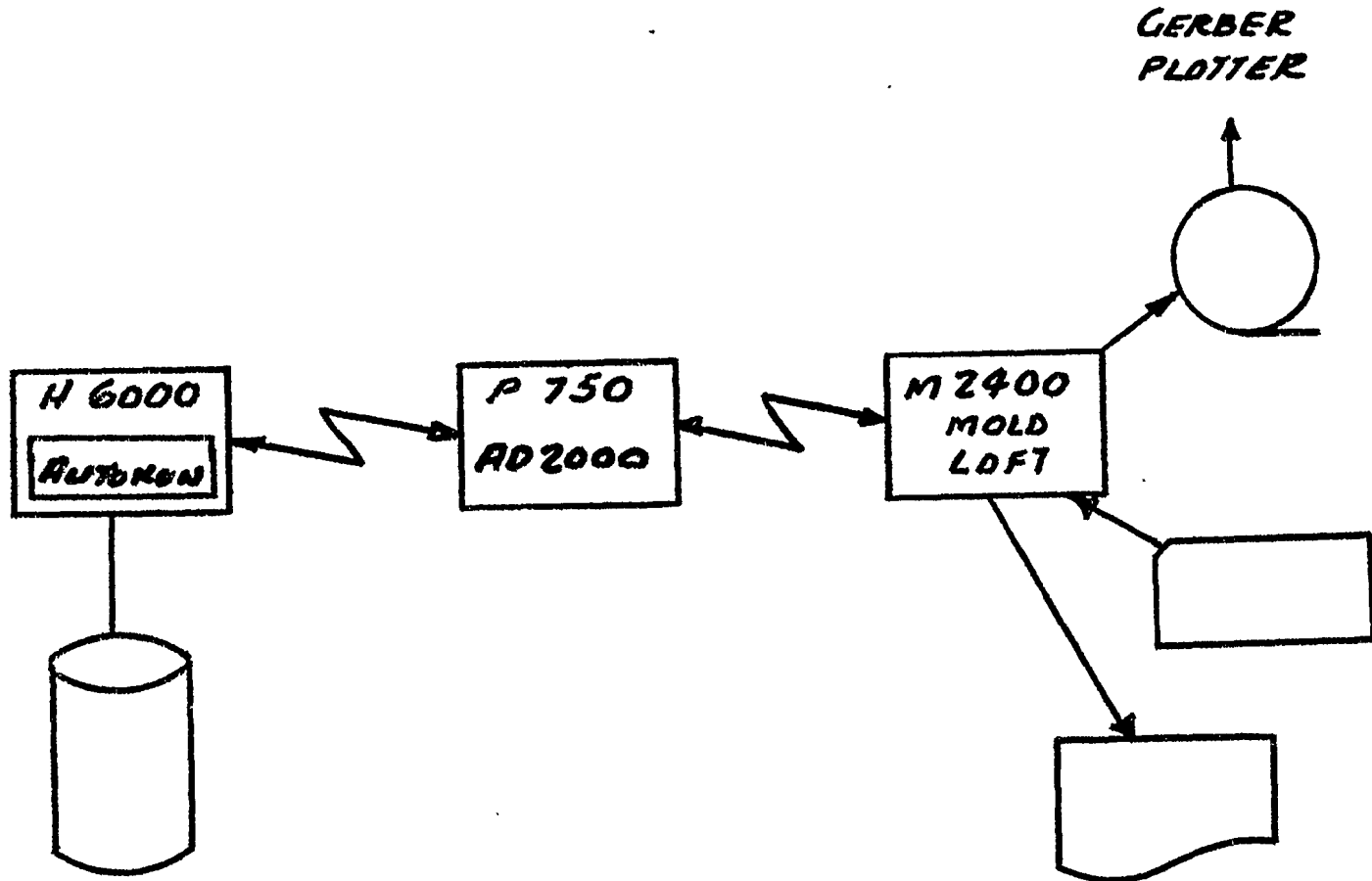
170

## TEKTRONIX 4081

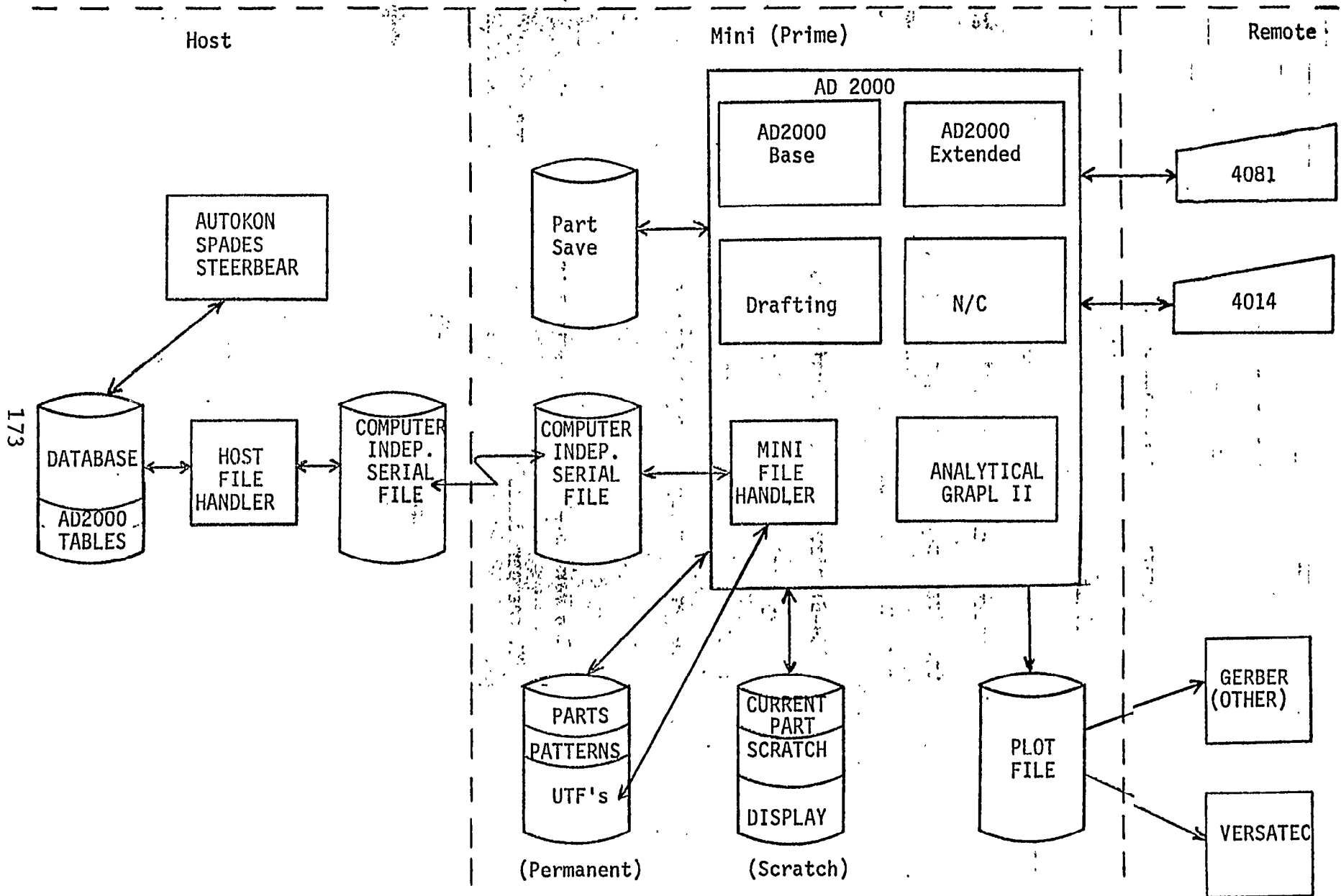
- LOCAL INTELLIGENCE
- SEMI REFRESH
- TABLET

