RECOMP II USERS' PROGRAM NO. 1127

PROGRAM TITLE:	DYNAMIC HEIGHTS PROGRAM, FLOATING POINT ARITHMETIC
PROGRAM CLASSIFICATION:	General
AUTHOR:	David McGill Woods Hole Oceanographic Institution
PURPOSE:	To compute dynamic heights from specific volume anomalies which have been computed from oceanographic data.
DATE:	25 May 1962

Published by

RECOMP USERS' Library

at

AUTONETICS INDUSTRIAL PRODUCTS

A DIVISION OF NORTH AMERICAN AVIATION, INC.

3400 E. 70th Street, Long Beach 5, California

I

1.0 INTRODUCTION

Having obtained the specific volume anomalies, $10^5\delta$, for the observed depths from a given hydrographic station, it is desired to interpolate from the given depths to a series of selected standard depths, for comparison among stations. It is also necessary to obtain the sum of the anomaly values for the total water column, this value being spoken of as the "dynamic depth" (from the surface) or dynamic height (from a fixed reference level in the water column). The value obtained represents the effect of pressure increase as a function of T, S and D throughout the water column.

2.0 METHOD

A linear interpolation is programmed between the intervals selected, although the curve of the anomaly distribution is non-linear at least in part. The variation from absolute values by use of simple linear interpolation is less than 3% and only at near-surface depths, for a maximum range of not more than 200 m, is even this amount of variation obtained. Agreement throughout the main depths of the water column is quite exact, since here the curve is essentially linear.

A. The anomaly values are interpolated to standard depths as follows:

$$10^5\text{DELD} = 10^5\text{DEL}_I + \frac{D_{ST} - D_I}{D_{IM_1} - D_I} \quad (10^5\text{DELIM}_1 - 10^5\text{DELI})$$

where D_{IM_1} = observed depth next lesser than standard depth

D_{ST} = standrad interval depth

D_I = observed depth next greater than standard depth

DELIM_1 = anomaly value at D_{IM_1}

DELD = anomaly value at standard depth D_{ST}

DELI = anomaly value at D_I

B. Calculation of dynamic height, ΔD between standard depth intervals D_{ST_1} and D_{ST_2}

$$\Delta D = (D_{ST_2} - D_{ST_1}) \quad \frac{DELD_2 + DELD_1}{2}$$

and cumulative addition to find $\Sigma \Delta D$ at each standard depth throughout water column.

3.0 RESTRICTIONS

a) The photo-electric reader and console are required for input, and the typewriter for output.

b) This program must be used in conjunction with WHOI's specific volume anomaly program. The punched paper tape of depths and specific volume anomalies which is the output from the latter program is used as input to this program.

c) Subroutines utilized are: Recomp Users Program 1046 and AN 015.

4.0 USAGE

a) Input data for this program are tapes in alphanumeric format which are the output from WHOI's specific volume anomaly program. The location counter setting on the tape at the beginning of one set of station data is 1247. The data on the tapes are station number (for identification), followed by pairs of numbers, each pair consisting of a depth and the corresponding specific volume anomaly.

The number of standard depths for each station (N) must be counted and then entered through the console.

b) The program occupies locations 1500 - 2107.

c) Operating Instructions:

1) Read in Program tape.

2) If a new standard depth table is to entered that differs

from the one programmed, put sense switch B ON. Otherwise, set sense switch B OFF.

TABLE OF STANDARD DEPTHS, as programmed

1-- 0.	13-- 800.	25-- 3500.
2-- 25.	14-- 1000.	26-- 3750.
3-- 50.	15-- 1200.	27-- 4000.
4-- 75.	16-- 1400.	28-- 4250.
5-- 100.	17-- 1600.	29-- 4500.
6-- 150.	18-- 1800.	30-- 4750.
7-- 200.	19-- 2000.	31-- 5000.
8-- 250.	20-- 2250.	32-- 5250.
9-- 300.	21-- 2500.	33-- 5500.
10-- 400.	22-- 2750.	34-- 5750.
11-- 500.	23-- 3000.	35-- 6000.
12-- 600.	24-- 3250.	

