

DATA CAD LLC

DataCAD Applications Language – DCAL

Programmer's Reference Manual

Updated by David Henderson Mar 2025

(more recent versions *may* be available at <http://www.dhsoftware.com.au/dcalmanual.htm>)

This manual describes the DataCAD Applications Language, DCAL. DCAL is a programming language that DataCAD can read and execute. It allows you to customize DataCAD to specific applications that are not built into DataCAD.

While this manual mainly describes the classic DCAL language, some (incomplete) notes have been added to note differences between the classic DCAL language and the newer DCAL for Delphi version. DataCAD for Delphi is abbreviated to “D4D”, and these notes are generally in red where they occur.

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Chapter 1 – Fundamentals

Concepts

This section describes some of the internal workings of DataCAD.

Angles

All angles in DCAL (and therefore internal to DataCAD), are expressed in radians starting at 0 to the right (east). Angles increase counterclockwise.

Note: The internal representation has no effect on how DataCAD displays angles to the user.

Coordinate System

Internally DataCAD stores all distances and coordinates as 1 unit = 1/32 inch. This is also true for metric units.

When converting distances to strings or strings to distances, the current scaling type (feet- inches- fractions, meters, decimal feet, etc.) determines the format of distance strings. This does not, however, affect the way that DataCAD maintains distances internally.

Entities

Every primitive graphic shape that DataCAD understands is called an entity. Currently supported entities include:

Point, Line, Arc, Circle, Polyline, Ellipse, Bézier, B-Spline, Contour, Text, Associative Dimension, Symbol, 3D Line, 3D Arc, Polygon, Bézier Surface, Block, Slab, Cylinder, Cone, Truncated Cone, Sphere, Torus, Surface of Revolution.

(XREF, Smart Entity)

Each entity has certain information associated with it such as which layer it is on, color, line type, line spacing, line weight, overshoot factor, and an attribute (integer). Each entity also has an address associated with it which is a handle to the entity in the drawing file. The address of an entity does not change, either during an editing session or between editing sessions.

Keyboard

A DataCAD macro perceives the keyboard differently from other programs. To simplify writing macros, all keys are returned from the keyboard as integers, not as characters. This allows DataCAD to represent the entire 256 extended ASCII character set, as well as any 'special' key. 'Special' keys return escape codes.

A special key is any key that has a macro- interpretable function. For instance, the function keys are special keys, as are the arrow keys, [Insert] and [Delete]. Some keys are special keys only some of the time. For instance, [q] returns an escape code under some circumstances which causes DataCAD to increment the current line type, and at other times (while reading a string) returns a normal key code.

Several of the DCAL routines return a result that tells you how they were exited. These result codes are res_normal for a normal finish and res_escape for an interruption because an escape code was read. A

result of `res_escape` typically means that the user pressed a function key while the macro was requesting some type of input. The escape code that was pressed returns from these routines as an integer.

Layers

Each entity is on a layer. Each layer is scanned during any search of DataCAD's database. When a layer is not searched, every entity on that layer is ignored. Ignoring certain layers (for instance layers that are off) or confining a search to a specific layer or set of layers improves search speed.

Selection Sets

DataCAD supports 16 selection sets. A selection set is a collection of entities. Every entity can be a member of some, none, or all of the selection sets. Selection sets are convenient ways of grouping entities so you can act upon them together. Selection sets also provide an alternative to using layers to group entities. The first eight selection sets are available to you and DCAL, while the other eight are reserved for DataCAD's internal use (although it may be possible for the macro to use these under certain circumstances – [see DDN post by Dave Giesselman on this topic](#)).

Selection sets exist across uses of a drawing file. That is, you can set up and manipulate a selection set. If the drawing is exited and then reentered, the selection set still exists. In this respect, selection sets are similar to layers as a way to group entities.

Local Variables

Routines can declare local variables. These variables can only be used inside this routine or any routine local to it. They are pushed on the stack and exist only during the lifetime of the routine.

Symbols

A symbol is similar to any other DataCAD entity. However, a symbol is a reference to a group of other entities that are drawn where the symbol is inserted. A symbol, as created at the DataCAD template menu, is referenced by its file name (including the path). With a symbol defined by a macro, however, all you need is a unique symbol name.

Symbols are instanced, that is, their geometry exists only once in the database. They can be globally updated, but no longer individually edited.

Basics

DCAL is a block-structured language similar to Pascal and Modula-2. DCAL supports recursive procedures and functions, as well as nested routines, local variables and constants, reference and value parameters, and conformant arrays.

Case Sensitivity

The functions and procedures in DCAL can be entered in either upper- or lower-case characters. DCAL is not case-sensitive, therefore, ABC, abc, and AbC are all the same to DCAL.

Comments

A comment is text that prints within the code of a macro, but is ignored by the macro. DCAL allows two different types of comments:

Comments that start with a left brace (`{`) and end with a right brace (`}`).

The other type of comment is the comment until end of line. This starts with an exclamation mark [!] and continues until the end of the current line. Comments cannot be nested, and cannot appear within a string.

Identifiers

DCAL macros are composed of identifiers, both pre-defined and user-defined. Examples are: variable names, procedure names, and procedure parameters.

Valid DCAL identifiers begin with a letter, and are followed by letters, numbers, and underscores. Identifiers may be up to 20 characters long. Identifiers longer than 20 characters result in compile time errors. Therefore, these are valid identifiers:

```
test
proc_1
alphābet
```

These, however, are not valid identifiers:

```
123test           Starts with a number.
_hello           Starts with an underscore.
abcdefghijklm     More than 20 letters.
nopqrstuvwxyz
ab$de            $ is an invalid character.
```

DCAL identifiers are not case sensitive, therefore, ABC, abC, and AbC are all the same identifier to DCAL.

Keywords

A keyword is a word that is part of the DCAL language. Keywords are reserved and cannot be used for any other purpose. A complete list of keywords follows:

and	of
array	off
begin	on
by	or
const	out
do	procedure
else	program
elsif	public
end	record
external	repeat
false	return
for	string
function	then
if	to
in	true
include	type
message	until
mod	var
module	while
not	

White Space

White space is ignored by the compiler. White space consists of spaces, newlines, and tabs that are not in a string or character literal.

Program Layout

Macro Header

There are two types of macro headers, depending on whether the .dcs file contains a program or a module:

Programs

As the sample macro spiral shows, DCAL program macros begin with the keyword `program` followed by the name of the macro, followed by a semicolon.

Modules

DCAL modules begin with the keyword `module`, followed by the name of the module, followed by a semicolon. Modules have no body, and thus no corresponding `begin` keyword. However, they do have an end followed by the module name and a period. The sample module `wrtutl.dcs` is an example of a module.

Constant

The Constant section, if present, starts with the keyword `const`. Following it are the constant identifier, an equal sign (=), followed by the value of the constant. Finally, a semicolon terminates each constant.

DCAL recognizes two types of constants, integers, and reals. The following is a valid constant section:

```
CONST    delta = 23.43; {real constant}    max_count = 45; {integer
constant}
```

Type

The Type section, when present, comes after the Constant section. It begins with the keyword `type`, followed by the type name, followed by the type definition.

Scalar Types

Scalar types consist of the DCAL built-in simple types which are described in the "Data Types" chapter. These simple types are indivisible: a DCAL macro cannot directly examine these variables to any greater degree.

Array Types

Array types are used by DCAL to group data together. To declare an array, use the keyword `array`, followed by a left bracket ([), followed by the lower bound, followed by two periods (..), followed by the upper bound, followed by a right bracket (]), followed by the keyword `of`, followed by the type of the element that the array is comprised of.

Notice that arrays can be made up of arrays. For instance:

```
TYPE    x = ARRAY [0..9] OF ARRAY [3..5] OF integer;
```

A shorthand notation for this is:

```
TYPE    x = ARRAY [0..9, 3..5] OF integer;
```

Records

Records are the other way DCAL groups data together. DCAL records are similar to Pascal records, including the use of the case variant record. The only distinctions are that in a DCAL case variant record, the case selector (tag) must be an integer, and no explicit tag variable is allowed. For example, the following are valid record descriptors:

TYPE

```
rec1 = RECORD
    a : integer;
    b : real;
END;
rec2 = RECORD
    a : integer;
    CASE integer OF
    0 : (r : real);
    1 : (b : boolean);
    END;
```

Variables

Next comes the optional variables section. It begins with the keyword var, followed by a list of identifiers, each followed by a colon, then the type of variable, followed by a semicolon. For example:

```
VAR
    i : integer;
    x, y : real;
    dis_Array : dis_Type;
                { a user defined type }
```

Notice that, unlike constants, more than one variable can be given the same type, as long as they are separated by commas.

Subprograms

A subprogram, or routine, is a procedure or function. A function is identical to a procedure except that it returns a value and can be used in an expression, if its type is appropriate for the expression. In this manual, the terms subprogram and routine mean either procedure or function.

Procedures

Procedures are declared by the keyword procedure, followed by the procedure name, followed by an optional parameter list. After that, a procedure may declare local constants, types, variables, and other routines. A procedure ends with control falling through to the final end statement, or by using the return statement.

Functions

Functions are similar to procedures, except they return a value of a certain type. Functions are declared with the keyword function, followed by the function name, an optional parameter list, a colon, and the type of variable the function returns. A function may declare local constants, types, variables, and other routines. In the body of the function, the return value is returned in the return statement. The returned value follows the keyword return. If control falls through to the final end in a function without encountering a return statement, a fatal runtime error occurs. Functions may only return scalar types.

NOTE: In this manual, the function or procedure is listed with a description, followed by the parameters, with descriptions of the parameters concluding the section.

Passing Parameters

Parameters are passed to routines in one of three ways: IN mode, OUT mode, and IN OUT mode. You can specify the usage of the parameter; and the compiler determines whether to pass the parameter by reference or value.

Valid routine declarations with parameters are:

```
PROCEDURE calc (x, y : real; x1, y1 : OUT real);
```

```
FUNCTION dist (x1, y1, x2, y2 : real) : real;
```

```
PROCEDURE readint (i : IN OUT integer);
```

IN Mode

An in mode parameter may be read from, but not written to. When no mode is assigned to a parameter, in is the default. You can substitute an expression for an in parameter; therefore, both (3) and (3 * i) are valid in parameters.

OUT Mode

An out mode parameter can be written to, but cannot be read. An example is a procedure that returns several results in out parameters.

```
PROCEDURE average (data : ARRAY OF integer; mean : OUT integer; sumation :  
OUT integer; median : OUT integer);
```

IN OUT

Mode in out parameters can be both read from and written to. These parameters typically have an initial value with a final value returned from the routine.

Open Array Parameters

DCAL supports open array parameters to procedures. An open array (also called a conformant array) is an array that does not have specified bounds, for example, a procedure that sorts an array of integers. The procedure can sort an array of any size. The declaration is:

```
PROCEDURE sort (i : ARRAY OF integer);
```

The functions low and high (described later) are used by the procedure to determine the actual bounds of the array parameter.

Expressions and Logical Operators This section discusses type compatibility issues. It also discusses mathematical operators that are valid in DCAL.

Type Compatibility

DCAL features strong type checking. Any operation may be performed on a variable as long as the operation is appropriate to the base type of that variable. However, variables and expressions must be the same type to operate or appear together in assignment statements.

For instance, if you declare:

```
TYPE
  count = integer;
```

```
VAR
  a, b, c : count;
  x, y, z : integer;
```

Then you can legally write:

```
a := b + c;
```

because a, b, and c are declared as identical types and the + operator is appropriate to the base type of count, which is integer. However, you could not write:

```
a := b + x;
```

because b and x are not of the same type.

You can escape the type checking through type casting. For example:

```
a := b + count (x);
```

Here, the type name is used to relax the type checking. For this to work, the base type of x must be the same as the base type of the type count, as it is in this example (both are integers). You can use type casting to convert any type to any other type, as long as they are the same size in computer memory.

Operators The mathematical operators *, /, +, and - are used for multiplication, division, addition, and subtraction, respectively. Use these operators with both real numbers and integer numbers. Both operands must be of the same type; with results of the same type.

The routines float, round, and trunc may be used within an expression in which both integer and real variables are mixed.

The operator mod is used only with integer operands and returns the integer remainder of division of the two numbers or variables. Here are some examples of these operators:

VAR

```
r11, r12,    : real;
int1, int2,  : integer;
rlResult     : real;
intResult    : integer;
```

BEGIN

```
rlResult := (r11 + r12) / 2.0;
intResult := (int1 - int2) * 2;
rlResult := float (int1) * 34.75;
intResult := 7 mod 3;
{ this gives intResult = 1 }
intResult := 7 / 3;
{ this gives intResult = 2 }
intResult := round (r11) / 4;
intResult := trunc (r12) * 6;
```

END XXX

Statements

This section describes the statements that make up DCAL.

Assignment Statement

The assignment statement is the statement DCAL uses to assign values to variables. Its use is identical to the Pascal assignment statement:

```
variable := expression;
```

The variable gets the value returned by the expression. The expression must evaluate to the same type as the variable (integers must be assigned to integer variables, reals to real variables, etc). The expression itself may be a variable.

IF Statement

The IF statement is used for testing Boolean conditions and branching based on the result. Several valid IF statements are:

```
IF f AND g THEN
  dofirst;
ELSE
  dosecond (f);
END;
```

```
IF apple + orange < pineapple THEN
  error1;
ELSIF i >= j THEN
  deleteFile;
ELSE
  formatDisk;
END;
```

```
IF today = Monday THEN
  getOutOfBed (late);
  goToWork (late);
END;
```

Conditional Expressions

Follow the keyword IF with an expression which returns a Boolean result. When the result is true, the code following the THEN keyword is executed. When the result is false, the code following the ELSE keyword is executed.

THEN Statements

The statements between the THEN and the following END, ELSE, or ELSIF are executed when the Boolean expression evaluates to true.

ELSE Statements

The statements between the ELSE and the corresponding END or ELSIF are executed when the Boolean test expression evaluates to false. The ELSE section is optional. When the ELSE section is not present and the test expression evaluates to false, no action is taken and control falls through to the next statement following the corresponding END of the IF statement.

ELSIF

Use the keyword ELSIF to shorten the number of lines needed for multiple IF statements. The following code:

```
IF key = 1 THEN
  code_for_1;
ELSE
  IF key = 2 THEN
    code_for_2;
  ELSE
    IF key = 3 THEN
      code_for_3;
    ELSE
      other_code;
    END;
  END;
END;
```

using ELSIF could be written as:

```
IF key = 1 THEN
  code_for_1;
ELSIF key = 2 THEN
  code_for_2;
ELSIF key = 3 THEN
  code_for_3;
ELSE
  other_code;
END;
```

Using ELSIF in this way can be a substitute for the Pascal CASE statement, which DCAL lacks.

Procedure Call Statement

With the procedure call statement you can execute procedures you have written or procedures that are built into DCAL and DataCAD. To call a procedure, simply use the procedure's name, followed by its parameters, if any. Example procedure calls are:

```
wrtterr ('Unable to open file.');
```

```
write_prompt;{ call proc. w/o parameters }
```

```
lblson;
```

```
add (x, y);
```

```
testit (3 + 4, a);
```

RETURN Statement

The RETURN statement occurs in two slightly different forms depending on whether it is used in a procedure or in a function. Both procedures and functions may have any number of RETURN statements.

RETURN Used in Procedures

When used in a procedure, the keyword RETURN appears by itself. It causes the execution of the procedure to terminate and control to return to the calling routine. There is an implicit RETURN statement at the end of every procedure.

RETURN Used in Functions

When used in a function, the keyword RETURN is followed by the expression that is returned as the value of the function. If control falls through to the final END of a function, a run-time error occurs. The value that follows a RETURN statement is returned to the calling routine.

WHILE Statement

The WHILE statement implements a loop. The keyword WHILE is followed by a Boolean expression, followed by the keyword DO. Following this are one or more statements, followed by END. The expression is evaluated at the top of the loop. When the statement is true, the statements in the loop are executed. The expression is then re-evaluated and the loop is rerun until the Boolean expression evaluates to false.

Notice that a loop can be executed zero times when the expression evaluates to false the first time it is tested.

A valid WHILE statement is:

```
i := 1;      { initialize counter }
done := false;
WHILE NOT done DO
  IF test (i) THEN;
    i := i + 1; { increment
                counter }
  ELSE
    done := true;
END;
```

REPEAT Statement

The REPEAT statement is another looping structure in DCAL. Unlike the WHILE loop, the body of the REPEAT statement is executed at least one time. The REPEAT loop consists of the keyword REPEAT, followed by the statements that make up the body of the loop, followed by the keyword UNTIL, followed by a Boolean expression. Every time control passes to the UNTIL statement, the Boolean expression is evaluated. When the expression evaluates to true, control passes through to the statement following UNTIL. When the expression is false, control goes back to the statement following the REPEAT statement.

A valid REPEAT statement is:

```
i := 10;
REPEAT
  write_file (i);
  i := i - 1;
UNTIL i = 0;
```

FOR Statement

The FOR statement is used to loop a specified number of times. The syntax of a FOR statement is:

```
FOR <ivar> := <startval> TO <endval> | BY <iconst> | DO <stmts> END;
```

The index variable (<ivar>) must be an integer variable that can be assigned. The optional BY is followed by an integer constant. This is the step size used in the FOR statement which may be positive or negative. When the BY section is not included, the step size is one (1). The <stmts> are executed until the value of

<ivar> is greater than <endval>. <endval> is only evaluated once, when the loop is entered. When <startval> is greater than <endval> (and the step size is positive), the <stmts> are never executed.

Chapter 2 – Constants

This chapter describes the constants that are built into DCAL. They are pre-declared and can be used by your programs.

NOTE: The values of these constants may change in future releases of DCAL and DataCAD; therefore, your programs should never depend on the actual value that these constants represent.

I/O Constants

File Operation

These operation constants are used and returned by file handling procedures:

fl_access_denied

This error is returned when an attempt is made to access a file which cannot be accessed, such as attempting to write to a read only file.

fl_invalid_access_code

If this error occurs, please notify Technical Support.

fl_invalid_function

If this error occurs, please notify Technical Support.

fl_invalid_handle

An attempt was made to access a file using an improper file variable. Usually, this indicates an uninitialized file variable.

fl_no_handles_left

An attempt was made to open too many files at once. Some operating systems restrict the number of files that can be opened at one time. For MS-DOS, you can set this number in the config.sys file with the files= statement.

fl_not_found

An attempt was made to open a file that could not be found.

fl_ok

The file routines return this constant when they are successful.

fl_path_not_found

A pathname was specified which does not exist.

fmode_read

This constant specifies that a file is open for reading only.

fmode_read_write

This constant specifies a file that is open for both reading and writing.

fmode_write

This constant specifies a file that is open for writing only.

Pathnames

DataCAD defines a number of built-in pathnames, which you can access with the routines `getpath` and `setpath`. These routines take an integer constant which has one of the following values:

pathchr

The path where DataCAD looks when loading a character set. Changing this has no effect on any previously-loaded character sets.

pathdef

This is the path from which DataCAD loads default files, such as the default angles, scales, and distances.

pathdrv

This path indicates where driver files are loaded from. This path is not used once DataCAD is running.

pathdwg **D4D: pathcad**

The path where DataCAD looks for drawing files.

pathdxf

This is the index of the path where DataCAD reads and writes dxf files.

pathfrm

This is the path where DataCAD looks for form files when executing the reports command.

pathlyr

`pathlyr` is the index of the path where DataCAD loads and stores layer files.

pathmcr

`pathmcr` is the index of the path where DataCAD looks when loading a new macro for execution. Changing this has no effect on an executing macro.

pathout

This determines where DataCAD sends text output files, such as output from the report command.

pathsup

`pathsup` is the index of the path where DataCAD looks for support files, such as message and label files. Do not change this pathname while DataCAD is running.

pathswp

`pathswp` is the path where DataCAD keeps virtual memory swap files. This may be changed while DataCAD is running without disturbing existing virtual address spaces.

pathsym

`pathsym` is the index of the pathname where DataCAD adds new symbol files. This is used when new symbol files are created. Once a symbol file exists in a template, the filename is stored in the template file.

pathtmp

This is the index of the path where temporary files are kept. It should be used for any temporary file that the macro needs.

pathtpl

The path where DataCAD looks for template files. This pathname may be changed while a template file is displayed on the screen. This does not affect any already-opened files.

Data Constants**Attributes**

The following constants are used to create, examine, and modify attributes.

atr_addr

Do not use this. The value of this attribute is a logical address (lgl_addr). These are the addresses of layers, entities, attributes, symbols, etc.

atr_ang

The value of the attribute is a real number interpreted as an angle.

atr_dis

The value of the attribute is a real number interpreted as a distance.

atr_int

An attribute that is an integer.

atr_name_len

The maximum length of the name of an attribute, 12 bytes.

atr_pnt

The value of an attribute of this type is a point.

atr_rl

The value of the attribute is a real number.

atr_str

An attribute whose value is a string of up to 80 characters.

Colors

These constants refer to the standard colors used by DataCAD.

NOTE: Because the value of these constants may change between versions of DataCAD, use the constant names.

Name	Color
clrblue	Blue
clrbrown	Brown
clrcyan	Cyan
clrdkgray	Dark gray
clrgrn	Green
clrltblue	Light blue
clrltcyan	Light cyan
clrltgray	Light gray
clrltgrn	Light green
clrltmgt	Light magenta
clrltred	Light red

```

clrmgta   Magenta
clrred    Red
clrwhite  White
clryellow Yellow

```

Line Types

The constants in this section refer to DataCAD's built-in line types.

ltype_dashed

ltype_dashed is the dashed line type.

ltype_dotdash

ltype_dotdash is the dot-dash line type. The user-defined line types are identified by integer values starting at 4.

ltype_dotted

ltype_dotted is the dotted line type.

ltype_solid

ltype_solid refers to the line type solid.

Entities

These constants are used in some of the database routines to refer to the different types of entities that DataCAD supports:

entar3

entar3 is used for a 3D arc (an arc not in the x-y plane).

entarc

entarc indicates that the entity is a two-dimensional arc.

entbez

entbez refers to a Bezier curve entity.

entblk

entblk represents a block. A block is similar to a slab, but has only four sides.

entbsp

entbsp indicates an entity type of a b-spline.

entcnt

entcnt represents a three-dimensional contour curve.

entcon

entcon refers to a cone. See also "[enttrn](#)".

entcrc

entcrc indicates a circle entity.

entcyl

entcyl refers to a cylinder.

entdim

entdim refers to the associative dimension.

entdom

entdom indicates a dome. A dome is any section of a sphere.

entell

entell indicates an ellipse.

entlin

entlin refers to a line, the most common entity.

entln3

entln3 refers to a three-dimensional line. This entity is a free vector in 3D space.

entmrk

entmrk is the point (marker) entity type.

entpln

entpln is the entity constant for a polyline.

entply

entply represents a polygon. A polygon is a flat, closed, three-dimensional entity.

entrev

entrev indicates a surface of revolution. Like polylines, this involves the copious data of polyverts.

entslb

entslb represents a slab. A slab is similar to a polygon, but has some specified thickness.

entsrf

entsrf refers to the three-dimensional mesh surface.

entsym

entsym refers to the insertion (an instance) of a symbol. Note that this is an instance of a symbol and does not describe its geometry.

enttor

enttor indicates the entity type torus, a doughnut shape.

enttrn

enttrn represents a truncated cone.

enttxt

enttxt refers to text strings.

Layer Mode

The constants in this section describe the mode that DataCAD uses to search for entities across layers. They are used with a mode_type variable.

lyr_all

Using this mode, all layers in the drawing are searched whether they are on or off.

lyr_curr

Using lyr_curr, only the current layer is searched.

lyr_on

Using lyr_on, all layers in the drawing that are turned on are searched.

Processing Constants

Entity Drawing

These constants are used when drawing entities on the screen. They are used by some of the routines which manipulate the screen.

drmode_black

When an entity is drawn with mode drmode_black, it is erased from the screen. This makes an entity vanish from the screen, but not from the database.

drmode_flip

With drmode_flip, the entity being drawn is XORed with what is currently on the screen. Notice that two consecutive XORs result in the restoration of the original image. By using drmode_flip twice in a row, you can make an entity blink.

drmode_white

Using drmode_white causes an entity to be drawn on the screen in whatever its color is. This is the opposite operation from drmode_black.

Function Key Return

The constants in this section are returned by the routines that detect function key presses, such as getchar, getpoint, and dgetint. Also, see the function "[FnKeyConv](#)".

f1, f2, f3, f4, f5, f6, f7, f8, f9, f0

These constants are returned when any of the unshifted function keys are pressed. When function key (F10) is pressed, f0 is returned.

s1, s2, s3, s4, s5, s6, s7, s8, s9, s0

These constants are returned when the shifted function keys are pressed. When (S10) is pressed, s0 is the constant returned.

Hatching

The constants in this section are used for hatching.

See "Chapter 7 – Processing Routines" for more information.

hatch_ignore

Indicates to procedure hatch_mode that all entities interior to the hatching boundary are ignored. In this case, each scan line creates one section of segments, at most. hatch_normal Indicates that hatching should start and stop the hatching scan line as it crosses the edge of each entity in its path.

hatch_outer

Indicates that no matter how many sections the scan line may be broken into, only the first and last section lying within the outer boundary will be drawn.

maxdash

Represents the maximum number of portions of dashes in a given scan line pattern. maxdash applies to portions of a broken scan line where the line is drawn and where the line is not drawn (the spaces). maxDash is equal to 6.

Object Snapping

Snap constants are used by the built-in variable osnap_mode, which controls the object snap mode. These constants can be added together.

For example, to set center, end point, and quick mode, use:

```
osnap_mode := osnap_center + osnap_endpoint + osnap_quick;
```

osnap_center

This constant sets object snap to recognize the center of arcs and circles.

osnap_endpoint

osnap_endpoint sets object snap to snap to the end points of the nearest line, point, Bezier curve, b-spline, arc, or associative dimension.

osnap_intsect

Object snapping recognizes the intersections of lines, circles, and arcs. Although powerful, this may significantly slow down snapping operations.

osnap_midpoint

When osnap_midpoint is on, snapping recognizes the midpoint of the nearest line, arc, or associative dimension.

osnap_nearest

When osnap_nearest is set, snapping recognizes the nearest point on the nearest line, point, Bezier curve, b-spline, circle, or arc. Bezier curves and b-splines use their control points.

osnap_npoint

osnap_npoint divides the nearest line or arc into osnap_num divisions, and snaps to one of these points.

osnap_perp

When object snap uses osnap_perp, points which are perpendicular to the nearest line, arc, or circle, and which pass through the last point entered are recognized.

osnap_quad

Object snapping snaps to the quadrant points of arcs and circles. Quadrant points are the points at 0, 90, 180, and 270 degrees. When an arc does not pass through one or more of these points, the points are not used.

osnap_quick

When `osnap_quick` is used and `osnap_intsect` is not, the search for the nearest entity is abandoned after an entity within the current miss distance is found.

osnap_tan

When object snap uses `osnap_tan`, if the point entered is within the miss distance of an arc or circle, a possible snapping point is considered at the point of tangency of a line passing through the last point entered and tangent to the arc or circle.

Polylines

The following constants are used in the polyline routines:

pv_bulge

`pv_bulge` represents a polyvert which is an arc segment between a polyvert and the next polyvert in the chain.

pv_vert

`pv_vert` represents a polyvert which is a straight line between a polyvert and the next polyvert in a chain.

Viewing

The following constants are used with the view management and calculation routines as well as with the function `getpointp`:

oblqelev

Represents an oblique projection calculated using the elevation oblique technique.

See "[view_calcoblq](#)" for more information.

oblqplan

Represents an oblique projection calculated using the plan oblique technique.

See "[view_calcoblq](#)" for more information.

vmode_all

Instructs DataCAD that any viewing projection is valid for a given function.

See "[view_checkmode](#)", `getpointp` for more information.

vmode_edit

Represents a viewing projection that the user can edit, including orthographic and parallel views. In general, data may be entered into a drawing in either an orthographic or a parallel projection where object snapping and all selection functions work properly.

See "[getpointp](#)" for more information.

vmode_oblq

Represents oblique viewing projections.

vmode_orth

Represents orthographic viewing projections.

vmode_para

Represents parallel viewing projections.

vmode_pers

Represents perspective viewing projections.

Walls

These constants are used by some of the built-in variables to determine certain wall conditions:

wall_cap

The variable wallend is set to the constant wall_cap when the end condition of walls is to cap them.

wall_clip

wallend is set to wall_clip when the end condition for walls is to clip an intersecting wall, forming a T-intersection.

wall_none

wallend is set to wall_none when the end condition for a wall is to do nothing.

wall_off

The built-in variable wallson is set to wall_off when walls are not being drawn, in which case DataCAD draws simple lines.

wall_on

wallson is set to wall_on if DataCAD is drawing walls.

Miscellaneous Constants**ABSZero**

This constant is equal to 1.0E-12. Useful for near zero tests.

halfpi

halfpi is defined as $\pi / 2.0$.

maxpnts

maxpnts is the maximum number of points in a polygon, slab, or contour. 36 is the maximum number of points.

pi

pi is defined as 3.141592654. This value is useful in many mathematical computations, since angles are stored and manipulated in DataCAD in radians.

res_escape

res_escape is the counterpart to res_normal. It indicates that an entry was not completed correctly, but that a key (such as a function key) was pressed during input. See "[getpoint](#)" for more information.

res_normal

res_normal is returned by several of the input routines to indicate a valid entry.

SQRZero

This is equal to ABSZero * ABSZero.

twopi

twopi is defined as $2.0 * \pi$.

x

The constant x is used whenever the x coordinate of a point is needed, or the x axis is specified, such as in a rotation.

y

The constant y is the counterpart of x, and indicates the y coordinate or y axis.

z

The constant z is similar to x and y, and indicates the z coordinate or z axis.

Chapter 3 – Data Types

The types explained in this chapter are built into the DCAL compiler. There are standard types (like integers, booleans, and reals) and more complex types (like entity, mode_type, and file) that are used to communicate with the DataCAD database and to read and write to files.

Standard Types

atrname

atrname is a twelve-character string used for the name of an attribute.

atraddr

atraddr is the logical address of an attrib. atraddr has a base type of lgl_addr. This is used mainly in reading attributes. For more information, see “Chapter 6 – Data Routines”.

bezarr

bezarr is defined as:

```
bezarr = ARRAY [1..20] OF point;
```

bezarr is used in b-spline and Bezier curve entities to store the array of defining points, which is restricted to twenty points in these entities.

boolarr

boolarr is defined as:

```
boolarr = ARRAY [1..maxpnts] OF boolean;
```

boolarr is used in polygon and slab entities to determine which line segments are drawn and which are not.

boolean

The type boolean can have only true and false values. Booleans are used for logical operations.

char

The type char is an eight-bit (0-255) ASCII value that uses the IBM extended ASCII character set. Character literals are enclosed in double quotes (") and use the same backslash sequences as string literals (see “[string](#)”).

integer

DCAL supports the primitive type integer, with values ranging from -32768 to +32767.

lgl_addr

lgl_addr is the base type for several types that involve drawing database memory addresses, including entaddr, symaddr, atraddr, pvtaddr, and viewaddr. These address types are of the same size, and essentially interchangeable. It is in their semantic usage that the source or type of the address is crucial.

DCAL allows type conversion of equal size variables using type casting. The procedure setnil and the function isnil take parameters of type lgl_addr.

See "[pvtaddr](#)" or "[viewaddr](#)" for an example of type casting using lgl_addr.

longint

The type longint is a four-byte long integer.

The operations currently allowed on a longint are to convert a real to a longint (round4 and trunc4) and to convert a string to and from a longint (cvlntst and cvstlnt).

Do not perform arithmetic operations on long integers.

modmat

modmat is the built-in type for a modeling matrix. This type is used for general three-dimensional manipulations. It is defined as:

```
modmat = ARRAY [1..4, 1..4] OF real;
```

For more information, see "Modeling Matrix Routines" in Chapter 7 – Processing Routines.

plot_type

plot_type is the type used by the plotting system for storing information pertaining to a single call. This type may not be examined.

pnt4arr

This type is used to define an entity type block. pnt4arr is defined as:

```
pnt4arr = ARRAY [1..4] OF point;
```

pntarr

pntarr is used in polygons, slabs, and contours to store the array of defining vertices. This version restricts this to 36 points in any of these entities. pntarr is defined as:

```
pntarr = ARRAY [1..maxpnts] OF point;
```

pntmat

This type is used to define a mesh surface entity. This built-in type is defined as:

```
pntmat = ARRAY [1..4, 1..4] OF point;
```

point

A point is a built-in record of reals. It is defined as:

```
point = RECORD
```

```
    x : real;  
    y : real;
```

```
        z : real;
    END;
```

The individual coordinates that make up a point are accessed by:

```
VAR
    x1, y1, z1 : real;
    pt : point;

BEGIN
    x1 := pt.x;
    y1 := pt.y;
    z1 := pt.z;
```

pvtaddr

pvtaddr is the type of address used to access polyverts.

```
VAR
    vaddr    : pvtaddr;

...

    setnil (lgl_addr (vaddr));
    IF isnil (lgl_addr (vaddr) THEN
        { vaddr is equal to nil }
    END;
```

The type **pvtaddr** has a base type of **lgl_addr**. DCAL allows for type conversion of variables of equal size with type casting.

