

SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

June 1977
NSRP 0003

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

Proceedings of the REAPS Technical Symposium

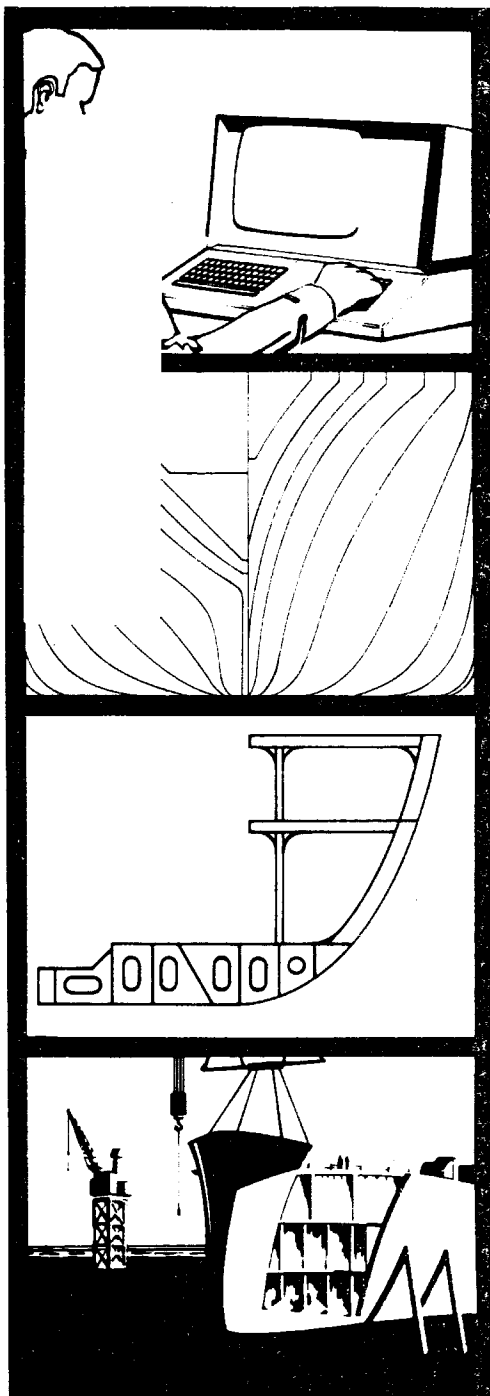
Paper No. 22: Recent Developments in Computer-Based Systems at Kockums

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

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE JUN 1977		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE The National Shipbuilding Research Program: Proceedings of the REAPS Technical Symposium Paper No. 22: Recent Developments in Computer-Based Systems at Kockums				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Surface Warfare Center CD Code 2230 - Design Integration Tools Building 192 Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 39	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

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R ESEARCH
E AND
E NGINEERING
A FOR
A UTOMATION
P AND
S RODUCTIVITY
IN
SHIPBUILDING

**Proceedings of the
REAPS Technical Symposium
June 21-22, 1977
New Orleans, Louisiana**

RECENT DEVELOPMENTS IN COMPUTER BASED SYSTEMS
AT KOCKUMS

Kai Holmgren
Kockums Computer Systems AB
Malmo, Sweden

As the Director of Kockums Computer Systems, Mr. Holmgren is responsible for all its activity (development of systems, marketing, computer production, etc.). He has been with Kockums in various positions since 1961. Before that time, he was in charge of technical systems development at the Swedish Aeroengine Company.

KOCKUMS

THE KOCKUMS GROUP

KOCKUMS AB

Group Staff

- Finance
- Personnel
- Legal
- etc

Employees 1977

8.000

Turnover 1976

.430 million dollars

Shipyard

Ships
Submarine

Shipping

Shipping operations

Computer
Systems

Computer based systems
Computer operations
System services

Industries

Highway trucks
towing vehicles and systems,
Sawmill equipment and systems

Automation

Marine electronics
Acoustic signalling equipment
Sawmill electronics
Electronic lifting devices

Chemical

Biochemical indicators

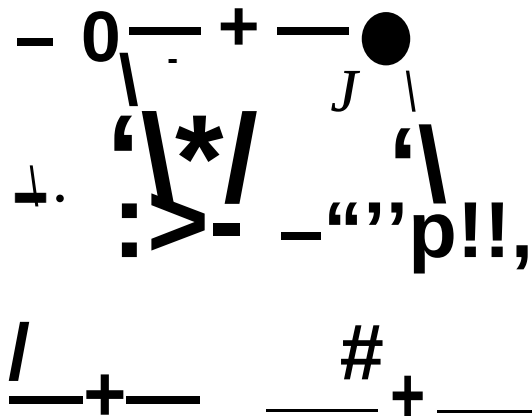
Construction

Feed-stuff plants
Installations for powdered
materials

Energy
Systems

Heat and power production plants
District heating systems
System components

Information System



- Stations (Departments, persons, machines etc)

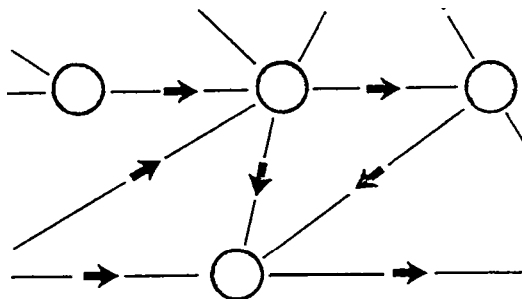
producing
consuming
handling

information

- Transportation ways

- Information media (documents, files, data bases etc)

Computer- based Information System

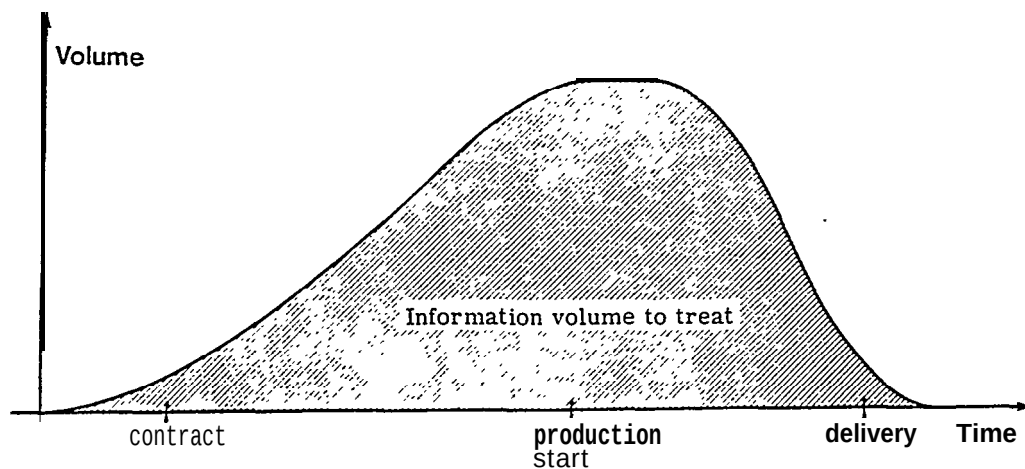


- Network covering the main activities of a company
- A major part of the activities are covered by computer applications
- The individual computer applications are designed so that they can "talk" to each other

Characteristics of Shipbuilding

- Tailor-made product
- Short series
- All activities concentrated around one complicated and expensive product
- Different types of design activities (Hull, out-fitting machinery)
 - . Different types of production
 - . Heavy product requiring extensive areas, transportations and lifting
- Much work done out-doors
 - . Steel is costwise almost 50 % of the total material

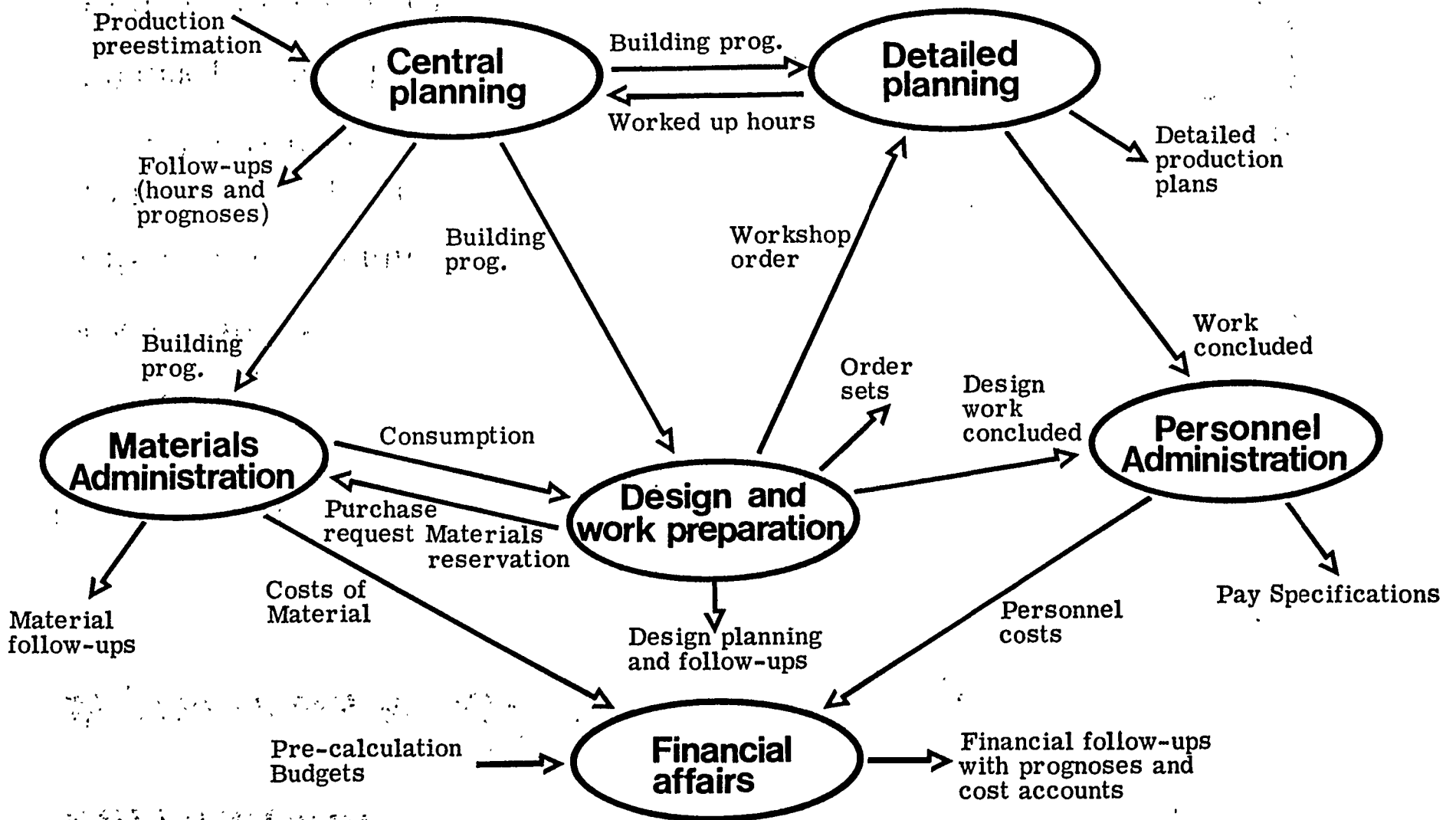
Information Structure



- Large volumes of design and work preparation information (short series)
 - Material information and standardization very vital.
- . The overall planning and follow-up is very essential (a ship represents a big and complicated project)