3) Insert data tape (from Specific volume anomaly program) in reader. Push fill button. Tape will read in and set location. counter to 1500.

4) Count the number of standard depths per station--N. Insert N in number format into 1500. (Be sure to type all number format entries as + 0.0. Location counter is previously set to 1500 by tape read-in.)

5) PUSH START to begin computing

6) Machine will halt at 1700 if standard depth table is to be entered. Enter it in number format (as above). Be sure to fill all allotted spaces (up to and including 2044) by using zeros after full entry of table is complete. This insures operation in RUP #1046. Reset location to 1551.1 and push START to resume computing after

new standard depth table has been entered.

7) At end of station, return to instruction 2, above.

5.0 EXAMPLE

See attached sheet

6.0 CODING INFORMATION

a) Constants

Floating point:	+ 2 in	1634 - 35
	+ 0 in	1666 - 67
	100 000 in	1672 - 73

Fixed point:	4 at binary 18 in 1636
	2 at binary 38 in 1637
	1 at binary 38 in 1670
	2 at binary 18 in 1671

b) Subroutines

AN-015	0650 - 1127
Recomp Users Program #1046	2050 - 2107

c) Temporary Storage

For input:	1500 - 01	(N)
	1247	(station number)
	1250 - 1477	(d, δ data)
For output:	1654	(Δ D)
	1656	($\Sigma\Delta$ D)
	1652	standard depth

d) Timing

Data Output

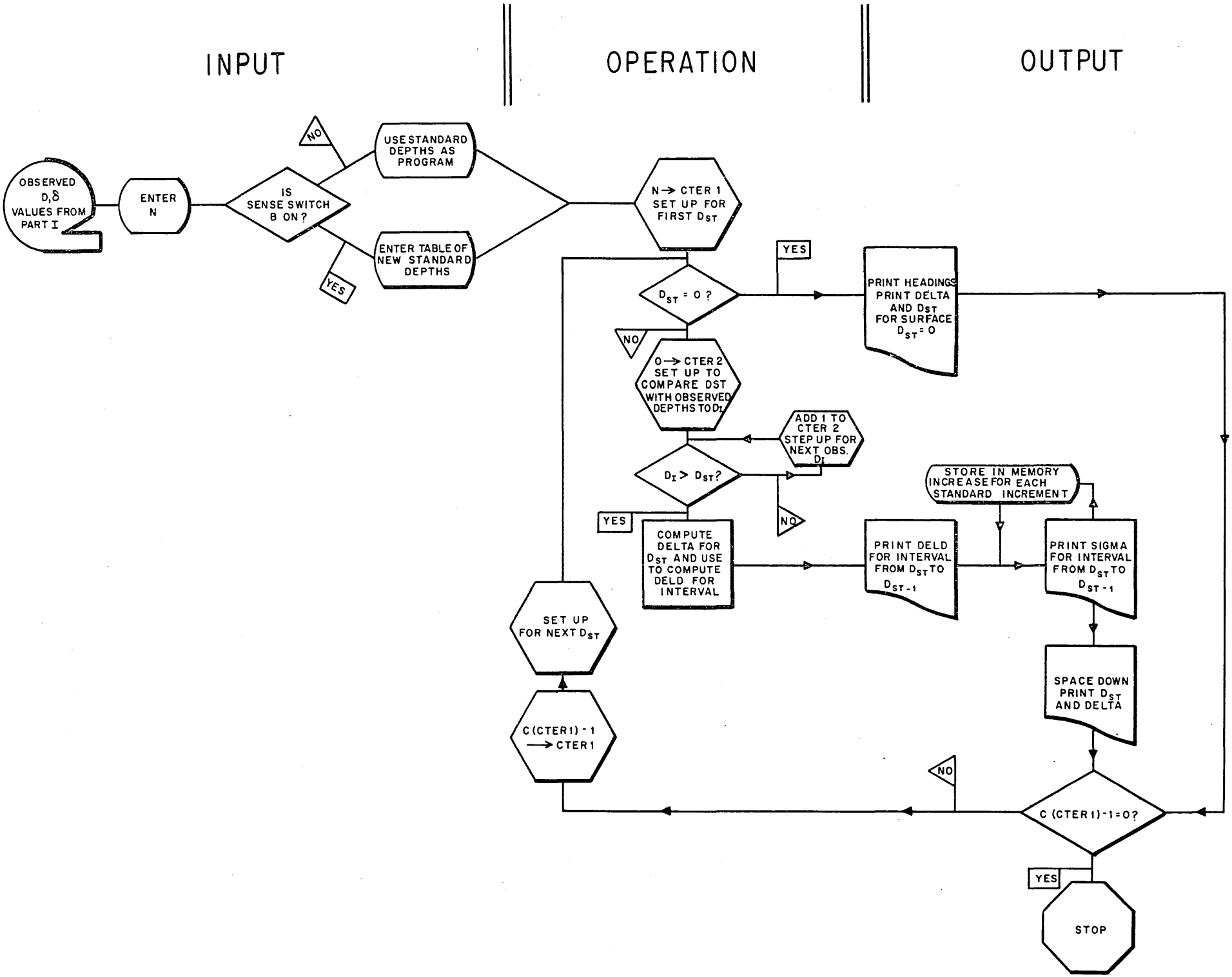
Total time for 27 standard depths	326.8 sec.
Allow for typing of headings	-2.8 sec.
	324.0 sec.