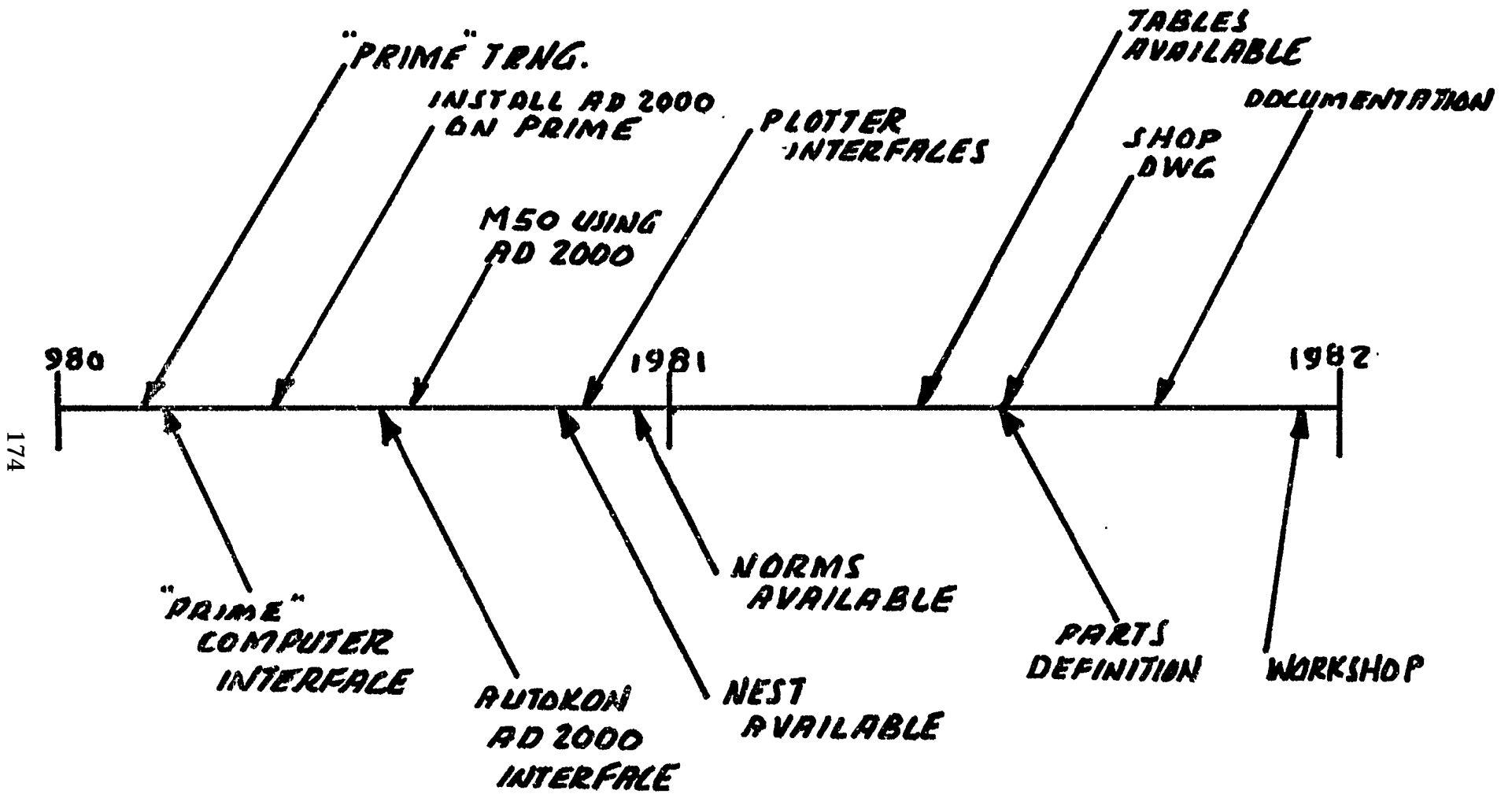
REJECT		YES				COMPLETE		NO		REPAINT		DEPTH		CANON											
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R								
U	V	W	X	Y	Z					0	1	2	3	4	5	6	7								
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27								
.	+	,	-	=	!	∇∇	#	\$	%	:	;	*	(	)	∇	&									
RETURN TO ORIGINAL SCALE		SELECT A NEW CENTER		NEW CENTER KEY-IN SCALE		DOUBLE SCALE		HALF SCALE		ALL POINTS		FROM TYPES		FROM ALL		LAST ENTITY CREATED									
Z		O		O		M				D		E		L		E									
KEY-IN SCALE		DIAGONAL POINTS		KEY-IN MAX-MINS		AUTO MAX-MINS		SAVE ZOOM STATUS		ALL NOT DISPLAYED		ALL OF A DISPLAYED TYPE		ALL OF A TYPE NOT DISPLAYED		ALL OF A LEVEL									
ENTITY TYPES																									
POINT		LINE		ARC/CIRCLE		CONIC		SPLINE		OTHER CURVES		GROUP AND ARRAY		EXT. GEOM. CURVE		SURFACE		LABEL AND NOTE		DIMEN.		CENTER LINE		CROSS HATCH	