Survey SYSTEM

369



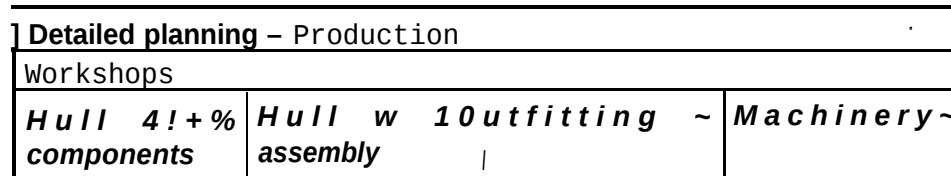
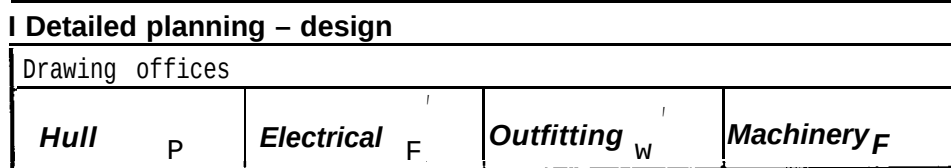
Display screen terminal

Inquiry / Dialogue

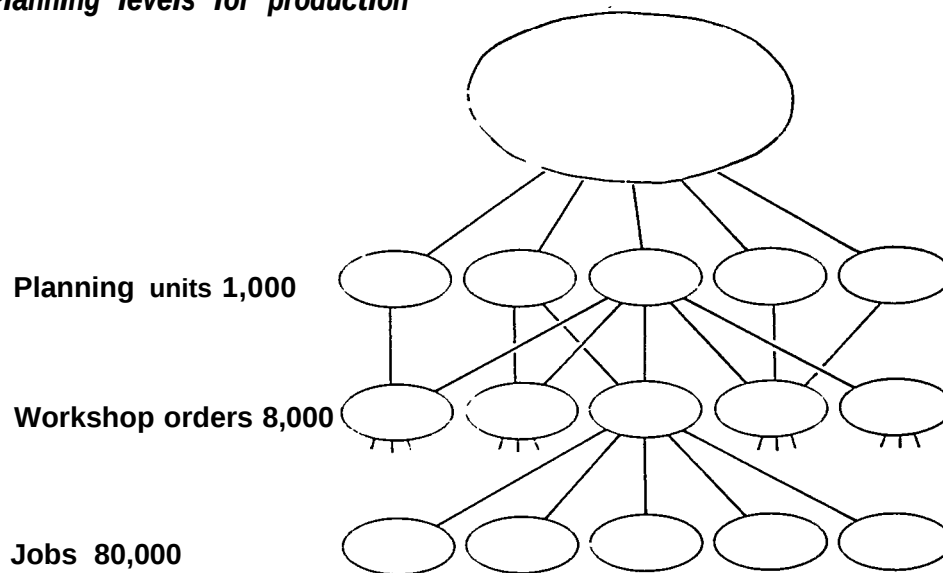
- Material status
- Work status
- Resource planning
- Plate and profile administration
- Work preparation
- Financial accounting
-



The planning function



Planning levels for production

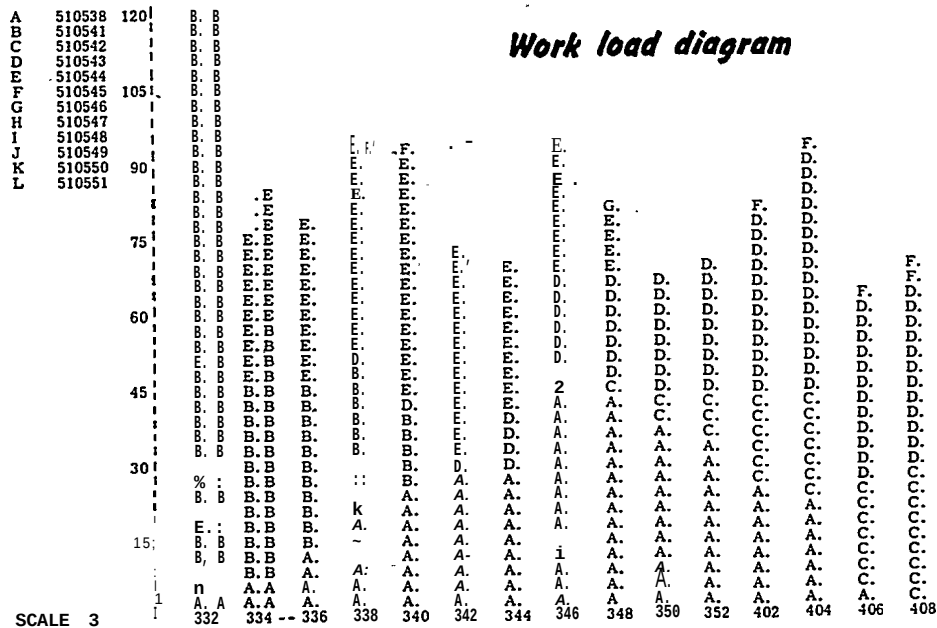




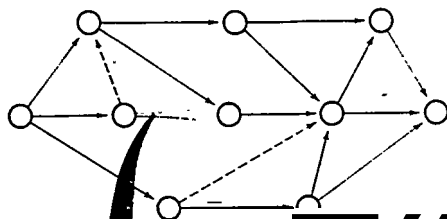
KOCKUMS MEKANISKA VERKSTADS AB
OH303A
WORK CENTRE: 729 -736

WORK LOAD DIAGRAM
730827 WORKLOAD SCHEME

1 PAGE 2-1



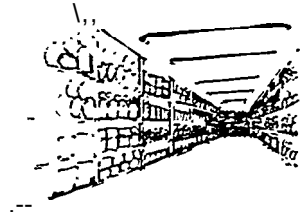
Conversion of a network
into a building programme



F " " RODUCT

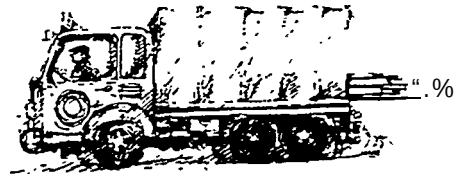
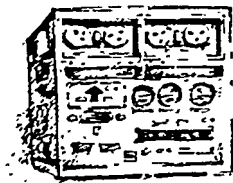
SECTION OUTFITTING CARGO PART D SECTION 48024 D796BB READY-MADE FOR SEC OUTF	---	515
FOREBODY	---	515
72002 FOREBODY OUTF. IN HULL DEPT	446	504
72003 EL 391 SEC OUTF	581	509
52004 B 991 READY-MADE FOR SEC OUTF	---	513
69501 PIPETOWER	446	504
69502 PIPETOWER READY-MADE	---	506
Deckhouses	---	---
71302 H702 SEC OUTF	503	511
71304 H702 READY-MADE FOR SEC OUTF	---	513
71503 H703SB SEC OUTF	502	510
71504 H7103SB READY-MADE FOR SEC OUTF	---	510

50,000 kinds of materials



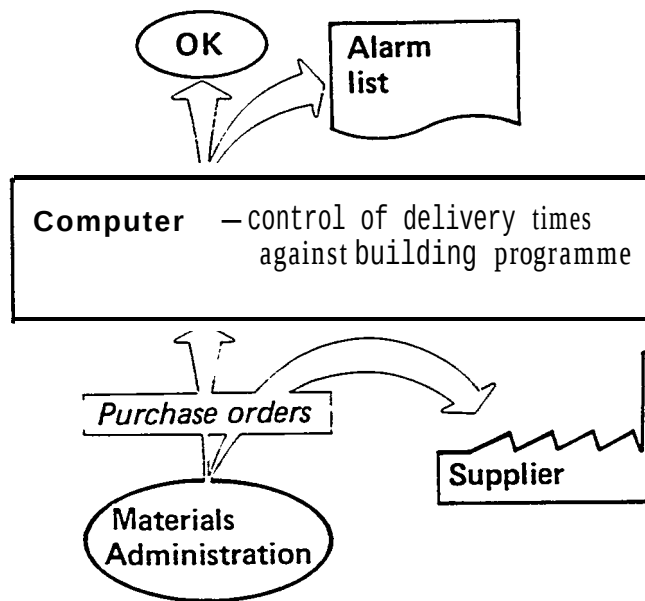
10,000 (stock materials)

*Ordered by
the computer*



40,000 (direct materials)

*Ordered by
the designer*



| Purchase requests

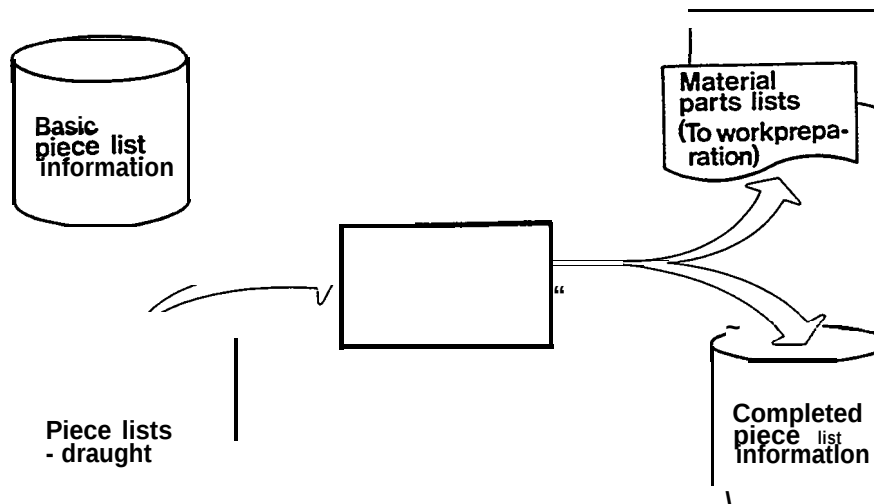


Reminder of non-delivery

KOCKUMS		b.a.nc'. o :C, C...titw.W PAMINNEME OM U7EEUVTN LEWRANE REMINDEER OP NON-DELIVERY 73-09-07 T AHLM 371000 39 1972	
BEEVARAS OMGAENDE ANVAND BIFOGAT LEVERANSBESKED SOM SVARSBLANKETT. DE MED ASTERSK (*) MARKERADE RADERNA IFYLLES AV ER. FOR IMMEDIATE ANSWER WHEN ANSWERING PLEASE USE NOTICE OF DELIVERY ATTACHED. LINES MARKED WITH AN ASTERSK (*) ARE TO BE FILLED UP BY YOU.		KABELHJO VETA A/S POSTBOX XYZ 53400 OSLO NORGE KOCKUMS KESKSTADS AB KOCKUMS KESKSTADS AB	
Week of delivery		Material No.	
RULLKLYS TYP 3 ENKELT MED 450 MM RULLE		Product No.	
4,00 ST 34 1973 441 00 857 001108 2 510544 23300 45016		Answer from the supplier	



Data bank for piece list information



Piece list — draught

NO.	QTY.	DESCRIPTION	UNIT	PRICE	TOTAL	REMARKS
46	18			836	1163	RR
47	6	Type OPR-200 DT		538	1275	RR
48	1	(500 x 2000 x 12.7)		1048		RR
49	1					RU
50	1					
51	1					
52	1					
53	2	L=600		831		L
54	2			001	831	L
55	2					L
56	2	L=30		246	058	L
57	2			278	539	F
58	2					F
59	2					F
60				084	102	LT
61	11			224	243	F
62	3			229	498	F
63	9			228	578	F
64	6			229	480	F

200	56	7946	10	4135.00	KR	06	52
PLAC. OF ALL VENT. PIPES AND DETAILS							
TOTAL LENGTH = 355 M AND FITTING, PLAC. AND WELDING OF							
ABOUT 400 HOLDERS, PLAC. OF SPINDLE LENGTHENING TO							
DAMPER POS. 53 (VALID FOR C-DECK)							
210	56	7946	10	3955.00	KR	06	52
PLAC. OF ALL VENT. PIPES AND DETAILS							
TOTAL LENGTH = 344.0 M AND FITTING, PLAC. AND WELDING							
OF ABOUT 355 HOLDERS (VALID FOR D-DECK AND NAV. DECK)							
211	56	7946	10	118.00	KR	06	52
INST. OF FAN							
220	56	7946	10	4135.00	KR	06	52
PLAC. OF ALL VENT. PIPES AND DETAILS							
221	56	7951	10				
WELDING OF PLAC. OF							

VENTILATION OF ACCOM. A-DECK 5B

- Id. of piece lists on a lower level
- Id. of materials
- Drawing No.