The procedure **setnil** and the function **isnil** take parameters of type **lgl_addr**. They may be used with variables of type **pvtaddr** via type casting. In the above example, **setnil** and **isnil** are used on variables of type **pvtaddr** by the use of type casting to type **lgl_addr**.

real The real type is an IEEE single precision, floating point number, having an approximate range of

+0.1E-63 to +0.999999E63

-0.1E-63 to -0.999999E63

Real number literals cannot begin with a period, they must begin with a number. Thus, you must write 0.4 instead of .4.

string

A string is a dynamic-length array of characters. Every string has two lengths associated with it, the maximum length (which is the length specified when the string is defined) and a current dynamic length. The built-in type **string** is not actually a type, but an operator that returns a string of a specified maximum length.

String literals are enclosed in single quotes ('). Inside a string literal the backslash (\) character is used to allow entry of control characters. The recognized sequences are:

```

\\      Backslash character (\)
\e      Escape character
\t      Tab character
\r      Carriage return
\n      Newline
\v      Vertical tab
\b      Backspace
\f      Form feed
\'      Single quote
\"      Double quote
\ddd   ASCII character specified by octal ddd
\xdd   ASCII character specified by hex dd

```

For example, declaring a variable `str : string (30)`; creates a variable named `str` that has a maximum length of 30 characters. If we were to assign to that string `str := 'Good morning'`; then the current dynamic length of the string (as returned by the function `strlen`) would be 12.

Because a string is an array of characters, the individual characters of a string may be accessed through indices. If `chr` were of type `char`, then with `chr := str [4]`; the fourth character in `str` (`d`) would be assigned to `chr`. `str [0]` contains the dynamic length of the string and should not be changed. Accessing `str [13]` in the example returns either garbage or a run-time error, because the current dynamic length of the string is 12.

str8

`str8` is a predefined string eight characters long. That is, `str8` is the same as `string (8)`.

str80

`str80` is a predefined string 80 characters long.

str255

`str255` is a predefined string 255 characters long.

symstr

`symstr` is a 63-character long string used for the internal name of a symbol.

symaddr

`symaddr` is the logical address of the definition of a symbol, similar to `entaddr`. `symaddr` has a base type of `lgl_addr`.

Complex Types

attrib

`attrib` is used for an attribute. An attribute can be attached to the drawing as a whole (system attribute), a layer, a symbol (the symbol definition), or to any entity (including an instance of a symbol). An attribute has a name and a value.

`attrib` is defined as:

```

attrib = RECORD
  atrtype      : integer;
  name        : atrname;
  addr        : atraddr;
  visible      : boolean;
  positn      : point;      xdata.positn for D4D
  txtsize     : real;       xdata.txtsize for D4D
  txtang      : real;       xdata.txtang for D4D
  txtslant    : real;       xdata.txtslant for D4D
  txtaspect   : real;       xdata.txtaspect for D4D

  CASE integer OF
    atr_str    : (str : str80);
    atr_int    : (int : integer);
    atr_rl     : (rl  : real);
    atr_dis    : (dis : real);
    atr_ang    : (ang : real);
    atr_pnt    : (pnt : point);
    atr_addr   : (lgladdr : lgl_addr); {atr_addr should not be used}
  END

```

Like symbol and entity, there are other fields that are not accessible. The name of the attribute must be unique for any given entity, symbol, or layer.

addr is the address of the attribute.

When the attribute belongs to an entity and is to be drawn, the field visible is set to true.

The value of the attribute is converted to a string (using atr_2str) and displayed at positn.

The text color, size, etc., are given by the txtcolor, txtsize, txtang, txtslant, and txtaspect fields. When the field name of the attribute is NOT visible, all the fields between positn and txtaspect, inclusive, are not saved in the database. You can change the type and visibility of an attribute with atr_update.

entity

The type entity is used to read and write from DataCAD's database. The DataCAD drawing database is a collection of entities on layers. Entities can be any of the DataCAD primitives: lines, arcs, circles, text, etc. entity is a complex case-variant record.

The description of entity follows. Notice that there is a variant for every type of entity. The description given here is NOT exact: other fields exist that are not given here; and fields may not overlap.

```

entity = RECORD
  enttype : integer;
  ltype   : integer;
  width   : integer;
  spacing : real;
  ovrshut : real;
  color   : integer;
  attr    : integer;
  addr    : entaddr;
  lyr     : layer;
  user0   : integer;

```



```
user1 : integer;
user2 : integer;
user3 : integer;
frstatr : atraddr;
lastatr : atraddr;
```

```
CASE integer OF
```

```
entLin : (linPt1 : point;
          linPt2 : point);
```

```
entLn3 : (ln3Pt1 : point;
          ln3Pt2 : point);
```

```
entMrk : (mrkPnt : point;
          mrkVec : point;
          mrkTyp : integer;
          mrkSiz : integer);
```

```
entArc : (arcCent : point;
          arcRad : real;
          arcBang : real;
          arcEang : real;
          arcBase : real;
          arcHite : real);
```

```
entCrc : (crcCent : point;
          crcRad : real;
          crcBase : real;
          crcHite : real);
```

```
entEll : (ellCent : point;
          ellRadx : real;
          ellRady : real;
          ellBang : real;
          ellEang : real;
          ellAng : real;
          ellBase : real;
          ellHite : real);
```

```
entTxt : (txtPnt : point;
          txtSize : real;           txtSiz in D4D
          txtAng : real;
          txtSlant : real;
          txtAspect : real;
          txtStr : str255;
          txtBase : real;
          txtHite : real;
          txtFont : str8);        txtfon in D4D
```

```
entBez : (bezNpnt : integer;
          bezPnt : bezarr;
          bezBase : real);
```

```
entBsp : (bspNpnt : integer;
          bspPnt : bezarr);
```

```

        bspBase    : real);

entBlk : (blkPnt    : pnt4arr);

entCnt : (cntPnt    : pntarr;
          cntTanpnt1 : point;
          cntTanpnt2 : point;
          cntNpnt    : integer;
          cntType    : integer;
          cntDivs    : integer;
          cntStiff   : real);

entDim : (dimPt1    : point;
          dimPt2    : point;
          dimPt3    : point;
          dimTxtpt   : point;
          dimExo1    : real;
          dimExo2    : real;
          dimExe     : real;
          dimDli     : real;
          dimAng     : real;
          dimOvr     : real;
          dimTxtsize : real;
          dimArrsize : real;
          dimArrratio : real;
          dimTxtaspect : real;
          dimTxtang  : real;
          dimBase    : real;
          dimTxtslant : real;
          dimDis     : real;
          dimInc     : integer;
          dimNlpts   : integer;
          dimTxtweight : integer;
          dimTictype : integer;
          dimType    : integer;
          dimLeader  : boolean;
          dimTih     : boolean;
          dimToh     : boolean;
          dimSel     : boolean;
          dimSe2     : boolean;
          dimMan     : boolean;
          dimTad     : boolean;
          dimNolftmrk : boolean;
          dimNorhtmrk : boolean;
          dimTicweight : integer;
          dimDINstd  : boolean;
          dimTtxtofs : real;
          dimFont    : str8;
          dimLdrpnts : ARRAY [1..9] OF point;

entPln : (plnFrst   : pvtaddr;
          plnLast   : pvtaddr;
          plnClose  : boolean;
          plnBase   : real;      //plBase in D4D
          plnHite   : real);

```

```

entSym : (symName   : symstr;
          symAddr   : symaddr;
          symMod     : modmat);

entPly : (plyNpnt    : integer;
          plyPnt     : pntarr;
          plyIsln    : boolarr;
          plyFrstvoid : entaddr;
          plyLastvoid : entaddr);

entSlb : (slbNpnt    : integer;
          slbPnt     : pntarr;
          slbThick   : point;
          slbIsln    : boolarr;
          slbFrstvoid : entaddr;
          slbLastvoid : entaddr);

entAr3 : (ar3Mod     : modmat;           //Matrix in D4D
          ar3Rad     : real;
          ar3Bang    : real;
          ar3Eang    : real;
          ar3Close   : boolean);

entCon : (conMod     : modmat;           //Matrix in D4D
          conDiv     : integer;
          conRad     : real;
          conTip     : point;
          conBang    : real;
          conEang    : real;
          conClose   : boolean);

entCyl : (cylMod     : modmat;           //Matrix in D4D
          cylDiv     : integer;
          cylRad     : real;
          cylLen     : real;
          cylBang    : real;
          cylEang    : real;
          cylClose   : boolean);

entTrn : (trnMod     : modmat;           //Matrix in D4D
          trnDiv     : integer;
          trnCent    : point;
          trnRad1    : real;
          trnRad2    : real;
          trnBang    : real;
          trnEang    : real;
          trnClose   : boolean);

entDom : (domMod     : modmat;           //Matrix in D4D
          domDiv1    : integer;
          domDiv2    : integer;
          domRad     : real;
          domBang1   : real;
          domBang2   : real;
          domEang1   : real;

```

```

        domEang2 : real;
        domClose : boolean);

entTor : (torMod      : modmat;           //Matrix in D4D
         torDiv1     : integer;
         torDiv2     : integer;
         torRad1     : real;
         torRad2     : real;
         torBang1    : real;
         torBang2    : real;
         torEang1    : real;
         torEang2    : real;
         torClose    : boolean);

entSrf : (srfPnt     : pntmat;
         srfSdiv     : integer;
         srfTdiv     : integer);

entRev : (revBang    : real;
         revEang     : real;
         revMod      : modmat;
         revDiv1     : integer;
         revDiv2     : integer;
         revFrst     : pvtaddr;
         revLast     : pvtaddr;
         revType     : integer);

END;
```

You can change all the fields except `addr`, which is the address of the entity in the database. Changing `lyr` and replacing the entity in the database moves the entity from one layer to another. See “Chapter 6 – Data Routines” for routines to manipulate the database. Each entity type is explained below:

- `enttype` is the type of the entity, such as `entlin`, `entrc`, etc. This determines which of the case-variant sections apply.
- `ltype` is the line type.
- `width` is the line weight, with the default single line being a weight of one.
- `spacing` is the distance over which the line type repeats itself. This is measured in world coordinates.
- `ovrshut` is the line overshoot distance, measured in world coordinates.
- `color` is the color of the entity, using the constants in the "Constants" chapter.
- `attr` is an integer used by DataCAD to determine what operation created the entity.
- `lyr` is the address of the layer that the entity is on.
- `user0`, `user1`, `user2`, and `user3` are reserved for the use of the macro writer. DataCAD does not change or examine these.
- `frstatr` and `lastatr` are pointers to the list of attributes for this entity.

- For an entity of type entLin, linPt1 and linPt2 are the two end points of the line. The z values of these points are used as the base and height of the line. For entLn3, the points ln3Pt1 and ln3Pt2 are the end points of the line. The line is drawn from ln3Pt1 to ln3Pt2.
- An entity of type entMrk is the basic marker or point entity. The marker is drawn at mrkPnt. mrkVec is currently unused, and may be used by the macro. The type of the marker is given by mrkTyp, and is given in the following table:

1	square
2	"x"
3	diamond
4	dot

When mrkTyp is any other value, nothing is drawn. This is a valid condition. mrkSiz is the size of the marker in pixels.

- An entity of type entArc has its center at arcCent. The z value of arcCent is unused. The radius of the arc is arcRad. arcBang is the beginning angle of the arc. arcEang is the ending angle of the arc. Angles are measured in radians, with 0 to the right, increasing in a counterclockwise direction. The base of the arc is at arcBase and the height is at arcHite.
- All fields of the entCrc entity are similar to the fields for entArc, but starting and ending angles are not required.
- entEll is the entity for an ellipse. The center is at ellCent. The z value is ignored. The distance from the center to the edge of the ellipse in the x direction is given by ellRadx, and in the y direction by ellRady. The starting angle of the ellipse is ellBang and the ending angle ellEang. The entire ellipse is rotated at an angle of ellAng. The bottom of the ellipse is at elevation ellBase, and the top is at ellHite.
- The data for a text string is given in the entTxt case. The text is drawn with the lower left corner of the string at txtPnt. The height of the characters is given by txtSize, measured in drawing units. The text is rotated at an angle of txtAng. The angle of slant is txtSlant, with 0 being no slant. The aspect ratio is txtAspect: 1 is normal, 2 results in narrow characters (still txtSize tall). The characters themselves are in the string txtStr. The bottom of the text is at elevation txtBase and the top is at txtHite. The font name for the string is txtFont, note that txtFont does not contain a pathname or extension.
- entBez is a Bezier curve entity. Bezier curves are defined by an array of points. The number of points is given by bezNpnt. The array of points is bezPnt. The curve is drawn at a z height of bezBase.
- entBsp is a b-spline entity. B-splines are defined the same as Bezier curves.
- The block entity, entBlk, is similar to a cube, but can be sheared in all three directions. All four points in the array blkPnt must be defined. The first point (blkPnt [1]) is the corner vertex for the block. The other three points define the three adjacent vertices on the block in any order. Since opposite faces of the block are parallel, each face is a parallelogram.

- entCnt is the definition of a three- dimensional contour curve. The node points are stored in the array cntPnt. The number of points on the curve is cntNpnt. cntType specifies the type of curve: 0 is a natural curve, 1 is a cyclic curve, 2 is a tangent curve. When cntType is 2 cntTanpnt1 is the tangent point at the start of the curve and cntTanpnt2 is the tangent point at the end of the curve. cntDivs is the number of line segments to draw between successive points on the curve. This is slightly different from the divisions as defined in other entities. cntStiff determines how stiff the contour is at the node points; it should be between 0.5 and 2.0, with 1.0 being neutral.
- An associative dimension is of entity type entDim; the most complicated entity type.

 - dimPt1 is the first point dimensioned to; dimPt2 is the second point dimensioned to;
 - dimPt3 is the point that defines where the dimension line itself is drawn. dimPt3 is the third point entered at the DataCAD standard dimensioning menu.
 - dimTtxtpt is the point where the text is drawn; it is valid only when the text is manually placed, dimMan is true.
 - dimExo1 is the offset from the first point, dimPt1, to the start of the first extension line; similarly, dimExo2 is the offset from the second point, dimPt2, to the start of the second extension line.
 - dimExe is the extension line extension, the distance the extension line is drawn past the dimension line.
 - dimDli is the dimension line increment and is the distance each dimension line is incremented in the baseline dimensioning case; it is used when FixdDis is turned on in the linear dimensioning DimStyle menu.
 - dimAng is the angle of the dimension line and is only valid when the dimension style is rotated.
 - dimOvr is the dimension line overrun distance; the distance the dimension line extends past the extension lines.
 - dimTtxtsize is the size of the text to draw.
 - dimArrsize is the arrow size, relative to the dimTtxtsize; when dimArrsize is 1.0, the arrow size is the same as the text size.
 - dimArratio is the aspect ratio of the arrows.
 - dimTtxtaspect is the text aspect ratio.
 - dimTtxtang is the text angle, relative to the x axis, not relative to the dimension line.
 - dimBase is the z coordinate at which the associative dimension is drawn.
 - dimTtxtslant is the text slant angle.
 - dimDis is the distance to use when the dimension is drawn. It is calculated when the entity is read from the database by ent_get.
 - dimInc is used when baseline dimensions are changed at the dimensioning change menu. dimInc is the number given to the dimension when it was entered; the first dimension has dimInc = 1, the second has dimInc = 2, etc. When dimDli is changed, the dimension line position is recalculated using dimInc.

dimNlpts is the number of leader points defined in the field dimLdrpnts; the maximum number of leader points is 9.

dimTxtweight is the weight of the text when it is drawn.

dimTictype is the tic mark type: for 0 arrows are drawn, for 1 tic marks are drawn, and for 2 circles are drawn.

dimType is the dimension orientation type: for 0 the dimension is horizontal, for 1 the dimension is vertical, for 2 the text is aligned with dimPt1 and dimPt2, for 3, the dimension is rotated at angle dimAng.

dimLeader is true when a leader line is drawn (see "[dimNlpts](#)" and "[dimLdrpnts](#)").

dimTih is the text-inside- horizontal flag; when text is automatically placed and fits inside the extension lines, and dimTih is true, text is horizontal; otherwise text aligns with the dimension line.

dimToh is the text-outside-horizontal flag, and is similar to dimTih but applies when a leader is drawn (dimLeader is true).

dimSe1 (suppress extension line 1) is true when the first extension line (the one that comes from dimPt1) is NOT drawn.

dimSe2 is the same for the second extension line.

dimMan is true when text is placed manually. When this is the case, text is placed at dimTxtpt.

dimTad is the text- above-dimension-line flag; it controls placing the dimension text inside the dimension line. When dimTad is true, text is placed above the dimension line; when it is false, the dimension line is broken into two lines and text is placed inside the dimension line.

dimNolftmrk is a flag that controls the drawing of the left tic mark; when it is true, no left tic mark is drawn.

dimNorhtmrk is a flag that controls the drawing of the right tic mark; when it is true, no right tic mark is drawn.

dimTicweight is the weight used to draw tic marks.

dimDINstd is true when text is entered with a European version of DataCAD.

dimTxfos is only used when dimMan is false and dimTad is true. When this is the case, dimTxfos is the offset from the dimension line to the text string.

dimFont is the font used to draw the text.

- entPln is a polyline consisting of a collection of polyverts. The address of the first polyvert is plnFrst. The polyverts are in a linked list structure (see the discussion in this chapter on "[polyvert](#)"). The last polyvert is pointed to by plnLast. When the polyline is closed (that is, there is a line between the last polyvert and the first polyvert), plnClose is true. The polyline is drawn at a z base of plnBase and a z height of plnHite.
- An instance of a symbol is an entity of type entSym. The symbol name is symName; in the DataCAD template system, this is the same as the file that the symbol came from, without the .sym extension. This is not necessarily the case in a macro, however. The modeling matrix

governing the placement of this particular symbol is symMod. The field symAddr is the address of the symbol of which this is an instance; this field is valid only after reading an entity from the database. This field should NEVER be altered.

- A three-dimensional polygon is of type entPly. The number of points in a polygon is plyNpnt; this number must be between 3 and 36. The points themselves are contained in the array plyPnt, indexed from 1 to plyNpnt. The corresponding array plyIsln is used to determine if a line is actually drawn on every edge of the polygon. When plyIsln [1] is true, a line is drawn from plyPnt [1] to plyPnt [2], and so on for every vertex. This method can be used to simulate much larger polygons by joining polygons but not drawing their connecting edges. plyFrstvoid is the first void in the chain entities which are voids in the polygon. plyLastvoid is the last void entity in the chain. For more information, see “Chapter 6 – Data Routines” on manipulating voids.
- entSlb is similar to entPly. All of the corresponding fields have the same meaning. The additional field slbThick determines the thickness and shear of the slab. The distance and angle from slbPnt [1] to slbThick determine the overall thickness and shear of the entire slab. While slbThick is interpreted relative to the first point of the slab, its value is in absolute, not relative, coordinates.
- The general three-dimensional arc is of type entAr3. The modeling matrix for the arc is ar3Mod, which specifies all translations, rotations, and scalings for the arc. This allows you to have elliptical arcs. The number of divisions used when drawing the arc is ar3Div, with a maximum of 36. This number is based on a complete circle, so when 36 is specified and only one quarter of a circle is drawn, nine divisions are used. The radius of the arc is ar3Rad. The beginning and ending angles are ar3Bang and ar3Eang, respectively. When ar3Close is true, a line is drawn from the starting point to the ending point of the arc.
- entCon is the entity type for a cone. The modeling matrix attached to the cone is conMod. The number of divisions, conDiv, is similar to ar3Div. The radius of the base of the cone is conRad. The cone's center is at the origin of a local coordinate system. conTip is relative to the origin. conMat transforms the local coordinate system into world (drawing) coordinates. Note that this form of definition allows a skewed cone. The beginning and ending sweep angles are conBang and conEang, respectively. When conClose is true, the cone has a triangular polygon connecting the starting and ending sides. See also the “[entTrn](#)” description.
- The entity for a cylinder is described in the entCyl section. The modeling matrix is cylMod. The number of divisions used to draw the cylinder is cylDiv. The radius of the cylinder is cylRad. The length of the cylinder is cylLen. The center is at the origin of a local coordinate system. The beginning and ending sweep angle are cylBang and cylEang, respectively. When cylinder is closed, cylClose is true.
- The data for a truncated cone is listed in the entTrn section. The modeling matrix is trnMod. The number of divisions used to draw the truncated cone is trnDiv. This is similar to ar3Div. The center of the base of the cone is trnCent. The radius at the bottom is trnRad1, and at the top trnRad2. The beginning and ending sweep angles are trnBang and trnEang. When the truncated cone is closed, trnClose is true.

- entDom is the entity type used for a dome or sphere.

domMod is the modeling matrix used to translate, rotate, and scale the dome. The suffix 1 on fields represents the sweep direction, and the suffix 2 represents the rise direction; domDiv1 is the number of divisions to use in the sweep direction, and domDiv2 is the number of divisions to use in the rise direction. The radius of the dome is domRad. The beginning and ending sweep angles are domBang1 and domEang1. The beginning and ending rise angles are domBang2 and domEang2, respectively. The range of values valid for domBang2 and domEang2 is from $-\text{halfpi}$ to halfpi . To draw the top half of a dome, domBang2 would be 0, and domEang2 would be halfpi . When the dome is a closed figure domClose is true.

- The torus entity is entTor. The modeling matrix for this entity is torMod. Like the dome (entDom), the suffix 1 represents values for the sweep direction and the suffix 2 is used for values in the roll direction.

torRad1 is the sweep radius, and torRad2 is the roll radius. When the torus is closed torClose is true.

- The mesh surface entity is described in the entSrf section. The matrix of points defining the mesh is contained in srfPnt. The number of divisions to divide the surface into in each direction is srfSdiv and srfTdiv.
- entRev is the definition for a surface of revolution entity. A surface of revolution consists of a profile made up of a collection of polyverts, and a collection of data defining the orientation, type, and angles of the surface. revFrst and revLast are the addresses of the first and last polyverts (copious data) which define the surface's profile. Only the x and y coordinates of the polyverts are used in the definition of the profile, the z coordinates are ignored. revMod is a modeling matrix which describes the local frame of reference of the surface. The x and y coordinates of the polyverts describe the surface profile in the local xz plane; defining the profile in an xy local coordinate system. The axis of sweep for the surface, however, remains the local z axis, and is thus consistent with other circular entities such as cylinders and tori. revBang and revEang are the beginning and ending angles of sweep, respectively. revDiv1 is the number of segment divisions in the sweep direction, and revDiv2 is the number of segment divisions in the roll direction for any profile vertices which are defined as bulges (similar to a torus). revType may take on one of the values, 1, 2, or 3 to determine whether or not the surface is a closed solid or an open surface: 1 indicates an open surface, 2 indicates closed at the ends, describing a solid object, and 3 indicates an entity is closed at the sides, describing a solid, doughnut-like object.

entaddr

Every entity has an address in the database associated with it. The address of the entity is of type entaddr. This address is used to read the entity from the database and to put the entity back into the database. entaddr has a base type of lgl_addr. An address which points to nothing is equal to nil. See the procedure "[isnil](#)".

file

A file in DCAL represents a disk file, either a text or blocked data file. The file variable references a disk file. A filename can contain a drive and pathname. Use forward or backward slashes in the pathname. When backslashes are used, they must appear in the string as two backslashes, for example:

```
\\dcad\\dcad.exe or /dcad/dcad.exe
```

See "[string](#)" in this section for more information.

Note that any file or device can be opened as a file. This is how you can write to the console. Just put the screen into text mode, open a text file called CON:, and write to it. You can also write to the printer in this way.

polyvert

polyvert is the type used for the copious data associated with polylines and surfaces of revolution. Polyverts belong only to entities of type polyline or surface of revolution. In either case, the polyverts are arranged in a double-linked chain and the addresses of the first and last polyvert in the chain are stored with the entity. For an entity of type entpln, the fields containing these addresses are ent_plnfrst and ent_plnlast. For an entity of type entrev, the fields containing these addresses are ent_revfrst and ent_revlast.

For entities of type polyline (entpln) and surface of revolution (entrev), any number of polyverts may be added to the entity (up to the limit of the size of the drawing file). Unlike polygons, slabs, and contour curves where there is currently a limit of 36 vertices or knots, polylines, and surfaces of revolution may have any number of polyverts associated with them.

```
polyvert = RECORD
  addr      : pvtaddr;
  next      : pvtaddr;
  prev      : pvtaddr;
  shape     : integer;
  pnt       : point;
  bulge     : real;
  nextpnt   : point;
  last      : boolean;
  END;
```

Each entity type is explained below:

addr is the address of this polyvert in the database. Of course, if the polyvert was not read out of the database, the value of this address is invalid. next is the address of the next polyvert in the chain and prev is the address of the previous polyvert in the chain. When next and/or prev are nil, they are the last or first polyverts in the chain respectively. shape may have one of two constant values: pv_vert and pv_bulge. The constant value pv_vert coincides with a polyvert which consists of a point and a straight line connected to the next polyvert in the list. The constant value pv_bulge coincides with a polyvert which consists of a point and an arc connected to the next polyvert in the list.

nextPnt contains the x, y, and z coordinates of the next polyvert in the list. In this way a typical call to polyvert_get reads not only the contents of the polyvert indicated by the address passed in polyvert_get,

but also the coordinates of the next polyvert in the list. The field last is true when the polyvert is the last polyvert in the list (the next field is equal to nil).

When shape = pv_vert, the bulge field is ignored. When a polyvert has a shape of pv_bulge, bulge is a real number which may take on a value between minus infinity and plus infinity. When bulge is zero, the polyvert indicates a straight line between it and the next polyvert in the list (same as pv_vert). When bulge is equal to 1.0 the polyvert defines a semi-circle to the left side of a line between the polyvert and the next polyvert in the list. When bulge is equal to -1.0 the polyvert defines a semi-circle to the right side of a line between the polyvert and the next polyvert in the list.

As you can see, a single polyvert by itself is insufficient to describe a given line or arc segment, but requires information from the following polyvert to determine the complete geometry between any two vertices. The record structure of a polyvert and the routines for managing polyverts are designed to take this into account. A variable of type polyvert contains both the coordinates of the vertex belonging to the polyvert itself as well as the coordinates of the polyvert which follows it in the chain. For the last polyvert in the list, DataCAD's polyvert management routines circle back to the top of the list to the "following" polyvert.

mode_type

Use mode_type to read through DataCAD's drawing database. This variable is used by DataCAD to keep track of what type of entities you want to read from the database. You can read through the database in many ways by using the appropriate mode_type.

By setting a variable of mode_type while searching the drawing database, you effectively restrict the search to a subset of entities. You could restrict the search to a group, selection set, or symbol; to a subset of layers; to a subset of types of entities; or to a certain region in the drawing. These mode search restrictions can be built upon each other to further limit the reading of the database to an intersection of the above subsets of entities. This technique of reading the database is one of the most important and powerful concepts in DCAL.

scanLineType

The type scanLineType defines the pattern for the scan lines that generate a hatch pattern.

```
scanLineType = RECORD
  ang      : real;
  origin   : point;
  delta    : point;
  numdash  : integer;
  dash     : ARRAY [1..maxDash]
            OF real;
  dashDraw : ARRAY [1..maxDash]
            OF boolean;

{ these fields do NOT need to be set }
  dashPart : ARRAY [1..maxDash]
            OF point;
  dashTotal : real;
END;
```

Each entity type is explained below:

The angle of the hatch pattern is ang.

The hatch pattern is calculated starting at origin.

delta contains the x and y values of the hatch pattern delta values.

The number of dashes in the hatch pattern is numdash.

The dash lengths are stored in the array dash.

dashDraw is a corresponding array that determines whether each dash pattern is drawn or if it is a 'skip' in the dash pattern.

The last two fields, dashpart and dashtotal, are used internally and need not be set.

symbol

The definition of a symbol is represented by a variable of type symbol. This is the definition of the geometry of a symbol, not an instance of one.

symbol is defined as:

```
symbol = RECORD
    name      : symstr;
    frstent   : entaddr;
    lastent   : entaddr;
    frstatr   : atraddr;
    lastatr   : atraddr;
    min       : point;
    max       : point;
    addr      : symaddr;
    refFlag   : boolean;
    num       : integer;
END;
```

All of the fields, with the exception of refFlag, may be examined but not modified. refFlag may be modified. Each entity type is explained below:

name is the unique symbol name.

frstent and lastent are pointers to the first and last entities that define the geometry of the symbol.

frstatr and lastatr are pointers to the first and last attributes assigned to the definition of the symbol.

min and max are the minimum and maximum extents, respectively, of the untransformed symbol.

addr is the address of the symbol.

For a description of refFlag, see "[sym_ref](#)" in Chapter 6 – Data Routines.

num is the number of instances of the symbol. This value is not constantly updated. See "[sym_count](#)".

num may be read but never written to.

viewaddr

viewaddr is the type of address used to access saved views. The type viewaddr has a base type of lgl_addr. DCAL allows for type conversion of variables of equal size via type casting.

```
VAR
  vaddr    : viewaddr;

...

setnil (lgl_addr (vaddr));
IF isnil (lgl_addr (vaddr) THEN
  { vaddr is equal to nil }
END;
```

The procedure setnil and the function isnil take parameters of type lgl_addr. They may be used with variables of type viewaddr with type casting. In the above example, setnil and isnil are used on variables of type viewaddr using type casting to type lgl_addr.

view_type

Use variables of type view_type for two different purposes when working with the viewer and saved views. A view_type can be used to calculate, interrogate, and update the current view and projection throughout DataCAD. Secondly, a view_type represents the object which is stored and retrieved from a drawing database when using saved views. These two functions can be used with each other.

The information contained in a variable of view_type is not necessarily in a form which makes the physical interpretation of a view obvious. A view_type is designed for efficiency in performance and space requirements. Therefore, some of the fields in a view_type variable are used for more than one purpose depending upon the type of projection and the value of other fields in the view variable. Some of the fields of a view_type are derived so that changing them does not necessarily change the view directly. However, the parameters for manipulating views are flexible enough that you can create a wide variety of views including animated sequences, slide shows, and multiple viewport output displays.

```
view_type = RECORD
  addr      : viewaddr;
  next      : viewaddr;
  prev      : viewaddr;
  projtype  : integer;
  viewmat   : modmat;
  clipmat   : modmat;
  editmat   : modmat;
  inptmat   : modmat;
  clipon    : boolean;
  name      : str8;
  clipmin   : point;
  clipmax   : point;
  windxmin  : real;
  windymin  : real;
  scale     : real;
  scalenum  : integer;
  viewcent  : point;
  perseye   : point;
```

```
persdis    : real;
togglelyr  : boolean;
frstlyr    : lgl_addr;
lastlyr    : lgl_addr;
currlyr    : lgl_addr;
flag1      : boolean
flag2      : boolean
END;
```

The meaning of the fields of a `view_type` are as follows:

`addr` is the address of the view when the view is read from the chain of saved views in the database. `addr` is valid only when the view is read from the database using `view_get`, or added to the database using `view_add`. When the current viewing parameters were read into the view using `view_getcurr`, `addr` is undefined.

`next` is the address of the next view in the chain of saved views. When the view variable is the last view in the chain of saved views, `next` is equal to `nil`. `next` is valid only when the view is read from the database using `view_get`, or added to the database using `view_add`. When the current viewing parameters were read into the view using `view_getcurr`, `next` is undefined.

`prev` is the address of the previous view in the chain of saved views. When the view variable is the first view in the chain of saved views, `prev` is equal to `nil`. `prev` is valid only when the view is read from the database using `view_get`, or added to the database using `view_add`. When the current viewing parameters are read into the view using `view_getcurr`, `prev` is undefined.

`projtype` is the type of projection which the view represents. `projtype` may take on one of the four constants: `vmode_orth`, `vmode_para`, `vmode_pers`, and `vmode_oblq` which represent orthographic, parallel, perspective, or oblique projections, respectively. The remaining fields in a `view_type` vary in their interpretation depending upon the value of `projtype`. Setting `projtype` to a value other than one these four constants causes an error. Never assign `vmode_edit` or `vmode_all` to `projtype`. Use these constants only with the function `getpointp` and the procedure `view_checkmode`.

`viewmat` is the primary viewing matrix. The value and interpretation of `viewmat` depends upon the projection type and whether or not clipping cubes are turned on for the view. For orthographic, parallel, or oblique projections with clipping cubes off, `viewmat` contains the complete and general viewing transformation. For orthographic, parallel, or oblique projections with clipping cubes on, `viewmat` contains the portion of the viewing transformation prior to clipping to the three-dimensional cube. When clipping cubes are turned on for the view, `viewmat` is normally the identity matrix and `clipmat` contains the complete and general postclip viewing transformation. For perspective projections, `viewmat` contains the portion of the perspective transformation prior to frustum or hither clipping. Clipping cubes are always ignored for perspective projections.