Average time per standard depth.....12.00 sec.

Approx.
- Output of DELD and SIGMA.....6.50 sec.
- Output of DELTA.....5.50 sec.

STATION 0421

D	DELTA	DELD	SIGMA
0.	254.72		
		.06355	.06355
25.	253.68		
		.06329	.12684
50.	252.63		
		.06294	.18978
75.	250.86		
		.06249	.25227
100.	249.08		
		.11793	.37019
150.	222.63		
		.10470	.47489
200.	196.17		
		.09443	.56932
250.	181.53		
		.08728	.65660
300.	167.58		
		.15984	.81643
400.	152.09		
		.14242	.95886
500.	132.76		
		.12478	1.08364
600.	116.80		
		.21158	1.29522
800.	94.78		
		.17215	1.46737
1000.	77.37		
		.14249	1.60987
1200.	65.12		
		.12117	1.73103
1400.	56.05		
		.10592	1.83695
1600.	49.87		
		.09560	1.93256
1800.	45.73		
		.08981	2.02237
2000.	44.08		
		.10939	2.13176
2250.	43.43		
		.10821	2.23997
2500.	43.14		
		.10777	2.34773
2750.	43.08		
		.10776	2.45549
3000.	43.13		
		.10757	2.56307
3250.	42.93		
		.10541	2.66848
3500.	41.40		
		.09678	2.76526
3750.	36.02		
		.08267	2.84793
000.	30.12		


INPUT
OPERATION
OUTPUT
OBSERVED D,δ VALUES FROM PART I
ENTER N
IS SENSE SWITCH B ON?
NO
YES
USE STANDARD DEPTHS AS PROGRAM
ENTER TABLE OF NEW STANDARD DEPTHS
N → CTER 1 SET UP FOR FIRST D_{ST}
D_{ST} = 0 ?
YES
PRINT HEADINGS PRINT DELTA AND D_{ST} FOR SURFACE D_{ST} = 0
NO
0 → CTER 2 SET UP TO COMPARE DST WITH OBSERVED DEPTHS TO D_I
ADD 1 TO CTER 2 STEP UP FOR NEXT OBS. D_I
D_I > D_{ST}?
NO
YES
COMPUTE DELTA FOR D_{ST} AND USE TO COMPUTE DELD FOR INTERVAL
PRINT DELD FOR INTERVAL FROM D_{ST} TO D_{ST-1}
STORE IN MEMORY INCREASE FOR EACH STANDARD INCREMENT
PRINT SIGMA FOR INTERVAL FROM D_{ST} TO D_{ST-1}
SPACE DOWN PRINT D_{ST} AND DELTA
SET UP FOR NEXT D_{ST}
C(CTER1) - 1 → CTER1
NO
C (CTER 1) - 1 = 0?
YES
STOP