DISPLAY TOLERANCE		SYSTEM DECIMAL PLACES		CHANGE CURVE FONT		MODIFY ENTITY LEVEL, FONT, OR PEN NO.		CONTROL SURFACE PATHS		CHANGE CURSOR MODE		CONTROL VIEW VECTORS		SEQ. NO./ POINTER SELECT		DISPLAY TITLE BLOCK									
ALL OF A TYPE		B ALL EXCEPT A TYPE		L ALL		A SELECT FROM TYPE		N SELECT FROM ALL		K LEVELS		U ALL		N ALL OF A TYPE		B ALL EXCEPT A TYPE		L ALL		A ALL					
SCREEN POSITION		KEY-IN		POLAR		DELTA		CIRCLE CENTER		ON A CIRCLE AT AN ANGLE		SCREEN POSITION		KEY-IN		JOIN 2 POINT									
CURVE ENDPOINT		INTERSECTION OF TWO CURVES		VECTORED		REGENERATE SPLINE POINTS		ON A LINE AT A COORDINATE		CURVE NORMAL		THRU POINT HORIZ/VERT		THRU POINT TANTO CURVE		PARALLEL TO LINE AT A DISTANCE									

# INTERFACES



# IPD Software Modules





## PROJECT PLAN PHASE II

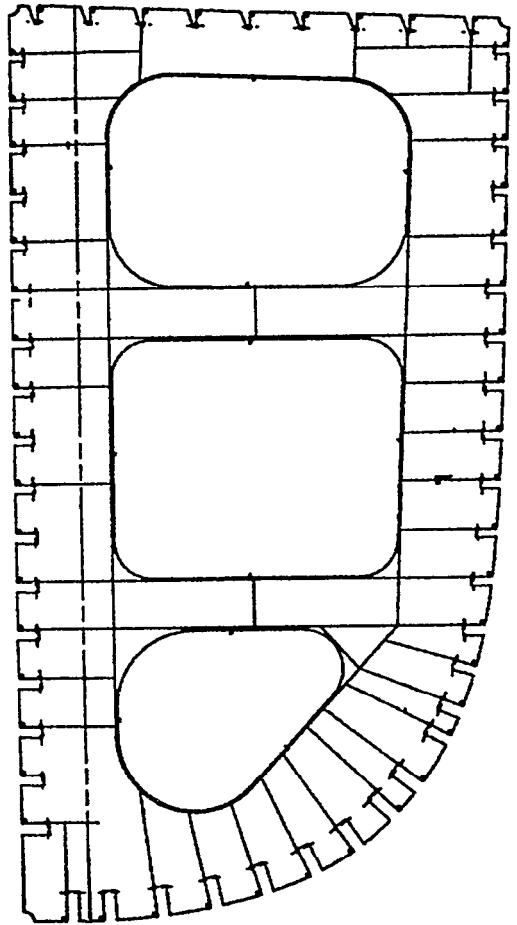
MONTH OF  
COMPLETION FROM  
START OF PHASE