`clipmat` is the secondary viewing matrix. The value and interpretation of `clipmat` depends upon the projection type and whether or not clipping cubes are turned on for the view. For orthographic, parallel, or oblique projections with clipping cubes off, `clipmat` is ignored but typically set to the identity matrix. For orthographic, parallel, or oblique projections with clipping cubes on, `clipmat` contains the complete and general post-clip viewing transformation that would otherwise be stored in `viewmat` as described

above. For perspective projections, clipmat contains the portion of the viewing transformation after frustum or hither clipping.

editmat is the complete and general viewing transformation regardless of whether or not clipping cubes are in effect. When the effect of clipping cubes is not considered, editmat is the complete concatenated viewing transformation. editmat is usually used during input operations where the effects of clipping cubes need not be considered until an input operation is complete. For perspective projections, editmat is the concatenation of viewmat and clipmat.

inptmat is the mathematical inverse of editmat. inptmat is used for reverse transformations, usually during input operations in parallel projections when the editing plane is not parallel with the xy-plane in the world coordinate system. inptmat is constantly updated by DataCAD so that upon any call to view_getcurr, you may be assured that inptmat is the correct and current inverse viewing transformation.

clipon is a Boolean flag which is true when clipping cubes are on for the view, and false when clipping cubes are off. clipon is ignored for perspective projections. Frustum or hither clipping is always in effect for perspective projections. clipmin and clipmax contain the minimum and maximum extents of the clipping cube. You must ensure that the values of clipmin are less than the respective values of clipmax. DataCAD does not automatically ensure their order.

NOTE: Simply toggling clipon on or off does not set the viewing matrices for clipping cubes in effect. viewmat and clipmat must also be adjusted accordingly.

name is the name of the view which appears on the function keys in the GoToView menus. name may be up to eight characters long, may contain any number of spaces, or may be a null string.

windxmin, windymin, scalenum, and scale collectively define the current two-dimensional window to viewport transformation. DataCAD maintains a separate two-dimensional, world coordinate, window-to-viewport transformation distinct from the general three-dimensional transformation. This is necessary for handling features such as user-defined line types and weighted lines. These display attributes are always applied after the general three-dimensional viewing transformation.

windlft is the position of the left edge of the viewing window in two-dimensional world coordinates.

windbot is the position of the bottom edge of the viewing window in two-dimensional world coordinates.

scalenum is an integer number between 1 and 18 inclusive, and indicates which of the 18 currently-loaded scales is the current window to viewport scaling of the drawing. Since the user may edit these scales, or may load different sets of scales into a drawing, scalenum is not necessarily unique in any given drawing database or across drawings. scale is the actual window-to-viewport ratio which scalenum represents. When the user changes the scale corresponding to a particular value of scalenum, scale is adjusted accordingly upon the next reading or updating of the view. scalenum always supersedes and controls the value of scale. scale is derived through a look-up table.

The value of viewcent changes depending upon the projection type of the view. When the view is a perspective projection, viewcent is the point in the view at which the viewer is looking; in this case viewcent defines the location of the picture plane relative to the eye point. The picture plane is perpendicular to a line which passes from perseye to viewcent and through viewcent. When the view is a

parallel projection, viewcent is the point about which the view is rotated during Control menu operations or by using the globe. For parallel projections, viewcent becomes the origin of the grid for that view. Therefore, the location of this point can be particularly important during editing operations in parallel projections. When the view is an oblique projection, viewcent is the center of the view, and determines the center of shear for the view. viewcent is ignored for orthographic projections.

perseye is used only for perspective projections, and ignored for all other projection types. perseye is the location of the eye point of the viewer.

persdis is the distance between the points viewcent and perseye, and is always derived. persdis is used only for perspective projections, and otherwise ignored. Setting the field persdis has no effect upon the view.

togglelyr, frstlyr, lastlyr, and currlyr manage layers depending upon the state of the *LayrSet toggle on the 3D GoToView menu. Currently, you can't manipulate this aspect of saved views from within DCAL. Do not alter these fields of a view_type. However, each view which is added to the list of saved views using view_add remembers which layers are on or off so you can adjust which layers are on prior to adding a view to the database. Furthermore, a call to view_update resets the list of layers for the views which are on.

flag1 and flag2 are general purpose Boolean flags which are stored, updated, and retrieved with saved views. You may set or clear these flags. flag1 and flag2 are not protected from use by other DCAL applications, so their values may not remain the same until you change them. DataCAD's standard user interface does not currently use these fields as they are primarily intended for DCAL applications.

Chapter 4 – Variables

The variables listed in this chapter access DataCAD's internal variables. These variables can only be passed as mode IN parameters; they cannot be used as mode OUT or mode IN OUT parameters. They can be read from and written to like regular variables. All these variables can be accessed from DataCAD.

When your macro performs a function similar to a DataCAD function (adding special door types, for instance), use the DataCAD variable for that function (door height, thickness, etc.).

I/O Variables

Plotter Variables

The variables in this section contain various user settings. These variables do not effect plotting as done through DCAL, but instead effect plotting done through DataCAD. They are available in DCAL so that a macro can be consistent with the DataCAD Plotting menu.

pltcentx

```
pltcentx : real;
```

The x value of the center of the current plot, as defined in world coordinates.

pltcenty

```
pltcenty : real;
```

The y value of the center of the current plot, as defined in world coordinates.

pltcolor

```
pltcolor : boolean
```

The current user setting for producing a color plot.

pltpcustx

```
pltpcustx : real;
```

The custom x paper size in inches. Notice that the units are inches, not 1/32s of an inch which is the base unit in world coordinates.

pltpcusty

```
pltpcusty : real;
```

The custom y paper size in inches. The following code determines the world coordinate sizes of the currently selected paper size:

```
IF pltpsize = 1 THEN
  x := 10.5;
  y := 8.0;
ELSIF pltpsize = 2 THEN
  x := 16.0;
  y := 10.0;
ELSIF pltpsize = 3 THEN
  x := 21.0;
```

```

    y := 16.0;
ELSIF pltpsize = 4 THEN
    x := 33.0;
    y := 21.0;
ELSIF pltpsize = 5 THEN
    x := 43.0;
    y := 33.0;
ELSE
    x := pltpcustx;
    y := pltpcusty;
END;
{ convert from inches to world
  coordinates }
x := x * 32.0;
y := y * 32.0;

```

pltpensort

```
pltpensort : boolean;
```

The current user setting for pen sorting.

pltpenspeed

```
pltpenspeed : integer;
```

The setting of the plotter pen speed. Not all plotters support pen speeds set within the program.

pltpenwidth

```
pltpenwidth : integer;
```

The setting of the plotter pen width.

pltpsize

```
pltpsize : integer;
```

The paper size used by the plotter. The following values are valid:

1	8 x 10.5
2	10 x 16
3	16 x 21
4	12 x 32
5	33 x 43
6	Custom (see " pltpcustx " and " pltpcusty ")

pltrot

```
pltrot : boolean;
```

true when DataCAD rotates the plots.

pltrotang

```
pltrotang : real;
```

When pltrot is true, pltrotang is the angle of rotation for the plot.

pltrotcentx

```
pltrotcentx : real;
```

The x value of the center of rotation when DataCAD is doing a rotated plot.

pltrotcenty

```
pltrotcenty : real;
```

The y value of the center of rotation when DataCAD is doing a rotated plot.

pltscalenum

```
pltscalenum : integer;
```

The current plotter scale index setting. See the procedure "[scale_get](#)" for more information on scale indices. Use `PGSavevar.plt.scalei` in D4D

Data Variables

Doors, Walls, and Windows

These variables access information about doors, walls, and windows. Most of these variables are accessible from the Architect menu.

Centwall

```
centwall : boolean;
```

true if you are currently specifying walls by their center lines. When centwall is false, walls are drawn by one side and DataCAD asks you to point to the other side.

cut_lyr

```
cut_lyr : layer;
```

The layer that DataCAD searches for wall lines when cut_srch is true.

cut_srch

```
cut_srch : boolean;
```

Controls whether the DataCAD cutout function searches for lines on the current layer (cut_srch = false) or on the layer determined by cut_lyr (cut_srch = true).

docut

```
docut : boolean;
```

true when the procedure that places a door or window in a wall cuts the wall opening, otherwise the wall is not cut. This is the same variable as is toggled on the Architect menu.

dojamb

```
dojamb : boolean;
```

true when jambs are drawn when an opening is cut. This is the same variable as is toggled on the Architect menu.

doorang

```
doorang : real;
```

The angle that determines the opening of a door. This is the same variable that is accessed from the Doors menu under Architect.

doorhgt

```
doorhgt : real;
```

The height of a door.

doorthk

```
doorthk : real;
```

The door thickness.

doortype

```
doortype : integer;
```

The type of door being drawn at the DataCAD Door menu. Its values are:

0	Single
1	Double
2	Bi-fold
3	Sliding

glassthk

```
glassthk : real;
```

The thickness of the pane of glass that is drawn in the window routines. A thickness of zero means only one line is drawn, rather than two.

headhgt

```
headhgt : real;
```

The header height for windows.

jambwth

```
jambwth : real;
```

The jamb width for doors and windows.

sidedoor

```
sidedoor : boolean;
```

true when doors and windows are drawn by their sides (jambs). false when they are drawn by their center and one side. This variable is used for both doors and windows.

sillhgt

```
sillhgt : real;
```

The window sill height.

sillin

```
sillin : real;
```

The window sill width on the inside of the wall.

sillout

```
sillout : real;
```

The window sill width on the outside of the wall.

wallend

```
wallend : integer;
```

The wall end condition; valid values are:

```
wall_none Nothing is done at the ends.  
wall_clip T-intersect with nearest wall.  
wall_cap Wall is capped.
```

wallhilit

```
wallhilit : boolean;
```

Controls wall highlighting when getesc is called.

wallhilitout

```
wallhilitout : boolean;
```

Controls whether wall highlighting highlights the inside or outside wall. true means the outside wall is highlighted when wallhilit is also true.

wallhilitcolor

```
wallhilitcolor : integer;
```

wallhilitcolor is the color used for highlighting wall lines.

wallhilitewidth

```
wallhilitewidth : integer;
```

The line width (weight) used for highlighting wall lines.

wallson

```
wallson : integer;
```

Determines when walls are drawn. The valid values for wallson are:

```
wall_on Draw walls.  
wall_off Don't draw walls.
```

wall_on and wall_off are described in the "Constants" chapter.

wallwidth

```
wallwidth : real;
```

The current wall width being drawn.

Entity Property Variables

The variables in this section are associated with entities that are added to the drawing database.

lineattr

```
lineattr : integer;
```

Contains the attribute that is assigned to added entities. This value is put into the attr field of a variable of type entity. This is used for such purposes as distinguishing hatching lines from wall boundary lines.

linecolor

```
linecolor : integer;
```

The color assigned to the entities that are added to the database. This variable is assigned by layer, and changing its value changes the value for the current layer only. Changing this variable does not change the color of the layer name on the screen. You must call wrtlyr to force the layer name to change.

LineColor is a function in D4D. It can be used to get (but not set) the current colour. To set the colour I have used the following logic:

```
if lyr_get(getlyrcurr, rlyr) then begin //rlyr is a variable of type RLayer
  rlyr.Color := newColour; //set the new colour
  lyr_put (rlyr);
end;
```

lineosht

```
lineosht : real;
```

The current line overshoot factor. Each line is drawn this distance past its actual end point.

linespcg

```
linespcg : real;
```

The current line spacing distance. It is the distance of each line pattern repeat (dot to dot, dash to dash, etc).

linetype

```
linetype : integer;
```

The line type used for entities added to the database. It may take any of the values: ltype_solid, ltype_dotted, ltype_dashed, or ltype_dotdash. In addition, any of the user-defined line types may be specified. These line types are assigned numbers beginning at 4; the first user line type is given the number 4, the next 5, etc.

linewidth

```
linewidth : integer;
```

linewidth is the line width (also called line weight) given to entities added to the database. This value is assigned to the field width of a variable of type entity.

Polygon Variables

The variables in this section are used in DataCAD's 2D Polygon menu.

plyrect

```
plyrect : boolean;
```

Controls whether the 2D Polygon menu enters regular polygons or rectangles. When it is true the menu starts off in the polygon entry state.

polycntr

```
polycntr : boolean;
```

Controls whether DataCAD adds a center point to the regular polygons it enters on the Polygons menu. The center point is added when polycntr is true.

polydiam

```
polydiam : boolean;
```

true creates polygons by the diameter of the inscribing or circumscribing circle. When false, polygons are created by the center and one point on a radius.

polyinsd

```
polyinsd : boolean;
```

true inscribes polygons inside their defining circle. When false, polygons are circumscribed about the defining circle.

polysides

```
polysides : integer;
```

The number of sides used in the regular polygons.

polyvert

```
polyvert : boolean;
```

true when the second point entered to define a polygon is at a vertex. When it is false, the second point defines a point on a face of the polygon.

Symbol Variables

The variables in this section are used when entering symbols from the template window.

symang

```
symang : real;
```

symang is the current symbol rotation around the z axis.

symenlx

```
symenlx : real;
```

symenlx is the current symbol enlargement factor in the x direction.

symenly

```
symenly : real;
```

symenly is the current symbol enlargement factor in the y direction.

symenz

```
symenz : real;
```

symenz is the current symbol enlargement factor in the z direction.

symexplode

```
symexplode : boolean;
```

true when instances of symbols entered at DataCAD's Template menu are exploded into their constituent entities.

symzoffset

```
symzoffset : real;
```

The z offset of instances of symbols entered in DataCAD.

Processing Variables

DCAL for Delphi: The processing variables appear to be generally part of either the PGSavevar or PGsv records. At this stage I have only documented a handful of the individual variables.

Grid Variables

These variables control the grid on the current layer. Unless noted, every layer has its own copy of these variables; therefore, changing layers may cause the value of these variables to change. Changing these variables does not cause the grid to redraw.

grid1sz

```
grid1sz : integer;
```

The size of the secondary display grid (the grid of crosses) measured in pixels. This is a global variable, that is, there is not a unique copy of this variable for every layer.

gridang

```
gridang : real;
```

The angle of the grid and cursor on the current layer.

gridclr

```
gridclr : integer;
```

The color of the primary display grid (the grid of dots). This is a global variable, that is, there is not a unique copy of this variable for every layer.

gridclr1

```
gridclr1 : integer;
```


The color of the secondary display grid (the grid of crosses). This is a global variable, that is, there is not a unique copy of this variable for every layer.

gridorgx

```
gridorgx : real;
```

The x coordinate of the grid origin on the current layer. Changing this variable does not cause the grid to redraw. Each layer has its own grid origin.

gridorgy

```
gridorgy : real;
```

The y coordinate of the grid origin on the current layer. Changing this variable does not cause the grid to redraw. Each layer has its own grid origin.

gridshow

```
gridshow : boolean;
```

Determines when the main grid on the current layer (the grid of dots) is drawn.

gridshowx

```
gridshowx : real;
```

The x spacing of the grid of dots on the current layer.

gridshowy

```
gridshowy : real;
```

The y spacing of the grid of dots on the current layer.

gridshw1

```
gridshw1 : boolean;
```

true when the secondary grid (the grid of crosses) is drawn.

gridshw1x

```
gridshw1x : real;
```

The x spacing for the secondary displayed grid.

gridshw1y

```
gridshw1y : real;
```

The y spacing for the secondary displayed grid.

gridsnap

```
gridsnap : boolean;
```

true when the cursor snaps to the snap grid.

gridsnapx

```
gridsnapx : real;
```

The x distance of the snap grid.

gridsnapy

```
gridsnapy : real;
```

The y distance of the snap grid.

numdivs

```
numdivs : integer;
```

The number of divisions that orthographic mode is using. When numdivs = 8, orthmode snaps every 45 degrees.

orthmode

```
orthmode : boolean;
```

true when orthographic snapping mode is on. When orthmode is false, orthographic snapping is off.

For D4D use Use PGSavevar.orthmode

Object Snap Variables

The variables in this section control the current object snap modes.

osnap_mode

```
osnap_mode : integer;
```

For a description of the values that this variable can have, see “Chapter 2 – Constants”.

osnap_num

```
osnap_num : integer;
```

This variable is used when one of the object snap modes currently in use is osnap_npoint. The line or arc is divided into osnap_num divisions before snapping occurs.

Text Variables

The variables in this section control text entry and display.

txtaline

```
txtaline : integer;
```

txtaline determines the type of text alignment currently used when text is entered.

The allowed values are:

- | | |
|---|------------------|
| 0 | Left justified |
| 1 | Center justified |
| 2 | Right justified |

txtang

```
txtang : real;
```

The angle at which text is entered.

txtaspect

```
txtaspect : real;
```

The aspect ratio of text that is entered.

txtboxclr

```
txtboxclr : integer;
```

The color of text boxes when text is too small to draw or when txton is false. If txtboxclr is 0, then text boxes are drawn as the color of the text entity currently being drawn.

txtboxmin

```
txtboxmin : integer;
```

When text entities are less than txtboxmin pixels tall, text boxes are drawn instead of the text itself.

txton

```
txton : boolean;
```

When txton is true, text is drawn when text entities are drawn, subject to txtboxmin. When txton is false, text is drawn as boxes when text entities are drawn.

txtsize

```
txtsize : real;
```

The size (in world coordinates) of entered text. Use `pgSaveVar^.txtsiz` in D4D

txtslant

```
txtslant : real;
```

The slant (in radians) of entered text.

txtweight

```
txtweight : integer;
```

The line weight of entered text.

Hidden Line Removal

The variables in this section control the operation of the DataCAD hidden line removal system.

hidecolor

```
hidecolor : integer;
```

Controls the line color used when DataCAD adds hidden lines.

hidetype

```
hidetype : integer;
```

Controls the line type used when DataCAD adds hidden lines.

hidepierce

```
hidepierce : boolean;
```

Controls the state of the pierce algorithm used in the hidden line removal system. When `hidepierce` is true, pierce calculations are performed.

hidespcg

```
hidespcg : real;
```

Controls the hidden line removal line spacing factor.

hidewidth

```
hidewidth : integer;
```

Controls the line width used for hidden lines.

Miscellaneous Variables

The variables in this section control several DataCAD functions. Some of them control how DataCAD looks, while others control what DataCAD does.

anglestyle

```
anglestyle : Integer;  
D4D: pgSaveVar^.angstyl
```

Controls DataCAD's current angle style:

0	Degrees, Minutes, Seconds
1	Bearings
2	Not used
3	Decimal Degrees
4	Radians
5	Gradians

aperture

```
aperture : boolean;
```

Controls the display of the "miss distance" box around the DataCAD cursor.

arrowratio

```
arrowratio : Real;
```

Controls arrow aspect ratio: Length/Width.

arrowsize

```
arrowsize : Real;
```

Controls the size of arrows drawn in the text menu. Size is relative to current text size.

arrowstyl

```
arrowstyl : Integer;
```

Controls the current style of arrow being drawn:

0	Open
1	Closed
2	Bridge

atrdraw

```
atrdraw : boolean;
```

When atrdraw is true visible attributes that belong to entities are drawn along with the entity. You can't control this variable from the standard DataCAD interface.

autopath

```
autopath : Boolean;
```

Automatic creation and setting of path for symbol files.

bigcurs

```
bigcurs : boolean;
```

Controls the drawing of the full screen cursor. When bigcurs is true, the full screen cursor is drawn. When it is false, the small cursor is drawn. This variable is toggled by the plus (+) key.

boxsym

```
boxsym : Integer;
```

Minimum size, in pixels, of symbols before boxes are drawn.

chamfera

```
chamfera : real;
```

The length of the chamfer for the first line entered in the Chamfer menu.

chamferb

```
chamferb : real;
```

The length of the chamfer for the second line entered in the Chamfer menu.

circlefact

```
circlefact : Real;
```

Factor for 2D curve drawing precision.

clockwise

```
clockwise : Boolean;
```

When true, angles increase in a clockwise direction.

constref

```
constref : boolean;
```

true when the distance read out at the bottom of the screen is the distance from the constant reference point (usually the origin). When constref is false, the distance is measured from the last point entered (see refpnt).

copyflag

```
copyflag : Boolean;
```

The AndCopy toggle in Move, Rotate, and Enlarge.

crctdiv1

```
crctdiv1 : integer;
```

The default primary circle divisions used with three-dimensional circular entities such as arcs and domes.

crctdiv2

```
crctdiv2 : integer;
```

The default secondary circle divisions used with three-dimensional circular entities such as domes and tori.

curssz

```
curssz : integer;
```

The size, in pixels, of each arm of the small cursor.

curvecenters

```
curvecenters : Boolean;
```

Controls center point display for 2D curves.

dimcontrolpts

```
dimcontrolpts : boolean;
```

Controls the display of associative dimension control points.

dimlimits

```
dimlimits : boolean;
```

When true, limits are added to dimensions.

dimminustol

```
dimminustol : Real;
```

Minus tolerance amount used with DimTolerance and DimLimits.

dimminustolang

```
dimminustolang : Real;
```

Minus tolerance amount used with DimTolerance and DimLimits for angular dimensions.

dimmon

```
dimmon Boolean;
```

Controls the display of associative dimensions.

dimorient

```
dimorient : integer;
```

The current default dimensioning orientation.

0	Horizontal
1	Vertical
2	Aligned
3	Rotated

dimplustol

```
dimplustol : real;
```

Plus tolerance amount used with dimtolerance and dimlimits.

dimplustolang

```
dimplustolang : Real;
```

Plus tolerance amount used with DimTolerance and DimLimits for angular dimensions.

dimticcolor

```
dimticcolor : integer;
```

The color of arrows to add to all dimensions.

dimtolerance

```
dimtolerance : boolean;
```

When true, tolerances are added to dimensions.

dimtxtcolor

```
dimtxtcolor : integer
```

The color of text to add to all dimensions.

distancesync

```
distancesync : Boolean;
```

The dissync toggle in the Settings menu.

distdelay

```
distdelay : Integer;
```

Delay time for distance readout.

drawlines

```
drawlines : boolean;
```

When drawlines are true, entities are drawn with their appropriate line type. When drawlines are false, entities, even those with a user-defined line type, are drawn with solid lines. This can speed up redrawing the display. This variable is toggled in the Display menu under Userline.

drawmarks

```
drawmarks : boolean;
```

Controls the drawing of markers every time a point is entered. These marks are drawn to the screen only and are not remembered. They disappear during the next screen refresh.

dynamic

```
dynamic : Boolean;
```

The Dynamic toggle in 2D Curve Creation menus.

dynamictxt

```
dynamictxt : boolean;
```

Controls the Dynamic toggle on the Text menu.

enlcopy

```
enlcopy : boolean;
```

Controls the state of the AndCopy flag in the Enlarge menu.

filcut

```
filcut : boolean;
```

When true, the lines that are pointed to during a fillet are cut back to join the resulting arc. When filcut is false, the lines are not modified.

filrad

```
filrad : real;
```

The radius of the arc used for a fillet.

findhatch

```
findhatch : Boolean;
```

When false, hatch lines are ignored for entity searches in object snapping.

hatchon

```
hatchon : Boolean;
```

Controls hatch line displays.

hither

```
hither : real;
```

The distance from the viewer to the hither clipping plane when DataCAD is in a perspective projection.

inpstyl

```
inpstyl : integer;
```

The current style of entering points when you press (Spacebar). inpstyl can have the following values:

0	Relative polar coordinates
1	Absolute polar coordinates
2	Relative Cartesian coordinates
3	Absolute Cartesian coordinates

lastdist

```
lastdist : Point;
```

Last distance used in Copy, Move, or Stretch.

lastenlpt

```
lastenlpt : Point;
```

Last point used for center of 2D enlargement.

lastrotpt

```
lastrotpt : Point;
```

Last point used for center of 2D rotation.

layerswitch

```
layerswitch : Boolean;
```

layerswitch is the LyrSet toggle in the Views menus.

layoutextents

```
layoutextents ; Boolean;
```

When true, only the extents of the drawing display in Plot Layout.

lyrsearch

```
lyrsearch : boolean;
```

lyrsearch controls whether DataCAD searches for entities on the current layer or on every layer that is turned on. When this variable is true, the search occurs on all of the layers that are on. When it is false, the search occurs on the current layer only. This variable is toggled at the Line, Shape, Area menus.

In D4D use `PGsavevar.srch`

See also the discussion of "[mode_init](#)".

maxdrag

```
maxdrag : Integer;
```

maxdrag is the maximum number of entities to consider for Move/Drag and Rotate/Drag before using the extents box.

mrkdraw

```
mrkdraw : boolean;
```

When mrkdraw is true, markers are drawn every time a point is entered.

mircopy

```
mircopy : boolean;
```

mircopy controls the state of the AndCopy flag at the Mirror menu.

mirfixtext

```
mirfixtext : boolean;
```

mirfixtext controls the state of the FixText flag at the Mirror menu. Also applies to the FixText flag in the Rotate Menu.

For D4D use `PGsavevar.rottext`

missdis

```
missdis : integer;
```

The size, in pixels, of the miss distance applied to searches of the database. It is also the size of the aperture around the cursor when aperture is true.

See also "[ent_near](#)".

movcopy

```
movcopy : boolean;
```

movcopy controls the state of the AndCopy flag at the Move menu.

multipen

```
multipen : Integer;
```

multipen controls sending pen change commands to plotter.

- 1 Send pen change commands.
- 2 Do NOT send pen change commands.

nofloat

```
nofloat : Boolean;
```

When true, DataCAD's distance output uses a fixed number of digits to the right of the decimal point as specified by the variable sigdigits.

noisy

```
noisy : boolean;
```

When noisy is set to true, DataCAD can beep. When it is false, DataCAD does not make noises.

nounits

```
nounits : Boolean;
```

When nounits is true, DataCAD's distance output does not append the currently-set scale units.

ovrdraw

```
ovrdraw : boolean;
```

When ovrdraw is false, line overshoots are not drawn.

ratiobox

```
ratiobox : boolean;
```

When ratiobox is true, a rubber band box is drawn from the last entered point. The rubberband box is forced to be of a specific aspect ratio given by ratioRatio. This rubber banding occurs during the next call to getpoint. Turn ratiobox on before calls to getpoint:

ratoratio

```
ratoratio : real;
```

ratoratio is the ratio of the rubberband box drawn when ratiobox is true.

regenorder

`regenorder : Integer;`

regenorder controls the order in which the database is re-drawn:

```
0      Active layer first.
1      Active layer last.
2      In order.
```

rotcopy

`rotcopy : boolean;`

rotcopy controls the state of the AndCopy flag at the Rotate menu.

rubbx

`rubbx : boolean;`

When rubbx is true, a rubberband rectangle is drawn from the last entered point. This rubber banding occurs during the next call to getpoint. Turn rubbx on before calls to getpoint:

```
rubbx := true;
result := getpoint (pt, key);
IF result = res_escape THEN
    ...
```

rubbx does not have to be turned off; the call to getpoint automatically turns it off.

In D4D rubbx is a function returning a pointer. Use rubbx^ to assign or get the current value.

rubln

`rubln : boolean;`

rubln controls the rubberband line being drawn. Use it in the same way as rubbx.

savedelay

`savedelay : Integer;`

savedelay is the delay time for automatic file save.

scaletype

`scaletype : Integer;`

Controls DataCAD's current scale type:|

```
0 Architectural      6 Centimeters
1 Engineering       7 Millimeters
2 Decimal           8 Metric
3 Meters            9 DIN
4 Inches Fraction  10 AS 1100
5 Inches Decimal
```

DCAL for Delphi : PGSaveVar^.scaletype

scrolldis

```
scrolldis : real;
```

scrolldis represents the fraction of the screen that moves during screen scrolling. scrolldis should be between 0.0 and 1.0, but DataCAD does not check this range.

selecttype

```
selecttype : integer;
```

selecttype controls the current Entity, Group, Area, Fence state when getmode is called.

1	Entity
0	Group
2	Area
3	Fence

DCAL for Delphi : PGSaveVar.Select**showinspt**

```
showinspt : Boolean;
```

Controls symbol insertion point displays.

showneg

```
showneg : Boolean;
```

When showneg is true, negative numbers show in the distance display.

showwgt

```
showwgt : Boolean;
```

Controls line weight displays.

showz

```
showz : Boolean;
```

Shows the current z-base and z-height values on the status line.

sigdigits

```
sigdigits ; Integer;
```

See "[nofloat](#)". Must be in the range 0-3.

smallgrid

```
smallgrid : integer;
```

The size, in pixels, of the smallest grid that can be drawn.

snplyrsearch

```
snplyrsearch : boolean;
```

Controls whether DataCAD uses layer searching when snapping to entities with object snapping.

snapquick

```
snapquick : boolean;
```

Controls the quick snapping state in DataCAD. This controls the snapping to selected 3D entities to their control points.

snapsymfast

```
snapsymfast : boolean;
```

Controls whether DataCAD searches through the description of symbols when snapping. When true, DataCAD considers the insertion points of symbols when calculating snap points.

srchquick

```
srchquick : boolean;
```

Controls the quick searching state in DataCAD. This controls the searching of selected 3D entities by their control points.

srfgrid

```
srfgrid : boolean;
```

When srfgrid is true the grid associated with Bezier surface entities (entSrf) is drawn when the entities are drawn.

srfpnts

```
srfpnts : boolean;
```

When srfpnts is true, the control points associated with Bezier surface entities (entSrf) are drawn when the entities are drawn.

txtcurs

```
txtcurs : boolean;
```

When txtcurs is set to true before calling getpoint the text cursor is drawn instead of the normal cross hair cursor. This is the cursor that is used when DataCAD asks you to position some text on the drawing. The shape and orientation of the text cursor is subject to txtang, txtsize, txtslant, and txtaspect

txtuseplt

```
txtuseplt : boolean;
```

Controls text scaling. When true, text is scaled relative to the current plot scale.

zbase

```
zbase : real;
```

The current value of Z-base as set when (z) is pressed.

DCAL for Delphi: zbase is a function that returns the current Z-base. If you need to set Z-base then assign a value to PGSavevar.basez.

zeroangle

```
zeroangle : Real;
```

The angle specifying zero for all of DataCAD's angle conventions.

zhite

```
zhite : real;
```

The current value of Z-height as set when (z) is pressed.

DCAL for Delphi: zhite is a function that returns the current Z-height. If you need to set Z-hite then assign a value to PGSavevar.hitez.

zuser1

```
zuser1 : real;
```

The Z-height that appears on the DataCAD menus as Z-User1.

DCAL for Delphi: PGsv.userz2

zuser2

```
zuser2 : real;
```

The Z-height that appears on the DataCAD menus as Z-User2.

DCAL for Delphi: PGsv.userz2

Chapter 5 – Input / Output Routines

Input Routines

Function Key Routines

With the routines in this section you control the clearing, setting, and display of function key labels, which DataCAD saves in an internal record.

The function keys are numbered from 1 to 20. (F1) through (F10) are numbered 1 through 10. The Shifted (or Alted) function keys (S1) through (S10) are numbered 11 through 20.

Clear_Keys (Added DataCAD 17.03)

```
PROCEDURE Clear_Keys; BUILTIN 663;
```

Clears the function keys with a forced repaint.

fnkeyconv

```
FUNCTION fnkeyconv (key : integer) : integer;
```

fnkeyconv takes a key returned from an input routine and converts it to an ordinal function key number in the range 1 to 20, or returns -1 when the key is not a function key.

For instance, when a user presses (F3), getchar returns the constant f3. fnkeyconv returns 3 when passed f3. The constants returned representing the function keys are not in numerical order, whereas the numbers returned by fnkeyconv are.

```
fnkeyconv (S7) returns 17  
fnkeyconv (Esc) returns -1  
fnkeyconv (F10) returns 10
```

To read any function key between (F1) and (S3), you can use the following code:

```
getchar (key);  
key := fnkeyconv (key);  
IF (1 <= key) AND (key <= 13) THEN  
    ...
```

getCurrLbl

```
PROCEDURE getCurrLbl (keynum : IN integer; lbl : IN OUT string); BUILTIN 497;
```

Returns in LBL the label currently at function key position KEYNUM.

lblmsg

```
PROCEDURE lblmsg (key : integer; str : string);
```

lblmsg sets the message that appears when a function key is pressed. The parameters are similar to lblset, but the string may be up to 60 characters in length.

lblset

```
PROCEDURE lblset (key : integer; str : string);
```

lblset sets the string str to the internal label associated with the label number key. This procedure does not cause anything on the display to change. Although the string passed to lblset can be any length, only the first eight characters appear. When the string is shorter than eight characters, it is padded on the right with spaces. **Note:** More than 8 characters appear in Windows Versions of DataCAD

lblsettf (added in DataCAD 9)

```
PROCEDURE lblsettf (KeyNum : integer; str : string; state : integer);  
BUILTIN 633;
```

This procedure is similar to lblset, but is used (within DataCAD) to control the keys when displaying Layers (as within the Layer On/Off menu) by passing the "state" of the key. Valid states are as follows:

- 1 = Button toggled On
- 2 = Button toggled Off
- 3 = Button toggled On and text is shown as "Active" color
- 11 = Button toggled On with text "Strike-through"
- 12 = Button toggled Off with text "Strike-through"
- 13 = Button toggled On and text is shown as "Active" color with text "Strike-through"

lblsett

```
PROCEDURE lblsett (key : integer; str : string; toggle : boolean);
```

lblsett is similar to lblset, but takes the additional parameter, toggle. When toggle is true, an asterisk is inserted in front of str before str is assigned to the function key. When toggle is false, a space is inserted before str.

lblsinit

```
PROCEDURE lblsinit;
```

This procedure clears DataCAD's internal record of the function key labels. Use it first prior to setting up a menu. Note that this procedure does NOT clear the function keys that are displayed. To do that, use lblsinit followed by lblson.

lblson

```
PROCEDURE lblson;
```

lblson takes the current internal function key labels and displays them on the monitor. The current labels are overwritten.