Operation list

WO, OPERATION LIST

200	56	7946	10	4135.00	KR	06	52
PLAC. OF ALL VENT. PIPES AND DETAILS							
TOTAL LENGTH = 355 M AND FITTING, PLAC. AND WELDING OF							
ABOUT 400 HOLDERS, PLAC. OF SPINDLE LENGTHENING TO							
DAMPER POS. 53 (VALID FOR C-DECK)							
210	56	7946	10	3955.00	KR	06	52
PLAC. OF ALL VENT. PIPES AND DETAILS							
TOTAL LENGTH = 344.0 M AND FITTING, PLAC. AND WELDING							
OF ABOUT 355 HOLDERS (VALID FOR D-DECK AND NAV. DECK)							
211	56	7946	10	118.00	KR	06	52
INST. OF FAN							
220	56	7946	10	4135.00	KR	06	52
PLAC. OF ALL VENT. PIPES AND DETAILS							
221	56	7951	10				
WELDING OF PLAC. OF							

200	56	7946	10	4135.00	KR	06	52
PLAC. OF ALL VENT. PIPES AND DETAILS							
• Production group							
• Department No.							
• Operation No.							
• Operation descr.							
• Estimate							

H 701 VENTILATION OF ACCOMMODATION 517:3 K-EH 1860 5 1 273 65361

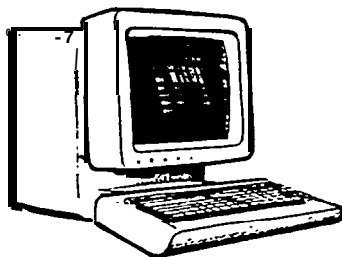
DRAW. DIST. R. SEE OP. 350 WO 517 1 7565 BRI 711 510552 273 30129

Detailed plan for Workshops

KOCKUMS MEKANISKA VERKSTADS AB								PRODUCTION PROGRAMME			
OUTFITTING								DEPT 734 ORDERDISTRIBUTION AREA 911			
QD1128								73-03-23			
PRODUCT NUMBER	WORK SHOP ORDER	PLAN UNIT	JOB	PROD GROUP	PLAN HOUR	CA- PACITY	START	FIN- ISHED	STATUS	WORK ORDE DESIGNATIO	
510539	59674	45015	10- 20	7046	16.7	0.8	73061	73085	8P	ou'rd3Cnt.	
510540	56248	32603	10- 20	7946	11.2	0.8	73081	73084	P	G 402 PLAC	
510540	57093	32603	10- 20	7946	10.9	0.8	73 001	73084	P	~ \;2&Yh;R	
510540	44327	24513	40- 40	7946	3.0	1.0	73082	73095			
510539	57179	71398	50- 70	7046	16.1	0.2	73082	73105	P	H-702 OUT	
REMAINING HOURS WEEK 7308 289								ACCUMULATED		1408	
510539	55410	62703	140- 150	7946	16.0	1.1	73091	73094		8903 DIDI	
510539	56960	38603	30- 70	7046	~%	---					

- Identification of department and order distribution area ①
- Identification of a job ②
- Planned man-hours ③
- Starting and completion time ④

Production situation for a work order ?



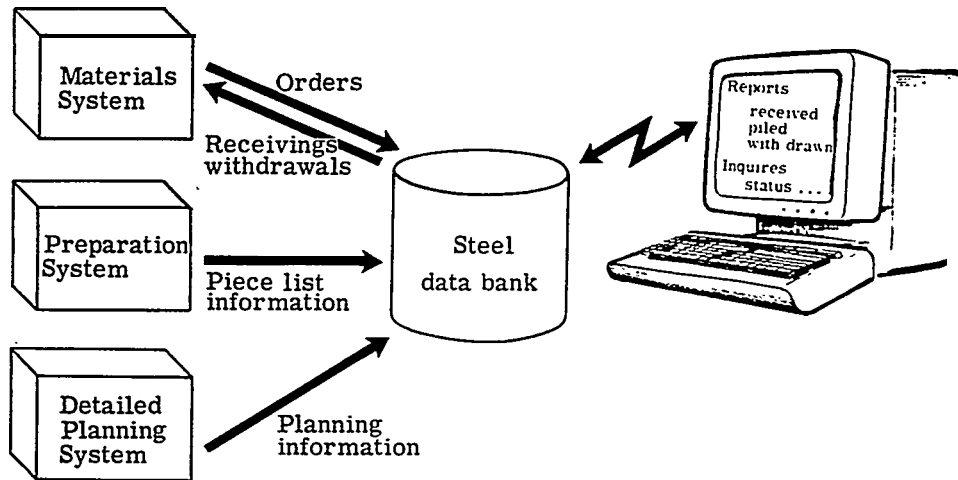
Planned,
processed and
remaining man
hours

Planned
start-end

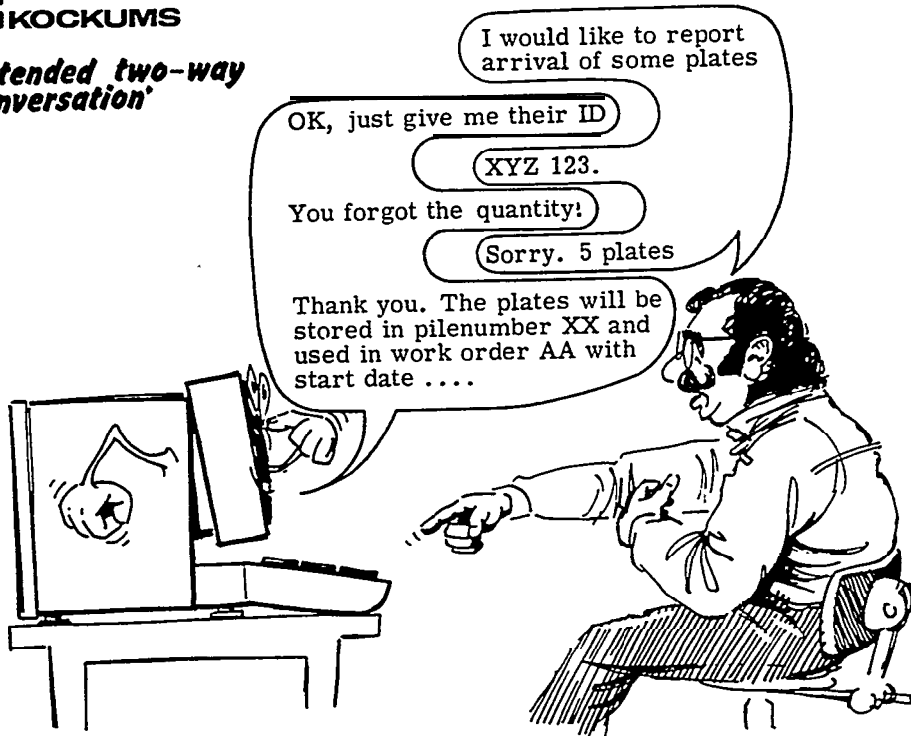
Actual
start-end

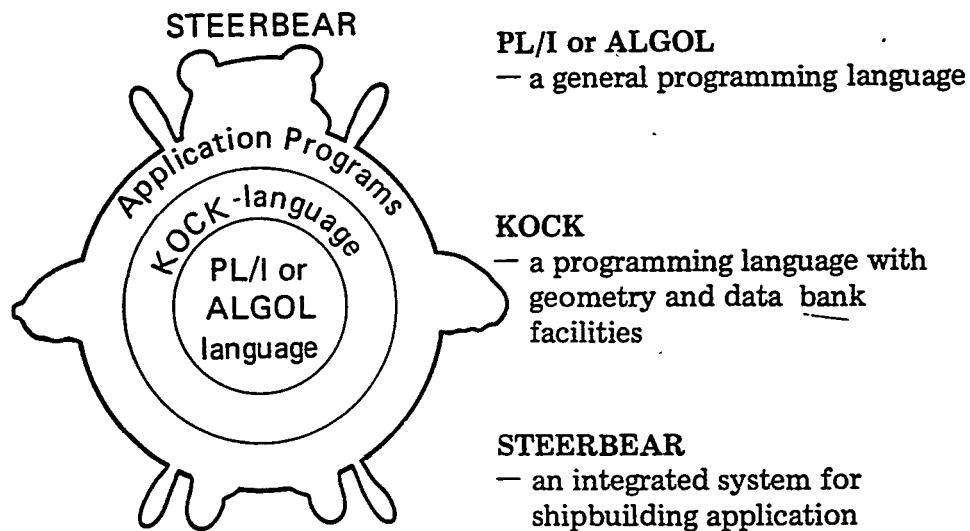
Current status
of operations

Steel administration system



Extended two-way 'conversation'



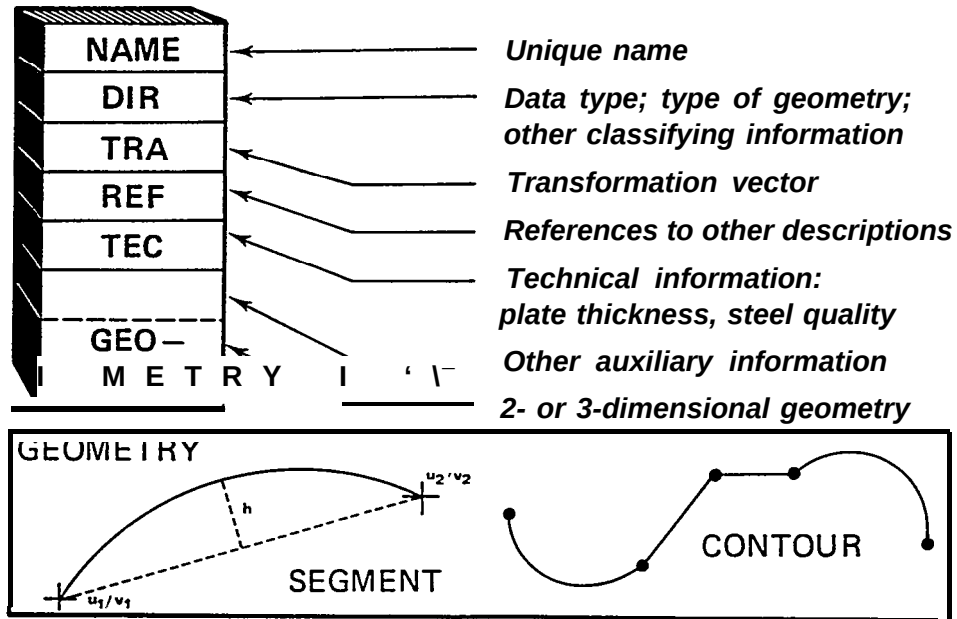


C 302

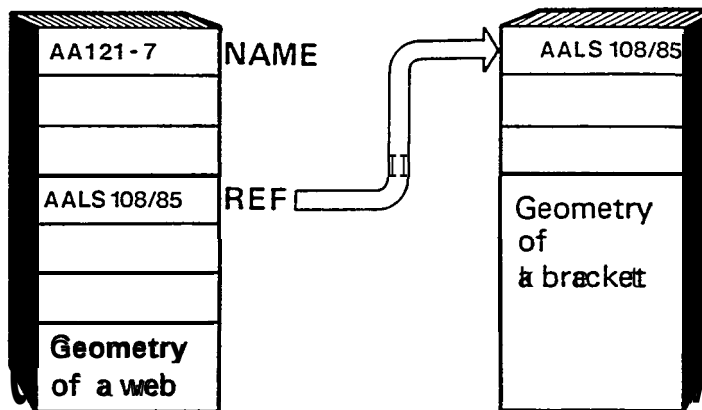
*Main features
of KOCK language*

- 1 All PL/I or ALGOL available
- 2 Data base formats for
 - Geometry
 - Tables
 - Arbitrary information
- 3 Extensive subroutine system for
 - Data base operations
 - Geometry and table handling