*	• ISSUE PURCHASE ORDERS	1
*	• PRIME TRAINING	3
*	• DEFINE DATA SPECIFICATION	5
*	• AD 2000 INTERFACE	5
*	• WRITE HOST ROUTINES	7
*	• HARDWARE/SOFTWARE INSTALLATION	7
*	• RJE INTERFACE	7
*	• AD 2000 INSTALLATION	9
	• AD 2000 TRAINING	10
*	• MINI SEND/RECEIVE	12
	• REFINE NEST	20
	• REFINE NORMS	15
	• TABLES	19
	• SHOP DRAWING CAPABILITY	20
	• REFINE PARTS DEFINITION	20
	• DOCUMENTATION	23
	• WORKSHOP	24

\*INDICATES WORK ALREADY COMPLETE

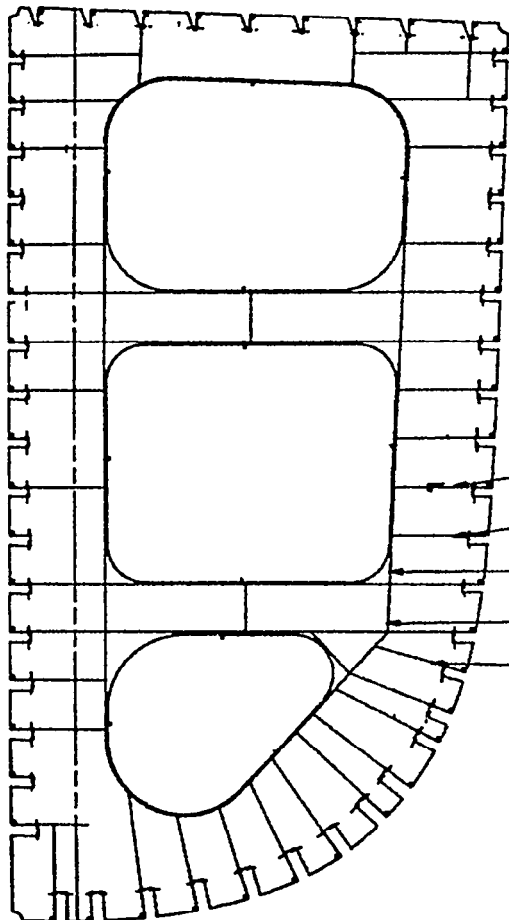


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MODIFY LEVEL/PEN NO.

BLANK/UNBLANK



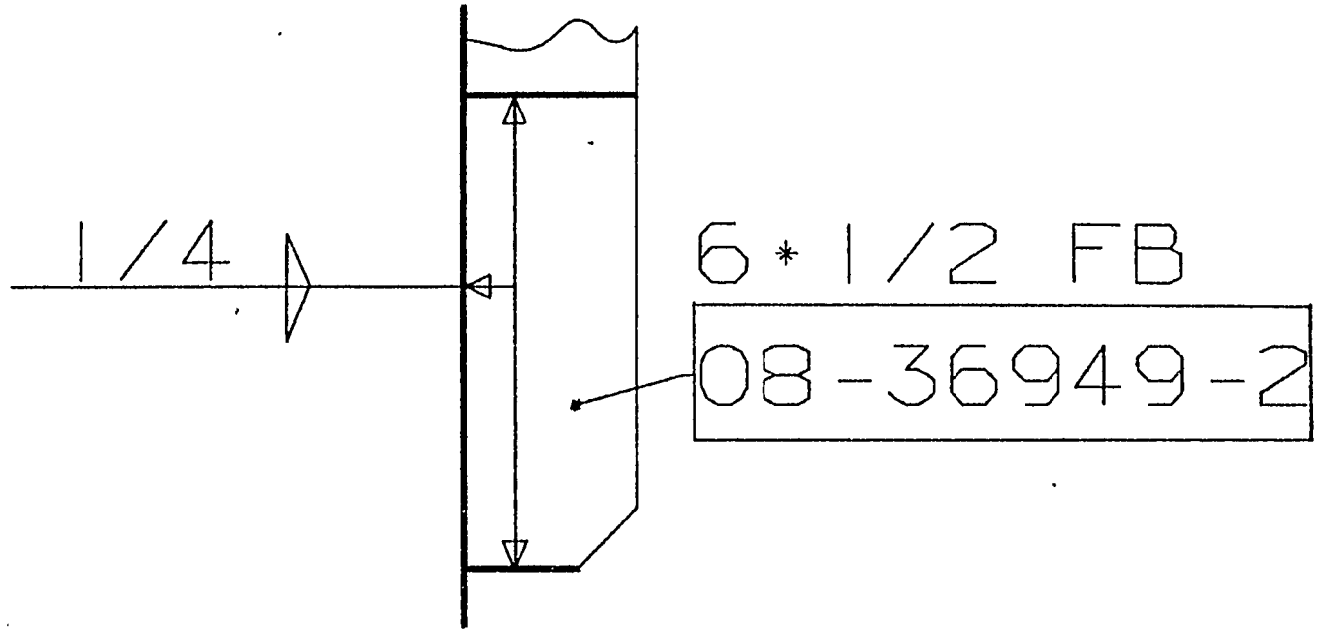
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08-12061-2 DETAIL 2-B