SetMacroHints (uncertain of version added, probably around DataCAD 13)

```
PROCEDURE SetMacroHints (DoHints : boolean); BUILTIN 651;
```

DoHints tells DataCAD whether or not to display tooltips for the function key labels.

Mouse / Keyboard Routines

The following routines access the mouse and keyboard. They allow you to use the default DataCAD menus for certain functions.

answer

```
FUNCTION answer (i :integer) : boolean;
```

Use answer to ask the user a yes/no type of question.

Depending on the value of i, different responses are expected. When i=0, the choices are Yes/No. When i=1, the options are Continue/Stop. The last recognized value is i=2, which is On/Off.

The function return value is true when the user picks the first option, false when the user picks the second option.

You can use answer as in the example below:

```
wrtmsg ('Are you sure?');
IF answer (0) THEN
  doit;
END;
```

dgetang

```
FUNCTION dgetang (ang : IN OUT real; key OUT : integer) : integer;
```

dgetang is used to enter an angle while the macro handles the use of function keys. Dgetang is similar to both getang and getpoint.

The return value is either res_normal or res_escape. The return value and use of the parameter key are the same as in getpoint. When you call dgetang, the default angle menu does not appear; however, the current angle style still applies.

```
done := false;
  ang := pi;
  REPEAT
    lblsinit;
    lblset ( 1, '25 Degr');
    lblset (20, 'Exit');
    lblson;
    wrtlvl ('test');
    wrtmsg ('Enter angle for widgets: ');

    result := dgetang (ang, key);
    IF result = res_escape THEN
      IF key = f1 THEN
        ang := radians (25.0);

        result := res_normal;
        { get out of loop }
      ELSIF key = s0 THEN
        done := true;
      END;
    UNTIL done OR (result = res_normal);
```

```
IF NOT done THEN
  { do processing here }
  ...
```

One useful feature of all of the dget functions is the ability to use (S10) as an Exit key.

dgetdis

```
FUNCTION dgetdis (dis : IN OUT real; key : OUT integer) : integer;
```

Use dgetdis to enter a distance while the macro handles the use of the function keys. dgetdis is similar to getdis and dgetang.

The return value is either res_normal or res_escape. The return value and use of the parameter key are the same as in getpoint.

D4D Note: to accept a distance string on a VCL form, use `toStr` to convert the distance to a string for initial display in the input field, and `toDis` to convert the entered string back to a distance (there is an example of this in the `UfrDisAngReal` unit in the sample `AEC_Model` macro).

dgetint

```
FUNCTION dgetint (int : IN OUT integer; key : OUT integer) : integer;
```

dgetint is similar to dgetang and dgetdis, but the user enters an integer.

The return value is either res_normal or res_escape. The return value and use of the parameter key are the same as in getpoint.

dgetrl

```
FUNCTION dgetrl (rl : IN OUT real; key : OUT integer) : integer;
```

dgetrl is used to enter real numbers (decimal numbers) while the macro handles the use of the function keys.

The return value is either res_normal or res_escape. The return value and use of the parameter key are the same as in getpoint.

dgetstr

```
FUNCTION dgetstr (str : IN OUT string; len : integer; key : OUT integer) :
integer;
```

dgetstr reads a string from the keyboard, while the macro handles the function keys.

The parameter str must be initialized.

The parameter len is the maximum allowable length of the string. len can be less than or equal to (but not greater than) the maximum length of str.

The return value is either res_normal or res_escape. The return value and use of the parameter key are the same as in getpoint.

fgetlyr

```
FUNCTION fgetlyr (offset : IN OUT integer; key : IN OUT integer; lyr : IN  
OUT layer) : integer; BUILTIN 226;
```

fgetlyr works like getlyr except that a valid selection need not be made to exit this function.

Initialize offset to zero. This returns the number of times scrolled forward into layer selections. When the function return value is res_escape, key returns which key was pressed. lyr is the layer selected when the function return value is res_normal. lyr should be initialized to a valid value before calling the routine. The return values are the same as in the routine getpointp.

D4D: PROCEDURE fgetlyr (var flyrarg: TFLyrArg; var iwant: wantType)

The result field of the TFLyrArg field returns the key code instead of a crtstat value. I have been able to use it by testing result for zero (indicating a layer was selected) or non-zero (indicating that a key was pressed, although I think s0 is the only key that will return). ... Not sure why this is different to the way result is reported in arguments for other similar functions.

getang

```
PROCEDURE getang (ang : IN OUT real);
```

getang reads an angle from the keyboard.

It displays the default angle menu, and allows the user to use the function keys or type the angle from the keyboard. The angle is expressed in radians, using the DataCAD angle convention, regardless of the currently-selected type of angle display. Notice that the parameter ang is an IN OUT parameter; and must be initialized before calling getang. The current value of ang displays as a default when getang is called.

getchar

```
PROCEDURE getchar (key : OUT integer);
```

getchar reads characters from the keyboard. As discussed in the "Introduction" chapter, the DataCAD keyboard returns an escape code when you press certain keys. Of particular interest are the codes that function keys return. The rest of the escape codes (such as the arrow keys, (Home), etc.) are handled within DataCAD.

The escape codes returned by the function keys are represented by the built-in constants f0 through f9 for the function keys, and the constants s0 through s9 for shifted function keys.

NOTE: Function keys always return their respective key codes even when nothing appears on them.

getclr

```
PROCEDURE getclr (clr : IN OUT integer);
```

getclr reads a color from the keyboard. It displays the color menu and asks the user to select from it.

getclr returns the color selected. clr should be initialized before calling getclr.

GetColorIndex (D4D only)

```
PROCEDURE getColorIndex (clr : IN OUT integer);
```

Displays a colour picker dialog using the current palette.

getdis

```
PROCEDURE getdis (dis : IN OUT real);
```

getdis reads a distance from the user. It displays the default distance menu and then accepts input from either the function keys or the keyboard.

The parameter dis is in DataCAD drawing units. The function keys and input strings depend on the currently-selected scale type, but the variable is always in the same units. The parameter must be initialized first since it is an IN OUT parameter and used for the default.

getesc

```
PROCEDURE getesc (key : OUT integer);
```

getesc reads in a function key from the user. Use this procedure when the user's only option is to select a function key, and has nothing to point to. This procedure is used in DataCAD's Edit and Utility menus. The user can enter walls when getesc is called.

An example piece of code that lets the user select from two different options or toggle a variable is:

```
done := false;
REPEAT
  lblsinit;
  lblset ( 1, 'Method 1');
  lblset ( 2, 'Method 2');
  lblsett ( 3, 'Fast', fast);
  lblset (20, 'Exit');
  lblson;
  wrtlvl ('Widgets');
  wrtmsg ('Enter widget options. ');
  getesc (key);
  IF key = f1 THEN
    doMethod1;
  ELSIF key = f2 THEN
    doMethod2;

  ELSIF key = f3 THEN
    fast := NOT fast;
  ELSIF key = s0 THEN
    done :=true;
  END;
UNTIL done;
```

getflname

```
FUNCTION getflname (fname, path : IN OUT string; ext : string; entire : OUT string; addext : boolean) : boolean;
```

getflname reads a filename from the user. You can scroll through the existing filenames which appear on the function keys, select a filename, or type the filename (and path if necessary).

Note: an error occurs if the selected path+filename is more than 80 characters long

fname is an IN OUT variable that is the eight-character filename being read. On input it is the default filename, on exit it is the user-selected filename. fname is only the eight-character filename without the extension or path.

path is the path where the file is located. It is this path that the default files are listed from. The user can change the path, and upon exit path may change from its input value.

ext is the file extension of files to list; it includes the dot. Therefore, .dc3 (not dc3) is used to read in a drawing name.

entire is the entire name, including the path, of the file that was read in. This may be a relative or absolute filename. addext is true when entire includes the extension ext, otherwise it is not.

getflname returns true when the user enters a filename or selects one from the function keys. false is returned when the user selects exit, (S10). getflname does not check to see if a file exists, it merely reads in a filename.

getint

```
PROCEDURE getint (i : IN OUT integer);
```

getint is used to read an integer from the keyboard. The default integer menu appears and the user can type the number or use the function keys.

When getint returns to the macro, the parameter i contains the value that was entered. Because this parameter is an IN OUT parameter it must be initialized before being passed to getint.

getlyr

```
PROCEDURE getlyr (lyr : OUT layer);
```

getlyr reads a layer from the keyboard. Input by function key or by typing the name of a layer. You can scroll through the default layers which appear on the function keys.

NOTE: Exit, (S0), does not work in getlyr, see "[fgetlyr](#)".

getmode

```
FUNCTION getmode (action : string; mode : IN OUT mode_type; key : integer) : integer;
```

getmode is the function that implements the entity, group, area, fence, selection set user interface.

D4D : There was no equivalent function prior to DataCAD 23.00.03.03. From 23.00.03.03 onward the equivalent function is menuGetMode.

action is the verb that determines what to do to selected entities, for example, action might be move at a Move menu.

mode is the variable that reads the user-selected entities. This is explained in greater depth in a following section.

For example:

```

done := false;
REPEAT

  lblsinit;
  lblset ( 7, 'Undo');
  lblset ( 8, 'Partial');
  lblset (10, 'Clr Undo');
  { lblson should NOT be used here }
  wrtlvl ('Erase');
  result := getmode ('erase', mode,
                    key);
  IF result = res_escape THEN
    IF key = f7 THEN
      undo;
    ELSIF key = f8 THEN
      partial;
    ELSIF key = f0 THEN
      clrUndo;
    ELSIF key = s0 THEN
      done := true;
    END;
  ELSIF result = res_normal THEN
    { note this loop is the same if the
      user picked entity, group, area,
      or selection set }
    addr := ent_first (mode);
    WHILE ent_get (ent, addr) DO
      addr := ent_next (ent, mode);
      deleteIt (ent);
    END;
  END;
UNTIL done;

```

There are several important points to note about the above example:

When setting the labels, do not use (F1) through (F6) or (S0). These are used by getmode for the entity, group, area, fence, selection set, layer search, and exit keys.

Do not call lblson before calling getmode. getmode does this itself, and if you call it, the functions keys blink.

The return value and the parameter key are used as in getpoint. When the user correctly selects entities, res_normal returns. When res_normal is returned, mode reads the selected entities out of the database.

If one of the function keys (F7) to (S9) are pressed, res_escape returns and the appropriate value is returned in key.

getpoint

```
FUNCTION getpoint (pt : OUT point; key OUT integer) : integer;
```

getpoint is used for reading the current cursor position using the mouse or keyboard.

When a valid point is entered, `getpoint` returns `res_normal`. When an escape code is read from the keyboard `getpoint` returns `res_escape`. The escape code is returned in the variable `key`. `key` determines which function key was pressed. `getpoint` returns when any of the following happen:

The left mouse button is pressed (a point is entered).

The middle mouse button is pressed and a point is snapped to.

The right mouse button is pressed. Pressing the right mouse button is ALWAYS the same as pressing (S10), regardless of where the cursor is pointing or what is assigned to (S10).

The user enters a point with (Spacebar).

A function key is pressed. See "[getchar](#)" for more information.

getrll

```
PROCEDURE getrll (rl : IN OUT real);
```

`getrll` reads a real number from the keyboard.

The default real numbers (decimal numbers) appear on the function keys. The user types a number or uses the appropriate function key.

The parameter `rl` must be initialized before calling `getrll`.

getstr

```
PROCEDURE getstr (str : IN OUT string; len : integer);
```

`getstr` reads a string from the keyboard. Since there is no default string menu, the function keys are not used by this procedure.

Note: max string length that can be returned by `getstr` is 133 in Classic DCAL (have not checked D4D)

The parameter `str` must be initialized.

The parameter `len` is the maximum allowable length of the string. `len` can be less than or equal to (but not greater than) the maximum length of `str`.

globalesc

```
PROCEDURE globalesc (key : IN integer);
```

`globalesc` handles keyboard toggles, keyboard interrupts, and user-defined keyboard macros. Ordinarily, these toggles and interrupts are handled automatically by input routines which take a keystroke as input. During a call to `getpoint` or `getmode`, when a key is pressed which is not trapped by the routine itself, the key is implicitly passed on to `globalesc` for further processing.

For example, if the user presses the forward slash key, the implicit call to `globalesc` presents the `WindowIn` menu. `globalesc` determines what action to take, if any, and executes the action corresponding to the keystroke if any is required.

These calls to `globalesc` are automatic and implicit to all DCAL input routines except `getchar` and `getpointp`. `getchar` always returns the integer key code of the key pressed no matter what key it may be. All Alt, Control, Function, and high-bit keys are returned by `getchar`; however, no processing is done on the key code by `globalesc`. When the user enters the forward slash key as input, the WindowIn menu does not appear unless the DCAL program tests the input for "/" and correspondingly calls `menuwindowin`.

`getpointp` gives you the option of whether or not to automatically process keys through `globalesc`.

If the `doesc` toggle passed to `getpointp` is `false` when `getpointp` is called, `globalesc` is not called automatically and key is handled the same as in a call to `getchar`. In this case, `getpointp` has a return value of `res_escape`, and `key` contains the key code of the pressed key. You can then examine the value of `key` prior to passing it to `globalesc`. Thus you can determine what action the user intends prior to calling `globalesc` in your program. This command is useful with `keyforceexit` to clean up before forced, or early termination of a macro occurs, for example:

```
...
iores := getpointp (pnt, key, vmode_all,
false);
IF iores = res_normal THEN
  { process point }
ELSIF iores = res_escape THEN
  { process key }
  IF key = f1 THEN
    { do your action }
    ...
  ELSIF keyforceexit THEN
    { do cleanup before termination }
    globalesc (key);
  ELSE
    globalesc (key);
  END;
  globalesc (key);
END;
...
```

NOTE: `getchar` and `getpointp` always trap the key combination (Ctrl)-(C). This is the only key combination that can never be trapped from within a DCAL macro. When (Ctrl)-(C) is pressed, the macro immediately stops executing under all conditions. See "[getpointp](#)", "[getchar](#)", and "[keyforceexit](#)".

Reading from the Database

Use the routines in this section to read entities from the DataCAD database. With these routines you can examine the drawing file. The routines are flexible enough read the same information in several ways.

The entities that read the database use a variable of type `mode_type`. This variable controls the type of entity that is being read and where in the database the current search is occurring.

draw_mode

```
FUNCTION draw_mode (mode : IN OUT mode_type; clear, dobrk, tod1 : IN boolean;
drmode : IN integer) : integer;
```

draw_mode draws a collection of entities described by the mode variable mode.

mode must be initialized by either the procedure mode_init or mode_init1, or be a return value from the procedure getmode. draw_mode gives you complete control over how to draw the entities using any of four parameters.

clear is a Boolean flag which, when true, indicates to clear the screen prior to drawing the collection of entities. When clear is false, the screen is not cleared first. dobrk is a Boolean flag which, if true, indicates to DataCAD that the (Del) and (End) keys should be monitored. When dobrk is true, and either the (Del) or (End) keys are pressed, redrawing the data is interrupted. When dobrk is false, (Del) and (End) are ignored and the data is drawn to completion.

tod1 is a Boolean flag which, when true, indicates to draw_mode that the hardware display list (if applicable) should be appended to during the screen refresh. When tod1 is false, the data is refreshed on the screen only and not appended to the display list. The display list is dependent on your graphics card and driver. drmode may take on one of three constant values: drmode_white, drmode_flip, or drmode_black. See "[ent_draw](#)".

The return value from draw_mode indicates the status of the break keys. When the toggle dobrk is false, draw_mode returns 0. When dobrk is true, draw_mode may return -1, 0, or 1. A return value of 0 indicates that draw_mode executed to completion and neither (Del) nor (End) was pressed. A return value of -1 indicates that (Del) was pressed and drawing was interrupted. A return value of 1 indicates that (End) was pressed and drawing was interrupted. With this information, draw_mode may be placed in a loop, and (Del) and (End) monitored accordingly.

ent_first

```
FUNCTION ent_first (mode : IN OUT mode_type) : entaddr;
```

ent_first returns the address of the first entity that mode specifies.

When mode is set to read from the current layer (lyr_curr), ent_first returns the address of the first entity on the current layer. When no entities are specified by mode, ent_first returns nil.

ent_get

```
FUNCTION ent_get (ent : OUT entity; adr : entaddr) : boolean;
```

ent_get reads the entity located at address adr from the database and returns true when an entity is read from that location. false returns when the address is nil or if DataCAD is unable to read an entity from that address.

The following loop is used to read the database:

```
{ first, set the mode variable up }
mode_init (mode);
mode_ss (mode, 10);
```

```

{ this part of the loop is INVARIANT
  with respect to the mode. No matter
  how many entities you are reading, be
  it one or all, the following piece of code is
  THE SAME }
addr := ent_first (mode);
WHILE ent_get (ent, addr) DO
  { do something to the entity here }
  { if the entity is deleted, call
    ent_next before it is deleted }
  addr := ent_next (ent, mode);
END;

```

ent_near

```

FUNCTION ent_near (ent : OUT entity; x, y : real; mode : IN OUT mode_type;
errmsg : boolean) : boolean;

```

ent_near is used to search the database for the entity that is nearest to the point (x, y).

When no entity is within the miss distance of the point (x, y), false returns.

When an entity is found, ent is set to that entity and ent_near returns true.

The database is searched according to the variable mode, which must be initialized before calling ent_near.

When errmsg is true, an error message prints if no entities are found within the current miss distance.

When errmsg is false, no error message prints. The value of errmsg does not affect the value that is returned by ent_near.

The following code example finds the nearest entity that is a line or arc on any layer that is turned on:

```

mode_init (mode);
mode_lyr (mode, lyr_on);
mode_enttype (mode, entlin);
mode_enttype (mode, entarc);
IF ent_near (ent, x, y, mode,
  true) THEN
  ent_draw (ent, drmode_flip);
  pause (0.1);
  ent_draw (ent, drmode_flip);
END;

```

ent_next

```

FUNCTION ent_next (ent : IN OUT entity; mode : IN OUT mode_type) : entaddr;

```

ent_next returns the address of the next entity specified by mode.

The entity parameter to ent_next is the last entity read from the database with mode. See also [“ent_get”](#).

ent_setunused

```

PROCEDURE ent_setunused (ent : IN OUT entity; ignore : boolean);

```

ent_setunused marks or unmarks an entity as being unused when the database is read by mode_ignore. An entity should always be marked as unused and then immediately marked as used after the database is read.

When ignore is true, ent is ignored. When ignore is false, the entity is read even if mode_ignore reads the database.

The following code is used to find the two nearest entities to a given point.

```
mode_init (mode);
IF ent_near (ent1, x, y, mode,
            true) THEN
  mode_init (mode);
  mode_ignore (mode);
  { do not read ent1 during this scan }
  ent_setunused (ent1, true);
  b = ent_near (ent2, x, y, mode,
              true);
  { reset ent1 as able to be read }
  ent_setunused (ent1, false);
  IF b THEN
    { look at the two entities }
  END;
END;
```

extents_mode

```
PROCEDURE extents_mode (mode : IN OUT mode_type; min, max : OUT point);
```

extents_mode calculates the x, y, and z extents of any collection of entities described by the mode variable mode.

mode must be initialized by either the procedure mode_init or mode_init1, or be a return value from the procedure getmode. Any valid mode may be used.

min and max describe the opposite corners of the smallest three-dimensional box which contains the extents of the data. min and max are the minimum and maximum extents of this box.

mode_1lyr

```
PROCEDURE mode_1lyr (mode : IN OUT mode_type; lyr : layer);
```

mode_1lyr instructs DataCAD to read the entities from only one layer, which is specified by the parameter lyr.

To set a mode variable to read all entities from the layer that a particular entity is on, use:

```
mode_init (mode);
mode_1lyr (mode, ent.lyr);
```

mode_atr

```
PROCEDURE mode_atr (mode : IN OUT mode_type; aname: string);
```

mode_atr sets the mode variable to return all entries in the drawing with an attribute attached named aname.

mode_box

```
PROCEDURE mode_box (mode : IN OUT mode_type; x1, y1, x2, y2 : real);
```

When mode_box is called, mode reads only entities that are completely inside the box specified by (x1, y1), (x2, y2). DataCAD automatically determines which corners of the box are given, so the coordinates do not have to be in any particular order.

mode_enttype

```
PROCEDURE mode_enttype (mode : IN OUT mode_type; enttype : integer);
```

By default, a mode variable returns all entities on a given layer or combination of layers. By calling mode_enttype once or more times, you can control which types of entities are read.

For example, the following code changes all lines and circles on the current layer to red.

```
mode_init (mode);
mode_enttype (mode, entlin);
mode_enttype (mode, entcrc);
addr := ent_first (mode);
WHILE ent_get (ent, addr) DO
  addr := ent_next (ent, mode);
  ent_draw (ent, drmode_black);
  ent.color := clrred;
  ent_update (ent);
  ent_draw (ent, drmode_white);
END;
```

mode_fence

```
PROCEDURE mode_fence (mode : IN OUT mode_type; pnts : IN ptarr; npnt : IN integer);
```

mode_fence is similar to mode_box, but is used to specify entities that are inside a polygonal fence.

The array of points is pnts.

The number of points is given by npnt.

mode_group

```
PROCEDURE mode_group (mode : IN OUT mode_type; ent : IN OUT entity);
```

mode_group specifies that a group (linked collection of entities) is to be read.

ent is any entity that is in the group. The first entity read will not necessarily be ent, but ent will be one of the entities read.

Note that sometimes not all entities in the group are returned: Entity types > 30 are not currently returned (tested in by DC20). These include MText, PText, Walls etc. If you pass one of these entities as the ent parameter then that entity (and any other entities of these types) will NOT be one of the entities read (note that you can retrieve these entity types using ent_near).

D4D : There was a bug in the interface file that caused mode_group to crash. This was fixed in v20, but you may also be able to fix the interface file yourself for previous versions by changing the following line:

Line in supplied interface file:

```
TPFmode_group = procedure(var mode: mode_type; var ent: entity); stdcall;
```

Change to:

```
TPFmode_group = procedure(var mode: mode_type; ent: entity); stdcall;
```

mode_ignore

```
PROCEDURE mode_ignore (mode : IN OUT mode_type);
```

mode_ignore sets mode to ignore any entities in the database that have been marked unused by ent_setunused. This is useful for snapping to a point and finding the next nearest entity.

See "[ent_setunused](#)" for an example.

mode_init

```
PROCEDURE mode_init (mode : IN OUT mode_type);
```

mode_init must be called to initialize the mode variable.

This procedure should be called before the mode variable is used. The default setting of the mode variable is to read all entities from the current layer.

D4D Note: I have experienced problems that appear to be caused by a mode_init call corrupting a local variable that is declared adjacent to the mode variable that is passed to the mode_init call. The following is a code snippet from one of my macros where I have introduced a filler to prevent problems caused by this:

```
{$Hints off}      // Supress hint about filler not being used.
function HiliteByAtr (AtribName : atrname; colour : integer) : boolean;
  /// colour of zero will UNhilite, result inicates if any entities were hilited.
var
  filler : byte; // Without this filler the AtribName parameter gets corrupted by mode_init call.
                // I expect that it has something to do with mode_type having an odd number of bytes and
                // mode_init operating on a word-aligned area of memory, but Mark/Dave have been unable
                // to reproduce the problem even though similar symptoms have happened for me predictably
                // in multiple projects
  mode : mode_type;
  atr : attrib;
  ent : entity;
```

mode_init1

```
PROCEDURE mode_init1 (mode : IN OUT mode_type);
```

mode_init1 is similar to mode_init, except the layer search type is set to the value currently being used by DataCAD. That is, when Layer Search is on in DataCAD, an automatic mode_lyr (mode, lyr_on) is performed, otherwise a mode_lyr (mode, lyr_curr) is performed on the mode variable.

mode_lyr

```
PROCEDURE mode_lyr (mode : IN OUT mode_type; lyr : integer);
```

mode_lyr sets the mode variable to read from layers in one of three ways, depending upon the value of lyr:

When lyr is lyr_curr, entities are read from the current layer only.

When lyr is equal to lyr_on, entities are read from all layers that are on.

When lyr is equal to lyr_all, entities are read from the entire database.

mode_lyrlocked (D4D only)

```
Procedure mode_lyrlocked(var mode: mode_type; locked: boolean);
```

mode_lyrlocked sets the mode variable to read only from locked layers (if locked is true), or only from unlocked layers (if locked is false).

mode_ss

```
PROCEDURE mode_ss (mode : IN OUT mode_type; ssnun : integer);
```

mode_ss sets mode to read from the database those entities that are in selection set number ssnun.

mode_sym

```
PROCEDURE mode_sym (mode : IN OUT mode_type; sym : IN OUT symbol);
```

mode_sym reads the entities that are in a symbol. The entities read from a symbol are read only.

NOTE: Do not attempt to change the entities with ent_update.

Additional Input Routines

The declarations for the routines in this section are not built-into the DCAL compiler, but require the inclusion of the file_input.inc.

The routines in this section are used to enter data or objects in more complex ways than by using getpoint alone. These routines complement the functions getpoint and getmode. They are similar in operation, but significantly increase the functionality of a macro's user interface. See also "[getpolyline](#)".

getarc

```
FUNCTION getarc (msg : IN string; init : IN OUT boolean; center : OUT point;  
radius, bang, eang : OUT real; key : OUT integer) : integer;
```

getarc allows the user to input an arc using one of seven different methods with a single call to a DCAL routine. This is the same function used throughout DC-Modeler for entering circular shapes such as cylinders and domes. getarc automatically handles dragging as required, clockwise/ counterclockwise toggling for two-point arc entry, changing of input modes, and the effects of changing the current color upon the input sequence.

init is a Boolean flag indicating whether getarc should initialize itself or not. Since getarc is reentrant,

init should be set to true prior to the capture of each new arc. init immediately sets to false after the first invocation of getarc and uses this fact to determine whether or not any particular call to getarc is reentrant or not.

msg is the message with which getarc prompts the user during the input sequence. It is the string which follows the prompt, "Enter ... point of".

getarc returns res_normal when a valid arc is entered. When res_normal returns, the description of the arc is contained in the fields center, radius, bang and eang. center is the center point of the arc. The z-coordinate of center is the value of Z-Base upon exit from the routine. radius is the radius of the arc. bang and eang are the beginning and ending angles of the arc respectively. begang and endang have been properly normalized prior to exit. Normalized angles are always positive, and bang is always smaller than eang.

When a function key is pressed, res_escape returns. In this case, key should be processed the same as it would with a call to getpoint and contains the key code of the function key pressed. getarc uses function keys (F1) through (F8), and (S0). The calling routine may use the remaining function keys. As with getmode, you need only execute lbsinit; lbson is performed automatically by getarc.

The following example acts as a template for the use of getarc:

VAR

```
key      : integer;
result   : integer;
done     : boolean;
center   : point;
radius   : real;
bang     : real;
eang     : real;
...

init := true;
REPEAT
...

  result := getarc ('Enter arc.',
    init, center, radius,
    bang, eang, key);
  IF result = res_escape THEN
    IF key = s0 THEN
      done := true;
    END;
  ELSIF result = res_normal THEN
    { A valid arc has been captured
      and is described by center,
      radius, bang, and eang. }
  END;
UNTIL done;
```

getpointp

```
FUNCTION getpointp (pnt : OUT point; key : OUT integer; vmode : IN integer;
doesc : IN boolean) : integer;
```


getpointp is used in place of the function getpoint when you want to explicitly control the viewing projection or to trap any calls to globalesc. The rest of getpointp operation is identical to that of getpoint.

getpointp returns an integer value equal to either res_normal or res_escape. When a valid point is entered the return value is res_normal.

pnt contains the point entered in world coordinates.

When one of the function keys is pressed, the return value is res_escape. When a keyboard interrupt is pressed doesc is false. In this case, key contains the value of the function key which was pressed ((F1) thru (F0) or (S1) thru (S0)), or the key code of the key pressed.

vmode may be one of the constants vmode_orth, vmode_para, vmode_pers, or vmode_oblq indicating that the allowable viewing projection for the call to getpointp is orthographic, parallel, perspective, or oblique, respectively. When the current viewing projection does not correspond to this projection, the screen automatically refreshes in the most current view in the appropriate projection. Effectively, getpointp executes a call to view_checkmode prior to allowing input.

vmode may be set to either of the constants vmode_edit or vmode_all. vmode_edit indicates that either an orthographic or a parallel projection is allowable. When editing in three dimensions, you can use either of these two projections for many input and editing operations. When the current projection is either orthographic or parallel, no action is taken. If the current projection is not either of these, then the most recent view in these two projections is used. vmode_all indicates that any viewing projection is allowable.

doesc is a flag which indicates whether or not getpoint should handle keyboard interrupts automatically. When doesc is true, keyboard interrupts are handled from within getpointp just as they are with getpoint. When doesc is false, keyboard interrupts are passed back to the calling macro. In this case, key contains the key code of the key which would normally be passed to the procedure globalesc. You can examine the value of this key and take action accordingly, or pass the key explicitly to the procedure globalesc.

The following example calls getpointp allowing only for orthographic or parallel projections. Handling of globalesc by getpointp is disabled. When (Esc) is pressed, a message prints and no further action is taken. Otherwise, control is explicitly passed to globalesc.

```
CONST
  esc = 27;

VAR
  key    : integer;
  result : integer;
  curs   : point;
  done   : boolean;
  ...

  result := getpointp (curs, key,
                      vmode_edit, false);
  IF result = res_escape THEN
```

```

IF key = s0 THEN
  { Exit control loop. }
  done := true;
ELSIF key = esc THEN
  wrterr ('ESC pressed.
  No action taken. ');
  { Do nothing. }
ELSE
  { Call globalesc explicitly. }
  globalesc (key);
END;
ELSIF result = res_normal THEN
  { Process input here the same as

  when using getpoint. }
END;

```

getpoly

```

FUNCTION getpoly (msg : IN string; init : IN OUT boolean; pnt : IN OUT
polyarr; npnt : IN OUT integer; key : OUT integer) : integer;

```

getpoly allows the user to input a polygon by a single call to a DCAL routine. Since polygons have a wide variety of uses, getpoly simplifies and standardizes a user interface for polygon input.

getpoly automatically handles dragging as required, partial drawing of the polygon when the screen is refreshed or the current color changed, and going backwards through the input process at the user's request.

init is a Boolean flag indicating whether or not getpoly should initialize itself. Since getpoly is reentrant, set init to true prior to the capture of each new polygon. init immediately sets to false after the first invocation of getpoly and uses this fact to determine whether any particular call to getpoly is reentrant or not. msg is a string which is concatenated to the end of the input request, "Enter the ... point of the ", by getpoly.

getpoly returns res_normal when a valid polygon is entered. When res_normal is returned, the variable pnt contains the array of vertices for the polygon. The z- coordinates of the polygon are set to Z-Base, and may not all be the same depending upon whether the user changed Z-Base during the operation. npnt is the number of vertices the polygon contains. When a function key is pressed or the user selects (Cancel), res_escape returns. In this case, key should be processed identically to a call to getpoint and contains the key code of the function key pressed. getpoly uses function keys (S7), (S8), and (S0). The calling routine may use the remaining function keys. As is the case with the function getmode, you need only execute lblsinit; lblson is executed automatically by getpoly. The following example acts as a template for the use of getpoly:

```

VAR
  key    : integer;
  result : integer;
  done   : boolean;
  pnt    : polyarr;
  npnt   : polyarr;
...

```

```

init := true;
REPEAT
...
  lblsinit;
  result := getpoly ( ' to enter ',
    init , pnt , npnt , key);
  IF result = res_escape THEN
    IF key = s 0 THEN
      done := true;
    END;
  ELSIF result = res_normal THEN
    { A polygon has been captured.
      pnt and npnt contain the
      description of the polygon. }
  END;
UNTIL done;

```

inputat

```
PROCEDURE inputat ( col, row : IN integer );
```

inputat controls the screen location of input for the functions dgetstr, dgetint, dgetrl, dgetdis, and dgetang.

Ordinarily, these input functions operate only on the message line (the bottom line of the screen) and the location of input is at the end of the last issued wrtmsg procedure. inputat makes it possible to obtain input using these functions at any location on the screen. col is the column (in characters) in which the input field begins. row is the row in which the input field exists. Currently, col must be an integer between 1 and 80 inclusively, and row must be an integer between 1 and 25 inclusively.

inputat can create form like input screens when used with the procedure printstr, and the input functions described above.

