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PRETART/TARTV USER'S MANUAL

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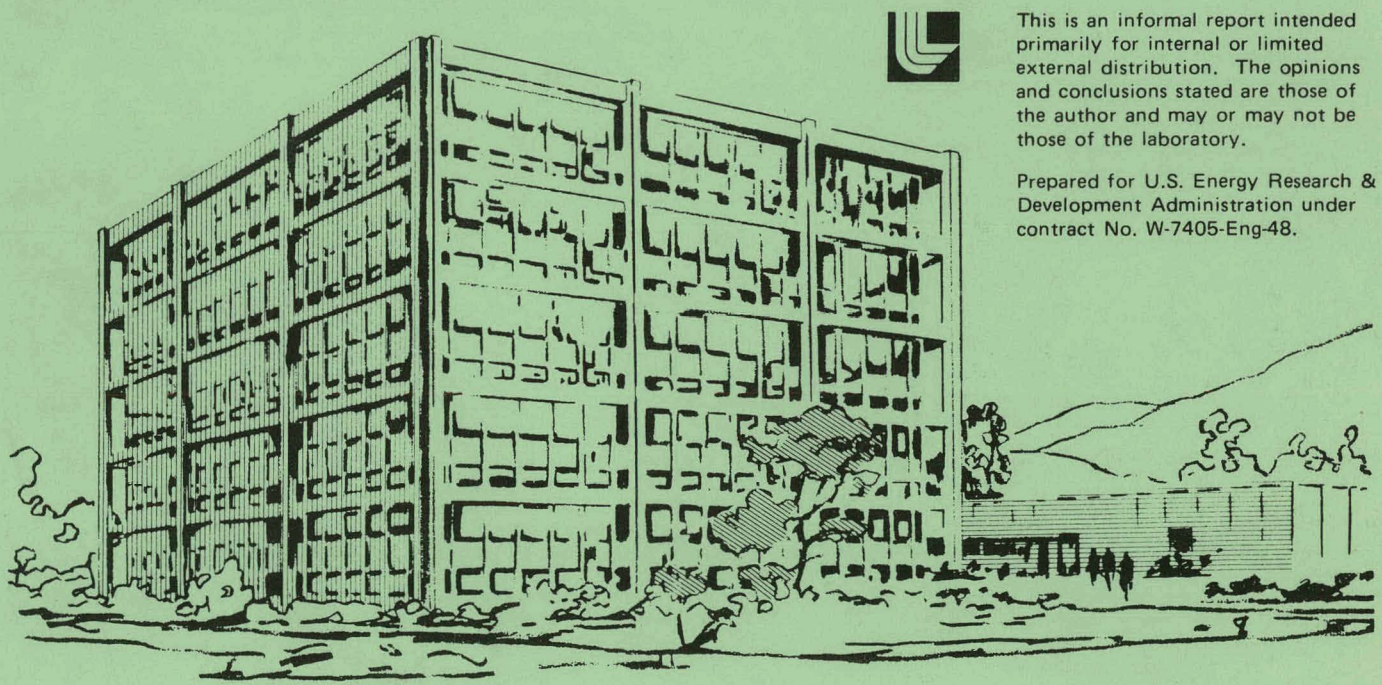

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DISCLAIMER

PRETART / TARTV USER'S MANUAL

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TABLE OF CONTENTS

1. INTRODUCTION

PRETART and TARTV are preprocessors for TARTNP input decks. They accept the normal TARTNP input decks. The purpose of these routines is to aid users in checking their geometry before making a TARTNP run.

PRETART finds the volume of each zone, or of any selected subset of zones. When the volumes of all zones are found, the user may select a percentage of random checking for gaps or overlaps between the zones. If gaps or overlaps are found, a diagnostic routine describes the difficulty as best it can.

TARTV allows the user to see a picture on TMDS (with a fiche copy) of a plane slice, parallel to the x-y plane or parallel to the x-z plane, through space, with an arbitrary picture window. One may ask that any subset or all of the zones be pictured. In the picture, each zone is labeled with its zone number and outlined by dots.

A complete description of how to use these routines follows. It needs to be emphasized that PRETART cannot be used naively. It requires an active user who understands what it is trying to do, and its limitations. Since TARTV uses the same algorithm, using it may give the user a better feel for what PRETART "sees."

Since this is the first release of PRETART/TARTV, users may find bugs or have suggestions for improvements. Please do not hesitate to contact the author in this connection.