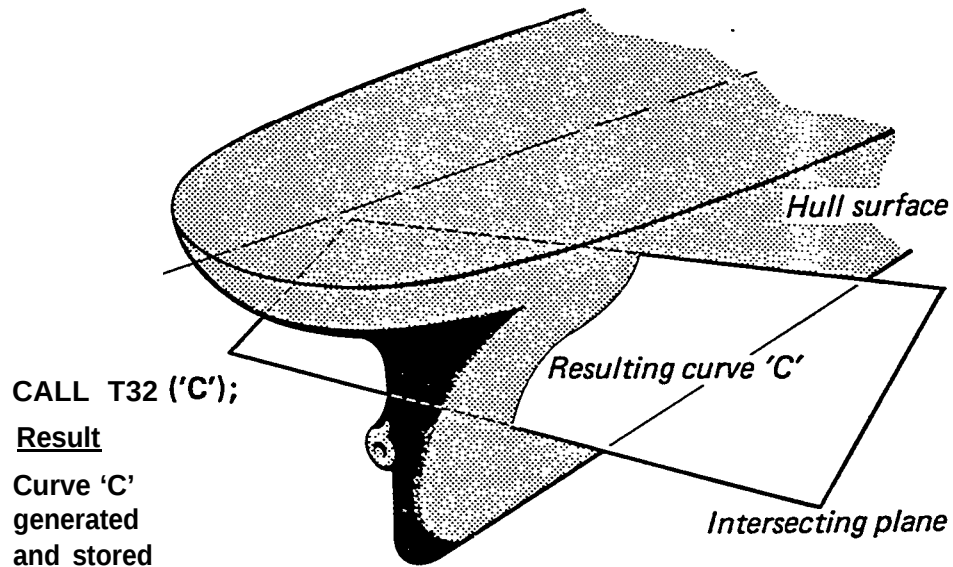
KOCK description in the data bank



Reference between KOCK descriptions in the data bank



Cut surface with plane



c 501

*Some typical
application subroutines*

Hydromechanical
calculations

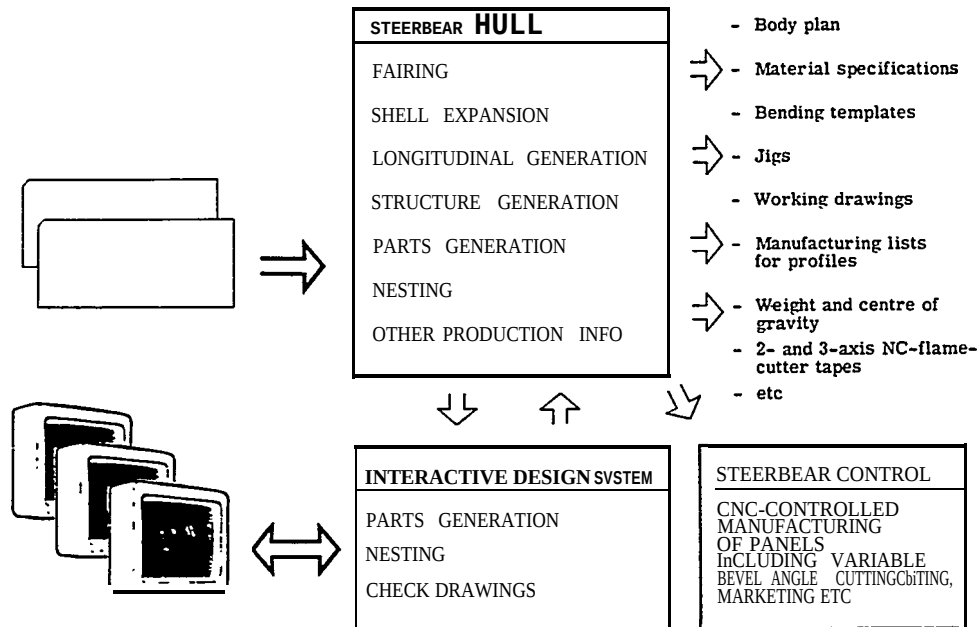
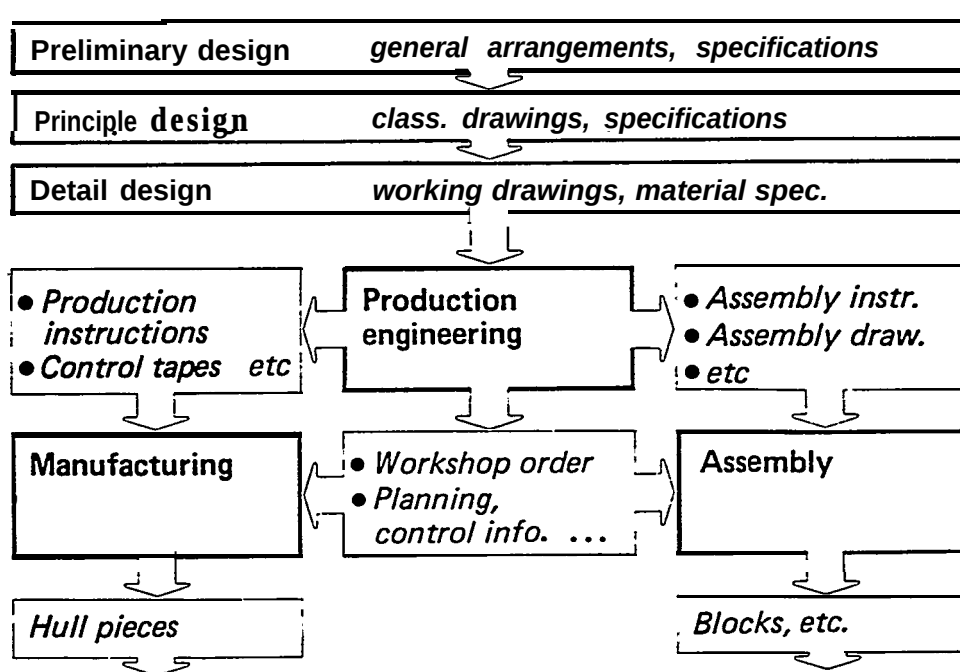
- T61 — Moment of surface
- T64 — Simpson integral
- ...

Nesting

- PA3 — A nest
- PM18 — Along to corner
- PD1 — Draw text
- ...

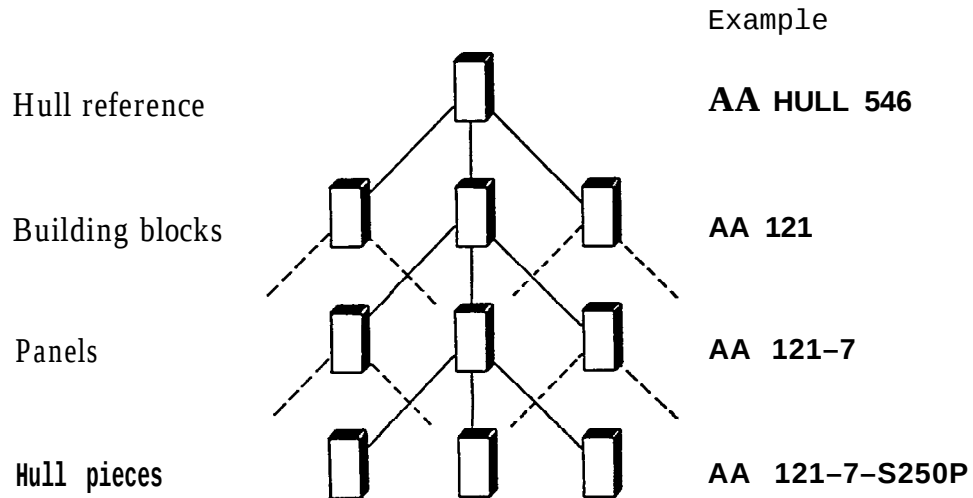
Generation of
hull pieces
(micro design standards)

- T200 — Generate outer contour
- T232 — Set cutouts
- T300 — Tripping bracket
- ...

Principle flow – design and production

C 304

Hierarchy in data bank



C 506

Hull structure generation

*Generation
of panels*

*... can be
done by*

... based on

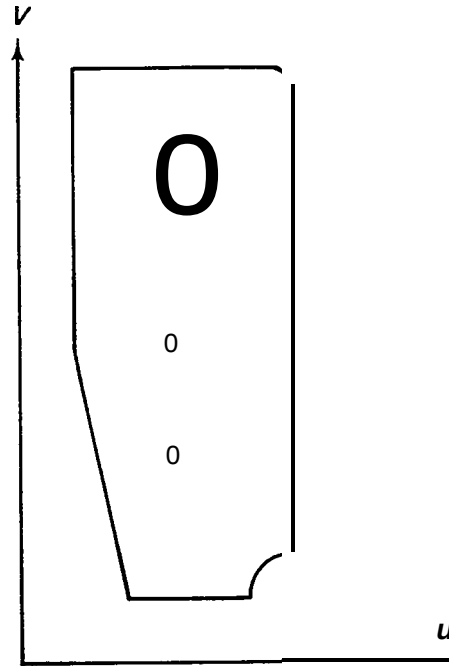
- . Brackets
- Scallops, cutouts, holes
- Stiffeners, flanges
- ...
- KOCK programming
or
- Structure programming
- Micro design standards
- Special set of application subroutines
- Structure data bank

Simple KOCK program

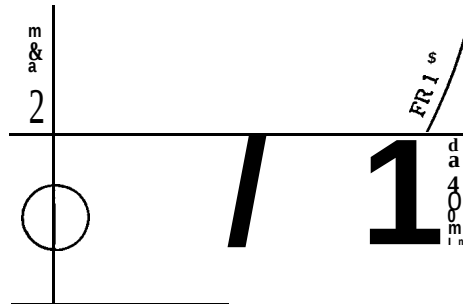
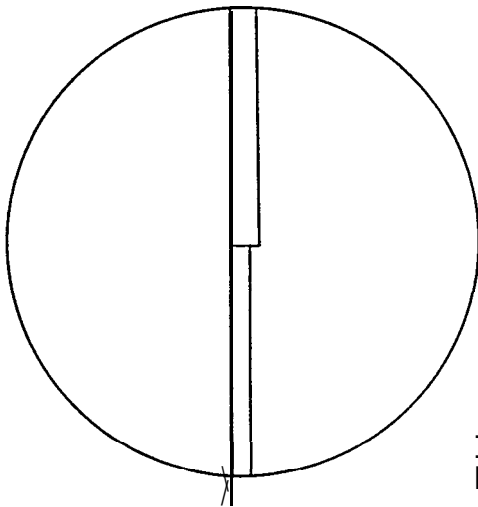
```

...
INITIATE KOCK (2000);
TREAT (<TESTEIT>);
POINT (200,100);
SEGMENT (0,425,100);
CIRCLE (-75,90,90);
SEGMENT (0,500,1050);
CIRCLE (50,90,90);
LINE WITH ANGLE (180,350);
LINE WITH ANGLE (270,500);
SEGMENT (0,200,100);
FOR V = 450,650,800 DO
IF V<900 THEN
ADD CIRCULAR CONTOUR (300,V,50)
ELSE
ADD CIRCULAR CONTOUR (300,V,75);
NREA = 1;
REA (1) = 14.5;
PUT RECORD (<JIM>,2,-1);
KOCK DUMP (<TESTEIT>);
DRAW DESCRIPTION (<TESTE
TERMINATE KOCK;
...

