

# How to Use PRESTA-CG (October 8, 2002)

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## 1. Body Definition

Following bodies are supported in PRESTA-CG\*.

1. Rectangular Parallelepiped (RPP)  
Specify the maximum and minimum values of x-, y-, and z-coordinates that bound a rectangular parallelepiped whose six sides are perpendicular to the coordinate axis.
2. Sphere (SPH)  
Specify the components of the radius vector  $\mathbf{V}$  to the center of sphere and the radius R of the sphere.
3. Right Circular Cylinder (RCC)  
Specify the components of a radius vector  $\mathbf{V}$  to the center of one base, the components of a vector  $\mathbf{H}$  from the center of that base to the other base, and the radius of the cylinder.
4. Truncated Right Angle Cone (TRC)  
Specify the components of a radius vector  $\mathbf{V}$  to the center of one base, the components of a vector  $\mathbf{H}$  from the center of that base to the center of the other base, and the radii R1 and R2 of the lower and upper bases, respectively.
5. Torus (TOR)  
Specify the components of a radius vector  $\mathbf{V}$  to the center of the torus, and the torus is configured parallel to one of the axis. Ri is the length between the center of torus and the center of tube, and R2 is the radius of the tube. Also, input the direction number of torus (n: x/y/z = 1/2/3). Furthermore, input starting angle of a part of torus. For the calculation of "complete" torus, set  $\theta_1=0$ , and  $\theta_2$ , respectively.

Table 1 Data required to described each body type.

Body Type	Inp. #	Real Data Defining Particular Body					
RPP	#	Xmin	Xmax	Ymin	Ymax	Zmin	Zmax
SPH	#	Vx	Vy	Vz	R		
RCC	#	Vx	Vy	Vz	Hx	Hy	Hz
		R					
TRC	#	Vx	Vy	Vz	Hx	Hy	Hz
		R1	R2				
TOR	#	Vx	Vy	Vz	R1	R2	
		$\theta_1$	$\theta_2$	n			

## 2. Region Definition

The basic technique for description of the geometry consists of defining the location and shape of the various regions in term of the intersections and unions of the geometric bodies. A special operator notations involving the symbols (+), (-), and (OR) is used to describe the intersections and unions. These symbols are used by the program to construct information relating material descriptions to the body definitions.

If a body appears in a region description with a (+) operator, it means that the region being described is wholly contained in the body. If a body appears in a region description with a (-) operator, it means that the region being described is wholly outside the body. If body appears with

\*Please see Appendix A of *JNC TN1410 2002-001* by T. Torii and T. Sugita[1].

an (OR) operator, it means that the region being described includes all points in the body. OR may be considered as a union operator. In some instances, a region may be described in terms of sub-region lumped together by (OR) statements. Sub-regions are formed as intersects and then the region is formed by union of these sub-regions. When (OR) operator are used there are always two or more of them, and they refer to all body numbers following them, either (+) or (-). That is, all body numbers between “OR’s” or until the end of the region cards for that region are intersected together before OR’s are performed.