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
15000	+	00	00000	N			N	Number of standard depths
1	+	00	00000					per station
15010	+	00	00000					Insert in no. format at
1	+	00	00000					1500
15020	+	00	16620	START		CLA	SPACER	
1	+	72	77600			TYC	7760	
15030	+	57	15661			TRA	1566.1	PATCH 4
1	+	72	77640			TYC	7764	
15040	+	57	15640			TRA	15640	PATCH 3
1	+	72	77600			TYC	7760	
15050	+	57	15460			TRA	PATCH 1 = Header +1/Header +2	
1	+	00	15000	INIT		CLA	N	
15060	+	60	16500			STØ	CTER 1	
1	+	57	15550			TRA	1555.0	PATCH 2 = Sta (LØØP 2)
15070	+	42	15340			SAL	PRINT D	
1	+	47	15160			SAL	$PKUP_2$	
15100	+	03	16710			SUB	L2.0	
1	+	42	15170			SAL	$PKUP_1$	
15110	+	30	16660			FCA	FLO	Floating 0
1	+	35	16560			FST	SIGMA	
15120	+	64	16000	LØØP 3		CTL	LØØP 1	
1	+	66	16100			CTV	LD	
15130	+	57	77610			TRA	7761	
1	+	64	16200	ØUT		CTL	BLØCK 1	
15140	+	66	16300			CTV	BLØCK 2	
1	+	57	77600			TRA	7760	

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
15150	+	64	16400	MAIN 1		CTL	DIM 1	
1	+	57	77600			TRA	7760	
15160	+	30	[0000]	$PKUP_2$		FCA	$[STD_i]$	
1	+	40	00000			SLL		
15170	+	06	[0000]	$PKUP_1$		FSB	$[STD_{i-1}]$	
1	+	07	77720			FMP	7772	
15200	+	35	16540			FST	DELD	
1	+	30	16500			CLA	CTER 1	Test if first time through
15210	÷	03	15000			SUB	N	
1	+	50	15330			TZE	PRINT D - 1.0	To return carriage to proper column
15220	+	72	00370			TYC	LS	
1	+	72	00100			TYC	CR	
15230	+	72	00330			TYC	FS	
1	+	72	00100			TYC	TAB	
15240	+	72	00100			TYC	TAB	
1	+	40	00000			NØP		
15250	+	57	15561			TRA	1556.1	Print ΔD
1	+	57	06500			TRA	PRINT	
15260	+	00	00050			PZE	0005.0	
1	+	77	15261			HTR	C	
15270	+	72	00100			TYC	TAB	
1	+	30	16540			FCA	DELD	
15300	+	04	16560			FAD	SIGMA	
1	+	35	16560			FST	SIGMA	

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
15310	+	40	00000			NØP		
1	+	57	06500			TRA	PRINT	Print $\Sigma\Delta$D
15320	+	00	02050			PZE	0205.0	
1	+	77	15321			HTR	C	
15330	+	72	00370			TYC	LS	
1	+	72	00100			TYC	CR	
15340	+	30	[0000	PRINT D		FCA	[StD]	
1	+	50	15770			TZE	PRINT 0	Print out StDi
15350	+	57	15731			TRA	PATCH 5	
1	+	00	15760	P.0.1		CLA	---- 0.	
15360	+	72	77660			TYC	7766	
1	+	72	00100	R.P.5		TYC	TAB	
15370	+	30	16520			FCA	LAST ANØM	Print out St δ_i
1	+	57	06500			TRA	PRINT	
15400	+	00	03020			PZE	03020	
1	+	77	15401			HTR	C	
15410	+	00	16500			CLA	CTER 1	Test if end of station
1	+	03	16700			SUB	1 FIX	1 in Fixed pt. notation
15420	+	50	15451			TZE	END	
1	+	60	16500			STØ	CTER 1	
15430	+	00	16020			CLA	LØØP 2	Step up standard
1	+	01	16710			ADD	L.2	depth
15440	+	60	16020			STØ	LØØP 2	pick-up and
1	+	42	15340			SAL	PRINT D	print out