```



Panel boundaries



INPUT:
BOUNDARY, FR148/V=5200/'AG162-3'

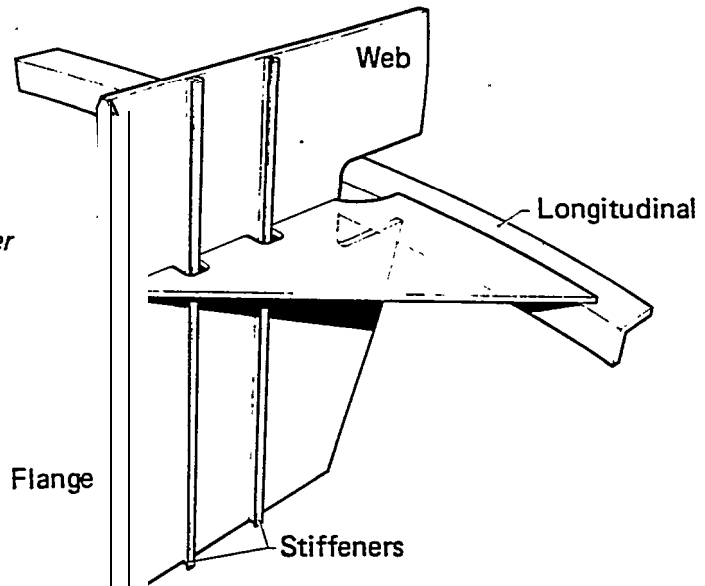
Tripping bracket

Input:

- *Connection code*
- *Longitudinal number*
- *Thickness*
- *Side*
- *Quality*

Result:

The bracket generated and stored .



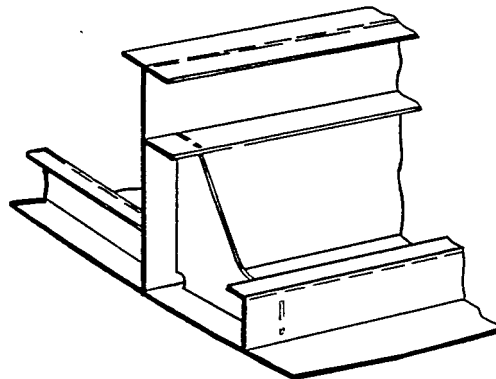
Special bracket

INPUT:

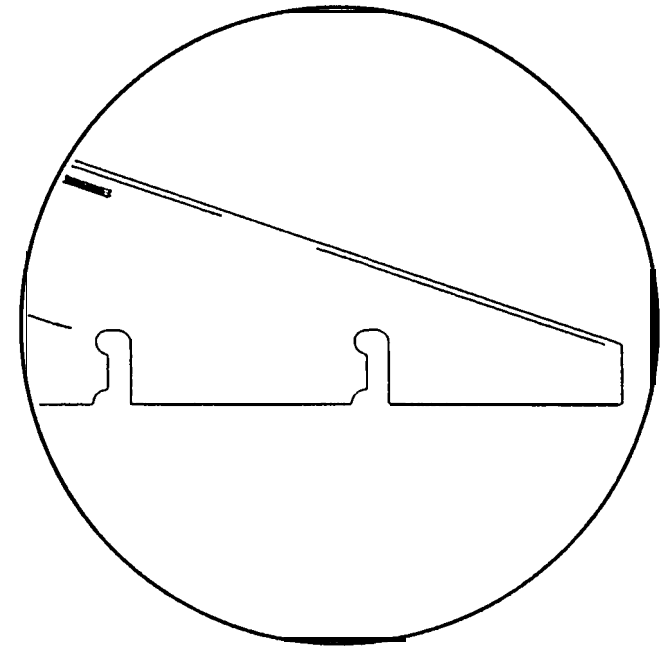
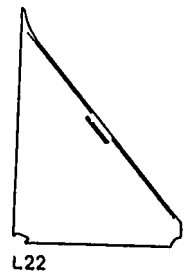
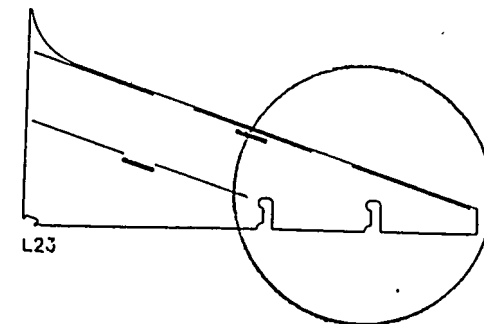
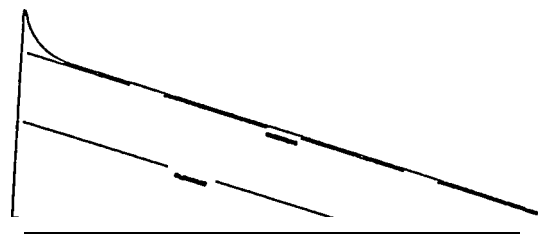
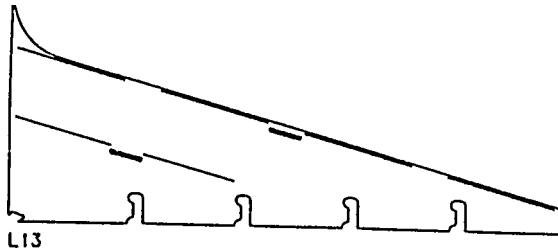
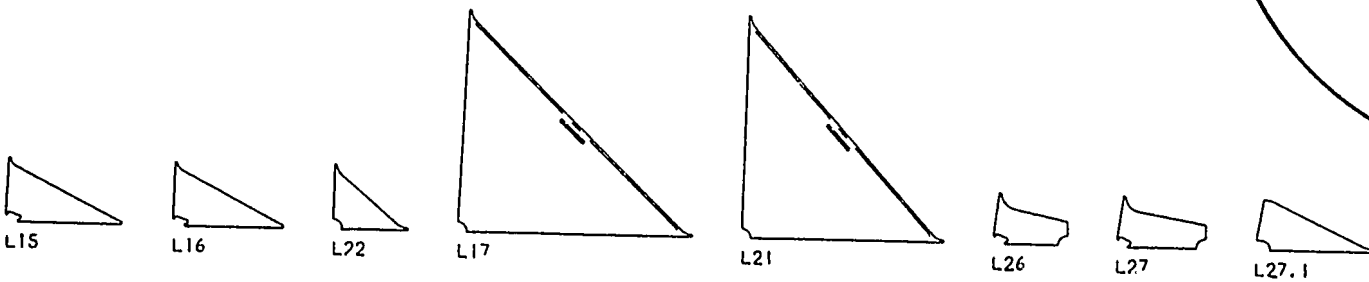
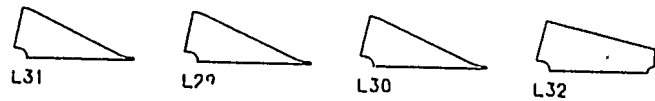
- References to longitudinal curve, surrounding panels, profiles etc.
- Some measurements
- Thickness
- Quality

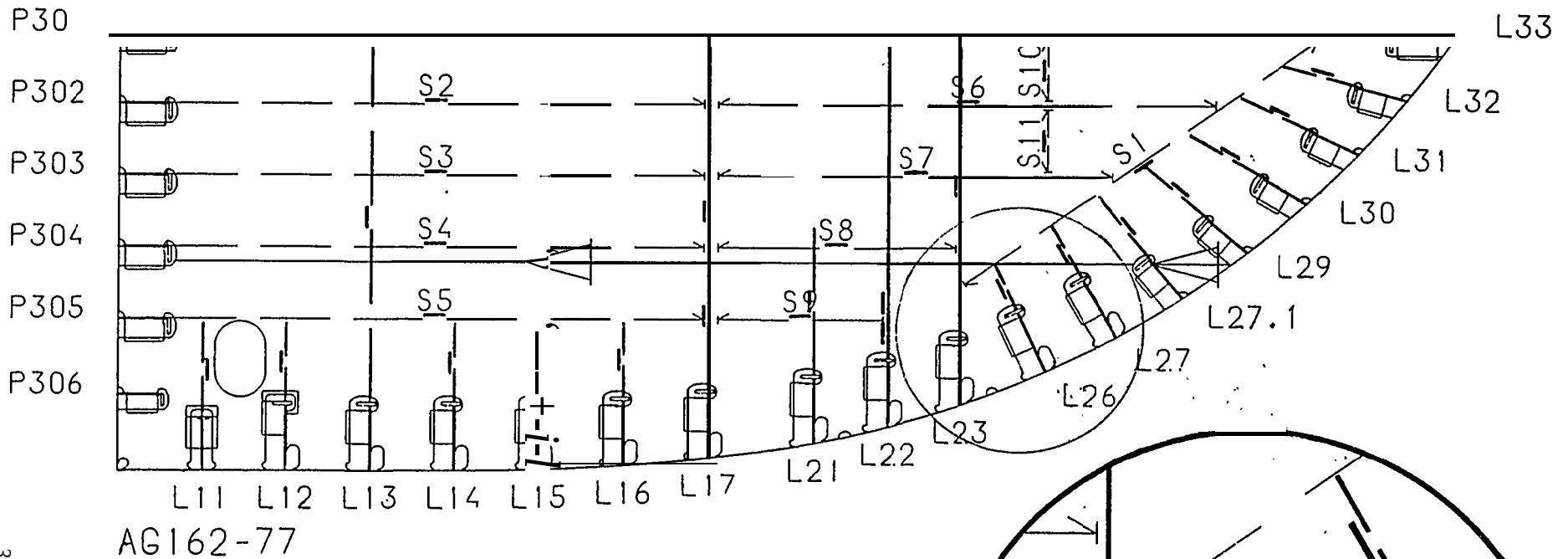
RESULT:

The bracket generated and stored.