2. TARTV User's Manual

2.1. Basic Instructions

To use TARTV, type:

TARTV / t v

The routine will respond with:

TYPE IN DATA FILE NAME AND OPTIONS AND THEN LINEFEED

This asks for the standard TARTNP input line. Usually one will reply with two file names, the data file and the name of a file to be used for output. The output file will contain some of the usual TARTNP preliminary output. Alternately, one can just type TARTV followed by the file names on a single line.

The routine will then ask whether or not to interchange the Y and Z axes. (The slices to be displayed will be parallel to the xy plane, so asking for the switch is the same as taking the slice parallel to the xz plane.) Simply reply Y or N.

Next the routine will request a TMDS monitor number. After entering this, one is ready for the routine proper.

To begin a picture, the routine must know the Z value at which it is to show a picture, and the portion of the x-y plane you wish displayed. The routine will ask:

ENTER Z, XL, XU, YL, YU

To respond, enter five numbers in F 10.4 format, as follows:

Z = the value of Z at which to slice

XL = the lower value for x for the picture window

XU = the upper value for x for the picture window

YL, YU = lower and upper bounds for y.

For example, using commas to terminate each input field, you might enter:

-6.,-10.,10.,-2.E1,2.E1,

which would define a picture window at Z = -6., $-10. \leq x \leq 10.$, $-20. \leq y \leq 20.$

The picture will be labeled with the z chosen and oriented with x horizontal, y vertical. If a y-z switch was performed, the labeling will show the y chosen (which is the "z" entered) and will show the x-axis vertically and the z-axis horizontally.

Next, the routine will repeatedly prompt:

ALL, ADD, RST, END

The reply is as follows:

(1) ALL

Display all zones

(2) END

Terminate this picture window. The routine will type AGAIN? If you answer Y or YES, the routine will again ask you to enter a picture window. If you answer anything other than Y as a first letter, the routine exits.

(3) ADD i_1, i_2, ..., i_{10}

The three letters ADD, followed by up to 10 zone numbers (I4 format) will ADD those zones to the present picture. For example,

ADD 7, 8, 9, 13,

will display zones 7, 8, 9, and 13 in addition to zones previously displayed (or just those if this is a new picture). One may type ALL instead, if all zones are now desired.

(4) RST

(Reset): Erases the flags pointing to those zones to be displayed, and then repeats ALL, ADD, RST, END.

For example:

ALL

(Picture displayed of all zones)

Routine: ALL, ADD, RST, END

RST

Routine: ALL, ADD, RST, END

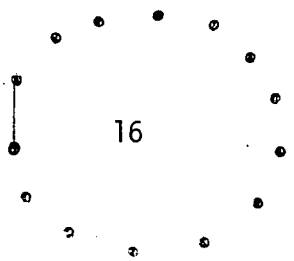
ADD6,0009

(Picture of zones 6 and 9 only)

2.2. Interpreting the Pictures

The pictures are built from left to right using 100 slices in the vertical (y) direction. For each zone, the interval or intervals formed by intersecting that zone (on the current z plane) with that vertical line are determined, and two points plotted for each interval, to indicate its top and bottom. Additionally, every nine lines the zone number is written in I3 format, beginning one line to the left, and centered between the two dots.

If no dots were drawn on the previous line for a zone, instead of two dots, the routine draws a solid line between two dots. Thus a solid line marks the beginning of a new zone from the left. Thus a circle might appear like this:

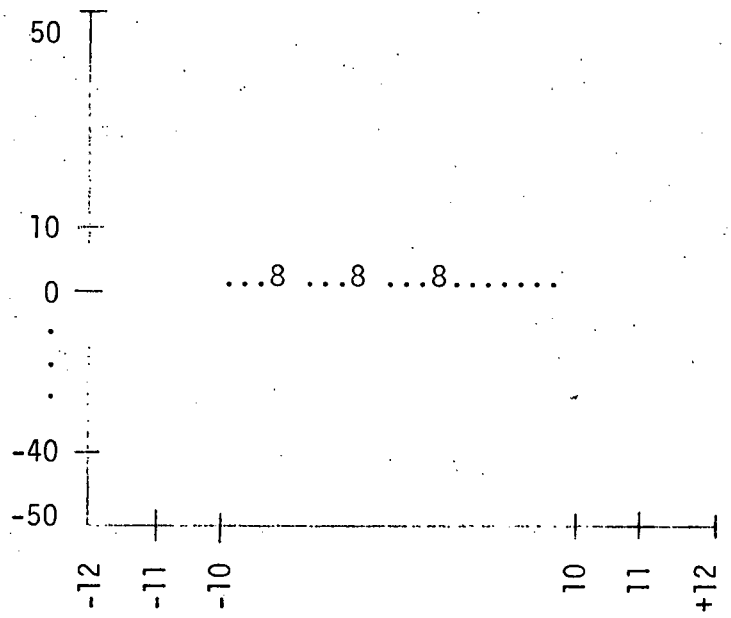


Sometimes a zone may not be wide enough from left to right to get its number printed. If the zone is too narrow from top to bottom, the number is printed anyway. If y and z have been switched, the solid lines indicate the beginning of a new zone from the bottom.