5 # 7/16 FB  
08-35161-2 DETAIL 2-A

8 # 3/4 FB  
08-16612-2

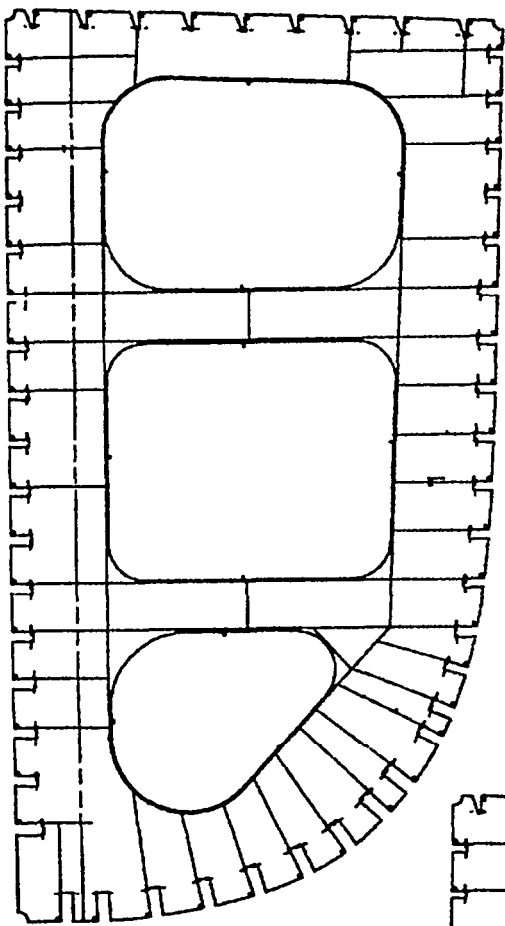
8 # 3/4 FB  
08-35187-2

5 # 7/16 FB  
08-35160-2 DETAIL 2-A

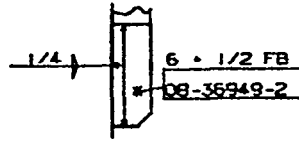


DETAIL 2-A1

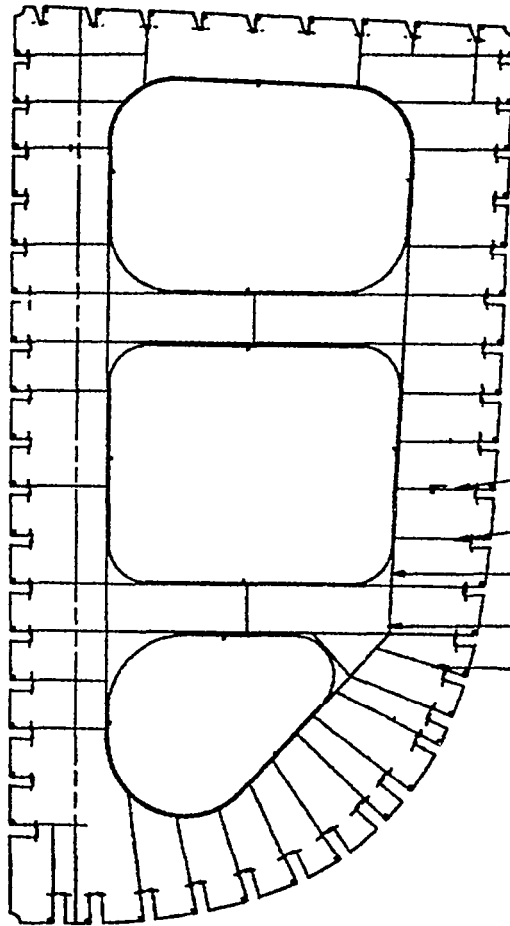
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AD-2000