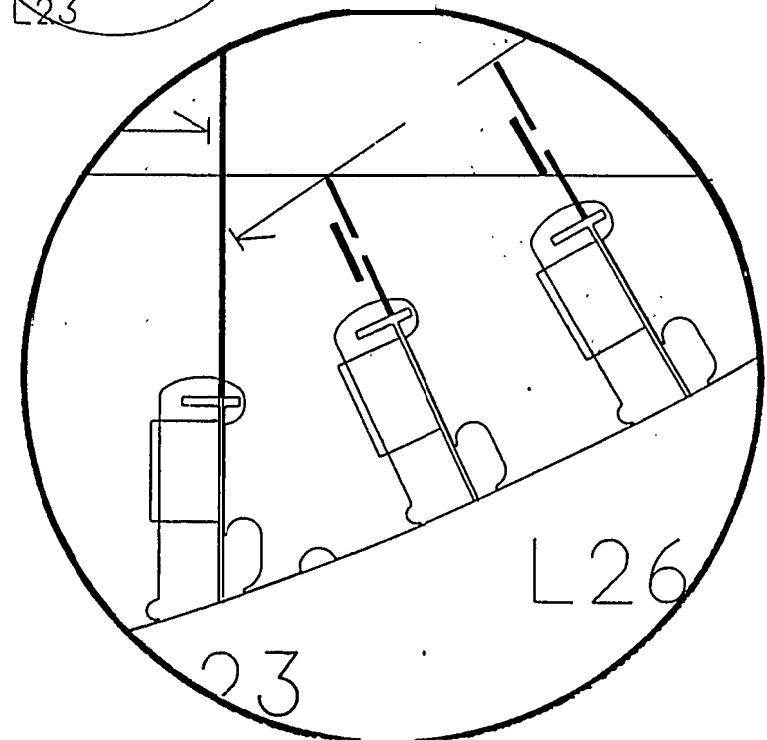
Result of structure programming





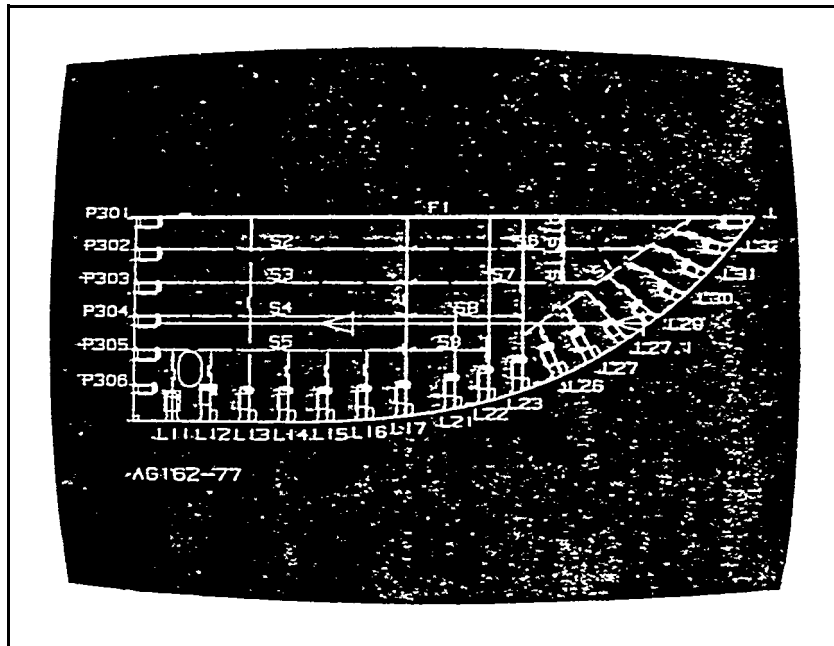
387

Result of structure programming

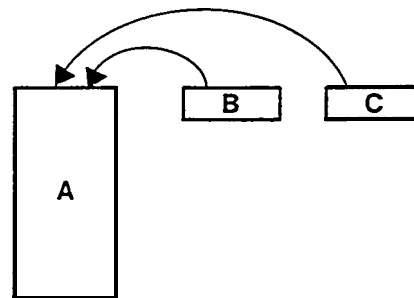
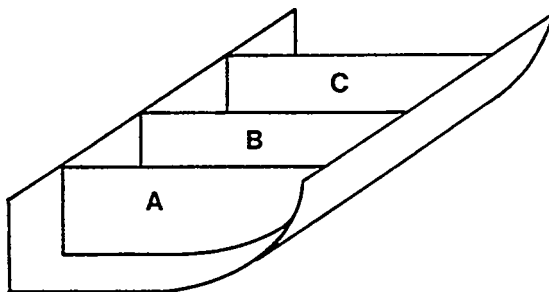




Check drawing



Identical panels



INPUT:

PANEL, 'B', 'C', EQUAL, 'A', X = FR252, FR255;

RTYMP 162 GR_PPNR 77

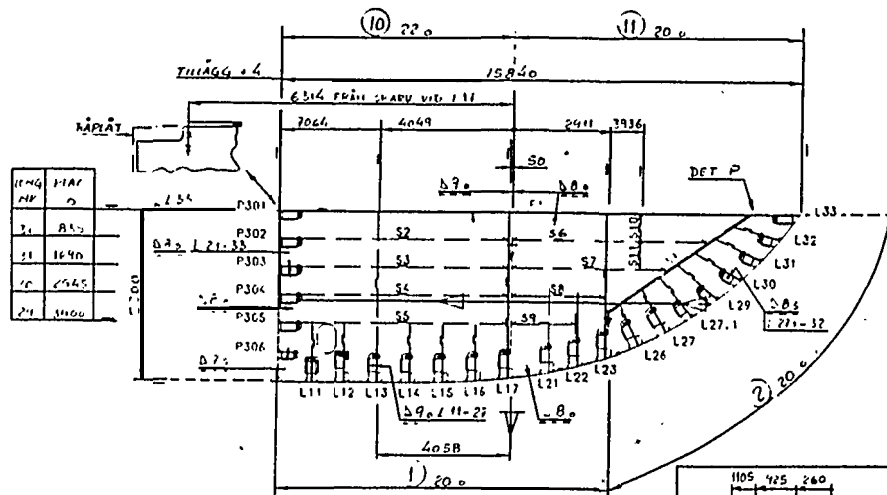
AG162-77

REF NR	POS NR	POS	PLAC	PLAC	DET
P1	0	PLS	450x20,0		
Stiffeners					
S1	1	P			N
S2-S5	2				N
S6	3				N
S7	4				N
S8	5				N
S9	6				N
S10	7		137x12,0		N
S11	8				N

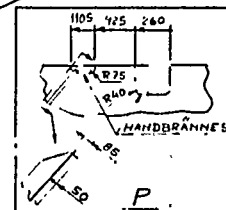
REF NR	POS NR	POS	PLAC	PLAC	DET	SB-VAR
L11		LC	112/51	-27°-13,0	APT	H
L12		LC	94/51	-20°-15,0		H
L13	R1	A	450/21	-42°-12,5		A
L14		LC	60/25	-30°-13,0		H
L15	B5					H
L16	B6					H
L17	B2					B
L18	B3					F
L19	B4					9
L20	B7					C
L21	B3		360/17	-42°-12,5		K
L22	B10		59/40	-60°-12,5		K
L23	R11		71/45	-60°-12,5		K
L24	B12		42/40	-13°-12,5		L
L25	B13		102/40	-30°-12,5		L
L26	B14					L
L27	B15		22/42	-17°-12,5		L
L28	R16		04/41	-60°-12,5		M
P001			88x5140	-110°-12,5		D

REF NR	KLIPP	DET
L11	16/17-16,0	
Clips		
L11-L12		
L13-L14		
L15-L16		
L17-L18		
L19-L20		
L21-L22		
L23-L24		
L25-L26		
L27-L28		
P001		
P002-P003		
P004		

WORKING DRAWING



VEB SPT * 148
BE SIDA VISAD-SB. LIKÄN



Data marking			
to name	to x	to y	to z
VEB SPT * 148	162	7	

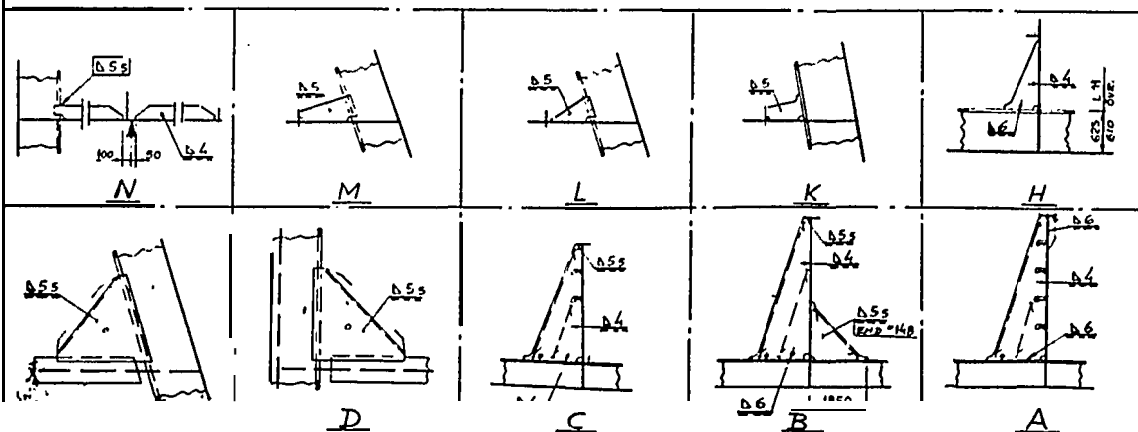
Personlistning	
Person	to x
VEB SPT * 148	120/130