In the following example, dgetstr is called, but input is directed towards the center of the screen using inputat:

```

VAR
  str      : str80;
  key      : integer;
  result   : integer;
...

  str := '';
  printstr ( 'Enter distance: ',
    15, 10, clrblue, 0, false);
  inputat (31, 10);
  result := dgetstr ( str, len, key);
  IF result = res_normal THEN
    { Input string captured. }
  ELSIF result = res_escape THEN
    { Function key pressed. }
  END;

```

inputwhere

```
PROCEDURE inputwhere ( col, row : OUT integer );
```

inputwhere returns the current input location which is used during the next call to dgetstr, dgetdis, etc.

See "[inputat](#)".

keyforceexit

```
FUNCTION keyforceexit (key : IN integer) : boolean;
```

keyforceexit determines when a keyboard interrupt should cause control to pass out of the calling macro to some other point in the program.

keyforceexit is used with getpointp. When getpointp is called with doesc set to false, the key passed back to the calling macro may be examined using keyforceexit. keyforceexit returns true when (;) is pressed. Pressing (;) exits the user from the current process and passes control to the main Edit menu.

Knowing when a macro is to be exited, allows the calling macro to clean up prior to releasing control. If you drew temporary data on the screen, keyforceexit allows you to know if the data should be undrawn before passing control to globalesc and subsequently out of the macro.

keyforceexit does not return true when the user presses (Ctrl)-(C). When (Ctrl)-(C) is pressed, the macro immediately stops executing under all conditions.

Dragging Routines

The declarations for the routines in this section are not built into the DCAL compiler, but require the inclusion of the file `_drag.inc`.

The following routines may optionally be used during input operations which use the functions getpoint and getpointp to drag an object on the screen. Many of DataCAD's standard editing functions either drag existing data as it is being manipulated, or drag a shape which is representative of the operation being performed. The routines described here provide for much of this functionality from within a DCAL macro.

All coordinates (points) are in absolute world coordinates unless specified otherwise.

Some of the dragging routines provide for defining the location of the cursor relative to the geometry of the dragged shape independently so that relative world coordinates may be used.

All of the dragging routines take a color parameter. The color parameter should be specified using one of the 15 predefined constants for DataCAD's standard colors. Alternatively, the color may be specified with the built-in variable linecolor so that the current line color is used. Note that linecolor varies on a layer by layer basis.

Many of the dragging routines also take an ortho parameter. This parameter is a Boolean flag which indicates whether or not the dragging routine should consider orthographic snapping. When the ortho parameter is true, orthographic snapping is enabled only if the user enabled orthographic snapping via

the [O] keyboard interrupt. When the ortho parameter is false, orthographic snapping is not enabled regardless of whether the user enabled orthographic snapping via the [O] keyboard interrupt or not.

drag2pt

```
PROCEDURE drag2pt (pt1, pt2 : IN point; ortho: IN boolean; clr: IN integer);
```

drag2pt drags two lines with the cursor. drag2pt is used in DataCAD's standard user interface by the Fence function for selecting entities during an editing operation.

One line extends from pt1 to the cursor and the other line extends from pt2 to the cursor. pt1 and pt2 are defined in absolute world coordinates.

clr is the color of the lines.

ortho indicates when dragging is sensitive to the orthographic keyboard interrupt.

dragbar

```
PROCEDURE dragbar (pt : IN point; lftofs, rhtofs, pntofs, curofs : IN real; ortho : IN boolean; clr : IN integer);
```

dragbar drags a rectangle by fixing one end of the rectangle and moving the other end of the rectangle with the cursor.

pt is the point about which the rectangle is rotated. The dimensions of the rectangle are defined using offsets relative to the point pt and the cursor.

pntofs is the distance between pt and the end of the bar nearest pt. When pntofs is zero, the end of the bar coincides with pt.

curofs is the distance between the cursor and the end of the bar nearest the cursor. When the end of the bar coincides with the cursor, curofs is zero.

lftofs is the distance from a line extending from pt to the cursor to the left side of the rectangle. rhtofs is the distance from a line extending from pt to the cursor to the right side of the rectangle.

clr is the color of the polygon; and ortho indicates when dragging is sensitive to the Orthographic keyboard interrupt.

dragboxmove

```
PROCEDURE dragboxmove (pt, min, max : IN point; clr : IN integer);
```

dragboxmove drags a rectangular box whose sides are parallel with the x and y axes of the screen. dragboxmove is used in DataCAD's standard user interface by the Move/Drag function when the number of entities to drag exceeds Maxlines.

min and max are the lower left and upper right corners of the box respectively.

pt is a point in the same coordinate system as min and max and describes the location of the cursor for dragging the box. When the coordinates of pt are identical to min, for example, the box is dragged by its lower left corner.

clr is the color of the box.

Equivalent D4D routine is **DragBoxMov** (pt, min, max: point; color: asInt; doOrth: boolean);

dragc3

```
PROCEDURE dragc3 (pt1, pt2 : IN point; doline, ortho : IN boolean; clr : IN integer);
```

dragc3 drags a circle defined by three points. dragc3 is used in DataCAD's standard user interface by the Curves/3Pt Circ function.

Two of the points are specified by pt1 and pt2; the third point is defined by the location of the cursor. pt1 and pt2 are defined in absolute world coordinates. When doline is true, a line is drawn extending from pt1 to pt2. When doline is false, this line is not drawn.

clr is the color of the circle.

ortho indicates when dragging is sensitive to the Orthographic keyboard interrupt.

dragdia

```
PROCEDURE dragdia (pt : IN point; doline, ortho: IN boolean; clr: IN integer );
```

dragdia drags a circle by extending a line across its diameter. dragdia is used in DataCAD's standard user interface by the Curves/Dia Circ function.

pt is the point from which to drag the line. The circle passes through the point pt and the cursor. When doline is true, a line is drawn from pt to the cursor bisecting the circle. When doline is false, this line is not drawn.

clr is the color of the circle.

ortho indicates whether dragging is sensitive to the Orthographic keyboard interrupt.

dragmodemove

```
PROCEDURE dragmodemove (mode : IN OUT mode_type; pt : IN point);
```

dragmodemove drags any collection of entities which exist in the drawing database. dragmodemove is used in DataCAD's standard user interface in the Move/Drag function.

mode is a mode_type variable which must be initialized and set using one or more of the mode routines. The definition of the mode variable is important to the performance of dragmodemove; some modes scan the database more efficiently than others. Set mode using the procedure mode_ss. Modes which are defined as selection sets are one of the more efficient ways to read the database, and result in maximum efficiency of dragmodemove. Adversely, modes defined using mode_fence or mode_box are more computationally intensive and result in poorer dragging performance by dragmodemove.

Because dragging is dependent upon the speed and performance of each particular computer system, it's not a good idea to specify a mode which refers to too many entities in the database. Certain entities such as mesh surfaces and surfaces of revolution may require the generation of many line segments,

seriously degrading the performance of dragmodemove. When specifying mode, use care as to how the mode variable is defined as well as the type of entities to which mode refers.

pt is a point in world coordinates which represents the location of the cursor relative to the data represented by the mode variable.

dragmoderot

```
PROCEDURE dragmoderot (mode : IN OUT mode_type; cent, ofs, ref : IN point);
```

dragmoderot drags a collection of entities which exist in the drawing database by rotating them about a point.

mode is a mode_type variable which must be initialized and set using one or more of the mode routines.

cent is a point in absolute world coordinates which defines the center of rotation relative to the entities in the database described by the mode variable.

ofs is a relative offset from cent describing a point to which the center of rotation maps. The entities are rotated about a point which is computed by adding the offset ofs to the point cent.

ref is a point in absolute world coordinates about which the cursor rotates and which is used as a reference point for calculating the rotation angle of the collection of entities.

cent, ofs, and ref may be identical in some applications. For example, if you rotated a collection of entities about a specified point named pt, cent and ref would be set equal to pt, and the coordinates of ofs would be set to zero.

Refer to "dragmodemove" regarding the specification of the mode_type variable. These notes apply equally to procedure dragmoderot. dragmoderot is not currently used in DataCAD's standard user interface but is provided for use by DCAL applications.

dragply

```
PROCEDURE dragply (pnt : IN pntarr; startidx, endidx : IN integer; ref : IN point; close, ortho : IN boolean; clr : IN integer);
```

dragply drags a polygon of arbitrary shape containing up to 36 vertices.

pnt is a variable of type pntarr and contains the vertices of the polygon. The actual values of the z-coordinates of the polygon are not critical since dragging is a two-dimensional operation, but they must be initialized to valid real numbers.

startidx and endidx are the starting and ending indices of the polygon respectively. startidx is typically equal to 1, but does not have to be.

ref is a point in world coordinates which indicates the location of the cursor relative to the points contained in array of vertices pnt.

When the polygon is closed, close is true. When the beginning and ending vertices of the polygon are not joined, close is false.

clr is the color of the polygon.

ortho indicates when dragging is sensitive to the Orthographic keyboard interrupt.

dragply is used in DataCAD's standard user interface when inserting symbols with the *DymRot toggle turned off.

dragplyrot

```
PROCEDURE dragplyrot (pnt : IN pntarr; startidx, endidx : IN integer; cent,  
ofs, ref : IN point; dclose, ortho, doline : IN boolean; clr : IN integer);
```

dragplyrot drags a polygon of arbitrary shape containing up to 36 vertices by rotating the polygon about a point.

pnt is a variable of type pntarr and contains the vertices of the polygon. The actual value of the z-coordinates of the polygon is not critical since dragging is a two-dimensional operation, but they must be initialized to valid real numbers.

startIdx and endIdx are the starting and ending indices of the polygon respectively. startIdx is typically equal to 1, but does not have to be.

cent is a point relative to the coordinates of the polygon about which the polygon rotates.

ofs is the relative distance between cent and the point in world coordinates to which cent maps, and about which the polygon rotates.

ref is a point in absolute world coordinates about which the cursor rotates and is used as a reference for calculating the rotation angle of the polygon.

Cent, ofs, and ref may be identical in some applications. If you rotate a polygon which currently exists in the database about its first vertex, cent and ref equal the coordinates of the first vertex of the polygon, and the coordinates of ofs are set to zero.

When doline is true, a line is drawn between the point ref and the cursor. When doline is false, this line is not drawn. clr is the color of the polygon.

ortho indicates when dragging is sensitive to the Orthographic keyboard interrupt.

dragplyrot is used in DataCAD's standard user interface when inserting symbols with the *DymRot toggle turned on.

dragrad

```
PROCEDURE dragrad (pt : IN point; doline, ortho : IN boolean; clr : IN  
integer);
```

dragrad drags a circle by extending a line from the center point of the circle to a point on the circle's circumference.

pt is the center point of the circle; and the circle passes through the cursor.

When doline is true, a line is drawn extending from the center of the circle to the cursor. When doline is false, this line is not drawn.

clr is the color of the circle.

ortho indicates when dragging is sensitive to the Orthographic keyboard interrupt.

dragRad is used in DataCAD's standard user interface by the Curves/Rad Circ function.

Output Routines

Display Routines

Use the routines in this section to write to the DataCAD command line area, to control the screen mode, and to control which parts of the drawing appear in the drawing viewport.

currwndw

```
PROCEDURE currwndw (lowleft, upright : IN OUT point);
```

This procedure sets lowleft and upright to be the lower left and upper right corners, respectively, of the current window. The two points are in world coordinates.

drawcursor

```
PROCEDURE drawcursor (pt : point);
```

drawcursor is used for debugging.

It draws a cursor at the given world coordinates using drmode_flip, so that calling drawcursor twice with the same point restores the screen to its original state.

extents

```
PROCEDURE extents ( min, max : OUT point; recalc : IN boolean );
```

extents calculates the extents of the current drawing. extents returns a set of values that reflect only the layers which are currently turned on.

min is a point which contains the x, y, and z- coordinates of the lower left corner of the bounding box.

max is a point which contains the x, y, and z-coordinates of the upper right corner of the bounding box.

When the flag recalc is true, the extents of the drawing are recalculated by examining each entity, and updating the extents which are saved with each layer prior to calculating the overall extents of those layers which are turned on. When the flag recalc is false, these calculations are not made, and the extents stored with each layer are assumed to be correct.

DataCAD constantly updates the extents of each layer when entities are added to the drawing database, or during editing operations which cause the extents of a layer to become larger. When an editing or erase operation causes the extents of a layer to become smaller, the extents stored for each layer may not correctly reflect the actual extents of the entities on those layers. In this case, recalculation of the drawing extents is required to correctly update the extents for each layer.

grafmode

```
PROCEDURE grafmode;
```

grafmode sets the display into graphics mode. The display is confusing, however, until redrawall is called.

pixsize

```
FUNCTION pixsize : real;
```

pixSize returns the size, in world coordinates, of a pixel at the current display scale.

popview

```
PROCEDURE popview;
```

popview pops a view off DataCAD's internal stack of 2D views. This is identical to pressing (P).

printstr

```
PROCEDURE printstr (str : string; col, row, color, cursor : integer; inverse  
: boolean);
```

printstr draws a string anywhere on the screen in graphics mode. This is the same procedure that is used internally to write all of the function keys and messages.

str is the string to be written.

col and row are the character coordinates of the position where the string is written. col is in the range 1 to 80 and row is in the range 1 to 25, with (1, 1) being the upper left of the screen.

color is the color in which the string appears.

cursor is the position in the string where the inverse cursor appears. When cursor is zero no cursor appears in the string (the typical case). Not all display drivers support a cursor in the string.

When inverse is true, the string is in inverse video.

See also "[inputat](#)" in this chapter.

PrintStr255 (added in DataCAD 18.04)

```
PROCEDURE PrintStr255(str : str255; Column, Row, Color, Curs : integer;  
Invert : boolean); BUILTIN 670;
```

pushview

```
PROCEDURE pushview;
```

pushview pushes the current view onto DataCAD's internal stack of 2D views. This is the procedure DataCAD calls before it performs WindowIn.

redraw

```
PROCEDURE redraw;
```

redraw is like regen, but on boards with a display list, the drawing is redrawn from the display list and not from the database. On cards without a display list, redraw is the same as regen, that is, the drawing is redrawn from the database. In general, when you want to redraw the drawing, call redraw.

redrawall

```
PROCEDURE redrawall;
```

redrawall redraws everything on the graphics screen after clearing the screen, including the messages, function keys, and the drawing.

regen

```
PROCEDURE regen;
```

regen redraws the entire drawing (all layers that are on) from the database. On boards with a display list, this is equivalent to the (U) key. On other boards, this is the same as the (Esc) key.

textmode

```
PROCEDURE textmode;
```

textmode sets the graphic display into text mode. Any of the input routines with the exception of getpoint (and its derivatives) work while in text mode.

toview

```
PROCEDURE toview (num : integer);
```

toview switches to one of DataCAD's ten saved views.

num must be between 1 and 10 inclusively.

vwptclear

```
PROCEDURE vwptclear;
```

vwptclear erases the portion of the screen where the drawing appears. When the template viewport is on, the screen is not cleared.

windowin

```
PROCEDURE windowin (lowleft, upright : point);
```

windowin zooms as close as possible to the two points passed to it using the available scales. The points are in world coordinates.

lowleft and upright can be any two diagonally-opposite corners of the new window.

wrterr

```
PROCEDURE wrterr (str : string);
```

wrterr writes its argument on the error line of the monitor, overwriting any previous error message. The error line is the second line from the bottom of the screen.

wrtltype

```
PROCEDURE wrtltype;
```

wrtltype updates the line type descriptor at the lower left corner of the screen. Changing the value of the built-in variable linetype does not automatically update this descriptor; wrtltype must be called explicitly to perform this function.

wrtlvl

```
PROCEDURE wrtlvl (str : string);
```

wrtlvl writes out str as the current program level. This is the eight-character string on the bottom line next to the message string.

When str is more than eight characters long, only the first eight characters are used. When str is less than eight characters long, it is padded on the right with blanks. The previous level string is overwritten.

wrtlyr

```
PROCEDURE wrtlyr;
```

wrtlyr writes out the name of the current layer in the lower left corner of the screen. On a color monitor, the layer name appears in the current color.

wrtmsg

```
PROCEDURE wrtmsg (str : string);
```

wrtmsg writes its argument on the bottom line of the display, overwriting the previous message.

Use this procedure to write prompts to the screen for input routines:

```
wrtmsg ('Enter number of divs: ');
getint (divs);

getout := false;
REPEAT
  wrtlvl ('Stairs');
  wrtmsg ('Point to center. ');
  result := getpoint (cent, key);
  IF result = res_escape THEN
    IF key = s0 THEN
      getout := true;
    END;
  END;
UNTIL (result = res_normal) OR
  getout;
```

wrtscl

```
PROCEDURE wrtscl;
```

wrtscl writes out the current scale in the lower left corner of the monitor.

wrtss

```
PROCEDURE wrtss;
```

wrtss updates the selection set indicator in the lower left hand corner of the screen to indicate the currently active selection set and whether or not selection set appending is active. wrtss is typically used immediately after a call to a selection set routine.

See "Selection Set Routines" for more information.

wrtstat

```
PROCEDURE wrtstat;
```

wrtstat updates the SWOTHLUD status indicator at the lower left corner of the screen.

Changing the value of one of the built-in variables such as ortho snapping, or walls on/off does not automatically update this indicator; wrtstat must be called explicitly to do this.

Plotting Routines

The declarations for the routines in this section are not built-into the DCAL compiler, but require the inclusion of the file `_plot.inc`.

The following routines invoke DataCAD's plotting system from within a DCAL macro. The plotting interface to DCAL is extremely flexible without compromising the performance or usability of the system. In fact, the plotting system available through DataCAD is a subset of the plotting system available through DCAL.

do_ChangePlotScale (added in DataCAD 16.03)

```
PROCEDURE do_ChangePlotScale (NewScale : integer); BUILTIN 654;
```

plot_close

```
PROCEDURE plot_close; (plot : IN OUT plot_type);
```

plot_close closes the plotting subsystem.

plot must be the same variable passed to plot_open.

plot_mode

```
PROCEDURE plot_mode (plot      : IN OUT plot_type;
                    mode      : IN OUT mode_type;
                    multipen  : IN boolean;
                    pensort   : IN boolean;
                    colors    : IN boolean;
                    vwptMin   : IN point;
                    vwptMax   : IN point;
                    wndwMin   : IN point;
                    wndwMax   : IN point;
                    center    : IN point;
                    ang       : IN real);
```

plot_mode does the actual plotting of entity data to the plotter or file. plot_mode may be called multiple times between calls to plot_open and plot_close.

plot is the variable initialized by plot_open. The entities to plot are determined by mode, just as in any reading of the database.

multipen controls whether or not a multiple pen plot is being performed.

pensort controls the sorting by pen option.

colors controls whether or not a color plot is being performed.

vwptmin and vwptmax control the area on the plotter where the plotted output appears. Only the x and y coordinates of these points are used; however, z-coordinates should be initialized to a real value.

wndwmin and wndwmax are the world coordinates that are plotted into the area defined by vwptmin and vwptmax (again, only the x and y values are used). Notice that the ratio of x and y values in vwptmin and vwptmax does not have to match the ratio of x and y values in wndwmin and wndwmax, but typically you want the ratios to be the same.

center is the center of rotation for a rotated plot. center should always be initialized to some value, even when no rotation is specified. center is specified in world coordinates (that is, relative to wndwmin and wndwmax).

ang is the angle of rotation for a rotated plot.

plot_mode1

```
PROCEDURE Plot_Model (plot : IN OUT plot_type
                      mode : IN OUT mode_type;
                      multipen : IN boolean;
                      pensort : IN Boolean
                      colors : IN boolean;
                      vwptMin, vwptMax : IN point;
                      wndwMin, wndwMax : IN point;
                      center : IN point;
                      ang : IN real); BUILTIN 498;
```

Works just like Plot_Mode except that the pen is not put away when the plot is completed.

plot_open

```
FUNCTION plot_open
  (penwidth   : IN integer;
   penspeed   : IN integer;

   maxx      : IN real;
   maxy      : IN real;
   tofile     : IN boolean;
   fname      : IN string;
   plot       : IN OUT plot_type)
  : integer;
```

plot_open opens the plotting subsystem. It must be called before a plot is started.

penwidth is the pen width (in plotter units) DataCAD uses to plot multiple weight lines.

penspeed is the pen speed DataCAD passes to the plotter driver. Not all plotter drivers support pen speeds; the units are plotter defined. When in doubt, pass the built-in variable pltpenspeed to plot_open.

maxx and maxy are the sizes, in world coordinates, of the paper in the plotter.

tofile is true when the plotter output is going to a file, and false when output is sent to the plotter.

fname is only used when tofile is true, and is the name of the plot file where the plotter data is sent.

The variable plot is initialized by plot_open and used in plot_close and plot_mode. The return value is zero if successful and non-zero if unable to open the plotter.

File Routines

Use the routines in the following section to manipulate DOS files. See "File I/O Routines" for reading and writing files. Any routines that return integers use the DOS file error constants described in the "Constants" chapter.

File Manipulation Routines

chdir

```
FUNCTION chdir (path : string) : integer;
```

chdir changes the current directory to path.

This procedure should NEVER be called, but is included for completeness.

ExportAutoCADFile (added in DataCAD 16.03)

```
PROCEDURE ExportAutoCADFile (acadfname: string;  
                             vernum, lyrmodenum: integer); BUILTIN 652;
```

1. "acadfname" is the fully qualified name of the DWG file to create.
2. vernum is the DWG version to create (18=AC2004, 21=AC2007, etc.).
3. lyrmodenum should be passed as either Lyr_On or Lyr_All.

file_copy

```
FUNCTION file_copy (oldname, newname : string) : integer;
```

file_copy copies a file from one location to another.

newname can be in the same directory as oldname as long as the filename is different.

file_del

```
FUNCTION file_del (fname : string) : integer;
```

file_del deletes a file.

fname is the pathname of a unique file (no wild cards). The return value is the DOS return code.

file_exist

```
FUNCTION file_exist (fname : string) : boolean;
```

file_exist checks for existence of a file.

file_exist returns true when the file fname exists, false when it does not.

file_find

```
FUNCTION file_find (str : OUT string; attr : OUT integer; buf : IN OUT dosbuf) : boolean;
```

file_find searches for files specified in the previous call to file_pattern.

The name of the file found (without the name of the path) is returned in str, and its attribute is returned in attr.

For example, the following example of code:

```
file_pattern ('c:/mtec/*.exe', 0, buf');  
WHILE file_find (str, attr, buf) DO  
  wrterr (str);  
END;
```

could produce the output:

```
DCAD.EXE  
CONFIG.EXE  
CONVTPL.EXE
```

file_pattern

```
PROCEDURE file_pattern (pat : string; attr : integer; buf : IN OUT dosbuf);
```

file_pattern is used with file_find to search directories for given files.

file_pattern initializes the variable buf for use by file_find.

attr is the file attribute to search for; for normal files, this number is zero.

For more information on file attributes, see your DOS Reference Manual.

file_ren

```
FUNCTION file_ren (oldname, newname : string) : integer;
```

file_ren renames a file from oldname to newname. This function can also be used to move files from one directory to another, as long as they remain on the same disk drive.

For example:

```
iores := file_ren ('c:/dcad/abc.def',  
                  'c:/abc.def');
```

moves the file abc.def to the root directory, as long as the return code is fl_ok.

mkdir

```
FUNCTION mkdir (path : string) : integer;
```

mkdir creates (makes) directories. Similar to the DOS mkdir command, mkdir can create only one directory at a time.

For example, when c:/dcad does not exist,


```
iores := mkdir (c:/dcad/dwg);
```

fails.

rmdir

```
FUNCTION rmdir (path : string) : integer;
```

rmdir is used to remove directories. Similar to the DOS keyboard command rmdir, the directory being removed must be empty.

File I/O Routines

The functions presented in this section allow DCAL macros to read or write to files or devices. All functions in this section (with the exception of `f_eof`) return one of the file i/o constants, described in the "Constants" chapter. An operation with no errors returns `fl_ok`. Once an error occurs in a file, no further operations are performed on that file, and all subsequent calls to any of the file i/o functions return the same error number.

DCAL understands two types of files: text files and binary (or data) files. Specify the file type in the `f_open` or `f_create` function calls. You can use the routines that read and write strings, reals, integers, and characters with either text files or data files. For text files, these routines convert the arguments to and from strings. For data files, the parameter is written to the file as a data item (not converted to a string).

f_close

```
FUNCTION f_close (fl : IN OUT file) : integer;
```

`f_close` closes the file `fl`.

`f_close` must be called before leaving the macro to ensure that the RAM buffer is flushed to the disk and the file handle is released.

f_create

```
FUNCTION f_create (fl : OUT file; fname : string; text : boolean) : integer;
```

`f_create` creates a file with the name `fname`.

When the file is a text file, `text` is true, otherwise `text` is false. The file is opened for writing (`fmode_write`).

f_eof

```
FUNCTION f_eof (fl : IN OUT file) : boolean;
```

`f_eof` returns true when the current state of file `fl` is the end of file; otherwise, it returns false.

f_open

```
FUNCTION f_open (fl : OUT file; fname : string; text : boolean; mode : integer) : integer;
```

`f_open` opens an existing file or device.

The name of the file (including the path) is given by fname.

The file variable fl is initialized to read, write, or read and write the file depending on whether mode is fmode_read, fmode_write, or fmode_read_write, respectively.

When text is true, the file is opened as a text file, and mode must be fmode_read. When text is false, the file is opened as a data file.

f_rdchar

```
FUNCTION f_rdchar (fl : IN OUT file; ch : OUT char) : integer;
```

f_rdchar reads a character from the specified file.

f_rdint

```
FUNCTION f_rdint (fl : IN OUT file; i : OUT integer) : integer;
```

f_rdint reads an integer from the file fl.

In a text file, an integer is specified as a string. This function skips leading white space, and converts the string that follows to an integer. In a data file, two bytes are read from the file and put in the variable i.

f_rdln

```
FUNCTION f_rdln (fl : IN OUT file) : integer;
```

This function reads past the next new line sequence. This function is important when you read a text file for strings.

The first call to f_rdstr returns the first line (string) of the file. The next call to f_rdstr returns a string of zero length, because the file is sitting at the new line mark, which terminates a string. To advance to the next line, call f_rdln between the calls to f_rdstr. This call is only valid for text files, and returns an error when used on a data file.

f_rdreal

```
FUNCTION f_rdreal (fl : IN OUT file; rl : OUT real) : integer;
```

This function reads a real from the file fl.

f_rdstr

```
FUNCTION f_rdstr (fl : IN OUT file; str : OUT string) : integer;
```

This function reads a string from the file fl. The string is terminated by either reaching the maximum length of the file or by hitting a new line character.

See the discussion of "[f_rdln](#)".

f_seek

```
FUNCTION f_seek (fl : IN OUT file; recnum : integer) : integer;
```

f_seek can only be used on data files.

f_seek positions the file pointer to the recnum record of file fl, based on the record length set for that file in f_setrec. Record numbers start at 0.

For example, to seek to the fourth record of a file, write:

```
iores := f_seek (fl, 3);
```

This positions the pointer for the file at the 18th byte of the file fl. f_seek and f_setrec allow a programmer to build and read a random access data file.

f_setrec

```
FUNCTION f_setrec (fl : IN OUT file; len : integer) : integer;
```

f_setrec sets the record length of a file in bytes. This record length is used only in the function f_seek.

The parameter fl must be a data file.

f_setrec must be called after f_open or f_create. If f_setrec is not called, the record length is assumed to be one byte. The function sizeof is useful with this function.

For example, if every record of a data file consisted of two fields, one a real and the other an integer, you might write:

```
iores := f_setrec (fl,  
    sizeof(0.0) + sizeof(0));
```

This sets the record size to 6 bytes. Because this number may change in future versions of DCAL and DataCAD, it is a good idea to use sizeof and f_setrec.

f_wrchar

```
FUNCTION f_wrchar (fl : IN OUT file; ch : char) : integer;
```

This function writes a single character to the file.

f_wrln

```
FUNCTION f_wrln (fl : IN OUT file) : integer;
```

f_wrln writes a new line to the file. This tells the file to start a new line at the current position.

f_wrint

```
FUNCTION f_wrint (fl : IN OUT file; int : integer) : integer;
```

This function writes an integer to the file.

integer is converted to a string first when using a text file. Notice that the integer is not padded on either side with spaces, so you may want to write leading or trailing spaces (or both) to the file using f_wrstr or f_wrchar.

f_wrreal

```
FUNCTION f_wrreal (fl : IN OUT file; rl : real) : integer;
```

f_wrreal is similar to f_wrint, except that it writes out a real instead of an integer. The real number is converted to a string before writing to the file when fl is a text file.

f_wrstr

```
FUNCTION f_wrstr (fl : IN OUT file; str : string) : integer;
```

f_wrstr writes a string to the file fl. The string is not padded with spaces or new line characters.

INI File Routines (added in DataCAD 9)

The following variables apply to the INI File Routines:

IniFile = A text file.

The file may have any valid name and extension. It does not need to have an 'ini' extension. If no path is given the file will be saved to the windows system directory.

Section = A heading within the Inifile under which the Ident/Value will be found. The section name appears in the format [section_name] Note the brackets.

Ident = The label of the value to be saved/read.

Value = The value to be saved/read.

Ident/Values are stored as pairs in the format 'ident = value' The quotes are not part of the format.

writeIniStr

```
PROCEDURE writeIniStr (IniFile, Section, Ident, Value : str255);  
BUILTIN 624;
```

Writes Value to Inifile as a string.

readIniStr

```
PROCEDURE readIniStr (IniFile, Section, Ident, Default : str255;  
ReturnStr : OUT str255); BUILTIN 625;
```

Reads ReturnStr from IniFile. If the string is not found Default is returned.

writeIniBool

```
PROCEDURE writeIniBool (IniFile, Section, Ident : str255;  
Value : boolean); BUILTIN 626;
```

Writes Value to IniFile as a Boolean. The value is converted to an integer with the value of 0 for false and 1 for true.

readIniBool

```
PROCEDURE readIniBool (IniFile, Section, Ident: str255; Default : boolean;  
ReturnBool : OUT boolean); BUILTIN 627;
```

Reads ReturnBool from IniFile. If ReturnBool is not found Default is returned.

writeIniInt

```
PROCEDURE writeIniInt (IniFile, Section, Ident : str255; Value : integer);  
BUILTIN 628;
```

Writes Value to IniFile as an Integer.

readIniInt

```
PROCEDURE readIniInt ( IniFile, Section, Ident: str255;  
                      Default : integer;  
                      ReturnInt : OUT integer); BUILTIN 629;
```

Reads ReturnInt from IniFile. If ReturnInt is not found Default is returned.

writeIniReal

```
PROCEDURE writeIniReal (IniFile, Section, Ident : str255;  
                       Value : real); BUILTIN 630;
```

Writes Value to IniFile as a real. Note that you are limited to 8 digits in your real value. This includes the decimal point. Any value exceeding 8 digits will be rounded when stored. For example 1.2345678 will be saved as 1.234568. This holds true for exponential formats as well. 1.234e23 will be written as is while 1.2345678e23 will be rounded to 1.234568e23.

readIniReal

```
PROCEDURE readIniReal (IniFile, Section, Ident: str255; Default : real;  
                      ReturnReal : OUT real); BUILTIN 631;
```

Reads ReturnReal from IniFile. If ReturnReal is not found Default is returned.

Chapter 6 – Data Routines

Character and String Routines

The routines in this section allow you to convert between several data types and strings, manipulate strings, and perform useful operations on characters.

cvangst

```
PROCEDURE cvangst (ang : real; str : OUT string);
```

cvangst converts its first argument (an angle measured in radians) to a string and which it returns in its second argument.

The returned string depends upon the current angle type. An error occurs when the string is not long enough to hold the result.

cvdisst

```
PROCEDURE cvdisst (dis : real; str : OUT string);
```

cvdisst converts a distance to a string. The distance is in DataCAD units as described earlier. **Note: the absolute value of the distance is converted to a string: you need to add the negative sign to the string yourself after the conversion if it is a negative distance.**

The returned string depends upon the current scale type (metric, architectural, etc.). An error occurs when the string is not long enough to hold the result.

cvintst

```
PROCEDURE cvintst (i : integer; str : OUT string);
```

cvintst converts an integer to a string.

An error occurs when the string is not long enough to hold the result.

For example, in the statements:

```
  i := 45;  
  cvintst (-1 * i, str);
```

str is equal to '-45'.

D4D Note: cvintst procedure is provided in D4D, but do NOT use it. Use the Delphi IntToStr function instead.

cvlntst

```
PROCEDURE cvlntst (li : longint; str : OUT string);
```

cvlntst converts a long integer to a string.

cvrllst

```
PROCEDURE cvrllst (rl : real; str : OUT string);
```

cvrllst converts a real number to a string.

An error occurs when the string is not long enough to hold the result.