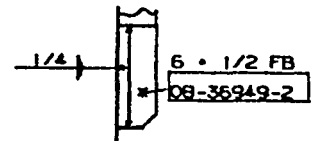


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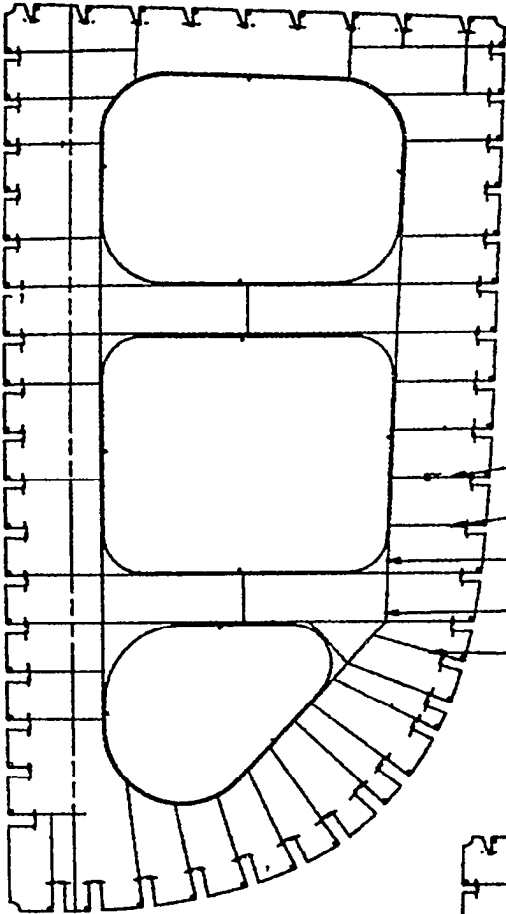


AD-2000

- 17.85 # FLG P:5 FLG  
08-12061-2 DETAIL 2-B
- 5 # 7/16 FB  
08-35161-2 DETAIL 2-A
- 8 # 3/4 FB  
08-16612-2
- 8 # 3/4 FB  
08-35187-2
- 5 # 7/16 FB  
08-35160-2 DETAIL 2-A

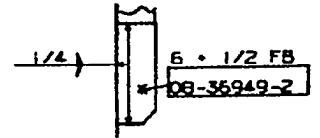


DETAIL 2-A1

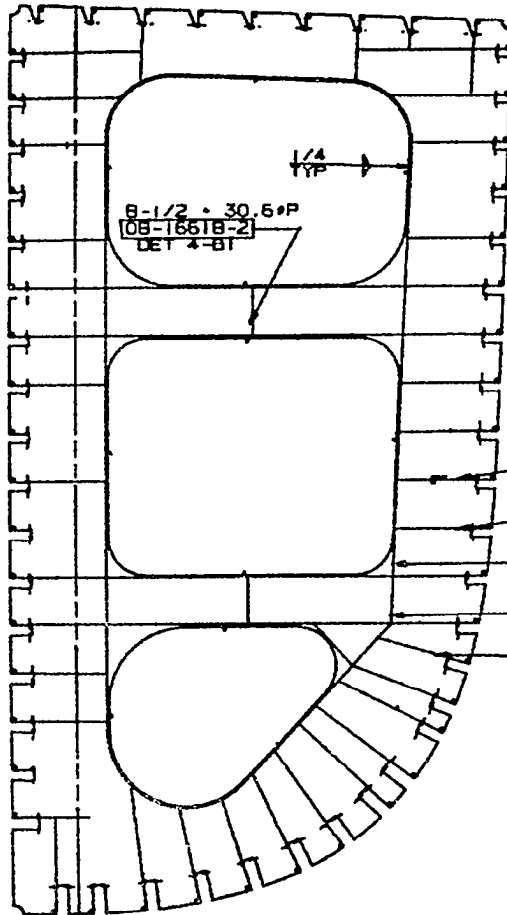


AD-2000

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- 5 # 7/16 FB  
[08-3516T-2] DETAIL 2-A
- 8 # 3/4 FB  
[08-1661Z-2]
- 8 # 3/4 FB  
[08-3518T-2]
- 5 # 7/16 FB  
[08-35160-2] DETAIL 2-A



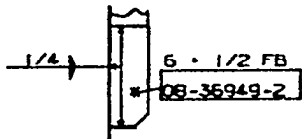
DETAIL 2-A1



AD-2009

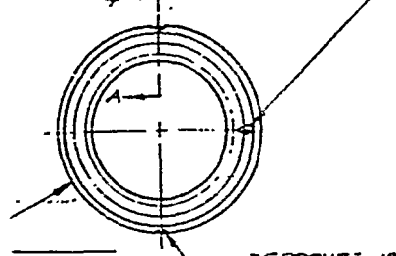
- 8-1/2 # 30.6#P  
[08-1661B-2]  
DET 4-B1

- 17.85 # FLG P:5 FLG  
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- 5 # 7/16 FB  
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- 8 # 3/4 FB  
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- 8 # 3/4 FB  
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- 5 # 7/16 FB  
[08-35160-2] DETAIL 2-A

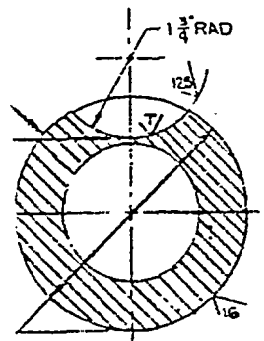
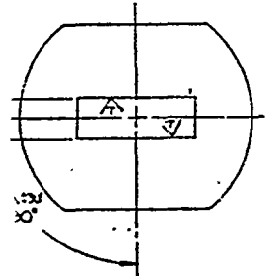