Tilläggs- och förändringsblad	
Blad nr	to x
1	

Användnings- och förändringsblad	
Blad nr	to x
1	

SE FÖLJANDE
2. ITAG PÅ PÅ ANFÄRANT
3. KLIPS PÅ PÅ FÖR CAN

A42
A4102



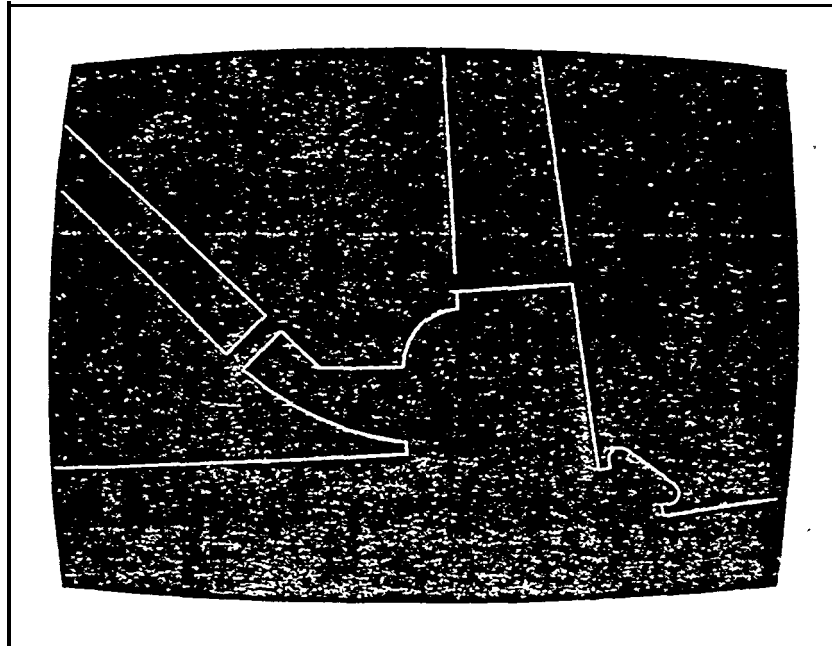
Blad	to x
1	

T.T. 552	
BOTTENVEB * 148	
623	1111
761	FORMAT
1682	A2 7625 1:100

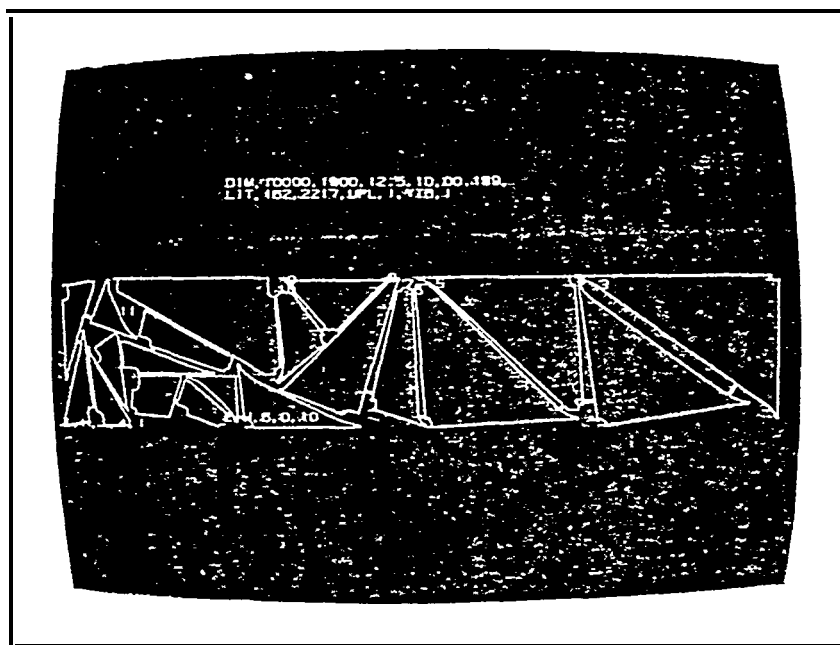
KOCKUMS



Nesting: burning bridges

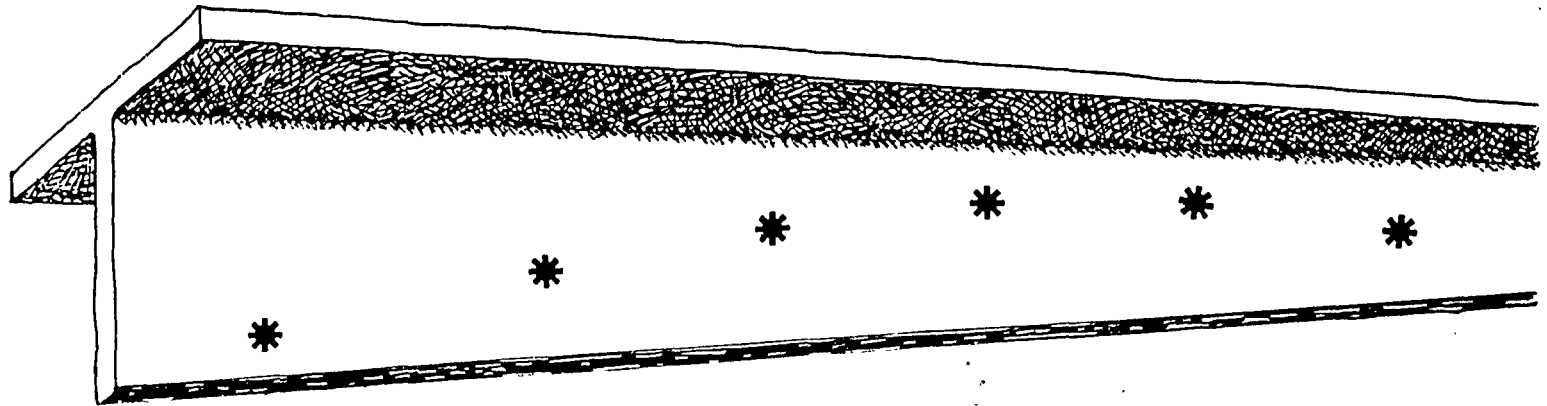


Complete nesting



C519

Longitudinal bending table



KUCKUMS MEKANISKA VERKSTADS AB
TS109A

MÄRKLISTA FÖR LONGITUDINALER
1973-09-07

RITNINGSNR
113/10146/-

KALKYLN
510-546

DKNR
113

VONR
1131

PLE
24202

SID
1

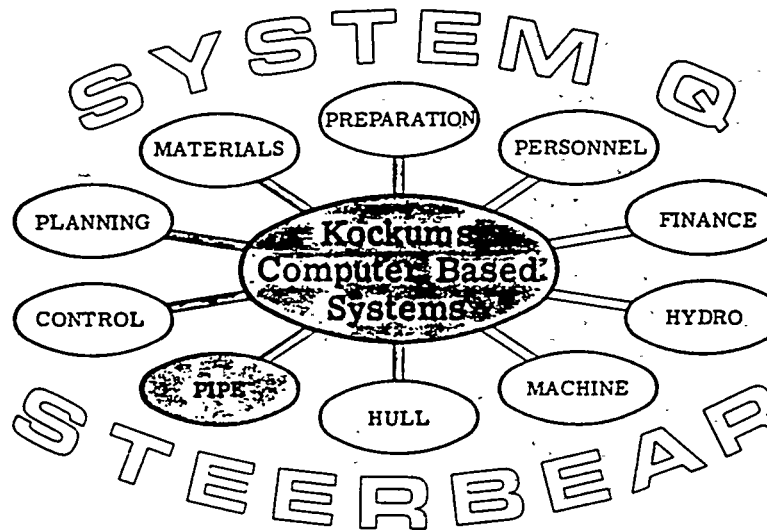
RNR-GNR-LNR	LANGD	/SB /DS	/BB /AS	/VIKT	/TYP	MÄRKES	X	N	D	K	A	P	S	D	A	T	A	V1	V2	V3	V4	FASL	FASF
131-1-4	8800	/--	--	/--	1/	1066	/	*1*	31	AKT			14	75		90,4	30	30	90,0				
													14	75		90,0	30	30	90,0				
TYP/DIMI 43/660*200*13,5*35,0																							
***** H A L *****																							
HE150*75 V=53 U=960,1920,2880,3840,5600,6400,7200,8000																							

BOCKNINGSTABELL 1

AVST	HUJO	AVST	HUJO	AVST	UUJO	AVST	HUJO
0	459	2500	465	5000	463	7500	4bQ
500	4b2	3000	4b5	5500	462	8000	460
1000	4b4	5500	464	6000	462	8500	459
1500	4b5	4000	464	b9Q0	461	0797	459
2000	4b5	4500	463	7000	461		

BOCKNINGSTABELL 2

AVST	HOJO	AVST	HUJO	AVST	HUJO	AVST	HUJO
------	------	------	------	------	------	------	------



- Simplify and rationalize design work
- Check production restrictions on design automatically
- Minimize manual search in standards file
- Automate pipe sketch production
- Simplify changes in standards and design
- Minimize the manual effort to obtain complete production information
- Automate the calculation of cutting lengths, bending angles etc
- Produce automatically NC-tapes for bending machines
- Simplify sister ship handling