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
15450	+	57	15601			TRA		Patch to modify PKUP 1-2
1	+	77	15451	END		HTR	1545.1	
15460	+	00	16640	PATCH 1		CLA	HEADER +1	Print headings
1	+	72	77600			TYC	7760	
15470	+	00	16650			CLA	HEADER +2	
1	+	72	77600			TYC	7760	
15500	+	54	15510			TSB	C + 1.0	
1	+	57	15051			TRA	INIT	
15510	+	77	17000			HTR	1700	
1	+	57	21061			TRA	KL1	Convert stnd depths to floating pt.
15520	+	00	17000			PZE	17008	
1	+	00	00620			PZE	62_8	
15530	+	57	15051			TRA	INIT	
1	+	30	16660	SETZERØ		FCA	FL 0	
15540	+	57	77640			TRA	DEL L	
1	+	00	00000					
15550	+	00	16600	PATCH 2		CLA	LD ST	
1	+	42	16020			STA	LØØP 2	
15560	+	57	15070			TRA	1507	
1	+	30	16540			FCA	DELD	
15570	+	05	16720			FDV	FL 10^5	
1	+	35	16540			FST	DELD	
15600	+	57	15251			TRA	1525.1	
1	+	00	15170			CLA	PKUP 1	

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
15610	+	01	16710			ADD	L.2.0	
1	+	42	15170			STA	PKUP 1	
15620	+	00	15160			CLA	PKUP 2	
1	+	01	16710			ADD	L.2.0	
15630	+	42	15160			STA	PKUP 2	
1	+	57	15120			TRA	LØØP 3	
15640	+	72	00370	PATCH 3		TYC	LS	
1	+	72	00100			TYC	CR	
15650	+	72	00100			TYC	CR	
1	+	00	16630			CLA	HEADER	
15660	+	57	15041			TRA	1504.1	
1	+	00	15720	PATCH 4		CLA	STATIØN	
15670	+	72	77600			TYC	7760	
1	+	72	00330			TYC	FS	
15700	+	00	12470			CLA	1247	
1	+	41	00240			ALS	20_{10}	
15710	+	57	15031			TRA	1503.1	
1	+	00	00000					
15720	+	26	00700	STATIØN				STATION space
1	-	33	03020					
15730	+	40	00000			NØP		
1	+	57	06500	PATCH 5		TRA	PRINT	
15740	+	00	04000			PZE	0400.0	
1	+	77	15740			HTR	C	ERROR

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
15750	+	57	15361			TRA	R.P.5	NORMAL
1	+	40	00000			NØP		
15760	+	20	41020	---- 0				
1	+	33	40000					
15770	+	72	00330	PRINT D		TYC	FS	
1	+	57	15351			TRA	P.O. 1	
16000	+	40	00000	LØØP 1		NØP		
1	+	40	00000			NØP		
16010	+	00	77710			CLA	ZERØ	V1
1	+	60	16510			STØ	CTER 2	
16020	+	30	17000	LØØP 2		FCA	[DST	
1	+	06	12500	DLØC		FSB	D]	
16030	+	50	15131			TZE	ØUT	
1	+	51	15131			TMI	ØUT	
16040	+	00	77620			CLA	DLØC	L2
1	+	01	77720			ADD	R 4.0	V2
16050	+	42	77621			SAR	DLØC	L2
1	+	00	16510			CLA	CTER 2	
16060	+	01	77720			ADD	R 4.0	V2
1	+	60	16510			STØ	CTER 2	
16070	+	57	77620			TRA	LØØP 2	L2
1	+	00	00000					
16100	+	00	00000	LD		PZE	0	Location of 1st unstandard
1	+	00	12500			MZE	1250	depth

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
16110	+	00	00000	ZERØ				V1
1	-	00	00000					
16120	+	00	00000	R 4.0				V2
1	-	00	00040					
16130								
1								
16140								
1								
16150								
1								
16160								
1								
16170								
1								
16200	+	35	77700	BLØCK 1		FST	BLØCK 2	V_0
1	+	00	16610			CLA	LANØM	
16210	+	01	16510			ADD	CTER 2	
1	+	42	16410			SAR	DELI	
16220	+	41	00240			ALS	20_{10}	
1	+	42	16440			SAL	DEL	
16230	+	03	77760			SUB	L 4.0	V_6
1	+	42	16420			SAL	DELIM1	
16240	+	00	16100			CLA	LD	
1	+	01	16510			ADD	CTER 2	