The statement:

```
cvrllst (45.56, str);
```

results in str being equal to '45.56'.

cvstint

```
FUNCTION cvstint (str : string; i : OUT integer) : boolean;
```

cvstint converts the string str to an integer and returns the result in i.

When cvstint is able to convert the string, it returns true. When there is an error in conversion, (for instance, str = '45x3') false returns.

cvstlnt

```
FUNCTION cvstlnt (str : IN string; li : OUT longint) : boolean;
```

cvstlnt converts a string to a long integer (longint).

cvstrll

```
FUNCTION cvstrll (str : string; rl : OUT real) : boolean;
```

cvstrll converts the string to a real.

true returns when there is no error in conversion; false returns when there is a conversion error.

islower

```
FUNCTION islower (ch : char) : boolean;
```

islower returns true when ch is a lowercase letter. When ch is an uppercase letter or not a letter islower returns false.

```
islower (a)    returns true
islower (B)    returns false
islower ($)    returns false
```

isupper

```
FUNCTION isupper (ch : char) : boolean;
```

isupper returns true when its argument is an uppercase character. When its argument is a lowercase character or not a character isupper returns false.

```
isupper (a)    returns false
isupper (B)    returns true
isupper ($)    returns false
```

strassign

```
PROCEDURE strassign (dest : IN OUT string; source : string);
```

strassign copies source into dest.

This procedure is needed because you can't assign two string variables of different maximum or dynamic lengths to one another using ':='. A string literal, however, can be assigned to a string variable with ':=' or strassign.

strcat

```
PROCEDURE strcat (str1 : IN OUT string; str2 : string);
```

strcat returns in its first argument the first argument concatenated with the second argument.

An error occurs when the maximum length of the first argument cannot hold the result.

If str1 = 'Good ' and str2 = 'Morning', then:

```
strcat (str1, str2);
```

results in str1 = 'Good Morning'. str2 will be unchanged. Similarly:

```
strcat (str2, str1);
```

results in str2 = 'MorningGood ' and str1 is unchanged.

strcmp

```
FUNCTION strcmp (str1, str2 : string; len : integer) : boolean;
```

strcmp compares two strings to see if they are equal.

When len is -1, the entire strings are compared, that is, their dynamic lengths must be the same for them to be equal. When len is a positive number, only the first len characters are compared.

```
strcmp ('Hello', 'Hello', -1) = true  
strcmp ('Hello', 'Hello1', 5) = true  
strcmp ('Hello', 'Hello1', -1) = false
```

strdel

```
PROCEDURE strdel (str : IN OUT string; start, len : integer);
```

strdel deletes len characters from str starting at position start.

When there are not len characters in the string after position start, a run-time error occurs.

For example if str = 'abcdefghij', then

```
strdel (str, 4, 3);
```

results in str = 'abcghij'.

strinc

```
PROCEDURE strinc (str : IN OUT string);
```

strinc increments a string.

The characters on the right end of a string that form a number are incremented to the next number. The string can have any number of digits on the right end of the string.

For example if str = 'abc123', then after calling strinc four times, str = 'abc127'.

strins

```
PROCEDURE strins (dest : IN OUT string; source : string; pos : integer);
```

strins inserts source into dest before position pos.

For example if dest = '12345', then

```
strins (dest, 'hi', 3)
```

results in dest = '12hi345'.

strlen

```
FUNCTION strlen (str : string) : integer;
```

strlen returns the current dynamic length of its argument.

For example, if str = 'hello, world', then:

```
strlen (str)
```

returns 12. Also,

```
strlen (test)
```

returns 4.

strpad

```
PROCEDURE strpad (str : IN OUT string; len : integer; ch : char);
```

strpad pads the string str on the right with character ch until its length (as returned by strlen) is equal to len.

When str is longer than len, it is truncated to be len characters long.

For example if str = '123', then

```
strpad (str, 6, "***")
```

leaves str = '123***'.

strpos

```
FUNCTION strpos (pat, str : string; start : integer) : integer;
```

strpos searches for pat in str, starting at position start.

It returns the position in str where pat first occurs, or 0 if pat does not occur in str after start characters.

For example:

```
strpos ('12', '123123', 2)
```

returns 4, the position of the first occurrence of '12' after position 2.

strsub

```
PROCEDURE strsub (source : string; start, len : integer; dest : IN OUT string);
```

strsub extracts a piece of a string.

On exit, dest contains len characters from source starting at start.

For example:

```
strsub ('12345678', 2, 4, dest)
```

results in dest = '2345'.

strupcase

```
PROCEDURE strupcase (str : IN OUT string; toupper : boolean);
```

strupcase converts a string to either all uppercase or all lowercase.

When the parameter toupper is true, the string is converted to uppercase. When toupper is false, the string is converted to lowercase. strupcase uses the same rules as the functions toupper and tolower.

tolower

```
FUNCTION tolower (ch : char) : char;
```

tolower returns its argument converted to lowercase if it is an uppercase character; otherwise, tolower returns its argument unchanged.

```
tolower (a)   returns 'a'  
tolower (A)   returns 'a'  
tolower ($)   returns '$'
```

toupper

```
FUNCTION toupper (ch : char) : char;
```

toupper returns its argument converted to uppercase if it is a lowercase character, otherwise, toupper returns its argument unchanged.

```
toupper (a)   returns 'A'  
toupper (A)   returns 'A'  
toupper ($)   returns '$'
```

Working with Entities

Use the routines in this section to perform operations on entities that have been read from the database. See the following section on ways to read entities from the database.

ent_add

```
PROCEDURE ent_add (ent : IN OUT entity);
```

ent_add adds the entity ent to the database on the current layer. All fields of an entity specific to the particular entity type (line, slab, dome) must be set prior to calling ent_add. The macro stops executing when there is not enough room to add the entity to the database.

During this procedure, the currently-set values of the variables that define line type, entity color, etc., are used for the added entity. When the entity is added to the database, it is not automatically drawn on the graphics screen. This must be done separately by the macro.

See “Chapter 4 – Variables” for more information.

ent_copy

```
PROCEDURE ent_copy (oldent, newent : IN OUT entity; toCurr, doAttr :  
boolean);
```

ent_copy duplicates an entity in the database.

Use this procedure instead of assigning entities and then adding the new one to the database.

For example:

```
ent_copy (oldent, newent, false, true);
```

The parameter toCurr controls whether newent is copied to the current layer or to the layer that oldent is on. When toCurr is true, newent is copied to the current layer. When toCurr is false, newent is copied to the same layer as oldent.

When doAttr is true, the attributes of oldent are copied to newent. When doAttr is false, the attributes are not copied. It is recommended that doAttr always be true, unless you have a specific reason not to copy attributes.

There is no need to call ent_init (newent,...); prior to ent_copy or to call ent_update (newent); after a call to ent_copy.

ent_del

```
PROCEDURE ent_del (ent : IN OUT entity);
```

ent_del deletes ent from the database.

ent must have been read from the database using one of the database routines. If it was not, a fatal internal error occurs.

ent_draw

```
PROCEDURE ent_draw (ent : IN OUT entity; drmode : integer);
```

ent_draw draws ent on the screen using the specified drawing mode.

drmode can be either drmode_white, drmode_black, or drmode_flip.

ent does not have to have been read from the database with ent_get, as long as all the information needed to draw the entity has been specified (color, end points, radius, etc).

This is useful for creating temporary images on the screen.

ent_draw_2d

```
PROCEDURE ent_draw_2d (ent : IN entity; drmode : IN integer);
```

ent_draw_2d is similar to procedure ent_draw except that in any viewing projection other than orthographic, ent_draw_2d draws an entity disregarding the 3D to 2D viewing projection.

ent_draw_2d is typically used during input and editing operations which are performed in parallel projections to allow for the drawing of entity geometry without accounting for the current viewing matrix, but correctly handling the current window-to-viewport transformation.

ent_draw_dl

```
PROCEDURE ent_draw_dl (ent : IN entity; drmode : IN integer;  
                      todl : boolean); BUILTIN 476
```

ent_draw_dl draws ent on the screen using the specified drawing mode.

drmode can be either drmode_white, drmode_black, or drmode_flip.

ent does not have to have been read from the database with ent_get, as long as all the information needed to draw the entity has been specified (color, end points, radius, etc).

When todl is true, the entity is added to the display list. When todl is false, the entity is not added to the display list. todl should be false for temporary screen data.

This is useful for creating temporary images on the screen.

ent_drawmode

```
FUNCTION ent_drawmode (mode : IN mode_type; drmode : IN integer; todl,  
                      clearscr : IN integer) : integer;
```

ent_drawmode is similar to ent_draw_dl, except that instead of drawing only one entity, every entity returned by mode is drawn.

drmode can be either drmode_white, drmode_black, or drmode_flip.

ent does not have to have been read from the database with ent_get, as long as all the information needed to draw the entity has been specified (color, end points, radius, etc).

When todl is true, the entity is added to the display list. When todl is false, the entity is not added to the display list. todl should be false for temporary screen data.

When clearscr is true, the screen is cleared before the entities are drawn.

See "mode".

ent_enlarge

```
PROCEDURE ent_enlarge (ent : IN OUT entity; cent : point; Xsc, Ysc, Zsc : real);
```

ent_enlarge enlarges entity ent by the factors Xsc, Ysc, and Zsc about the point cent.

Perform an ent_update after the entity is enlarged to update the database.

ent_extent

```
PROCEDURE ent_extent (ent : IN OUT entity; lowleft, upright : OUT point);
```

ent_extent finds the minimum and maximum extents of ent. This is the smallest box that completely encloses the entity.

Notes:

1. For polylines with bulges ent_extent can sometimes return incorrect results. I think I have also found incorrect results for ellipses. My experience of this is in D4D, but it may also apply to Classic DCAL.
2. In D4D I have made notes previously that the use of ent_extent caused DataCAD to crash subsequent to the ent_extent call (it does not crash at the call itself, but at some subsequent logic). This does not always happen and I cannot reproduce it at will now (but be aware of it as a possibility if you use this procedure and find that DataCAD crashes).

ent_init

```
PROCEDURE ent_init (ent : IN OUT entity; enttype : integer);
```

Whenever an entity is declared, ent_init should be called to initialize the entity. This call initializes all fields of an entity so that it may be drawn and otherwise operated on. Failure to call this procedure before using an entity can result in an entire range of errors.

enttype is the constant for the type of entity, such as entlin or entply.

ent_isLockSize (added in DataCAD 17.03)

```
FUNCTION Ent_IsLockSize (Ent : IN OUT entity) : boolean; BUILTIN 667;
```

ent_mirr (added in DataCAD 19.03)

```
PROCEDURE Ent_Mirr(ent : In Out entity; pt1, pt2 : point;  
FixText : boolean); BUILTIN 675;
```

ent_move

```
PROCEDURE ent_move (ent : IN OUT entity; dx, dy, dz : real);
```

ent_move moves entity ent by dx, dy, and dz.

Perform an ent_update after moving an entity to replace the entity in the database.

ent_relink

```
PROCEDURE ent_relink (ent1, ent2 : IN OUT entity);
```

ent_relink moves the logical location of an entity in the database.

ent1 is not relocated in the database.

Ent_SetPenStyle (added in DataCAD 17.02)

```
PROCEDURE Ent_SetPenStyle (PenStyleName : string;  
                           Ent : IN OUT entity); BUILTIN 661;
```

Ent_SetPenSpacing (added in DataCAD 17.02)

```
PROCEDURE Ent_SetPenSpacing (PenSpacing : IN real;  
                             Ent : IN OUT entity); BUILTIN 662;
```

ent_tran

```
PROCEDURE ent_tran (ent : IN OUT entity; mat : IN modmat; update, doatr: IN  
boolean);
```

ent_tran transforms an entity by the transformation described in a modeling matrix. ent_tran may not be used on all of DataCAD's entities, but only those which may be arbitrarily translated, scaled, mirrored, and rotated in space.

The function ent_tranok determines if the entity will respond to the procedure ent_tran. Entities which can be described by the following constants can be used with ent_tran and cause the function ent_tranok to return true:

```
entLn3   entAr3   entDom  
entMrk   entCon   entTor  
entSym   entCyl   entSrf  
entPly   entTrn   entBlk  
entSlb   entCnt   entPln
```

ent is the entity to transform.

mat is the modeling matrix to apply to ent. Set mat using one or more of DCAL's matrix calculation routines.

When the flag update is true, an ent_update is supposed to be performed automatically by ent_tran. When the flag update is false, an ent_update is not performed automatically.

Entities of type polygon or slab which contain voids, have their voids transformed and updated in the database regardless of the value of the flag update.

When the flag doatr is true, any visible attributes attached to the entity ent are transformed as well.

ent_tranok

```
FUNCTION ent_tranok (ent : IN OUT entity) : boolean;
```

ent_tranok determines if an entity responds to a transformation applied directly via a modeling matrix. ent_tranok is typically used with the procedure ent_tran to determine if ent_tran can be applied to an entity of a particular type. When the entity passed to ent_tranok can be transformed using ent_tran, ent_tranok returns true. When the entity cannot be transformed ent_tranok returns false. ent is the entity to check.

ent_update

```
PROCEDURE ent_update (ent : IN OUT entity);
```

ent_update updates the database with the current description of ent.

For example, you can read entities from the database, undraw them, change their colors, put them back into the database, and then redraw them using the following code:

```

mode_init (mode);
mode_lyr (mode, lyr_curr);
adr := ent_first (mode);
WHILE ent_get (ent, adr) DO
  ent_draw (ent, drmode_black);
  ent.color := clrred;
  ent_update (ent);
  ent_draw (ent, drmode_white);
  adr := ent_next (ent, mode);
END;

```

ent_updates (D4D only)

```
PROCEDURE ent_updates (ent : IN OUT entity);
```

The same as `ent_update` *except that it will update entities on LOCKED LAYERS.*

GetDimFont (added DataCAD 17.03)

```
PROCEDURE Get_DimFont(Ent : Entity; FontName : IN OUT str80); BUILTIN 640;
```

This procedure retrieves the name of the font used in the associative dimension, Ent

GetDimTxtPnt (added DataCAD 17.03)

```
PROCEDURE GetDimTxtPnt(Ent:IN OUT entity; dmTxtPt:IN OUT point); BUILTIN 668;
```

SetKnockout (added DataCAD 21)

```
PROCEDURE SetKnockOut(Ent:In Out entity; TurnOn:boolean); BUILTIN 678;
```

This can use the drawing Knockout settings for DCAL generated text. This procedure performs the necessary update on the entity's header.

SmartEntity2RegularEntities (D4D only - added in DataCAD 22)

```
PROCEDURE SmartEntity2RegularEntities (ent: entity; var p: pipe_type;
                                       var xForm: modmat;
                                       EntOut: EntOutProc;
                                       do2D, do3d: boolean); stdcall;
```

Use this procedure to convert a smart entity (mtext, smart walls etc.) to regular entities. The entities are not automatically added to the drawing database, but are passed to EntOut which is an EntOutProc procedure which should handle any required processing. EntOutProc is defined as follows:

```
EntOutProc = procedure(Ent: entity; var p: pipe_type; var xForm: modmat); stdcall;
```

The below example does not create any new drawing entities, but uses this procedure to get the full text from an mtext or ptext entiting into a string variable:

```

VAR
  mtxtstr : string;
  pipe : pipe_type;
  ent : entity;
  addr : lgl_addr;
  pipe : pipe_type;
  Mat : modmat;
  mode : mode_type;

PROCEDURE SmartEntProc (ent: entity; var p: pipe_type;

```



```

                                var xform: ModMat); stdcall;
BEGIN
  if ent.enttype = enttxt then begin
    if mtxtstr > '' then
      mtxtstr := mtxtstr + ' ';
      mtxtstr := mtxtstr + string(ent.txtstr);
    end;
  END;

mode_enttype (mode, DCPlainTextObject);
mode_enttype (mode, DCRTFTextObject);
addr := ent_first (mode);
if ent_get (ent, addr) then begin
  mtxtstr := '';
  SmartEntity2RegularEntities (ent, pipe, mat, SmartEntProc, true, true);
  // mtxtstr now contains the text from the ent - process as required
end;

```

stopgroup

```
PROCEDURE stopgroup;
```

As entities are added to the database, they are considered part of the same group. stopgroup sets the last entity entered as the last entity belonging to a group. stopgroup works only on the current layer. When the current layer is changed, an implicit stopgroup is performed since a group cannot span layers.

Selection Set Routines

Use the routines in this section to add to, delete from, and scan selection sets. DataCAD provides eight selection sets for the macro writer.

Every entity 'knows' which selection set(s) it belongs to. Therefore, when an entity is deleted, its selection set is automatically corrected to reflect that the entity is no longer present. This ensures that selection sets never contain invalid data by pointing to entities that no longer exist.

Every selection set routine takes a selection set number as a parameter. This number must be in the range of 0 to 7, specifying one of the eight selection sets available. There are other selection sets within DataCAD, but they are used internally and should not be used by the macro programmer. Use of a selection set other than those numbered zero through seven can cause unpredictable results in both the execution of the macro and the subsequent use of DataCAD.

Note: [Dave Giesselman advised that I could use selection set 11](#) (defined as snap_ss in D4D) provided that the user did not have control whilst it was in use, and also that I should clear it once I had finished with it

do_Get_Active_SSet (added DataCAD 20)

```
FUNCTION do_Get_Active_SSet : integer; BUILTIN 672;
```

In D4D you can look at the value of PGSavevar^.ssactive, **but** this variable does not hold the number of the active set directly, rather the 8 bits of the low order byte represent the 8 selection sets. e.g. a low order byte of 2#0000001 would indicate SelSet1 as the active set, a value of 2#10000000 would indicate SelSet8 as active etc.

set_Active_SSet (added DataCAD 17.03)

```
PROCEDURE Set_Active_SSet (SSet : integer); BUILTIN 664;
```

For D4D set the appropriate bit in the low order byte of PGSavevar^.ssactive as described for do_Get_Active_SSet above. My code to do this (based on DataCAD code supplied by MFM) is:

```
PGSavevar^.ssactive := PGSavevar^.ssActive and ord(32768); //2#10000000000000000  
PGSavevar^.ssactive := PGSavevar^.ssactive or (1 shl SSet);
```

ssAdd

```
PROCEDURE ssAdd (ssNum : integer; ent : IN OUT entity);
```

ssAdd adds its second argument, ent, to the selection set number ssNum.

When ent is already a member of ssNum, no operation is performed.

ssClear

```
PROCEDURE ssClear (ssNum : integer);
```

ssClear clears out selection set number ssNum. All entities that were in the selection set are deleted from the selection set. These entities are removed from this selection set only. They remain in the database and are still members of other selection sets.

ssDel

```
FUNCTION ssDel (ssNum : integer; ent : IN OUT entity) : boolean;
```

ssDel deletes ent from selection set number ssNum.

When ent is a member of ssNum, true is returned. When ent is not a member of ssNum, false is returned and no other operation is performed.

ssDelAll

```
PROCEDURE ssDelAll (ent : IN OUT entity); BUILTIN 227; ;
```

Deletes ENT from all selection sets.

ssGetName

```
PROCEDURE ssGetName (ssNum : IN integer; sname : OUT string);
```

ssGetName reads the name of one of the first eight selection sets (0 through 7).

ssLength

```
FUNCTION ssLength (ssNum : integer) : integer;
```

ssLength returns the number of entities that are in selection set number ssNum.

ssMember

```
FUNCTION ssMember (ssNum : integer; ent : IN OUT entity) : boolean;
```

ssMember determines when an entity is a member of a particular selection set.

When ent is a member of selection set ssNum, ssMember returns true, otherwise false returns.

ssSetName

```
PROCEDURE ssSetName (ssNum : IN integer; sname : IN string);
```

ssSetName sets the name of one of the first eight selection sets.

Unset_Active_SSet (added DataCAD 17.03)

```
PROCEDURE Unset_Active_SSet (SSet : integer); BUILTIN 665;
```

For D4D you couple probably just set a value of zero for ssactive, but the code to do this (based DataCAD code supplied by MFM) is:

```
PGSavevar^.ssactive := PGSavevar^.ssactive and ord(0); // (2#0000000000000000);
```

Layers

Every entity in a drawing is on a layer. The routines in this section manipulate layers. Notice that some of the built-in variables described in the "Variables" chapter also affect the current layer.

getlycurr

```
FUNCTION getlycurr : layer;
```

getlycurr returns the current (or active) layer.

getlyrname

```
PROCEDURE getlyrname (lyr : layer; name : OUT string);
```

getlyrname returns the name of the layer lyr in name.

When lyr is not a valid layer, an error occurs.

getLongLayerName (uncertain of version it was added, probably around DataCAD 13)

```
PROCEDURE GetLongLayerName (lyr : layer; name : OUT str255); BUILTIN 636;
```

Returns the long name of the layer lyr in name.

GetSetLayerFilter (added in DataCAD 18.04)

```
PROCEDURE GetSetLayerFilter(Filter : IN OUT str8;  
                             ReadOnly : boolean); BUILTIN 671;
```

lyr_clear

```
PROCEDURE lyr_clear (lyr : layer);
```

lyr_clear erases every entity from layer lyr and deletes them from the database.

lyr_create

```
FUNCTION lyr_create (lname : string; lyr : OUT layer) : boolean;
```

lyr_create adds a new layer to the current drawing.

The layer is created with the name lname.

The layer variable that describes the new layer is returned in lyr.

lyr_create returns true when DataCAD creates the layer, and false when DataCAD is unable to create the layer (too many layers or out of disk space).

D4D Note: The D4D version of lyr_create does *not* return a valid layer address (the layer is created, but address not returned) (tested with DataCAD 20)

lyr_del

```
PROCEDURE lyr_del (lyr : IN layer);
```

lyr_del deletes a layer from a drawing database.

lyr must be a valid layer in the drawing database and must be a part of the standard layer/entity data structure. All entities on the layer, as well as the layer itself, are deleted and completely removed from the database. Unless the drawing is cancelled, the layer and its entities are completely deleted and may not be undone or recovered in any way.

Do not attempt to use lyr_del on a layer which was added to the drawing database using the function lyr_init. lyr_init adds a layer to the database which is not a part of the standard layer/entity structure. In this case, use the procedure lyr_term. lyr_term is specifically designed to terminate and delete layers which are not part of the standard layer/entity database structure.

lyr_extents (D4D only)

```
PROCEDURE lyr_extents = procedure(plyr: lgl_addr; var min, max: point);
```

lyr_find

```
FUNCTION lyr_find (lname : string; lyr : OUT layer) : boolean;
```

lyr_find looks for a layer with the name lname in the database.

Only supports short layer names prior to DataCAD 19.

When successful, true returns and lyr is set to be the layer that was found. When there is no layer named lname, false returns.

lyr_find_longname (uncertain of version added, probably around DataCAD 13)

```
FUNCTION Lyr_Find_LongName(Name : str80; lyr : OUT layer): boolean ; BUILTIN  
637;
```

Not certain of the difference between this and lyr_find in DataCAD 19 onwards.

lyr_first

```
FUNCTION lyr_first : layer;
```

lyr_first returns the first layer that is in the database.

lyr_get (D4D only)

```
FUNCTION lyr_get(lyr: lyraddr; var rlyr: Rlayer): boolean;
```

lyr_get returns the layer specified by the layer address. Returns true if lyr is found.

lyr_islocked (D4D only)

```
FUNCTION lyr_islocked = function(plyr: lgl_addr): boolean;
```

lyr_islocked does not appear to work reliably. You can use the following logic to find if a layer is locked: call "lyr_get" then inspect the .group field of the Rlayer record. If that field is equal to -1, the layer is not locked.

lyr_ison

```
FUNCTION lyr_ison (lyr : layer) : boolean;
```

lyr_ison returns true when the layer lyr is on (displayed). When lyr is off (not displayed), lyr_ison returns false.

lyr_next

```
FUNCTION lyr_next (lyr : layer) : layer;
```

lyr_next returns the next layer in the database after lyr. When lyr is the last layer in the drawing, lyr_next returns a layer that is nil. Test this with lyr_nil.

lyr_nil

```
FUNCTION lyr_nil (lyr : layer) : boolean;
```

lyr_nil returns true when the layer lyr does not point to anything.

The following code writes the name of every layer in the database that is on:

```
lyr := lyr_first;
WHILE NOT lyr_nil (lyr) DO
  IF lyr_ison (lyr) THEN
    getlyrname (lyr, str);
    wrterr (str);
    pause (0.5);
  END;
  lyr := lyr_next (lyr);
END;
```

lyr_put (D4D only)

```
PROCEDURE lyr_put = procedure(var rlyr: Rlayer);
```

lyr_read

```
FUNCTION lyr_read (lyr : IN layer; filename : IN string; clearlyr, drawlyr :
IN boolean) : integer;
```

lyr_read reads a layer from a layer file into the drawing database.

lyr_read returns fl_ok when the layer file successfully loads or returns one of the other file operation constants. See “Chapter 2 – Constants” for more information.

D4D Note: The D4D Lyr_Read function DOES NOT WORK (tested DataCAD 20)

lyr is the layer to which the contents of the layer file are added. lyr must exist in the drawing database, and must have been added to the drawing using lyr_create, lyr_init, or DataCAD's standard layer user interface. lyr is renamed to match the name of the file which was read in. This could result in two different layers in a drawing with the same name.

filename is the name of the layer file to read. filename must be a correct layer filename including a complete or relative pathname of the file but without the .lyr extension. This function only looks for files with .lyr extensions. (Note: more recent versions of DataCAD use a .dlf extension, so lyr_read looks for that extension in these versions.)

clearlyr is a flag that is true when the layer lyr is to be cleared of all entities prior to appending the contents of the layer file. When clearlyr is false, the contents of the layer file are appended to the layer and any existing entities on the layer are not deleted.

drawlyr is a flag which is true when the layer is to be drawn immediately after it is loaded. When drawlyr is false, the layer is loaded into the drawing database, but is not drawn.

If lyr is on when new entities are concatenated to it by lyr_read and drawlyr is false, although the new layer file information is not visible, that information is scanned during the next editing or snapping operation. The next operation which causes the screen to refresh redraws the new data as well.

lyr_set

```
PROCEDURE lyr_set (lyr : layer);
```

lyr_set sets the current layer to the parameter lyr.

When lyr is not a valid layer, an error occurs.

lyr_seton

```
PROCEDURE lyr_seton (lyr : layer; onoff : boolean; redraw : boolean);
```

lyr_seton toggles layers on or off.

lyr is the layer to act upon.

onoff is true when the layer is to be turned on and false when it is to be turned off.

The parameter redraw is true when the layer is to be drawn, and false when the layer is not to be redrawn.

To remove entities (which reside on a particular layer) from the screen, set onoff to false and redraw to true. The current layer cannot be turned off.

lyr_viewfile

```
PROCEDURE lyr_viewfile (filename : IN string; refresh, extents : IN boolean;  
imagesize : IN real);
```

NOTE: The declaration for the procedure lyr_viewfile is not built into the DCAL compiler but may be found in the system include file _views.inc.

lyr_viewfile duplicates the functionality of Layer/ViewFile in DataCAD allowing the user to quickly view images or pictures as though they were slides. The layer file appears on the screen only; the file is not loaded into the drawing database.

filename is the name of the layer file to view. filename must be a complete pathname to the file, or a valid pathname relative to the current directory. filename must contain the .lyr filename extension, when applicable.

When the flag refresh is true, the screen is cleared prior to drawing the contents of the layer file. When refresh is false, the screen is not refreshed prior to displaying the contents of the layer file.

When the flag extents is true, a WindowIn based on the extents of the layer file is performed prior to the display of the contents of the layer file. When extents is false, the layer file appears at the current scale and window-to-viewport mapping.

imagesize controls the size of the image relative to the current viewport. imagesize has an effect when extents is true. When extents is false, imagesize is ignored. imagesize must be a real number between 1.0 and 100.0 and indicates the percentage of the screen area which the image should fill. For example, if imagesize is set to 80.0, the actual size of the image is reduced by 20 percent of the screen width or height (as appropriate) so that the image does not bleed to the edges of the screen.

lyr_write

```
FUNCTION lyr_write (lyr : IN layer; filename : IN string) : integer;
```

lyr_write writes a layer out to a layer file.

lyr is the layer to be written. lyr must exist in the database.

filename is the name of the file to which the layer is written. filename should contain either the full pathname of the file, or a valid pathname relative to the current directory. The filename should not contain the .lyr extension. This is added by the routine. (Note: more recent versions of DataCAD use a .dlf filename extension.)

When a layer file of the same name exists, the layer file is overwritten and no warning is generated. To first check for the existence of a layer file with the same name prior to writing the layer using lyr_write, use the function file_exist.

numlayer

```
FUNCTION numlayer : integer;
```

numlayer returns the number of existing layers in the drawing. This number is always at least one.

setlyrname

```
PROCEDURE setlyrname (lyr : layer; name : string);
```

setlyrname sets the name of lyr to name. Long layer names are supported in DataCAD 19 and later (this proc only supports short layer names in versions prior to DataCAD 19).

When lyr is not a valid layer, an error occurs. The layer name on the screen is not updated when lyr is the current layer.

You must call wrtlyr to force the layer name to be updated.

SortLayersByName (added in DataCAD 16.04)

```
PROCEDURE SortLayersByName; BUILTIN 656;
```

Symbol Routines

A symbol is often a name given to a variable like pt1. With the routines in this section you can add and manipulate symbols in the current drawing. Symbol instances are treated just like any entity. Use these routines to manipulate the definition of a symbol.

sym_clearref

```
PROCEDURE sym_clearref;
```


Every symbol has a Boolean field in its header, `.refflag`, that determines if the symbol has been referenced by the procedure `sym_ref`. `sym_clearref` clears (sets to false) all `.refflag` fields for all symbols in the database.

sym_count

```
PROCEDURE sym_count (mode : IN OUT mode_type);
```

`sym_count` looks through the entities returned by `mode` which are instances of symbols (`entsym`) and counts the number of instances of each symbol. This count can then be examined by looking at the `num` field of each symbol.

A macro should never write a value to `num`.

For example, to count the number of times each symbol has an instance on the current layer, use:

```
mode_init (mode); {look on this layer}
sym_count (mode);
saddr := sym_first;
WHILE sym_get (sym, saddr) DO
  writeCount (sym.num);
  saddr := sym_next (sym);
END;
```

sym_create

```
PROCEDURE sym_create (sym : OUT symbol; mode : IN OUT mode_type; ref : point;
sname : string; delEnts, undraw : boolean);
```

`sym_create` creates or redefines a symbol.

When a symbol of name `sname` already exists, it is redefined; when it does not exist, it is created.

The entities that make up the symbol are read by `mode`.

The reference point of the symbol is `ref`.

When `delEnts` is true, the entities read from `mode` are deleted.

When `undraw` is true, the entities are undrawn as the symbol is created.

On exit, `sym` refers to the new (or updated) symbol.

As an example, the following code converts everything in selection set 0 to a symbol:

```
mode_init (mode);
mode_ss (mode, 0);
setpoint (pt, 0.0);
sym_create (sym, mode, pt, 'newSym',
           true, true);
```

sym_find

```
FUNCTION sym_find (sname : string; sym : OUT symbol) : boolean;
```

`sym_find` looks in the database for a symbol named `sname`.

When `sname` is found, `sym` is set to the symbol and `true` is returned. If the symbol is not found, then `sym_find` returns `false`.

sym_first

```
FUNCTION sym_first : symaddr;
```

`sym_first` returns the address of the first symbol in the database. This, along with `sym_next` and `sym_get`, are used to scan through the symbols defined in the drawing.

sym_get

```
FUNCTION sym_get (sym : OUT symbol; saddr : symaddr) : boolean;
```

`sym_get` reads a symbol `sym` given its address.

If the address is `nil`, `sym_get` returns `false`, otherwise it returns `true`.

For example, to write the name of every symbol in the database, use:

```
saddr := sym_first;
WHILE sym_get (sym, saddr) DO
  wrterr (sym.name);

  pause (0.5);
  saddr := sym_next (sym);
END;
```

sym_get_atr

```
FUNCTION sym_get_atr (sym : OUT symbol; saddr : symaddr; atrName : string;
atr : OUT attrib);
```

`sym_get_atr` is similar to `sym_get`, but returns the next symbol that has an attribute with the given name. If no more such symbols exist in the database, `false` is returned.

This example shows how to use `sym_get_atr`. This piece of code reads every symbol that has an attribute named `'*mtec'`.

```
saddr := sym_first;
WHILE sym_get_atr (sym, saddr,
  '*mtec', atr) DO
  wrtAtr (atr);
  saddr := sym_next (sym);
END
```

sym_next

```
FUNCTION sym_next (sym : symbol) : symaddr;
```

`sym_next` returns the address of the next symbol in the database. When there is no next symbol, `sym_next` returns `nil`.

See the example under [“sym_get”](#).

sym_read

```
FUNCTION sym_read (fName, symName : string; sym : OUT symbol) : integer;
```

sym_read reads a symbol from a symbol file.

The filename fName may not contain the file extension; .sm3 is automatically added.

symName is the internal name to use for the symbol. On exit, the function returns the file i/o constant from reading the symbol file. fl_ok indicates success.