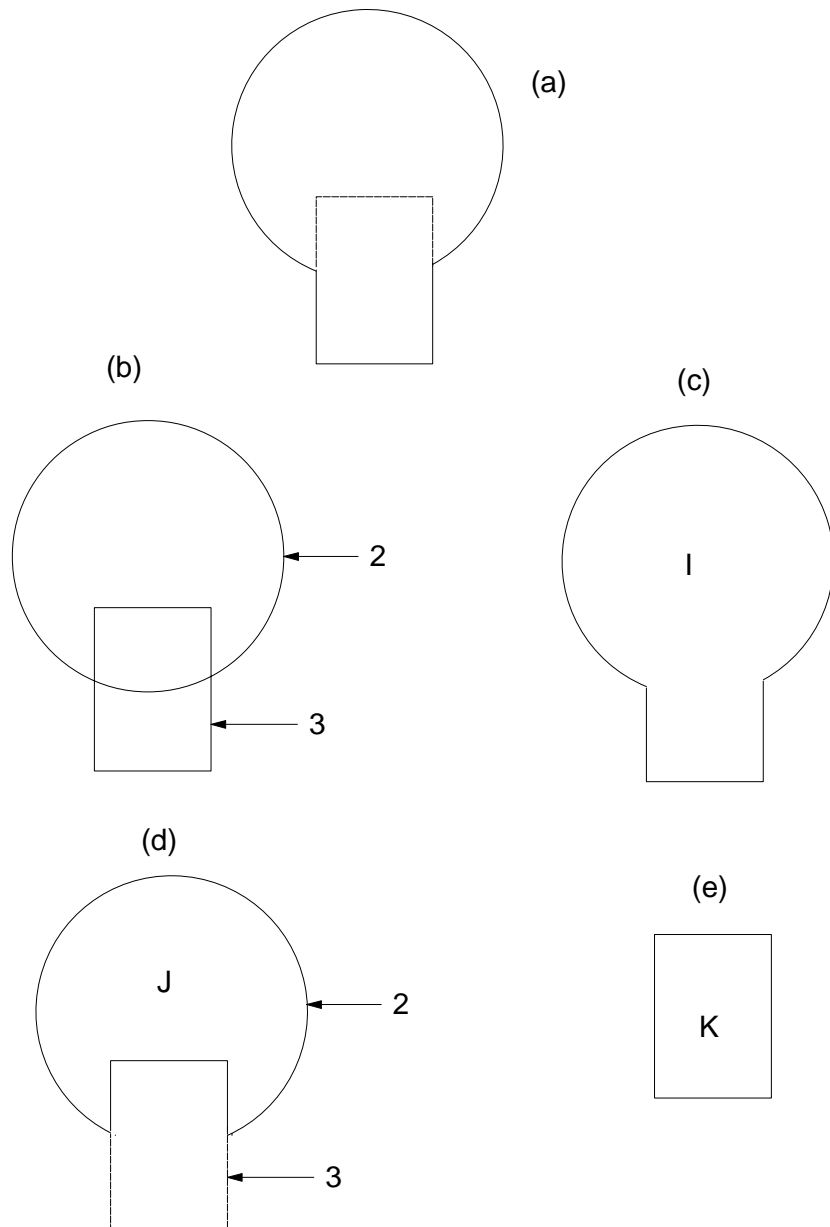


Figure 1: Examples of Combinatorial Geometry Method.

### 3. Example of Region Description

Consider an object composed of a sphere and a cylinder as shown in Fig. 1. To describe the object, one takes a spherical body (2) penetrated by a cylindrical body (3) (see Fig. 1). If the

materials in the sphere and cylinder are the same, then they can be considered as one region, say region I (Fig. 1c). The description of region I would be

$$I = +2OR + 3.$$

This means that a point is in region I if it is either inside body 2 or inside body 3.

If different material are used in the sphere and cylinder, then the sphere with a cylindrical hole in it would be given a different region number (say J) from one cylinder (K).

The description of region J would be (Fig. 1d):

$$J = +2 - 3.$$

This means that points in region J are all those points inside body 2 which are not inside body 3.

The description if region K is simply (Fig. 2e):

$$K = +3.$$

That is, all points in region K lie inside body 3.

Combination of more than two bodies and similar region descriptions could contain a long string of (+), (-), and (OR) operators. It is important however to remember that **every spatial point in the geometry must be located in one and only one region.**

As a more complicated example of the use of the (OR) operator, consider the system shown in Fig. 2 consisting of the shared region A and the unshared region B. These regions can be described by the two BOX's, bodies 1 and 3, and the RCC, body 2. The region description would be

$$A = +1 + 2$$

and

$$B = +3 - 1OR + 3 - 2.$$

Notice that OR operator refers to all following body numbers until the next OR operator is reached.