STEERBEAR PIPE

— Main Activities

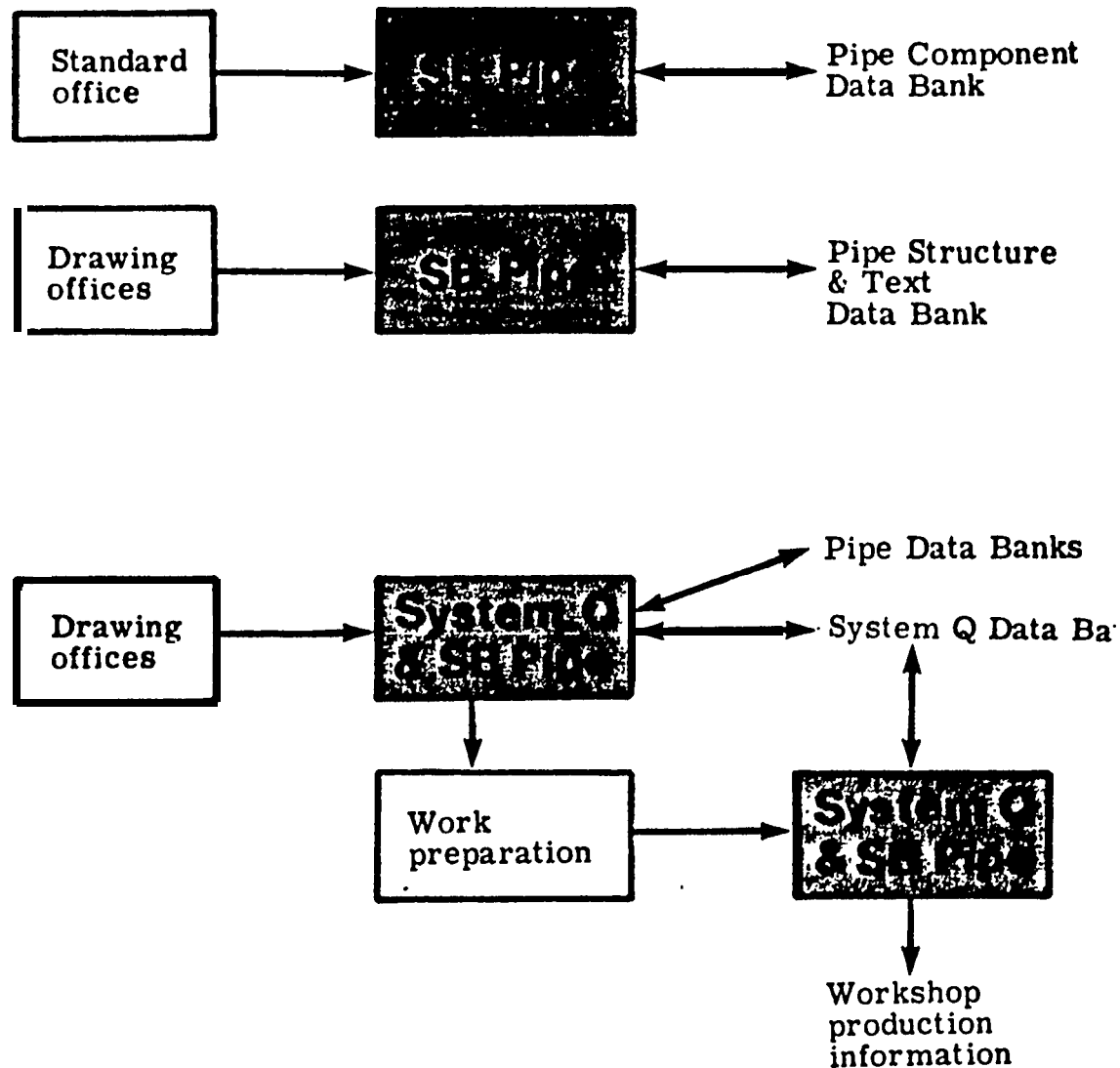
COMPONENT DEFINITION

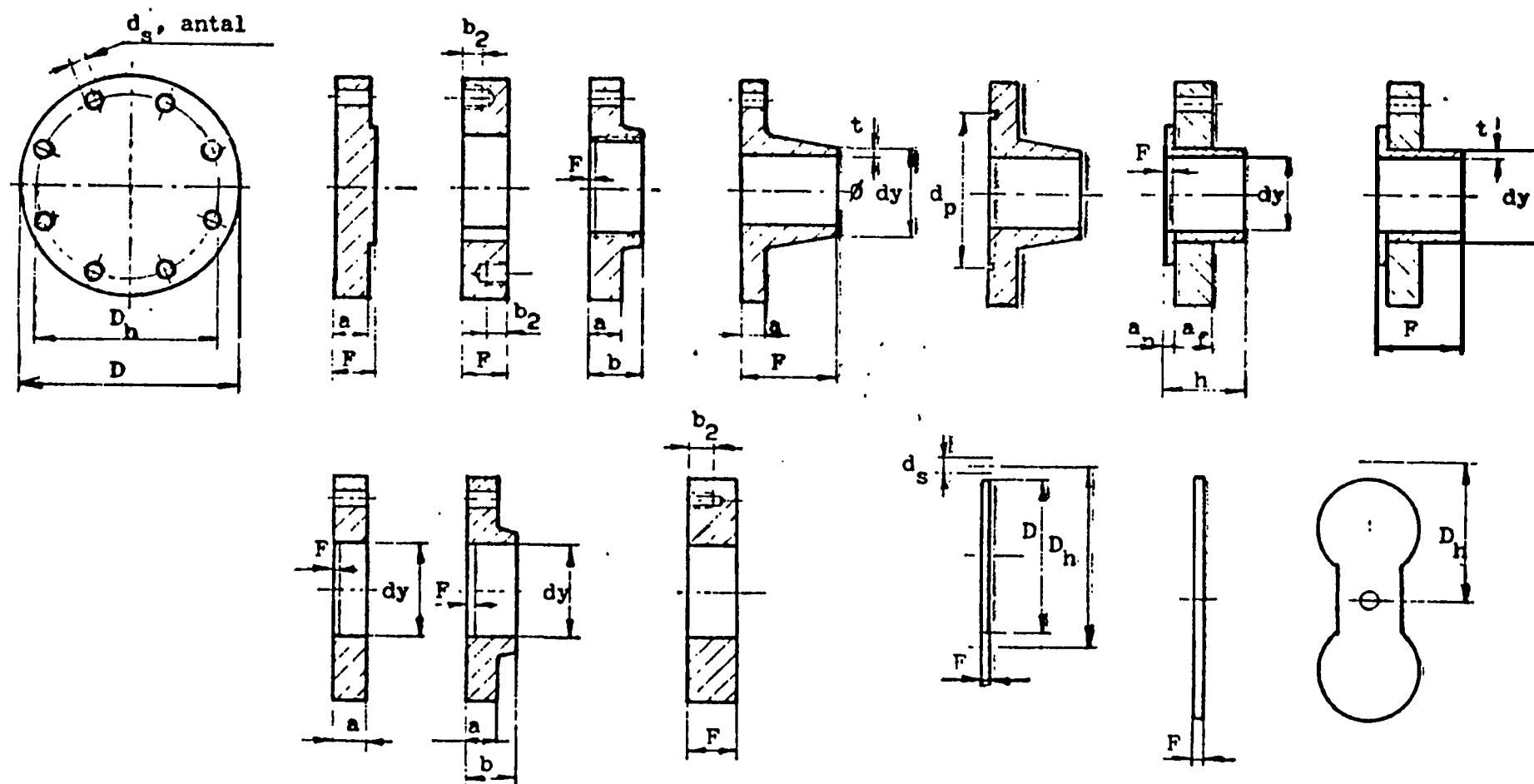
DESIGN

- Initiation
- Scheme input
- Pipe Geometry Definition

PRODUCTION

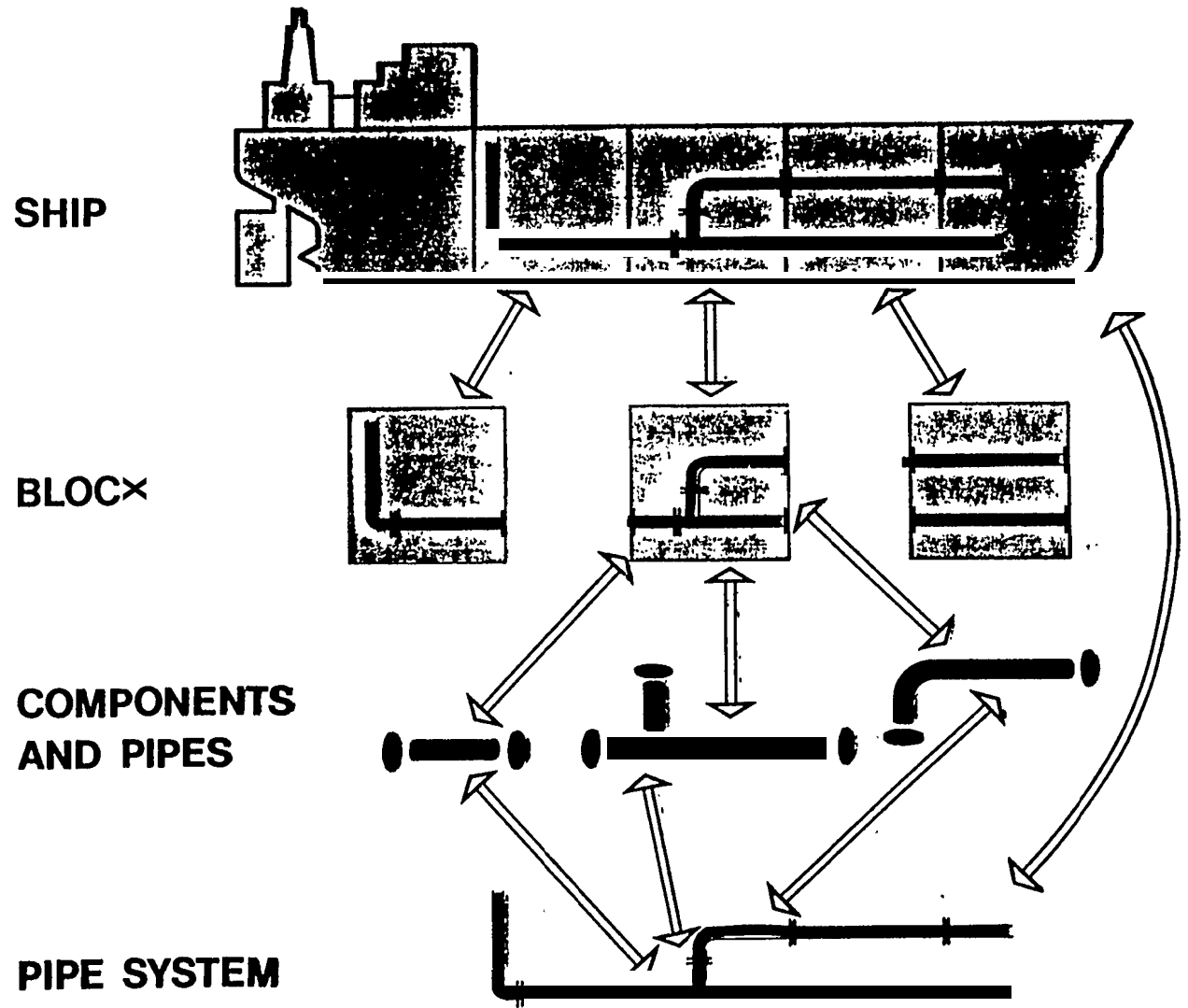
- Work preparation information
- Workshop information







STEERBEAR PIPE ***- Data Bank Structure***





STEERBEAR PIPE

— Pipe Scheme Input

LIST OF VALVES AND FITTINGS

Item	Service	Qty	Size	Type	Material	Supplier/Type No.	Code	As-Built	Notes
V22	Inert gas line waterseal	1	700	Butt fly	Cast iron	205-354541	19		
V13	Inert gas line waterseal	1	700	Butt fly	Cast iron	367-305215	19		
V15	Inert gas branch line	5	400	Hi-jet	Steel	836-323767	10		
V16	Inert gas branch line	1	300	Butt fly	Duct iron	JF 9980 N	10		11. 05
V17	Inert gas branch line	5	250	Butt fly	Duct iron	JF 9980 N	10		11. 75

V17	Inert gas branch line	5	250	Butt fly	Duct iron	JF 9980 N	207-348908
-----	-----------------------	---	-----	----------	-----------	-----------	------------

• Item • Quantity • Type • Supplier/Type No.
• Service • Size • Material • Code

Proj. Dept
6 625
2 V3.7

Syst No
5 HN
V4 13

Roll
510 985
V14 19

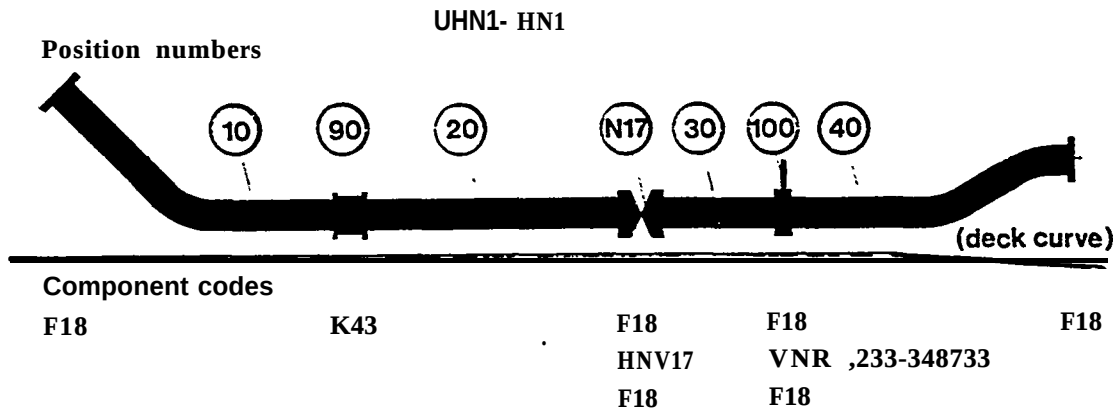
Date
6-02-04

Rev No.
Inert gas and tank venting system

Sheet No
1 of

List No.
831 150214 1

KOCKUMS
STEERBEAR PIPE
- Pipe Geometry Definition



KOCKUMS
STEERBEAR PIPE - Pipe Geometry Definition

Position		Components	
LEDN, HN1			
60, 258, 273-8-1358-16			
2, -2158, 8DKA+1482		ANSL, 4	
		F18	
		RL	
	-1878, 8DKA+1188+D/2		RL
STP,	1579, 8DKA+1188+D/2	K43	RL
		RL=5000	R20
		F18	
		HN17	
	11221, 8DKA+258+D/2		
KN1+10, 6ENDER		RL=11871/-1	
		RL	
	11987, 8DKA+698+D/2		
		RL	
SLP,	12140, 8DKA+712+D/2	F18	
Module			
1999	10	625	K Smithberg
		1	TX12
		2	UHN1
			6510985



- Piece List Draught

Kochhaus Mechanische Vorrichtung AB

[illegible]



STEERBEAR PIPE - Pipe Sketch

Pos	Anzahl	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
1	1	4HC 27378 STAL 1330-06 V13 83 LARY	A=	00 005 482	3773	M	24		
2	2	PIA-FIX'S HP16 DY=273 STAL V13 37-34	CC	23 233 233		ST	17		
3	1	STAL 26,1	CC	23 233 233		ST	17		

Pos	Anzahl	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
IST PART									

Pos	Anzahl	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
A ---- B ---- C ---- D ---- E									

Alt	Pos	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
A1	2	2404/C		91					
B1	3	2387/A	BIC/D						
C1	2	233/D	C/D						

Alt	Pos	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
ASSEMBLY PART									

Alt	Pos	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
AUTOMATISVEIS									
PKT: POS: PKT: POS: VINK: PKT: AVGT									
A1 21 0,000 B1 233/D									

DOCKING									
E1 -3423 -90,0 30,3 112									
D1 350 -180,0 30,0 399									
C1									

Alt	Pos	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
Anmerkung									

Alt	Pos	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
Verhandlung									
Protych MPa									
Reise									
Typ									
Rev									
Datum									
System									
Dier									
Seiten									
Vite									
Sondierung									
Anzahl									
Seiten									
Rev									
Anmerkung									

Alt	Pos	Verw./Bestandsmenge	Unit	Verw./Bestandsmenge	Alt	Kvart	Kvart	Vite	Anmerkung
A	2	242	617	76-08-11	1	831	25C	X8	273,0
10 5-0885 985 UHN9 60									

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