DETAIL 2-A1

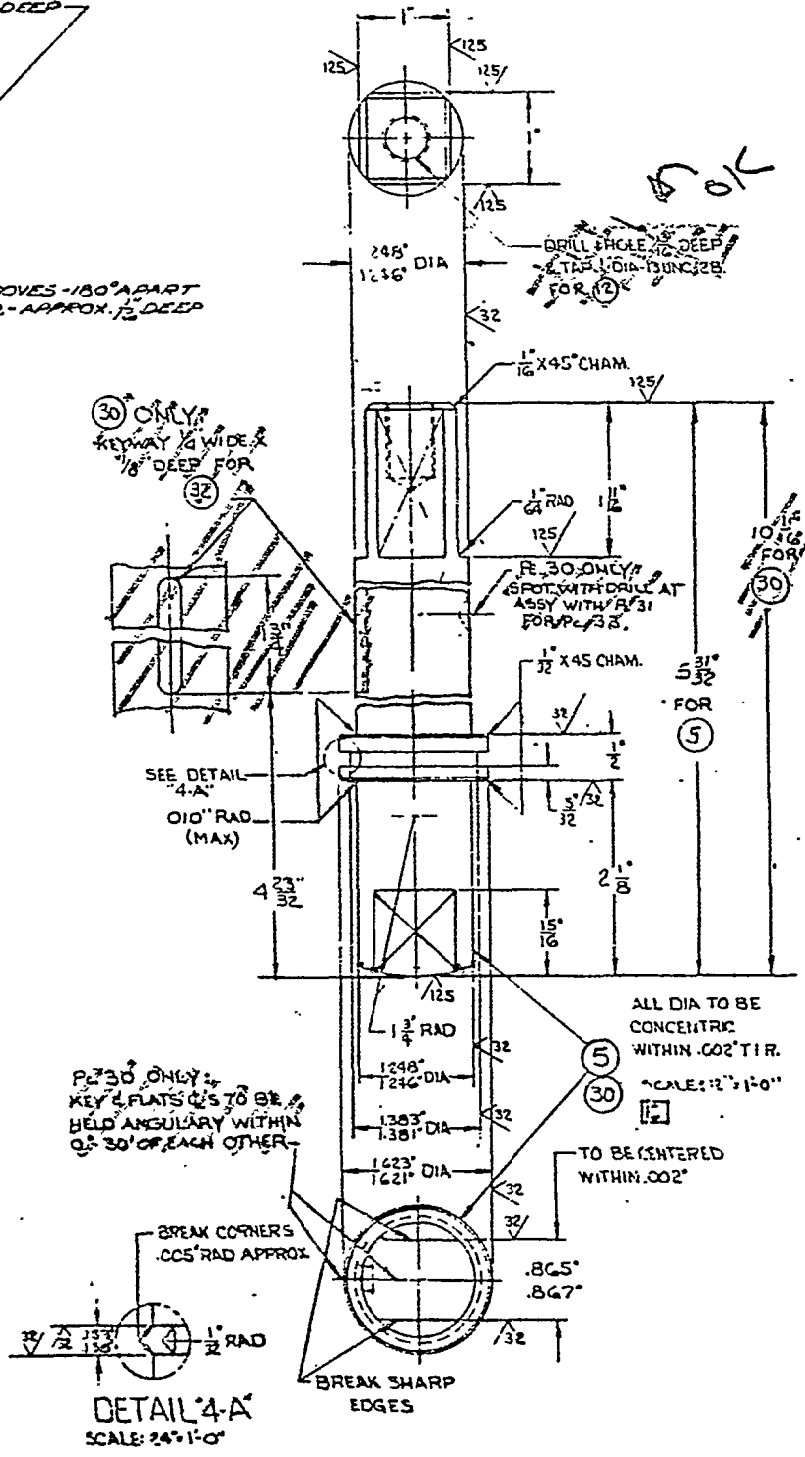
ROOVE-LOCATE AS SHOWN  
 $\frac{1}{8}$ " RAD APPROX. - APPROX  $\frac{1}{32}$ " DEEP



ALL OVER EXCEPT AS SHOWN.  
 2 GROOVES - 180° APART  
 $\frac{1}{8}$ " RAD. - APPROX.  $\frac{1}{32}$ " DEEP



$5.125 \pm .002$  DIA BALL TO BE SPHERICAL WITHIN .002"



30 ONLY  
 KEYWAY 1/8" WIDE &  
 1/16" DEEP FOR 32

DRILL HOLE 1/8" DEEP  
 & TAP 1/16" DIA - 13UNC/32  
 FOR 32

OK

R. 30 ONLY  
 SPOT WITH DRILL AT  
 ASSY WITH R. 31  
 FOR P. 33.

10 1/16  
 FOR 30

SEE DETAIL  
 4-A  
 0.10" RAD  
 (MAX)

5 3/32  
 FOR 5

ALL DIA TO BE CONCENTRIC WITHIN .002" T.I.R.