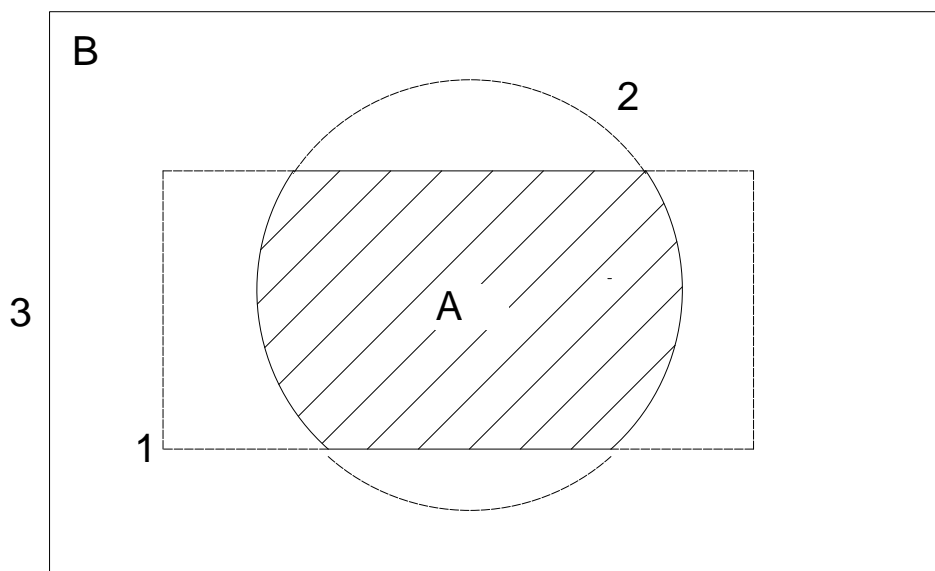


Figure 2: Use of OR operator.

#### 4. Input data for Sample 1

Sample 1 is the model for a Ar detector including a radiation solution inside and surrounded with air show

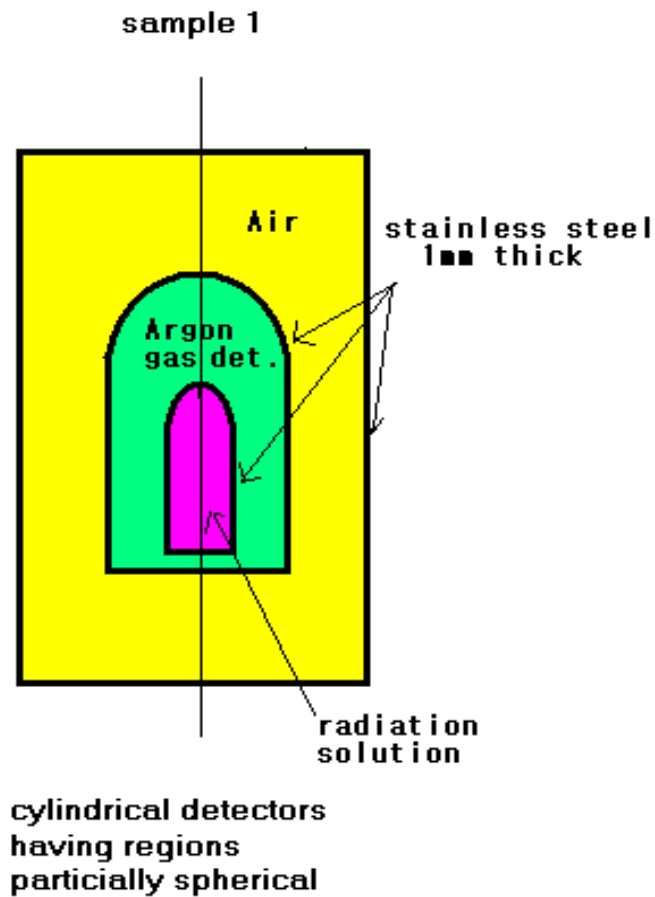


Figure 3: Geometry of sample 1.

The input data for this geometry can be written as follows in PRESTA-CG:

RCC	1	0.0	0.0	0.0	0.0	30.0
		10.0				
RCC	2	0.0	0.0	0.1	0.0	29.8
		9.9				
RCC	3	0.0	0.0	5.0	0.0	15.0
		5.0				
RCC	4	0.0	0.0	5.1	0.0	14.9
		4.9				
RCC	5	0.0	0.0	6.0	0.0	8.0
		2.0				
RCC	6	0.0	0.0	6.1	0.0	7.9
		1.9				
SPH	7	0.0	0.0	14.0	1.9	
SPH	8	0.0	0.0	14.0	2.0	
SPH	9	0.0	0.0	20.0	4.9	
SPH	10	0.0	0.0	20.0	5.0	
RCC	11	0.0	0.0	-1.0	0.0	40.0
		15.0				
END						
Z1			+6 OR +7			

```

Z2      +5 -6 OR +8 -7 -5
Z3      +4 -5 -8 OR +9 -4
Z4      +3 -4 OR +10 -9 -3
Z5      +2 -3 -10
Z6      +1 -2
Z7      +11 -1
END

```

The definitions of each region above can be understood from the following figures (Figs. 4-10).