On exit, sym refers to the symbol that was read.

sym_ref

```
PROCEDURE sym_ref (mode : IN OUT mode_type);
```

sym_ref sets the .refflag fields to true for all symbols that have instances returned by mode, including nested symbols. The main use of this routine is internal to DataCAD to determine when a redefinition of a symbol is self-referencing. It is also used when saving a symbol to a file.

sym_write

```
FUNCTION sym_write (sym : symbol; fName : string) : integer;
```

sym_write writes an existing symbol sym to a file. As with sym_read, the filename must not contain the file extension.

The return constant of fl_ok indicates success. The symbol and all of the nested symbols that it references as well as all of its attributes are written to the file.

Attribute Routines

Use the routines in this section to handle attributes. Attributes consist of two parts, the name and the value. The name is a string of maximum length atr_name_len characters. The value can be a real, integer, distance, angle, point, string, or logical address.

Attributes can be attached to symbols, entities, symbol instances, layers, and the drawing (referred to as system attributes). Most of the routines in this section deal with attributes attached to any of these, but some are specific as to what the attribute is attached to. These have ent, sym, lyr, or sys in their name.

atr_2str

```
PROCEDURE atr_2str (atr : IN OUT attrib; str : OUT string);
```

atr_2str converts the value of atr to a string str, for any type of attribute. This procedure correctly converts any attribute of type integer, real, distance, angle, point, or string to a string.

atr_add2ent

```
PROCEDURE atr_add2ent (ent : IN OUT entity; atr : IN OUT attrib);
```

atr_add2ent adds an attribute to an entity. **See notes below**

| The attribute atr must be initialized with atr_init and the name and value of the attribute should be assigned. The entity atr is added to ent. When the attribute field visible is true, the value of atr appears

when the entity is drawn. The remaining fields of the attribute type describe how the attribute is displayed.

For example, to add an integer attribute to an entity:

```
atr_init (atr, atr_int);
atr.name := '*EVS';
atr.int := 3;
atr_add2ent (ent, atr);
```

DO NOT RE-USE atr after adding it to an entity without retrieving it again (at least in Classic DCAL):

I have found that atr_add2ent can actually change the atr variable. In one instance atr.name was set to a string with 12 characters; after calling atr_add2ent, atr.name had a length of 13 characters. Doing an atr_entfind (using the original 12 character name) found an attribute with the correct name. The code below illustrates what I am trying to explain:

```
atr.name := '123456789012';
atr.int := 3;
atr_add2ent (ent, atr);
i := strlen(atr.name);           ! i has a value of 13, will cause problems
                                ! if you subsequently try to use atr.name
                                ! as the type has a max length of 12
if atr_entfind (ent, '123456789012', atr) then
  i := strlen (atr.name);       ! atr.name is valid and strlen returns 12
end;
```

atr_add2lyr

```
PROCEDURE atr_add2lyr (lyr : IN OUT layer; atr : IN OUT attrib);
```

atr_add2lyr adds an attribute to the chain of attributes attached to a layer in the drawing database.

lyr is the layer to which the attribute is added. lyr must exist in the drawing database before calling atr_add2lyr.

I atr is the attribute to add to the layer. atr should be initialized using the procedure atr_init, and should contain a valid name and data.

The attribute field visible may be set to true, but the layer attribute does not appear. Visible attributes appear only for entities.

See notes for atr_addent regarding using atr after calling this procedure: I have not verified that the same problem exists with this proc, but I think it is likely.

atr_add2sym

```
PROCEDURE atr_add2sym (sym : IN OUT symbol; atr : IN OUT attrib);
```

This procedure is virtually identical to atr_add2ent, except it adds an attribute to a symbol.

The attribute atr must be initialized with atr_init and the name and value of the attribute should be assigned.

The entity atr is added to ent.

The attribute field visible may be set true, but the symbol attribute will not appear. Visible attributes are displayed only for entities. The remaining fields of the attribute type describe how the attribute appears.

See notes for atr_addent regarding using atr after calling this procedure: I have not verified that the same problem exists with this proc, but I think it is likely.

atr_add2sys

```
PROCEDURE atr_add2sys (atr : IN OUT attrib);
```

atr_add2sys adds an attribute to the chain of attributes attached to a drawing at the system level.

atr is the attribute to add. atr should be initialized using the procedure atr_init, and should contain a valid name and data.

The attribute field visible may be set to true, but the system attribute does not appear. Visible attributes appear only for entities.

See notes for atr_addent regarding using atr after calling this procedure: I have not verified that the same problem exists with this proc, but I think it is likely.

atr_delent

```
PROCEDURE atr_delent (ent : IN OUT entity; atr : attrib);
```

atr_delent deletes an attribute from an entity.

The parameters are the entity to delete from, ent, and the attribute to delete, atr.

atr_dellyr

```
PROCEDURE atr_dellyr (lyr : IN OUT layer; atr : IN OUT attrib);
```

atr_dellyr deletes an attribute from the chain of attributes attached to a layer.

lyr is the layer from which to delete the attribute.

atr is the attribute to delete. atr must be read from the chain of attributes attached to the layer using the function atr_get.

atr_delsym

```
PROCEDURE atr_delsym (sym : IN OUT symbol; atr : attrib);
```

This procedure deletes an attribute from a symbol definition.

The parameters are the entity to delete from, ent, and the attribute to delete, atr.

atr_delsys

```
PROCEDURE atr_delsys (atr : IN OUT attrib);
```

atr_delsys deletes an attribute from the chain of system attributes. Space in the drawing file taken up by the attribute is freed up for later use.

atr is the attribute to delete. atr must have been read from the chain of system attributes using the function atr_get. The attribute is deleted from the drawing database.

atr_entfind

```
FUNCTION atr_entfind (ent : IN OUT entity; aName : string; atr : OUT attrib)
: boolean;
```

atr_entfind finds an attribute atr of name aName belonging to entity ent.

When an attribute with the given name exists, atr_entfind returns true and sets atr equal to the attribute. If the attribute does not exist, false is returned.

Note: aName is NOT case-sensitive (e.g. if you have an attribute named 'ABC' then it will be found by this function if you pass aName of 'abc'). Also, it is possible to use special characters in an attribute name (e.g. \n) and the attributes will be saved with those characters in the name, but atr_entfind does not seem capable of finding attributes with special characters in their name.

atr_entfirst

```
FUNCTION atr_entfirst (ent : IN OUT entity) : atraddr;
```

This function returns the address of the first attribute associated with an entity.

See the example under atr_get.

atr_get

```
FUNCTION atr_get (atr : OUT attrib; addr : atraddr) : boolean;
```

atr_get reads an attribute atr given its address addr.

When addr is nil, false returns; otherwise true is returned.

This function is similar to [ent_get](#) and [sym_get](#).

To read all of the attributes belonging to an entity, use:

```
aAddr := atr_entfirst (ent);
WHILE atr_get (atr, aAddr) DO
  processAtr (atr);
  aAddr := atr_next (atr);
END;
```

To read all of the attributes belonging to a symbol, use:

```
aAddr := atr_symfirst (sym);
WHILE atr_get (atr, aAddr) DO
  processAtr (atr);

  aAddr := atr_next (atr);
END;
```

Notice these two pieces of code are identical except for the function used to find the address of the first attribute. This code shows how all attributes are the same, regardless of what they are attached to.

See also "[atr_lyrfirst](#)" and "[atr_sysfirst](#)".

atr_init

```
PROCEDURE atr_init (atr : IN OUT attrib; atrtype : IN integer);
```

atr_init initializes a variable of type attrib so the attribute can then be added to the database.

Always call atr_init before adding an attribute to any data object.

atr is the attribute to initialize.

atrtype is an integer constant indicating the type which the attribute assumes (integer, distance, real, angle, string, or address).

atr_lyrfind

```
FUNCTION atr_lyrfind (lyr : IN layer; aname : IN string; atr : OUT attrib) :  
boolean;
```

atr_lyrfind searches for an attribute of name aname belonging to layer lyr.

When an attribute with the given name exists, atr_lyrfind returns true and sets atr equal to the attribute. If the attribute does not exist, false returns.

lyr must exist as a valid layer in the drawing database.

atr_lyrfirst

```
FUNCTION atr_lyrfirst (lyr : IN layer) : atraddr;
```

atr_lyrfirst returns the address of the first attribute attached to a given layer.

atr_lyrfirst is usually used with the routines atr_get, and atr_next to linearly scan the chain of attributes attached to a layer.

lyr is the layer to examine for attributes.

The following example scans the list of attributes attached to a layer and counts those which are a distance:

```
VAR  
  atr : attrib;  
  addr : atraddr;  
  count : integer;  
  lyr : layer;  
...  
  
  count := 0;  
  addr := atr_lyrfirst (lyr);  
  WHILE atr_get (atr, addr) DO  
    addr := atr_next (atr);  
    IF atr.atrtype = atr_dis THEN  
      count := count + 1;  
    END;  
  END;  
END;
```

atr_next

```
FUNCTION atr_next (atr : IN OUT attrib) : atraddr;
```

atr_next returns the address of the next attribute after atr. This procedure is used regardless of whether the attributes are coming from entities, symbols, layers, or the system.

When there are no more attributes after atr, nil is returned.

atr_symfind

```
FUNCTION atr_symfind (sym : IN OUT symbol; aName : string; atr : OUT attrib) : boolean;
```

atr_symfind finds an attribute atr of name aName belonging to symbol sym.

When an attribute with the given name exists, atr_symfind returns true and sets atr equal to the attribute. If the attribute does not exist, false returns.

atr_symfirst

```
FUNCTION atr_symfirst (sym : IN OUT symbol) : atraddr;
```

atr_symfirst returns the address of the first attribute belonging to a symbol.

atr_symfirst is usually used with the routines atr_get, and atr_next to linearly scan the chain of attributes attached to a symbol.

sym is the symbol to examine for attributes.

atr_sysfind

```
FUNCTION atr_sysfind (aName : IN string; atr : OUT attrib) : boolean;
```

atr_sysfind searches for an attribute atr of name aName belonging to symbol sym.

When an attribute with the given name exists, atr_sysfind returns true and sets atr equal to the attribute. If the attribute does not exist, false returns.

atr_sysfirst

```
FUNCTION atr_sysfirst : atraddr;
```

atr_sysfirst returns the address of the first system attribute.

atr_sysfirst is usually used with the routines atr_get and atr_next to linearly scan the chain of system attributes.

The following example scans the list of system attributes and counts those which are a distance.

```
VAR
  atr : attrib;
  addr : atraddr;
  count : integer;
  ...
```



```

count := 0;
addr := atr_sysfirst;
WHILE atr_get (atr, addr) DO
  addr := atr_next (atr);
  IF atr.atrtype = atr_dis THEN
    count := count + 1;
  END;
END;

```

atr_update

```
PROCEDURE atr_update (atr : IN OUT attrib);
```

atr_update updates an attribute in the database after it is changed. The type of an attribute may change, as well as whether or not the attribute is visible.

InitSolidFillAttribute (D4D only)

```
FUNCTION InitSolidFillAttribute (fill_color, fill_pattern,
                                pattern_color: longint): attrib;
```

This function initializes and populates an attribute that can be added to a polyline to create solid fill.

fill_color and pattern_color are the colours for the fill and pattern.

Fill_pattern can be one of the following values:

0 = solid 1 = Horizontal 2 = Vertical 3 = Fwd Diagonal 4 = Back Diagonal
5 = Cross 6 = Cross Diagonal

The attribute is initialized with SPBvisible true (will display outline). Set this field to false if you do not wish an outline to display around the fill.

Polyline and Polyvert Routines

The declarations for the routines in this section require the inclusion of the file _pline.inc because they are not built-into the DCAL compiler.

The following types, constants, and routines manipulate the geometric data associated with entities of type polyline and surface of revolution. These two entities, unlike most other entities, contain what is referred to as copious data. In a typical entity such as an arc, all of the data describing the arc can be contained completely within a variable of type entity; attributes are stored in a separate list attached to each entity. With polylines and surfaces of revolution, not all the data for the entity is contained within the entity record structure.

An entity of type polyline or surface of revolution consists of header information (like color, linetype, etc.) which is exactly like that for any other entity. These entities also contain additional information in the entity record structure like z-base and z-height, with polylines, or a modeling matrix, with surfaces of

revolution. The data describing the vertices, lines, and arcs of a polyline or surface of revolution profile is contained in a list of objects attached to the entity. This list, comprised of objects called polyverts, is accessed through the address of the first and last polyvert in the list.

The basic entity also contains the addresses of the first and last polyverts in the list associated with each entity. The remaining polyverts are accessed by linearly scanning the list. With the exception of where these two addresses are stored, access to and manipulation of polyverts is identical for both polylines and surfaces of revolution.

Additional steps must be taken to access the geometry of this copious data. Therefore, DataCAD and DCAL have a variety of built-in types, constants, routines, and functions for managing and manipulating copious data.

Each vertex of the polyline requires that a polyvert be attached to the entity. A polyvert contains the (x, y, z) coordinates of a single point (the vertex) and a real number which describes the type of arc between the vertex and the following vertex. This real number is usually referred to as the bulge.

arc_to_bulge

```
PROCEDURE arc_to_bulge (center : IN point; radius, begang, endang : IN real;
ccw : IN boolean; pnt1, pnt2 : OUT point; bulge : OUT real);
```

arc_to_bulge converts an arc which is defined by the same method as entities of type entarc to the form used by polylines and surfaces of revolution.

The arc is defined using five parameters:

center is the center point of the arc

radius is the arc's radius

begang and endang are the arc's beginning and ending angles

ccw is a Boolean flag which is true when the arc goes counterclockwise from begang to endang; and false when the arc goes clockwise from begang to endang.

The results of the computation are stored in pnt1, pnt2, and bulge:

pnt1 contains the coordinates of the polyvert vertex

pnt2 contains the coordinates of the next polyvert in the list

bulge contains the value of the bulge parameter for the polyvert. When the value of bulge is zero the polyvert is a line and should be assigned a shape of pv_vert;

otherwise it is an arc segment and should be assigned a shape of pv_bulge.

For example, to convert an ordinary entity of type entarc to a polyvert, use the following code:

```
arc_to_bulge (ent.arccent,
ent.arcradius, ent.arcbang,
ent.arceang, true, pv.pnt,
pv.nextpnt, pv.bulge);
```

In actual use, ccw must first be calculated, but its computation is typically dependent on the application. true is used here for simplicity.

bulge_to_arc

```
PROCEDURE bulge_to_arc (pnt1, pnt2 : IN point; bulge : IN real; center : OUT
point; radius, begang, endang : OUT real; ccw : OUT boolean);
```

bulge_to_arc performs the complement function of arc_to_bulge. It takes a polyline vertex of shape pv_bulge and converts it into the standard description of an arc segment.

The input to this routine consists of three parameters:

pnt1, the coordinates of the polyvert vertex pnt2, the coordinates of the next polyvert vertex in the list
bulge, the value of the bulge parameter for the polyvert.

The output of bulge_to_arc consists of five parameters:

center is the center point of the arc

radius is the arc's radius

begang is the beginning angle of the arc segment

endang is the ending angle of the arc segment

ccw is a Boolean flag which is true when the arc goes counterclockwise from begang to endang, and false when the arc goes clockwise from begang to endang.

NOTE: When working with arc segments as related to polyverts, maintain sufficient information indicating the direction of the arc segments because a polyline or surface of revolution maintains the connectivity of polyverts. A polyvert maintains this information by maintaining the order of the vertices in a polyline and, implicitly, via the bulge parameter. For the standard description of an arc, an additional flag, ccw, indicates the direction of the arc relative to the center and beginning of arc.

Contour_Offset (added in DataCAD 17.01)

```
FUNCTION Contour_Offset (cursor : IN point; Offset_Dis : IN real;
color : IN integer;
pln : IN OUT entity) : boolean; BUILTIN 658;
```

Contour_Search (added in DataCAD 17.01)

```
FUNCTION Contour_Search (cursor : IN point;
Boundary : IN OUT pntarr) : integer; BUILTIN 657;
```

D4D equivalent of Contour_Search was added in DataCAD 21 with the following definition:

```
FUNCTION boundary_search(pt1 : point;
var frst, last : lgl_addr) : asint; stdcall;
```

disfrompolyvert

```
FUNCTION disfrompolyvert (pv : IN OUT polyvert; tstpnt : IN point) : real;
```

disfrompolyvert returns the square of the distance (note that this is not the actual distance) from a point to a polyvert. Use this function to determine exactly which polyvert in a polyline a user is pointing to.

Note: I always thought of 'polyvert' as being the actual point or vertex, but by 'polyvert' the notes on this function actually mean the side (be it a straight line or a bulge) between pv and the pv.nextpnt.

There does NOT appear to be a D4D equivalent of the disfrompolyvert function. See the Appendix for code that I have written to replicate the functionality.

In the following example, the variable ent has already been read using ent_near or a similar operation and is a valid entity of type entpln. The following code finds the nearest polyvert to a point:

```
VAR
  pv      : polyvert;
  addr    : pvtaddr;
  ent     : entity;
  pnt     : point;
  nearest : pvtaddr
  dis     : real
  neardis : real
  first   : boolean
...

first := true;
addr := ent.plnfrst;
WHILE polyvert_get (pv, addr, ent.plnfrst, ent.plnlast) DO
  addr := pv.next
  dis := disfrompolyvert (pv, pnt);
  IF first THEN
    first := false;
    closedis := dis;
    nearest := pv.addr;
  ELSE
    IF dis < closedis THEN
      closedis := dis;
      nearest := pv.addr;
    END;
  END;
END;

IF NOT first THEN
  { At least one polyvert was scanned
  and nearest now contains the

  address of the polyvert which is
  nearest to the point pnt. }
END;
```

ent2polyvert

```
PROCEDURE ent2polyvert (ent : IN entity; pv : OUT polyvert);
```

ent2polyvert performs the complement function of polyvert2ent.

An entity of type entlin or entarc converts to a polyvert of the appropriate type. When the entity is of type entarc and has a valid geometry, a polyvert of shape pv_bulge returns. When the entity is of type entlin a polyvert of shape pv_vert returns.

getpolyline

```
FUNCTION getpolyline (msg : IN str80; viewmode : IN integer;
    dodraw, doclosed : IN boolean; init, isclosed : IN OUT boolean;
    frst, last : IN OUT pvtaddr; key : OUT integer) : integer;
```

getpolyline allows user input of a complete polyline by a call to a single DCAL routine. This routine takes most of the work out of designing a user interface for entering a series of polyverts which make up a polyline or surface of revolution.

The many parameters of getpolyline allow as much control over its operation as possible. With getpolyline you can use some function keys (those not used by getpolyline itself). getpolyline automatically allows the user to enter chains of polyverts which contain bulges using two-point arc, three-point arc, and tangent arc inputs, with all dragging handled automatically.

msg is a string constant or variable containing the message you want to appear on the message line during the entering of normal vertices.

viewmode takes a value of one of the viewing projection constants.

Set dodraw to true when you want getpolyline to draw the polyline as the user enters each polyvert. When dodraw is false, the chain of polyverts are not drawn as they are entered.

Set doclosed to true when you want getpolyline to automatically present the *Closed label key to the user and handle the toggling of this flag; then the variable isclosed reflects the status of this toggle. When doclosed is false, getpolyline does not handle the toggling of the closed field. In this case, whether or not the chain of polyverts is closed is determined by the current value of the variable isclosed.

- init is a Boolean variable which indicates to getpolyline that you are starting a new input sequence. When init is true, the variables frst and last are automatically set to nil. After the first call to getpolyline, init is set to false. In this way, getpolyline is reentrant. You can trap the function keys, process them accordingly, call getpolyline again, and you are at the same place as before. Simply reset init to true when you want to initiate a new input sequence.
- getpolyline returns an integer value which should be interpreted in the same way as a call to getpoint. The return value of getpolyline is either of the constants res_normal or res_escape. When the return value is res_normal, a valid chain of polyverts has been captured and entered into the database. This chain may be processed accordingly. The parameters frst and last contain the addresses of the first and last polyverts in the chain. The parameter isclosed is true when the chain of polyverts is closed (as indicated by the user), or false when the chain of polyverts is open.
Note: there appears to be a bug in this routine: if the user presses S8 (Cancel) and then presses S0 (Exit) without selecting another point then you get a 'No function return value' error (crashes the macro, but fortunately does not crash the drawing).

- When one of the function keys not used by getpolyline is pressed, the return value from getpolyline is res_escape. getpolyline uses keys (F1), (F2), (F3), (F5), (S7), (S8) and (S0). Don't assign labels to these keys because they will be overwritten.
- The variable key contains the key code of the pressed function key. You can test this variable and process it accordingly.

As is the case with the function getpoly, you need only execute lblsinit; lblson is performed automatically by getpolyline.

The following portion of DCAL code provides a skeleton for the use of getpolyline. In this example, the viewing projection may only be orthographic as indicated by the vmode_orth parameter. In this example getpolyline controls the drawing of the polyline during its operation, and allows the user to toggle the closed option on or off.

When the polyline is closed, the variable isclosed is returned with a value of true, otherwise it is false. frst and last return the address of the first and last polyverts created during the call to getpolyline.

```

VAR
    done,
    init,
    isclosed : boolean;
    key,
    result   : integer;
    frst,
    last     : pvtaddr;

...

done := false;
init := true;
closed := true;
REPEAT
    lblsinit;
    { lblson done by getpolyline }

    result := getpolyline ('Enter the
        next point of polyline.',
        vmode_orth, true, true, init,

        isclosed, frst, last, key);

    IF result = res_normal THEN
        { A valid chain of polyverts
        was entered. Process the
        chain of polyverts. }
    ELSIF result = res_escape THEN
        { A function key was pressed. }
        IF key = s0 THEN
            done := true;
        END;
    END;
UNTIL done;
```

pline_area

```
FUNCTION pline_area (frst, last : IN pvtaddr) : real;
```

pline_area calculates and returns the area enclosed by a polyline. The area returned may be positive or negative depending upon the sense of the polyline. Usually you want the absolute value of the resulting area so an appropriate call to absr is included in the expression. pline_area assumes that the polyline is closed regardless of the status of the entity to which the chain of polyverts is attached.

frst and last are the addresses of the first and last polyverts defining the polyline.

Note: In D4D (and possibly also Classic DCAL), the last parameter does not actually seem to be used (i.e. if you pass the address of a polyvert that is not the last in the chain of polyverts then it uses the last in the chain regardless).

pline_centroid

```
PROCEDURE pline_centroid (frst, last : IN pvtaddr; totarea : IN OUT real;  
frstmoment, centroid : IN OUT point; first, add : IN boolean);
```

pline_centroid calculates the first moment and centroid of an area described by a polyline. This procedure calculates centroids of areas made of multiple subareas, each described by a polyline, and allows for both positive and negative areas.

frst and last are the addresses of the first and last polyverts in the chain making up each loop.

When the flag first is true, pline_centroid automatically assumes that this is the first or only call of a sequence, and initializes the parameters totarea, frstmoment, and centroid prior to initiating calculations. first should be set to false when pline_centroid is called the second or later time in a sequence of calls in order to accumulate calculations for multiple areas.

totarea is the cumulative total area of the polyline and used for calculating the centroid of areas containing multiple subareas and/or voids.

frstmoment is the cumulative first moment of the area of the polyline and used for calculating the centroid of areas containing multiple subareas and/or voids.

I centroid is the centroid of the polyline or composite polyline when multiple subareas and/or voids are considered.

When the flag add is true, the area of the polyline passed to pline_centroid is assumed to be a positive area in the calculations. When the flag add is false, the area of the polyline passed to pline_centroid is assumed to be negative or a void in the calculations.

The following example assumes that mode is a mode_type variable containing a selection set of entities of type polyline. The first entity in the selection set is assumed to be a positive area encompassing a series of voids. The remaining polylines are assumed to be voids within this area. This example computes the centroid of the resulting area:

```
VAR  
  ent    : entity;  
  addr   : entaddr;
```

```

mode    : mode_type;

first   : boolean;
addit   : boolean;
area    : real;
frstmom : point;
centroid : point;
...

first := true;
addit := true;
{ First time through, initialize
  and add result--subsequent times
  subtract the result. }
addr := ent_first (mode);
WHILE ent_get (ent, addr) DO
  addr := ent_next (ent, mode);

pline_centroid (ent.plnfrst,
  ent.plnlast, totarea,
  frstmom, centroid,
  first, addit);

first := false;
addit := false;
END;

{ centroid now contains the centroid
  of the polyline with voids. }

```

pline_perim

```
FUNCTION pline_perim (frst, last : IN pvtaddr) : real;
```

pline_perim calculates the perimeter of a polyline.

pline_perim returns the perimeter of the polyline. pline_perim assumes that the polyline is closed regardless of the status of the entity to which the chain of polyverts is attached.

frst and last are the addresses of the first and last polyverts describing the polyline.

plinCovered (added in DataCAD 19.01)

```
PROCEDURE PlinCovered(Plin : In Out entity;
  covered : boolean); BUILTIN 674;
```

plinVoidAdd (added in DataCAD 19.01)

```
PROCEDURE PlinVoidAdd(Parent, Void : In Out entity;
  DoDraw : boolean); BUILTIN 673;
```

D4D : I have been unable to get the D4D plvoid_add procedure to work properly (see [DCN thread](#) in case there is any update to this)

polyvert_add

```
PROCEDURE polyvert_add (pv : IN OUT polyvert; frst, last : IN OUT pvtaddr);
```

polyvert_add takes the polyvert contained in pv and adds it to the end of the chain of polyverts for which frst and last are the addresses of the first and last polyvert in the chain.

When frst and last are part of an entity you must perform ent_update to ensure that the entity itself is properly updated in the database.

For example:

```
polyvert_init (pv);
pv.shape := pv_vert;
pv.bulge := 0.0;
pv.pnt.x := 10.0;
pv.pnt.y := 50.0;
pv.pnt.z := 0.0;
polyvert_add (pv, ent.plnfrst,
              ent.plnlast);
ent_update (ent);
```

polyvert_copy

```
PROCEDURE polyvert_copy (oldfrst, oldlast, newfrst, newlast : IN OUT
pvtaddr);
```

polyvert_copy makes a complete copy of a chain of polyverts.

Because polyvert_copy needs only the addresses of the first and last polyverts in both the existing (old) and new chains, polyvert_copy works correctly regardless of what the chains are attached to.

Initialize newfrst and newlast before calling polyvert_copy. Typically, newfrst and newlast are initialized to nil. Alternatively, newfrst and newlast may represent an existing chain of polyverts, in which case the old chain is appended to the new chain.

To copy an entire entity which may contain a chain of polyverts, use ent_copy rather than polyvert_copy. ent_copy properly copies the chains of polyverts which make up entities of type polyline or surfaces of revolution. For complete control over which polyverts are copied, use polyvert_copy.

For example, the following code copies an entity of type polyline without using ent_copy. Note that any attributes associated with the old entity are not copied to the new entity.

```
VAR
  oldent      : entity;
  newent      : entity;
...

ent_init (newent);
setnil (entaddr (newent.plnfrst));
setnil (entaddr (newent.plnlast));
newent.plnbase := oldent.plnbase;
newent.plnhite := oldent.plnhite;
```

```

newent.plnclose := oldent.plnclose
polyvert_copy (oldent.plnfrst,
  oldent.plnlast, newent.plnfrst,
  newent.plnlast);
ent_update (newent);

```

polyvert_count

```
FUNCTION polyvert_count (frst : IN pvtaddr) : integer;
```

polyvert_count returns the number of polyverts in a chain beginning with the polyvert pointed to by frst.

For example, to know how many polyverts are attached to a surface of revolution, use the following code:

```
numverts := polyvert_count (ent.revfrst);
```

polyvert_del

```
PROCEDURE polyvert_del (pv : IN OUT polyvert; frst, last : IN OUT pvtaddr);
```

polyvert_del deletes a polyvert from the chain of polyverts indicated by the fields frst and last. The polyvert is deleted from the database.

When frst and last are part of an entity the entity itself must be updated after the delete operation.

For example, if pv had previously been read out of the database and belongs to an entity of type surface of revolution, then the following two calls must be made to delete the polyvert from the database and update the entity appropriately:

```

VAR
  ent    : entity;
  pv     : polyvert

...

  polyvert_del (pv, ent.revfrst,
               ent.revlst);
  ent_update (ent)

```

polyvert_get

```
FUNCTION polyvert_get (pv : OUT polyvert;
  addr, frst, last : IN pvtaddr) : boolean;
```

for D4D:

```
FUNCTION polyvert_get (pv : OUT polyvert; addr, frst IN pvtaddr) : boolean;
```

polyvert_get reads a polyvert out of the database and places its contents into the variable pv.

addr is the address of the polyvert to read.

frst and last are the addresses of the first and last polyverts in the chain. frst and last must be valid addresses of polyverts in the database or an error occurs.

To read the entire list of polyverts associated with an entity of type polyline, use the following code:

```
VAR
  pv          : polyvert;
  addr        : pvtaddr;
  ent         : entity;
  frst, last  : pvtaddr
...

  addr := ent.plnfrst;
  WHILE polyvert_get (pv, addr, ent.plnfrst, ent.plnlast) DO
    addr := pv.next

    { Operate upon the polyvert here. }

  END;
```

polyvert_init

```
PROCEDURE polyvert_init (pv : IN OUT polyvert);
```

polyvert_init initializes a polyvert variable before using it for a subsequent polyvert_add or polyvert_ins call.

Similar to ent_init and atr_init, polyvert_init initializes all the fields of the polyvert, in particular those which might affect the way the polyvert is added to or read from the database.

polyvert_ins

```
PROCEDURE polyvert_ins (pv : IN OUT polyvert; locaddr : IN pvtaddr; frst,
  last : IN OUT pvtaddr);
```

polyvert_ins is similar to polyvert_add but with polyvert_ins you can add a polyvert at a particular location in the list of polyverts for a particular entity, not just at the end of the list.

locaddr is the address of the polyvert after which to insert the new polyvert. Typically, locaddr is determined from an editing operation which immediately precedes the adding of a polyvert to the chain.

frst and last are the addresses of the first and last polyverts in the chain of polyverts for this particular entity.

polyvert_update

```
PROCEDURE polyvert_update (pv : IN OUT polyvert);
```

polyvert_update updates a polyvert in the database after it is changed.

This is only a valid operation when the polyvert was read from the database via polyvert_get or added to the database via polyvert_add or polyvert_ins.

NOTE: As is the case with most database operations, simply changing the values of a variable does not update the database; an appropriate update call must be performed.

polyvert2ent

```
PROCEDURE polyvert2ent (pv : IN polyvert; ent : OUT entity);
```

polyvert2ent converts a polyvert into an entity of the appropriate type. polyvert2ent automatically accounts for the directionality of the arc.

When the polyvert has a shape of pv_vert, or the value of the bulge parameter for the polyvert is zero, the entity is of type entlin. When the polyvert has a shape of pv_bulge and the value of bulge is non-zero, the entity is of type entarc. When the distance between the vertex of the polyvert and the vertex of the next polyvert is zero, the entity is of type entmrk.

NOTE: The nextpnt field is used by polyvert2ent, and therefore must contain valid information.

Void Database Routine

The following routines manage voids in entities of type polygon or slab (entply or entslb). Voids are handled much like the polyverts which are attached to entities of type polyline and surface of revolution in that voids constitute copious data. Copious data is information which is required to completely describe an entity's geometry, but which is not fully contained in the record structure of a variable of type entity. Unlike polyverts, voids do not have their own record type, but instead use the type entity for their description. Voids do, however, have their own set of database routines. You must take care when using voids not to use any of the standard entity database management routines even though a void uses the same variable type as a standard entity.

A polygon or slab may have zero or more voids attached to it. There is no limitation (except for drawing file size) on the number of voids which may be attached to an entity of type polygon or slab. The routines described here are used only for the database management of voids attached to entities of type polygon and slab. The geometric calculation, manipulation, and integrity of voids is the responsibility of the programmer, and may be managed using DCAL's standard library of arithmetic and geometric routines.

For more information, see "Voids" in the DataCAD Reference Manual which contains a discussion of voids and the operations which may be performed upon them. Of particular importance are the concepts regarding geometric integrity, the geometric relationship of the master polygon or slab to the void, the relationship of the reference and offset face when working with slabs, and the rules regarding convex and degenerate polygons, slabs, and voids.

void_add

```
FUNCTION void_add (ent, void : IN OUT entity); boolean;
```

void_add adds a void to an entity of type polygon or slab. void_add returns true when a void is added.

ent is the entity to which the void is added.

void is an entity variable which is initialized using void_init, and contains the valid geometric description of a void corresponding to that particular entity.