SCALE: 1" = 1'-0"

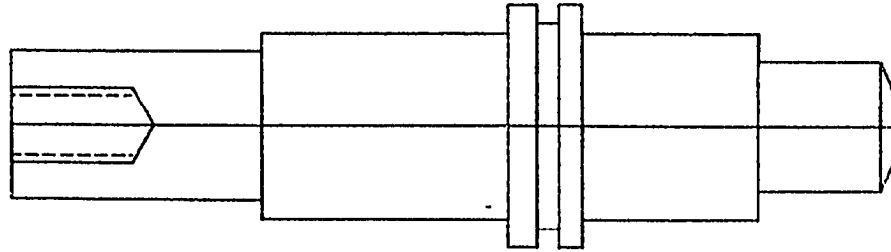
TO BE CENTERED WITHIN .002"

P. 30 ONLY  
 KEY & FLATS Q'S TO BE HELD ANGULARLY WITHIN Q'S 30° OF EACH OTHER

BREAK CORNERS .005" RAD APPROX

BREAK SHARP EDGES

DETAIL 4-A  
 SCALE: 24" = 1'-0"

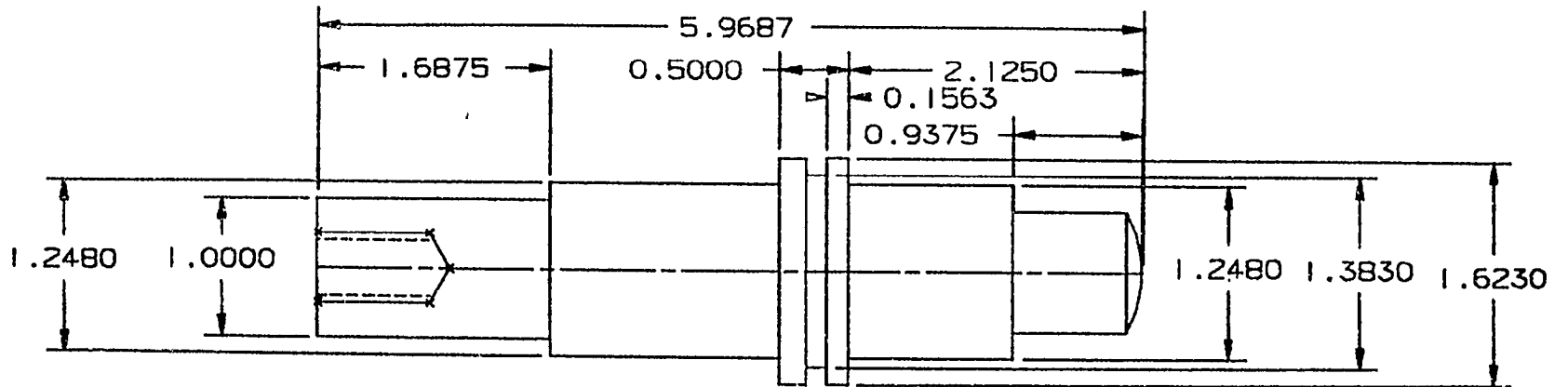


LEVEL MANAGEMENT

LISTING FOR 'STEN

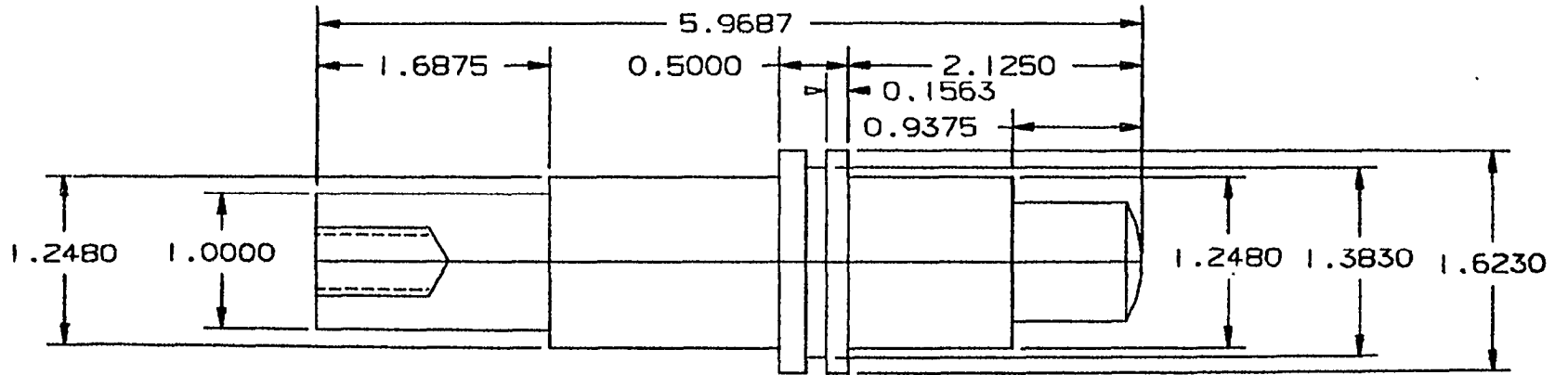
- DRAWING SPACE
- TURNING GEOMETRY
- MILLING GEOMETRY
- DIMENSIONS
- NOTES
- GEOMETRY POINTS

~~NOT YES OR NO TO CONTINUE - V -~~  
~~LEVEL MANAGEMENT~~



m-2884

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