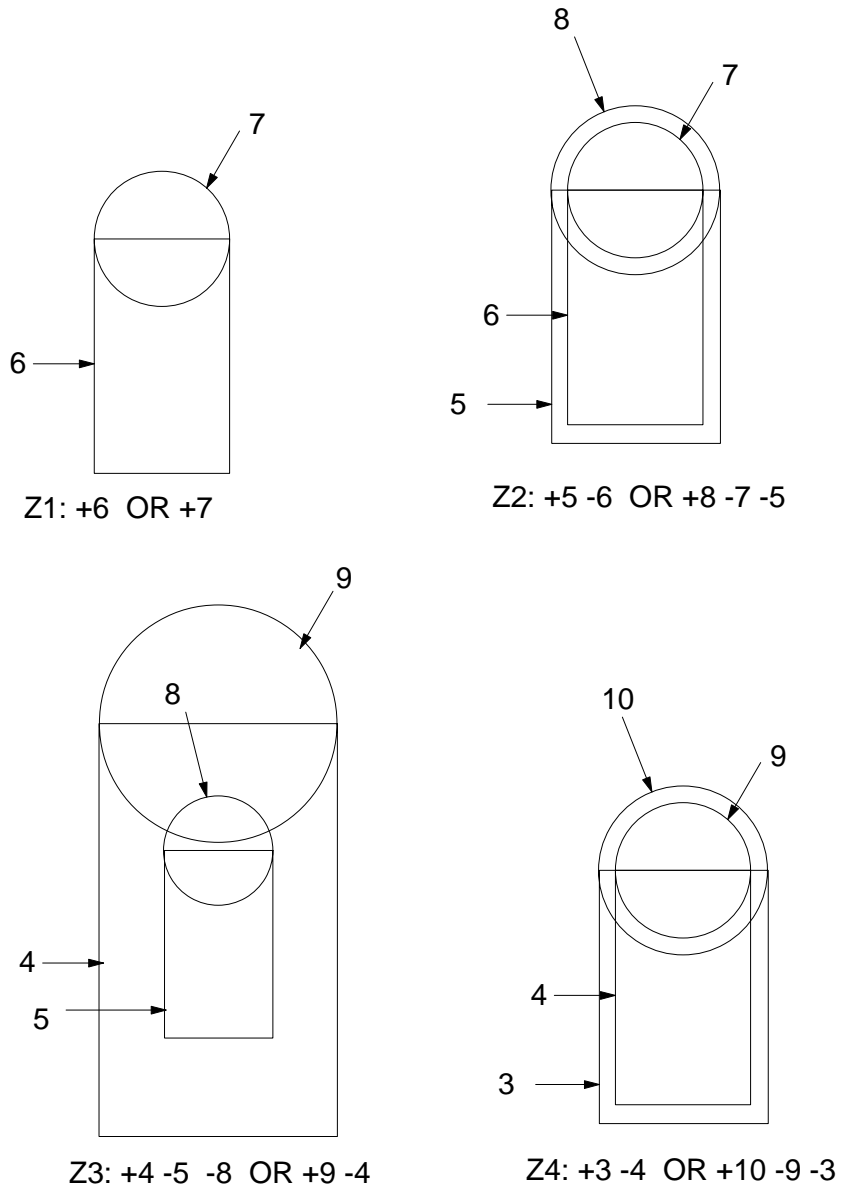
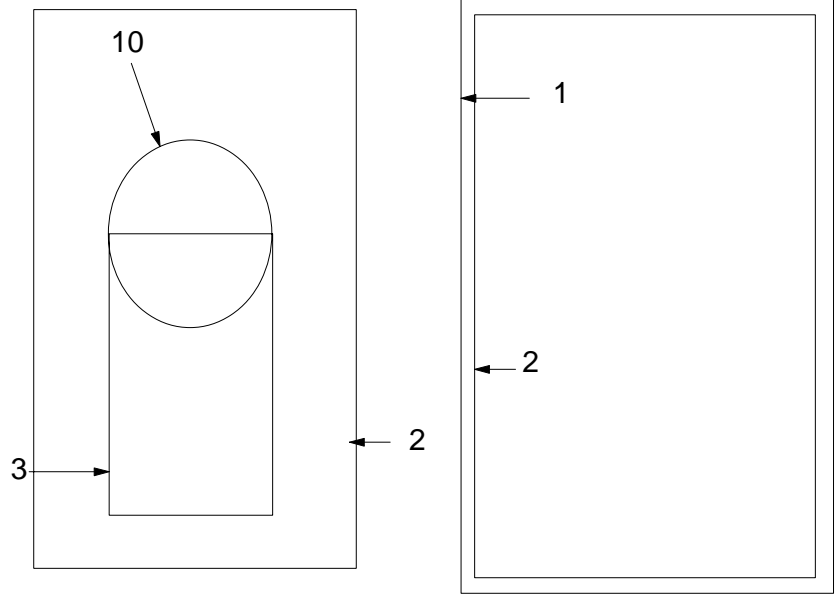
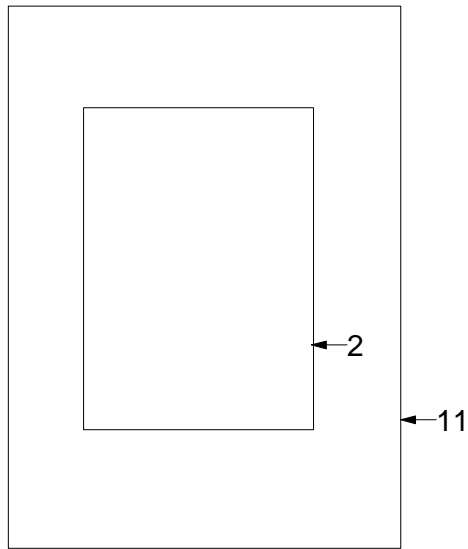


