

**LA-6799-MS**

Informal Report

UC-35

Issued: May 1977

C.3

CIC-14 REPORT COLLECTION  
**REPRODUCTION  
COPY**

**An HP-25 Program for Solving the Strong Shock  
Algorithm for Yield and Origin-Shift**

H. C. Goldwire, Jr.



  
**los alamos**  
**scientific laboratory**  
of the University of California  
LOS ALAMOS, NEW MEXICO 87545

An Affirmative Action/Equal Opportunity Employer

UNITED STATES  
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION  
CONTRACT W-7405-ENG. 36



Printed in the United States of America. Available from  
National Technical Information Service  
U.S. Department of Commerce  
5285 Port Royal Road  
Springfield, VA 22161  
Price: Printed Copy \$3.50 Microfiche \$3.00

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

AN HP-25 PROGRAM FOR SOLVING THE STRONG SHOCK ALGORITHM  
FOR YIELD AND ORIGIN-SHIFT

by

H. C. Goldwire, Jr.

ABSTRACT

We present a program for the HP-25 hand calculator which solves the strong shock algorithm for yield and origin-shift. The program is intended for quick-look analysis of field data and could easily be modified and improved upon for use with other calculators having larger program and data memories.

LOS ALAMOS NATIONAL LABORATORY



I. INTRODUCTION

The strong shock yield algorithm provides a means of analyzing hydrodynamic shock propagation data to obtain the yield of an underground explosion. Where  $a$  and  $b$  are known constants and  $R(t)$  is the experimentally measured shock front position at time  $t$ , the strong shock algorithm can be written in terms of the explosion yield  $W$  as

$$R(t) + R_0 = a W^{\frac{1-b}{3}} (t + t_0)^b \quad (1)$$

Here, the units of radius, time, and yield are meters, milliseconds, and kilotons, respectively.  $R$  and  $t$  are determined relative to a presumed spatial and temporal origin of the explosion.  $R_0$  and  $t_0$  are additive corrections which correct the data to the actual explosion time and location. The least squares solution of Eq. (1) for  $W$  and  $R_0$  given in Ref. 1 is herein implemented in its barest essentials for the HP-25 hand calculator [e.g., data times are presumed to have already been corrected such that we can ignore  $t_0$  in Eq. (1)]. The program may easily be converted to other calculators having larger program and data memories and thereby made more elaborate and/or easier to use.

II. THE HP-25 PROGRAM

Our HP-25 program is presented in TABLE I with user instructions in TABLE II. Using data taken from Case 2 of Ref. 1, program results are demonstrated in the following example:

i	$t_i$	$R_i$	Fitted Values (Using points 1 to i)	
			W	$R_0$
1	1.0	20.1318	--	--
2	1.1	20.8166	132.19	-5.35
3	1.2	21.5138	159.05	-4.85
4	1.3	22.1247	148.71	-5.04
5	1.4	22.7172	141.62	-5.17
.	.	.	.	.
.	.	.	.	.
26	3.5	32.3807	149.5404	-5.0120

Note that, as presented in TABLE I, the program computes  $W$  and  $R_0$  after each radius-time pair is entered. This takes  $\sim 4-1/2$  s. If step 06 in the program is changed from NOP to GTO 00, this calculation is skipped and the calculator stops after  $\sim 1$  s and displays instead the number of points entered so far. To calculate  $W$  and  $R_0$ , press

GTO 07 followed by R/S once the calculator has stopped.  $W$  and  $R_0$  will be computed and displayed

as before. The user can then continue to add or delete points as desired.

TABLE I  
THE HP-25 PROGRAM

Step	Instruction	Notes	Step	Instruction	Notes	Register Usage
00	STOP		25	x	$R_0$	0 $\Delta^{-1}$
	x < 0	Remove data point?		RCL 3		1 a
	GTO 45			RCL 5		2 b
	RCL 2			x		3 N
	$y^x$	$t_i^b$		RCL 7		4 $\Sigma R_i$
05	$\Sigma^+$		30	RCL 4		5 $\Sigma R_i t_i^b$
06	NOP	(or GTO 00 - see text)		x		6 $\Sigma (t_i^b)^2$
07	2			-		7 $\Sigma t_i^b$
	RCL 3			RCL 0		
	x < y	$N \geq 2 ?$		x		
10	GTO 00		35	RCL 1		
	RCL 6			$\div$		
	x			1		
	RCL 7			RCL 2		
	$x^2$			-		
15	-		40	3		
	1/x	$\Delta^{-1}$		x $\neq$ y		
	STO 0			$\div$		
	RCL 7			$y^x$	$(y)=R_0, (x)=W$	
	RCL 5			GTO 00		
20	x		45	CHS	Take out data point.	
	RCL 4			RCL 2		
	RCL 6			$y^x$		
	x			$\Sigma^-$		
	-		49	GTO 06		

TABLE II  
USER INSTRUCTIONS

Step	Instructions
1	Enter program
2	Clear registers [press f STK]
3	Load register 1 with a-value [key in a value followed by STO 1]
4	Load register 2 with b-value [key in b value followed by STO 2]
5	Initiate program [press f PRGM in run mode]
6	Key in first radius point (m) and press ENTER
7	Key in first time point (ms)
8	Restart program [press R/S]. Program stops and displays 1.00.
9-11	Key in next radius and time points and press R/S

When program stops, W is displayed in x-register

$R_0$  is available for display  
in y-register [press x  $\leftrightarrow$  y]

If program step 06 is changed to GTO 00, program skips over calculation of W and  $R_0$  after each point is entered and stops with the display showing the number of points so far entered. To do the W,  $R_0$  calculation, press GTO 07 and R/S. Results are given as in above case.

Options:

1. To enter additional points, repeat steps 9 - 11.
2. To remove a point, execute steps 9 - 11, but set time value negative.
3. To reinitiate for another problem, start over from step 2.

REFERENCES

1. H. C. Goldwire, Jr., "Solving the Strong Shock Algorithm for Yield and Origin-Shift," Los Alamos Scientific Laboratory report LA-6786 (In preparation).