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
16250	+	40	00000			NØP		V_7
1	+	42	16401			SAR	DI	
16260	+	41	00240			ALS	20_{10}	
1	+	03	77760			SUB	L 4.0	V_6
16270	+	42	16400			SAL	DIM_1	
1	+	57	15150			TRA	MAIN 1	
16300				BLØCK 2				
1								
16310								
1								
16320				BLØCK 2+2				
1								
16330								
1								
16340				FL 2				
1								
16350								
1								
16360	+	00	00040	L 4.0				
1	-	00	00000					
16370	+	00	00000	R 2.0				
1	-	00	00020					
16400	+	30	[00000]	DIM_1		FCA	$[D_i - 1]$	
1	+	06	[00000]	DI		FSB	$[D_i]$	

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
16410	+	35	77720			FST	BLOCK 2+2	V2
1	+	34	[00000]	DELI		FCS	$[\delta_i]$	
16420	+	04	[00000]	$DELIM_1$		FAD	$[\delta_i - 1]$	
1	+	07	77700			FMP	BLØCK 2	VO
16430	+	05	77720			FDV	BLOCK 2+2	V2
1	+	53	15531			TØU	SET ZERØ	
16440	+	04	[00000]	DEL		FAD	$[\delta_i]$	
1	+	35	77700			FST	BLØCK 2	VO
16450	+	04	16520			FAD	LAST ANØM	
1	+	05	77740			FDV	FL 2	V4
16460	+	35	77720			FST	BLØCK 2+2	V2
1	+	30	77700			FCA	BLØCK 2	VO
16470	+	35	16520			FST	LAST ANØM	
1	+	57	15160			TRA	PKUP 2	
16500	+	00	00000	CTER 1		BFX		
1	-	00	00000					
16510				CTER 2				
1								
16520				LAST ANØM				
1								
16530								
1								
16540				DELD				
1								

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
16550								
1								
16560				SIGMA				
1								
16570								
1								
16600	+	00	17000	LDST		PZE	1700	Loc. of 1st standard depth
1	-	00	00000			MZE		
16610	+	00	00000	LANØM				Location of 1st Anomaly
1	-	00	12520				1252	
16620	+	75	02040	SPACER				
1	-	00	00000					
16630	-	47	32171	HEADER				
1	-	44	14500					
16640	-	17	32171	HEADER +1				
1	-	44	14441					
16650	+	55	07621	HEADER +2				
1	-	33	27011					
16660	+	00	00000	FLO				
1	-	00	00000					
16670	+	00	00000					
1	-	00	00000					
16700	+	00	00000	1 FIX				+1 in Number format, then hit C for command
1	-	00	00001					

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
16710	+	00	00020	L 2.0				
1	-	00	00000					
16720				FL10^5				
1								
16730								
1								
16740								
1								
16750								
1								
16760	+	00	00000	PZE				
1	-	00	00000					
16770								
1								
17000				DST				
1								

Storage for all Std. Depths
ROUTINE INTERVALS PROGRAMMED

1 - 0	13 - 800	25 - 3500
2 - 25	14 - 1000	26 - 3750
3 - 50	15 - 1200	27 - 4000
4 - 75	16 - 1400	28 - 4250
5 - 100	17 - 1600	29 - 4500
6 - 150	18 - 1800	30 - 4750
7 - 200	19 - 2000	31 - 5000
8 - 250	20 - 2250	32 - 5250

PROGRAM TITLE: DYNAMIC HEIGHTS

ABSOLUTE LOCATION	S	OPRN	ADDRESS	LOCATION SYMBOL	S	OPRN	ADDRESS	REMARKS
							9 - 300	21 - 2500	33 - 5500
							10 - 400	22 - 2750	34 - 5750
							11 - 500	23 - 3000	35 - 6000
							12 - 600	24 - 3250	
2044									
2050				RUP1046 Subroutine					
to 2107									