Thus, the cylinder $x^2 + z^2 = 10^2$, $2 \leq y \leq 2.1$, might be viewed as follows (assuming this is zone 8):

```
ENTER Z, XL, XU, YL, YU
0.,-12.,12.,-50.,50.
ALL, ADD, RST, END
ADD 12,
```

The picture displayed would look like:



2.3. Fiche Output and Classification Rules

After execution, the displayed pictures are available as fiche output. Normally, there will be one file left named FX105/hhmm where hhmm is the time TARTV was started. This file may be destroyed, or given to user-1 by typing

GIVE FX105/hhmm 999999

The fiche will be delivered to the box specified on line 1 of the TARTNP input deck. In accordance with usual TARTNP rules, pictures will be labeled "SRD" unless the unclassified sentinel in the TARTNP deck is on.

Thus, to view an unclassified picture, put a -1 in columns 67-68 of Card 2. If this is not done, you must log on at level 5 to see the pictures on TMDS, and they will be labeled "SRD."

3. PRETART User's Manual

3.1. Introduction

PRETART finds the volumes of those zones requested inside a rectangular box defined by the user. It is important to understand the method used by PRETART in order to use it most effectively.

Basically, the user gives PRETART a list of zones whose volumes are desired, the percentage of gap/overlap checking desired, and a "window" XL, XY, YL, YU in the x-y plane in which to look for the zones.

Also, one must specify how finely to slice the x-y planes (the slices are parallel to the y-axis) and how many planes, and between what Z limits, to take. For Z limits ZL and ZU, the routine takes ZNUM planes, starting at ZL + DELTAZ/2, in even steps of DELTAZ size, where DELTAZ = (ZU-ZL) / ZNUM, ZNUM being supplied by the user. For each such Z_0, the plane $Z = Z_0$, bounded by $XL \leq x \leq XU$, $YL \leq y \leq YU$, is sliced XNUM times starting at X = XL + DELTAX/2, where DELTAX = (XU-XL)/XNUM, XNUM being user supplied.

Thus, at the finest level, for some Z_0 and X_0, the routine is operating on the line segment $X = X_0$, $YL \leq y \leq YU$, $Z = Z_0$. This line segment is intersected with all requested zones, and the length ℓ_I of the intersection with zone I is used to estimate the volume $V_I(X_0, Z_0)$ of zone I in the neighborhood of this line segment by

$$V_I(Z_0,Z_0) = \ell_I * DELTAX * DELTAZ$$

At the risk of being pedantic, let us consider what this means for a few examples.

Suppose XL = YL = -40, XU = YU = 40, and ZL = -10, ZU = 10. Suppose zone 1 is the inside of the sphere $x^2 + y^2 + z^2 = r^2$. For any given Z_0, the routine will be estimating the cross section at $Z = Z_0$, which is the circle $x^2 + y^2 = r^2 - Z_0^2$. The area of this circle will be estimated with XNUM little rectangles. If XL and XU are too large, many of these rectangles

will be useless, lying outside the circle. This will require a larger XNUM than if XL and XU were a better "box" around the zone. Similar remarks apply to ZL, ZU, and ZNUM.

The routine makes no mistakes in the y-direction of any consequence. For example, a very thin ellipse like $x^2 + 10^6 y^2 = 5^2$ will have its area estimated just as well as a more spherical ellipse.

Thus, the ideal arrangement is to have all the fine detail in the y-direction. Facility is provided for the user to switch y and z if desired. For example, if the zones are a series of cylinders with common cross section $x^2 + y^2 = r^2$ and boundaries $Z = Z_1, Z_2, \ldots, Z_r$, it would be advantageous to switch Y and Z so that the routine slices down through all the zones at once. If the Z_i's are close together, and the switch is not made, then ZNUM must be large or one must break the problem into pieces in the Z direction, to avoid missing some of the cylinders altogether.

It should be obvious that a very small sphere (relative to the box being searched) cannot be located by any method, short of analysis, or the expenditure of inordinate CPU. If you aren't convinced of this, buy a 300 pound cheddar cheese, put a BB in it somewhere and then try to hit the BB with your cheese slicer!