Figure 4: Region 1, 2, 3 and 4.



Z5: +2 -3 -10

Z6: +1 -2



Z7: +11 -1

Figure 5: Region 5, 6 and 7.



## 5. How to Use PRESTA-CG in EGS4 System

### 5.1. Install PRESTA-CG and sample files

Copy presta\_cg.exe to the directory that EGS4 system is installed.  
Extract files on PC by presta\_cg.  
The following files are extracted:

- egs4runcgp.bat
- Cgpmac.mor
- cghowfar.mor
- ucsampl1cgp.mor
- sampl1cg.inp
- ucsampl2cgp.mor
- sampl2cg.inp
- sampl\_1\_2.dat

### 5.2. How to run EGS4 with PRESTA-CG

You can run ucsampl1cgp.mor using egs4runcgp.bat.  
C:\egs4lect> egs4runcgp ucsampl1cgp.mor sampl\_1\_2.dat sampl1cg.inp  
Third argument is the input data file of CG.

```
@ECHO OFF

REM Usage: egs4runcgp %1 %2 %3
REM use PRESTA-CG
REM %1: User Code (ex: ucsampl1cgp.mor)
REM %2: Material Data (ex: sampl_1_2.dat)
REM %3: CG input file (ex: sampl1cg.inp )

DEL MORTJOB.*
DEL USER.F90

REM Produce MORTJOB.MOR.
COPY LISTING.ON+EGS4MAC.MOR+NRC4MACP.MOR MORTJOB1.TMP
COPY MORTJOB1.TMP+PRESTA.MOR+KEK4MAC.MOR MORTJOB2.TMP
COPY MORTJOB2.TMP+CGPMAC.MOR+%1+CGHOWFAR.MOR+KEK4.MOR MORTJOB3.TMP
COPY MORTJOB3.TMP+EGS4BLOK.MOR+EGS4.MOR MORTJOB.MOR

DEL MORTJOB*.TMP

REM Copy material data.
COPY %2 MORTJOB.XSE

COPY %3 USER.F90

REM Convert from MORTJOB.MOR to MORTJOB.FOR.
MORTRAN3.exe

REM Compile, link and execute MORTJOB.FOR.

REM Use one of the following lines
REM -----

REM Layey Fortran 90
rem echo "Use Lahey Fortran 90"
rem lf90 MORTJOB.for -nw -lst

REM Microsoft FORTRAN POWERSTATION
rem echo "Use Microsoft FORTRAN POWERSTATION"
REM FL32 /Ox /WO /G4 MORTJOB.for
```

```
REM Visual FORTRAN (Ver.5)
REM echo "Use Visual FORTRAN (Ver.5)"
REM F90 MORTJOB.for

REM Visual FORTRAN (Ver.6.1)
REM echo "Use Visual FORTRAN (Ver.6.1)"
REM DF /Ox MORTJOB.for

REM g77 compiler under Windows
echo "Use g77 Fortran"
g77 -o mortjob -O -fno-automatic -fno-backslash mortjob.for

MORTJOB
```

## References

- [1] T. Torii and T. Sugita, "Development of PRESTA-CG Incorporating Combinatorial Geometry in EGS4/PRESTA", *JNC TN1410 2002-201*, Japan Nuclear Cycle Development Institute (2002).