The moral is: no code can find volumes accurately without your help. You have to picture at all times what your zones look like to the routine.

3.2. How To Execute PRETART

To execute PRETART, type

```
PRETART / t v
```

The routine will respond:

```
ENTER DATA FILE, etc.
```

Type the name of the data file and the name of a file to be used for output.

(This is the regular TARTNP input line, use whatever response you would normally make.) Alternately, one can type this on the original PRETART execute line.

Next, after processing the input file, the routine will type:

ENTER CONTROL FILE

Enter the name of a file which contains PRETART input data. This file should have the following structure:

CARD 1: Format: A3

Starting in column 1, the word "ALL" or anything else. If "ALL" there is no card 2, and all zones will be calculated.

CARD 2: Format: 020 (each card)

If not all zones are desired, next after Card 1 should come 1 + (number of zones) / 60 cards in Octal 20 (020) format. The first card corresponds to the first 60 zones, the next to the next 60, etc. A "1" in a bit means that the zone should be calculated. For example, if there are 68 zones,

77001

22

would calculate volumes for zones 1, 2, 3, 4, 5, 6, 15, 62, and 65.

WARNING: Due to an ORDERLIB error, an input of 20 "7's" will not work. For some reason, an input of 20 "7's" in 020 format results in all bits set to 0 instead of 1. Thus, until this can be corrected, such usage must be avoided.

CARD 3: (XL,XU,YL,YU,ALPHA): Format 5F10.4

The first four numbers describe the "window" in the x-y plane which surrounds all the area desired.

The last number, ALPHA, should be between 0. and 1. For each line $Z = Z_0$, $X = X_0$, there will be a check made, with probability ALPHA, that the sum of the lengths of all zones is YU - YL. If it is not, a subroutine is called to analyze the trouble.

Note that ALPHA will be reset to ALPHA = AMAX1(0.,-ALPHA) if Card 1 does not say ALL. Thus, to do checking in the case that only some zones are being used, set ALPHA to be negative on this card.

Note that this is "dangerous," since if a zone appears in the region examined whose volume is not being calculated, a "gap" will be reported on every line where that zone appears. The purpose of this reset is to insure no checking in these cases unless asked for deliberately.

NOTE: Currently, a limit of 5 errors per Z plane are reported, and a total of 100 errors per problem. The most useful such limits need to be determined by user experience.

CARD 4: Format: I2

Number of boundaries that follow, one per card. (Must be at least 2.)

CARD 5: Format: F10.4 each card.

One per card, in ascending order, the values of Z which are to be used as boundaries for slicing. The first such card will be used as ZL, the next as ZU. A number of slices (depending on the input on the corresponding ZNUM card, below) will be taken between ZL and ZU. Then ZU will be made ZL, and the next Z boundary used as ZU. A cumulative volume report is made at the end of each "chunk."

CARD 6: Format A1

Y = switch the y and z axes. The slices will be taken at various y values, parallel to the x-z plane. Be sure to give YL, YU and the Z-boundaries as if this switch has been done.

N = do not switch y and z. Slices will be parallel to the x-y plane.

CARD 7: (XNUM): Format: F10.4

The number of slices to take in the plane. This number is used for all slices.

CARD 8: (ZNUM): Format: F10.4

The number of slices to take in between ZL and ZU. There should be one card for each "chunk"; i.e., one less than the number on Card 4. The more complicated the geometry is in a chunk, the higher the number ought to be.

3.3. PRETART Output

On the teletype, PRETART will send a message as it completes each "chunk." This will be either:

"FROM (ZL) TO (ZU) O.K."

or

"BETWEEN (ZL) AND (ZU), N ERRORS FOUND."

If ALPHA is zero, only the first message can be issued.

On the high speed output file, PRETART writes a summary of the input deck and then, for each "chunk," prints a volume report. These volumes are cumulative. If Zone 1 is the inside of $x^2 + y^2 = 1$, $-1 \leq Z \leq 1$, then the control file might look like (assuming 3 zones total):

	CARD	COMMENT
1.	NIX	"Don't do all zones."
2.	4	$4_8 = 100_2$: Just do Zone 1.
3.	-2., 2., -2., 2., .5	XL = -2., XU = 2
		YL = -2., YU = 2
		ALPHA = .5
4.	03	Three Z's to be used.
5.	-1.	"Chunk" boundaries
6.	0	"Chunk" boundaries
7.	1	"Chunk" boundaries
8.	N	No y-z switch
9.	128.	128 slices per plane
10.	75.	75 slices from Z = -1. to Z = 0
11.	80	80 slices from Z = 0 to Z = 1.

The output might look like:

XL = -2 XU = 2

YL = -2 YU = 2

```
PERCENT GAP/OVERLAP CHECKING .50
CALL 1  TO SLICE
BETWEEN -1 AND 0., 75. SLICES MADE
NO. OF X SLICES 128.
VOLUME IN ZONE 1 is 1.57Ø7EØØ
CALL 2 TO SLICE
BETWEEN 0. AND 1., 80. SLICES MADE
NO. OF X SLICES 128.
VOLUME IN ZONE 1 IS 3.1416E1ØØ
CPU XX IO  0
CHARGE IS xxx SECONDS  PRIORITY IS x.xx
```

Suggested Parameters

We recommend trying XNUM = 128. The running time roughly is proportional to XNUM * ZNUM * (the number of checked zones). There is some overhead, so checking 10 zones is not 10 times as long as checking 1 zone, but 100 zones is roughly twice as expensive as 50 zones with comparable JPBS.

For a first pass at a new problem, keep XNUM small, say 25 or 50, and set ALPHA to 1. This will find a surprisingly high proportion of the geometry errors especially if run once with y and z normal and once switched.

As a guide to timing, roughly:

(1) Calculate #zones * average JPBS/zone * XNUM * ZNUM.

(2) Divide by 10^5: answer is about how many seconds the run will take with ALPHA = 0. Add 10% for ALPHA = 1.

3.4. Explanation of Messages

On error detection, PRETART will issue a message of the following types:

First, a message is printed indicating that the sum of zone cross sections along a line does not equal YU-YL to within a tolerance (YU-YL) * TOLR, where TOLR is a parameter currently set to 10^{-9}. Please report any difficulties with this tolerance.

The message is of the form:

ERROR DETECTED AT Z = xxx.xx, X = xxx.xx

Thus, the routine has detected that along the line YL $\leq y \leq$ YU, Z = xxx.xx, X = xxx.xx, the zones have a sum total cross-section greater than (1 + TOLR) (YU-YL) or less than (YU-YL)(1-TOLR). This message should be followed by one or more messages indicating gaps or overlaps. Either:

GAP BETWEEN ZONES I AND J

or GAP BETWEEN LOWER LIMIT AND ZONE J

or GAP BETWEEN ZONE J AND UPPER LIMIT

or OVERLAP OF ZONES I AND J

For each zone mentioned, a description will be printed showing what portions of the line $Z = Z_0$, $X = X_0$, YL $\leq y \leq$ YU are occupied by the zone. Several pieces may be printed. The general form is:

ZONENO. Y1 Y2 Y3 Y4 Y5 Y6 ...

This indicates that this zone intersected with the line YL $\leq y \leq$ YU has the intersection (Y1, Y2) U (Y3, Y4) U (Y5, Y6) ...

Due to the algorithm used, some pieces may appear of the form (Y1, Y2) where Y1 = Y2. These pieces are empty and can be disregarded.

Other possible messages:

(1) I AM CONFUSED. THERE ARE N ZONES ALONG THIS LINE.

Please report occurrences of this message. This is a message indicating that an error was detected, but something unforseen by the code designer has happened.

(2) TOO MANY PIECES FOR ANALYSIS

Please report occurrences of this message. There were more than 300 zone pieces along this line.

(3) FOR ZONE I, 2*NUMBER OF PIECES IS GE MAXPIECES

Currently the code allows for a zone to have up to five disconnected pieces along a line, which occupy 2 words each. (This includes possibly empty pieces.) Thus, ten words are reserved for each zone. If MAXPIECES, currently 10, is not large enough, the code exits to its driver. Only user experience will determine if this is large enough, so please report any instances of this message.

4. How to Obtain PRETART / TARTV

PRETART and TARTV may be obtained via ELF by typing:

```
RSL .233825:TART  TARTV PRETART
```

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 $; Microfiche $3.00

Page Range	Domestic Price	Page Range	Domestic Price
001–025	$ 3.50	326–350	10.00
026–050	4.00	351–375	10.50
051–075	4.50	376–400	10.75
076–100	5.00	401–425	11.00
101–125	5.50	426–450	11.75
126–150	6.00	451–475	12.00
151–175	6.75	476–500	12.50
176–200	7.50	501–525	12.75
201–225	7.75	526–550	13.00
226–250	8.00	551–575	13.50
251–275	9.00	576–600	13.75
276–300	9.25	601–up	*
301–325	9.75		

*Add $2.50 for each additional 100 page increment from 601 to 1,000 pages; add $4.50 for each additional 100 page increment over 1,000 pages.

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