The geometric integrity of the void relative to the entity is the responsibility of the programmer. No geometric checking is performed by void_add.

void_del

```
PROCEDURE void_del (ent, void : IN OUT entity);
```

void_del deletes a void from an entity of type polygon or slab.

ent must be previously read from the database using the function ent_get and must contain a valid description of an entity of type polygon or slab.

void must be previously read from the database using the function void_get or procedure void_get_di and be a void belonging to ent. The void is deleted from the entity and removed from the database.

void_del_all

```
PROCEDURE void_del_all (ent : IN OUT entity);
```

void_del_all deletes all voids from an entity of type polygon or slab when any voids currently belong to the entity. When the entity does not have any voids associated with it, no action is taken.

void_del_all is functionally identical to the following code, but is more efficient:

```
VAR
```

```
    ent    : entity;  
    void   : entity;  
    addr   : entaddr;
```

```
...
```

```
addr := ent.plyfirstvoid;  
WHILE void_get (void, addr) DO  
    addr := void.next;  
    void_del (ent, void);  
END;  
ent_update (ent);
```

```
void_get
```

```
FUNCTION void_get (void : OUT entity; addr : IN entaddr) : boolean;
```

void_get reads a void from the drawing database.

void_get is usually used in a WHILE loop to read the chain of voids attached to an entity of type polygon or slab. After each void is read, the data for that void may be interrogated or updated. void_get returns true when the void is successfully read out of the database. void_get returns false when there are no voids attached to the entity, or when the end of the chain of voids is reached (addr is equal to nil).

I void is an entity variable containing the contents of the void which is read from the database.

addr is the address of the void.

The following code demonstrates this principle. In this example, ent is known to be an entity of type polygon (entply):

```

VAR
  void      : entity;
  ent       : entity;
  addr      : entaddr
...

  addr := ent.plyfrstvoid;

  WHILE void_get (void, vaddr) DO
    addr := void.next;

    { Operate on the void here. }

  END;

```

void_get_di

```
PROCEDURE void_get_di (void : OUT entity; addr : IN entaddr);
```

void_get_di works similarly to the function void_get except void_get_di is used when addr is not equal to nil, but points to a valid void.

void_init

```
PROCEDURE void_init (ent, void : IN OUT entity);
```

void_init initializes a variable of type entity for use as a void.

void_init should always be called prior to adding a void to an entity. It is good practice to call void_init before using an entity for any void database management operation.

ent must be an entity of type polygon or slab, and should be the entity to which the void is added.

void_update

```
PROCEDURE void_update (void : IN OUT entity);
```

void_update updates a void in a drawing database.

void_update is usually called after a void is read from the database using void_get and its geometry is altered. As is the case for entities, simply altering the contents of the void variable do not update the description of the void in the drawing database. void_update makes the drawing database reflect the changes made to the variable void.

Chapter 7 - Processing Routines

Math Routines

The following routines are routines for handling arithmetic data, geometry, and modeling matrices.

absi

```
FUNCTION absi (i : integer) : integer;
```

absi returns the absolute value of an integer expression.

absr

```
FUNCTION absr (r1 : real) : real;
```

absr returns the absolute value of a real expression.

acos

```
FUNCTION acos (r1 : real) : real;
```

acos returns the inverse cosine of its argument r1 (the angle whose cosine is r1).

asin

```
FUNCTION asin (r1 : real) : real;
```

asin returns the angle whose sine is the argument r1 (the inverse sin of r1).

atan

```
FUNCTION atan (r1 : real) : real;
```

atan returns the angle whose tangent is the argument r1. Note that this angle is always in the first or fourth quadrant. A more useful function is atan2.

atan2

```
FUNCTION atan2 (dx, dy : real) : real;
```

atan2 returns the angle given by the delta values dx and dy. This is similar to atan (dy / dx), but the angle is in the correct quadrant and you don't need a special test for dx = 0.

chr

```
FUNCTION chr (i : integer) : char;
```

chr is a type conversion procedure. It takes an integer and returns the corresponding character value. The high eight bits of the integer are ignored.

cos

```
FUNCTION cos (angle : real) : real;
```

cos returns the cosine of the angle that is its argument.

exp

```
FUNCTION exp (x : real) : real;
```

exp returns e raised to the x power (the inverse of natural logarithm).

expt

```
FUNCTION expt (a, x : real) : real;
```

expt returns a raised to the x power.

x can be fractional but not negative.

float

```
FUNCTION float (i : integer) : real;
```

float is a type conversion function. It returns a real value that is the same as its integer argument.

For example, float (-4) returns -4.0.

This function is needed because DCAL does not provide automatic type conversions.

intand

```
FUNCTION intand (int1, int2 : integer) : integer;
```

intand returns the bitwise AND of its two arguments.

For instance, intand (326, 211) returns 66.

intor

```
FUNCTION intor (int1, int2 : integer) : integer;
```

intor returns the bitwise OR of its two arguments.

For example, intor (326, 211) returns 471.

intxor

```
FUNCTION intxor (int1, int2 : integer) : integer;
```

intxor returns the bitwise exclusive OR of its two arguments.

For example, intxor (326, 211) returns 405.

log

```
FUNCTION log (x : real) : real;
```

log returns the natural logarithm (base e) of its argument.

max

```
FUNCTION max (a, b : real) : real;
```

max returns the maximum of its two arguments.

min

```
FUNCTION min (a, b : real) : real;
```

min returns the minimum of its two arguments.

odd

```
FUNCTION odd (i : IN integer) : boolean;
```

odd returns true when the integer i is odd.

When the integer *i* is even, `odd` returns false.

ord

```
FUNCTION ord (ch : char) : integer;
```

`ord` is a type conversion function. It takes a character and returns the integer ASCII value.

order

```
PROCEDURE order (a, b : real; min, max : OUT real);
```

`order` returns in `min` the minimum of *a* and *b*, and returns in `max` the maximum of *a* and *b*.

round

```
FUNCTION round (r1 : real) : integer;
```

`round` takes a real and returns the nearest integer to it.

round4

```
FUNCTION round4 (r1 : IN real) : longint;
```

`round4` takes a real number and rounds it to the nearest long integer.

sin

```
FUNCTION sin (ang : real) : real;
```

`sin` returns the sine of the angle that is passed to it.

sqr

```
FUNCTION sqr (r1 : real) : real;
```

`sqr` returns the square of its argument. This routine is slightly faster than multiplying something by itself (especially when the argument is an expression).

sqrt

```
FUNCTION sqrt (r1 : real) : real;
```

`sqrt` returns the square root of its argument.

A run-time error occurs when the argument is negative.

tan

```
FUNCTION tan (ang : IN real) : real;
```

The function `tan` returns the tangent of the angle `ang`.

When `ang` is a multiple of $+\pi/2$ or $-\pi/2$, `tan` returns a value, but the value is undefined.

trunc

```
FUNCTION trunc (r1 : real) : integer;
```

`trunc` is similar to `round`, except the returned value is truncated toward zero.

For example, `trunc (3.8)` returns 3.

trunc4

```
FUNCTION trunc4 (r1 : IN real) : longint;
```

`trunc4` takes a real number and truncates it to the nearest long integer.

Geometric Routines

The routines in this section let you manipulate geometric data, such as the geometry of lines and arcs. This refers to geometric concepts, not necessarily to DataCAD entities.

addpnt

```
PROCEDURE addpnt (pt1, pt2 : point; respnt : OUT point);
```

`addpnt (pt1, pt2, respnt)` is equivalent to:

```
respnt.x := pt1.x + pt2.x;  
respnt.y := pt1.y + pt2.y;  
respnt.z := pt1.z + pt2.z;
```

angle

```
FUNCTION angle (pt1, pt2 : point) : real;
```

`angle` returns the angle (in radians) between two lines. The first line is defined by the two IN parameter points. The second line goes through `pt1` and is parallel to the x axis. The angle is measured from zero degrees in a counterclockwise direction. The return value is equivalent to that given by `atan2 (pt2.x - pt1.x, pt2.y - pt1.y)`.

Although `angle` ignores the z coordinate, the z coordinate should be initialized to some valid value.

For example, when:

```
pt1.x := 0.0;  
pt1.y := 0.0;  
pt2.x := 2.6;  
pt2.y := 5.7;  
x := angle (pt1, pt2);
```

`x` is equal to 1.142848 radians, or about 65.5 degrees.

angnormalize

```
PROCEDURE AngNormalize (ang : IN OUT real); BUILTIN 491;
```

Forces $(0 \leq \text{ang} \text{ AND } \text{ang} < \text{twoPI})$.

between

```
FUNCTION between (pt1, pt2, testpt : point) : integer;
```

`between` determines when a point `testpt` is on, between, or beyond the line segment defined by `pt1` and `pt2`.

between has the following return values:

-2	beyond pt2
-1	beyond pt1
0	between pt1 and pt2
1	on pt1
2	on pt2

The following conclusions can be drawn based on the return value:

< 0	The point is beyond either end point.
<> 0	The point is on or beyond either end point.
= 0	The point is between both end points.
>= 0	The point is between or on both end points.
> 0	The point is on either end point.
<= 0	The point is not on an end point.

betweenang

```
FUNCTION betweenang (tstang, ang1, ang2 : real);
```

betweenang returns true when tstang is between ang1 and ang2, otherwise, false returns. Between is defined in a counterclockwise direction.

For example:

```
betweenang (0.0, -pi, pi) returns true  
betweenang (0.0, 1.0, pi) returns false
```

cart_cylind

```
PROCEDURE cart_cylind (x, y, z : real; rad, planang, zdis : OUT real);
```

cart_cylind converts from Cartesian to cylindrical coordinates.

For example, the point (x, y, z) converts to (rad, planang, zdis).

cart_sphere

```
PROCEDURE cart_sphere (x, y, z : real; rad, planang, riseang : OUT real);
```

cart_sphere converts from Cartesian to spherical coordinates.

For example, the point (x, y, z) converts to (rad, planang, riseang).

circ3pt

```
FUNCTION circ3pt (pt1, pt2, pt3 : point; cent : OUT point; rad : OUT real) :  
boolean;
```

circ3pt calculates the circle that goes through any three points, pt1, pt2, and pt3.

The center of the circle is returned in cent.

The radius of the circle is returned in rad.

When the three points do not define a circle (they are collinear), circ3pt returns false, otherwise true returns.

clip

```
FUNCTION clip (pt1, pt2 : IN OUT point; min, max : point; doz boolean) :  
boolean;
```

clip is used to clip a line segment to a box. clip works either in three dimensions (x, y, and z) or in two dimensions (x and y) based on the parameter doz.

When doz is true, clip works in three dimensions, otherwise it works in two.

min and max are the bounding corners of the box.

pt1 and pt2 are the two points defining the ends of the line segment. When clip returns false, the line segment defined by pt1 and pt2 is not in the bounding box. When true returns, pt1 and pt2 change to the portion of the line segment inside the box.

crossprod

```
PROCEDURE crossprod (pt1, pt2, pt3 : point; result : IN OUT point);
```

crossprod calculates the vector cross product of two input vectors.

The notation used is somewhat non-standard and is defined to make classifying polygons simple.

The first vector is defined as going from pt1 to pt2. The second vector goes from pt2 to pt3. The resulting vector is returned as result. Think of result as a 3D vector, with the x, y, and z values representing the x, y, and z components of the vector.

crossz

```
FUNCTION crossz (pt1, pt2, pt3 : point) : real;
```

crossz is similar to crossprod, except it returns the z value of the resulting cross product. crossz is useful to determine which side of a two-dimensional line an arbitrary point lies on.

The first vector is defined as going from pt1 to pt2. The second vector goes from pt2 to pt3. When a line goes from pt1 to pt2, crossz returns a positive number if pt3 lies to the left of the line and a negative number if pt3 lies to the right of the line. If pt3 lies on the line, zero is returned.

cylind_cart

```
PROCEDURE cylind_cart (rad, planang, zdis : real; x, y, z : OUT real);
```

cylind_cart converts from cylindrical to Cartesian coordinates.

For example, (rad, planang, zdis) is converted to (x, y, z).

degrees

```
FUNCTION degrees (angle : real) : real;
```

degrees converts its argument (which is given in radians) to degrees. All DCAL functions (except radians, see below) expect their arguments in radians.

dis_from_arc

```
FUNCTION dis_from_arc (center : IN point; radius, begang, endang : IN real;
testpnt : IN point) : real;
```

dis_from_arc returns the square of the shortest distance from an arc specified by its center, radius, beginning angle, and ending angle to a point.

center is the center point of the arc.

radius is the radius of the arc.

begang and endang are the beginning and ending angles of the arc respectively.

testpnt is the point from which to calculate the distance to the arc.

dis_from_arc returns the square of the distance between the point and the arc.

dis_from_line

```
FUNCTION dis_from_line (pt1, pt2, tstpt : point) : real;
```

dis_from_line returns the square of the shortest distance from the point tstpt to the infinite line defined by pt1 and pt2.

dis_from_seg

```
FUNCTION dis_from_seg (pt1, pt2, tstpt : point) : real;
```

dis_from_seg returns the square of the shortest distance from the point tstpt to the line segment defined by pt1 and pt2.

distance

```
FUNCTION distance (pt1, pt2 : point) : real;
```

distance returns the distance between the two points, pt1 and pt2.

Although distance ignores the z coordinates, the z coordinate should be initialized to a valid value.

For example, when:

```
pt1.x := 0.0;
pt1.y := 0.0;
pt2.x := 2.6;
pt2.y := 5.7;
x := distance (pt1, pt2);
```

x is equal to 6.265.

dotprod

```
FUNCTION dotprod (pt1, pt2, pt3 : point) : real;
```

dotprod computes the scalar dot product of two vectors.

See "[crossprod](#)" for the definition of the parameters pt1, pt2, and pt3.

FixAngs

```
PROCEDURE FixAngs (bengang, endang : IN OUT real);          BUILTIN 488;
```

Forces ($0 \leq \text{bengang}$ AND $\text{bengang} < 2\pi$) AND ($\text{bengang} < \text{endang}$).

gridcalc

```
PROCEDURE gridcalc (origin : IN point; ang : IN real; gridIn, gridout : OUT modmat);
```

gridcalc calculates two modeling matrices which are the transformations required for snapping a point to a grid which is defined by an origin and an angle of rotation. The procedure gridcalc is typically called once prior to using gridsnapto procedure for snapping a point to a grid. By using modeling matrices for the definition of the grid orientation, gridsnapto is efficient in its calculations, particularly when used inside repetitive loops.

Procedures gridcalc and gridsnapto are coordinate system independent when used together and may be used in any real number, Cartesian coordinate system. ang is the angle of rotation of the grid coordinate system about its specified origin.

origin is the origin of the grid in the grid coordinate system. The grid need not be defined in the global world coordinate system.

gridIn is the modeling transformation from the base coordinate system to the translated and rotated grid coordinate system.

gridout is the modeling transformation from the translated and rotated grid coordinate system to the base coordinate system.

ent_incirc

```
FUNCTION ent_incirc (ent : IN OUT entity; center : IN point; radius : IN real) : boolean;    BUILTIN 228
```

Returns true if the the entity ENT lies wholly within the circle specified by CENTER & RADIUS.

gridsnapto

```
PROCEDURE gridsnapto (pnt : IN OUT point; gridsize : IN point; gridin, gridout : IN modmat);
```

gridsnapto snaps a point to a grid whose origin and angle of rotation are specified by two modeling matrices, and whose grid size is specified by an x and a y offset.

pnt is the point that is snapped to the grid.

gridsize is a point whose x and y-coordinates describe the size of the grid in the translated and rotated coordinate system described by the modeling matrices gridin and gridout.

gridin and gridout are modeling matrices which are ordinarily computed using the procedure gridcalc.

See "[gridcalc](#)" for a discussion of the definition of these two matrices.

intr_arcarc

```
FUNCTION intr_arcarc (cent1, cent2 : point; rad1, rad2, bang1, eang1, bang2,
eang2 : real; int1, int2 : OUT point) : integer;
```

intr_arcarc computes the intersections of two arcs.

The first arc is centered at cent1, its radius is rad1, and its beginning and ending angles are bang1 and eang1. The second arc is similarly defined.

intr_crcarc

```
FUNCTION intr_crcarc (cent1, cent2 : point; rad1, rad2, bang, eang : real;
int1, int2 : OUT point) : integer;
```

intr_crcarc is similar to intr_crcrc except that cent2 is the center of an arc whose beginning and ending angles are bang and eang, respectively.

intr_crcrc

```
FUNCTION intr_crcrc (cent1, cent2 : point; rad1, rad2 : real;
int1, int2 : OUT point) : integer;
```

intr_crcrc computes the intersections (if any) between two circles.

int1, int2, and the return value have the same meaning as they do in intr_linarc.

The first circle has its center at cent1 and its radius is rad1.

The second circle has its center at cent2 and its radius is rad2.

intr_linarc

```
FUNCTION intr_linarc (center : point; radius, bang, eang : real; pt1, pt2 :
point; int1, int2 : OUT point; segment : boolean) : integer;
```

intr_linarc computes the intersection of either a line or a line segment with an arc.

When intr_linarc returns 0, the line (or line segment) does not intersect the arc. When the return value is 1, int1 contains the only intersection. When the return value is 2, int1 and int2 contain both of the intersections.

center is the center of the arc, radius is its radius, and bang and eang are its beginning and ending angles.

When segment is true, pt1 and pt2 are considered the end points of a line segment, otherwise they are points defining an infinite line.

intr_linarc returns the number of intersections found.

intr_lincrc

```
FUNCTION intr_lincrc (center : point; radius : real; pt1, pt2 : point; int1,
int2 : OUT point; segment : boolean) : integer;
```

intr_lincrc is similar to intr_linarc, but computes the intersection of a line (or line segment) and a circle.

center is the center of the arc and radius is its radius.

When segment is true, pt1 and pt2 are considered the end points of a line segment, otherwise they are points defining an infinite line.

The circle being tested for intersection has its center at center and its radius is radius.

intr_linlin

```
FUNCTION intr_linlin (pt1, pt2, pt3, pt4 : point; intr : OUT point; segments
: boolean) : boolean;
```

intr_linlin computes the intersection point of two lines or two line segments.

The two lines (or segments) are defined from pt1 to pt2 and from pt3 to pt4.

When the parameter segments is true, the intersection must be on or between the end points. When segments is false, the intersection can be anywhere on the two lines. If the lines do intersect and the intersection is between the two end points if segments is true, then the function returns true, otherwise false returns.

When true is returned, intr is the intersection point.

linelen3

```
FUNCTION linelen3 (pt1, pt2 : point) : real;
```

linelen3 returns the square of the distance from pt1 to pt2. Note that this is the three-dimensional distance in space, not the two dimensional distance returned by distance.

meanpnt

```
PROCEDURE MeanPnt (pt1, pt2 : point; meanpt : IN OUT point);    BUILTIN 489;
```

meanpnt := (PT1 + PT2) / 2.

mulpnt

```
PROCEDURE mulpnt (pt : point; scale : real; respnt : OUT point);
```

mulpnt (pt, scale, respnt) is equivalent to:

```
respnt.x := pt.x * scale;
respnt.y := pt.y * scale;
respnt.z := pt.z * scale;
```

pnt_in_poly

```
FUNCTION pnt_in_poly (testpnt : IN point; pnt : IN pntarr; npnt : IN integer;
min, max : IN point) : integer;
```

Note: I have found the results of this function to be NOT reliable. Also the D4D equivalent (PntInPoly) does not work at all and crashes the drawing. Update: the D4D PntInPoly definition was changed in v21.00.01, it may now work correctly but I have not tested it.

pnt_in_poly determines if a point lies within, on, or outside of the boundaries of a polygon. The polygon is described as an array of up to 36 points. The polygon may be arbitrarily concave or convex, but may not be degenerate.

Only the x and y-coordinates of the test point and the polygon vertices are considered, but the z-coordinates of the test point and the polygon vertices must be initialized to valid real numbers. `pnt_in_poly` returns the value 1 when `testpnt` lies within the boundary of the polygon, 0 when `testpnt` lies on the boundary of polygon, and -1 when `testpnt` lies outside the boundaries of the polygon.

- `testpnt` is the point to test.
- `pnt` is the array of vertices of the polygon, up to a maximum of 36.
- `npnt` is an integer indicating the number of vertices in the polygon. `npnt` must be at least 3, but no more than 36.
- `min` and `max` contain the extents of the polygon. `min` and `max` are used for trivial rejection to increase performance when `pnt_in_poly` is used in a repetitive manner.

pntscolinear

```
FUNCTION PntsColinear (pt1, pt2, pt3 : point;
                      epsilon : float) : boolean;          BUILTIN 492;
```

Returns true if PT1, PT2 and PT3 are co-linear +/- epsilon.

polar

```
PROCEDURE polar (pt1 : point; ang, dist : real; pt2 : OUT point);
```

`polar` takes a point `pt1` and returns in `pt2` the point that is at a distance `dist` and angle `ang` from that point.

poly_fix

```
PROCEDURE poly_fix (pnt : IN OUT pntarr; npnts : IN integer; min, max : IN
OUT point);
```

`poly_fix` performs three operations upon a polygon to normalize the polygon for use in some algorithms. `poly_fix` tests to insure that the points of the polygon are specified in a counterclockwise order. When they are not, the order of points is reversed. Secondly, `poly_fix` insures that `pnt [1]` of the polygon is the point which has the minimum x-coordinate among the points which have the minimum y-coordinate. This normalization allows some algorithms which test for inclusion in a polygon to be used when they would not otherwise operate properly. Third, `poly_fix` computes the extents of the polygon.

`pnt` is the array of points which are the vertices of the polygon, up to a maximum of 36.

`npnts` is an integer indicating the number of vertices in the polygon. `npnts` should be a number between 3 and 36 inclusive.

`min` is the minimum extents of the polygon and `max` is the maximum extents of the polygon.

project

```
PROCEDURE project (pt1, pt2 : point; tstpt : IN OUT point);
```

`project` projects `tstpt` onto the line formed by `pt1` and `pt2`.

On entry, tstpt is any point. On exit, tstpt is on the line (not line segment) formed by pt1 and pt2 perpendicular to the original value of tstpt.

radians

```
FUNCTION radians (ang : real) : real;
```

radians takes an angle ang in degrees and converts it to radians.

radians (180.0) returns a number that is equal to pi.

setpoint

```
PROCEDURE setpoint (pt : OUT point; r1 : real);
```

setpoint sets the three coordinates of pt to be equal to r1. This is identical to:

```
pt.x := r1;  
pt.y := r1;  
pt.z := r1;
```

but executes faster, generating less code.

sphere_cart

```
PROCEDURE sphere_cart (rad, planang, riseang : real; x, y, z : OUT real);
```

sphere_cart converts the point (rad, planang, riseang) from spherical coordinates to its Cartesian equivalent (x, y, z).

subpnt

```
PROCEDURE subpnt (pt1, pt2 : point; respnt : OUT point);
```

subpnt (pt1, pt2, respnt) is equivalent to:

```
respnt.x := pt1.x - pt2.x;  
respnt.y := pt1.y - pt2.y;  
respnt.z := pt1.z - pt2.z;
```

swappnt

```
PROCEDURE SwapPnt (pt1, pt2 : IN OUT point);          BUILTIN 490;
```

PT1 := PT2 and PT2 := PT1

Modeling Matrix Routines

The routines in this section manipulate modeling matrices. A modeling matrix is a four- by-four matrix of real numbers. With it, any series of arbitrary three-dimensional scalings, rotations, and translations can be applied to any entity that has a modeling matrix in its definition, such as a symbol or a dome. In addition, using the procedure xformpt, you can apply these same transformations to any point. These scalings, rotations, and enlargements can be applied one after the other, or concatenated.

For examples of the usage of modeling matrices, see the Sample Arrow macro provided with DCAL.

catenlrel

```
PROCEDURE catenlrel (mat : IN OUT modmat; xsc, ysc, zsc : real; pt : point);
```

catenlrel is very similar to setenlrel, but concatenates the relative enlargement instead of setting it.

catmat

```
PROCEDURE catmat (mat1 : IN OUT modmat; mat2 : modmat);
```

catmat concatenates two modeling matrices, mat1 and mat2.

catrotate

```
PROCEDURE catrotate (mat : IN OUT modmat; ang : real; axis : integer);
```

catrotate adds a rotation of ang around axis to the current transformation of mat.

See the description of "[setrotate](#)" for the usage of ang and axis.

catrotrel

```
PROCEDURE catrotrel (mat : IN OUT modmat; ang : real; axis : integer; pt : point);
```

catrotrel is similar to setrotrel, but the rotation is concatenated onto the existing transformation of mat.

catscale

```
PROCEDURE catscale (mat : IN OUT modmat; xsc, ysc, zsc : real);
```

catscale concatenates a scaling onto the current transformation assigned to mat.

See "[setscale](#)".

cattran

```
PROCEDURE cattran (mat : IN OUT modmat; dx, dy, dz : real);
```

cattran concatenates, or adds, a translation of (dx, dy, dz) to the current transformation assigned to mat.

invert

```
FUNCTION invert (matin : modmat; matout : OUT modmat; det : OUT real) : boolean;
```

invert calculates the inverse transformation for matin, if one exists.

false returns when no inverse exists, otherwise true returns. When the inverse does exist, the determinate of the matrix returns in det and the inverse matrix returns in matout.

D4D: My experience is that the invert function in D4D can return false even though the modmat was correctly inverted. (Examples I have tried return a determinant of 1 and the matrix appears to have been correctly inverted I would expect a determinant of 0 if the invert failed).

matmmat

```
PROCEDURE matmmat (mat1, mat2 : modmat; result : OUT modmat);
```

matmmat multiplies two modeling matrices, mat1 and mat2, and places the result in result. Multiplying two matrices concatenates the transformations of mat2 onto mat1.

setenlrel

```
PROCEDURE setenlrel (mat : IN OUT modmat; xsc, ysc, zsc : real; pt : point);
```

setenlrel sets mat to produce an enlargement relative to pt. This procedure is similar to setscale but the enlargement is not relative to the origin.

setident

```
PROCEDURE setident (mat : OUT modmat);
```

setident sets mat to have the identity transformation, that is, no affect at all. A point transformed by the identity matrix yields the original point.

setrotate

```
PROCEDURE setrotate (mat : OUT modmat; ang : real; axis : integer);
```

setrotate sets mat to have a rotation of ang about the axis axis.

The axis should be one of the built-in constants x, y, or z. Notice that the center of this rotation is around the origin.

setrotrel

```
PROCEDURE setrotrel (mat : IN OUT modmat; ang : real; axis : integer; pt : point);
```

setrotrel is similar to setrotate but the rotation is relative to the point pt.

setscale

```
PROCEDURE setscale (mat : OUT modmat; xsc, ysc, zsc : real);
```

setscale sets mat to apply a scaling of xsc, ysc, and zsc along the x, y, and z axes, respectively. The scaling is relative to the origin.

settran

```
PROCEDURE settran (mat : OUT modmat; dx, dy, dz : real);
```

settran sets mat to have a translation of (dx, dy, dz). This is used to move a point or entity.

transpose

```
PROCEDURE transpose (mat : IN OUT modmat);
```

transpose swaps the rows and columns of the matrix mat. Row one becomes column one, row two becomes column two, etc.

xformpt

```
PROCEDURE xformpt (ptin : point; mat : modmat; ptout : OUT point);
```

xformpt transforms the point ptin according to the transformations that have been assigned to mat, and places the result in ptout. This is most often used to set up a transformation and then transform a series of points to determine their new values.

Viewing Routines

The declarations for the routines in this section are not built into the DCAL compiler, but require the inclusion of the file `_views.inc`.

Use the routines in this section to manage and manipulate saved and displayed views in DataCAD. The basic unit of information used by DataCAD's viewing system is the view. A view, represented in DCAL as a variable of type `view_type`, represents two kinds of information:

A view can represent the information necessary to completely specify or calculate a viewing projection. In this case, a view is any one particular orientation of a drawing or model relative to the screen in a particular projection. For example, with a perspective projection, a view contains the location of the viewer, the direction in which the viewer is looking, clipping information, and window to viewport mapping information, as well as a variety of supporting information.

A view can represent the basic unit of information for the storage and retrieval of viewing parameters in a drawing database. In this case, a variable of type `view_type` is the data object used for maintaining a linked data structure consisting of sets of viewing parameters.

DataCAD supports four types of projections:

orthographic, parallel, perspective, and oblique.

Refer to the DataCAD Reference Manual for a discussion of the differences between views and projections, as well as the differences between each of the four types of projections. The DataCAD Reference Manual also includes instructions on how to define and create different views in each of the projection types. Many of the DCAL view calculation routines are used by DataCAD's viewing system, therefore the explanations in the DataCAD Reference Manual also apply to these routines.

Viewing Database Management Routines

The following routines manage views in the drawing database.

view_add

```
PROCEDURE view_add (view : IN OUT view_type);
```

`view_add` adds a view to the list of saved views in a drawing database.

The variable `view` must be initialized using `view_init`, or previously read from the database using `view_get`. `view` must contain a valid set of viewing parameters. The view is added to the chain of saved views at the end of the list. Adding a view to the list of saved views does not make a view the current view, nor does it set the current viewing parameters to those of the view variable, nor does it refresh the screen.

view_add is strictly a database function which adds the contents of the view variable to the list of saved views. view_add automatically stores a list of those layers which are on at the time with the view. In this way, a view is sensitive to the *LayrSet toggle in the DataCAD 3D GoToView menu.

view_del

```
PROCEDURE view_del (view : IN OUT view_type);
```

view_del deletes a view from the list of saved views in a drawing database.

The view must be previously extracted from the database by a call to view_get. Do not attempt to delete a view which has not been previously read from the database using view_get.

view_first

```
FUNCTION view_first : viewaddr;
```

view_first returns the address of the first view in the list of saved views in a drawing database.

When the list of saved views is empty, view_first returns the value nil. view_first is used with view_get so you can linearly scan the list of saved views in a drawing database.

See "view_get".

view_get

```
FUNCTION view_get (view : IN OUT view_type; addr : IN viewaddr) : boolean;
```

view_get reads a view from the drawing database located at address addr.

When addr is nil the list is either empty or the end of the list has been reached and view_get returns false. In this case, the view returned is undefined.

When view_get is successful, true is returned and the variable view contains the view located at address addr.

view_get is most often used with view_first to linearly scan the list of saved views.

For example, to scan the list of saved views and test for those which are orthographic projections, use the following code:

```
VAR
  view      : view_type
  addr      : viewaddr
  ...

  addr := view_first
  WHILE view_get (view, addr) DO
    addr := view.next
    IF view.projtype = vmode_orth THEN
      { Process orthographic
        projections here.}
    END;
  END;
```

view_init

```
PROCEDURE view_init (view : IN OUT view_type);
```

view_init initializes the fields of a variable of type view_type.

Call view_init before using a view_type variable, particularly when adding or deleting views from the database.

view_last

```
FUNCTION view_last : viewaddr;
```

view_last returns the address of the last view in the list of saved views in a drawing database.

When the list of saved views is empty, view_last returns a value of nil. Use view_last to scan the list of views in reverse order or to test against the address of the last view.

view_update

```
PROCEDURE view_update (view : IN OUT view_type);
```

view_update updates a view in the list of saved views in a drawing database.

The view must be previously extracted from the database with a call to view_get. The view must also contain a valid set of viewing parameters. view_update is strictly a database function. To make the view the current view, use view_setcurr. view_update does not alter the current viewing parameters, nor will it refresh the screen.

Viewer Control and Interrogation Routines

The routines described in this section control the current viewing projection in various ways, or interrogate the current viewing parameters. The routines are most-frequently used during three-dimensional editing operations or during the specification of views.

inmat_curr

```
PROCEDURE inmat_curr (inmag : OUT modmat);
```

inmat_curr returns the value of the current input matrix. This matrix is applicable only in parallel projections, and contains the inverse of the complete viewing transformation.

inmat_curr is typically used with the function getpointp when entering or editing data in parallel projections as is done in the DC- Modeler. The matrix returned by inmat_curr represents the transformation required to change from world coordinates to the screen coordinate system used by getpointp.

scale_curr

```
FUNCTION scale_curr : integer;
```

scale_curr returns the number of the current two-dimensional window-to-viewport display scale.

The value that returns is an integer in the range of 1 to 18.

To determine the window-to-viewport scale factor corresponding to this integer number, use the following code:

```
VAR
  scale    : real;
  name     : string (8);
  ...

  scale_get (scale_curr, scale, name);
```

scale_get

```
PROCEDURE scale_get (num : IN integer; scale : OUT real; name : OUT string);
```

scale_get returns the display scale and name for a given scale number.

scale is the ratio of the world coordinate system to the display coordinate system. DataCAD maintains up to 18 discrete drawing display scale factors. The user can edit these scale factors via the Settings/EditDefs/ Scales function. The DataCAD support file dcad.scl may also be edited directly so that any new drawing reflects these new scales. Therefore, the 18 numbered scales are not necessarily unique for any particular drawing nor from drawing to drawing.

name is a string, up to eight characters in length, which is the name of the scale used in DataCAD's ToScale menu.

view_checkmode

```
PROCEDURE view_checkmode (projtype : IN integer);
```

view_checkmode checks the current viewing projection to determine if it is the same as projtype.

view_checkmode takes an integer parameter which must be equal to one of the constants vmode_orth, vmode_para, vmode_pers, vmode_oblq, or vmode_edit. The first four constants check for the projection which they represent as described above. vmode_edit indicates to view_checkmode that either an orthographic or a parallel projection is acceptable.

With vmode_edit, when the current projection is either orthographic or parallel no action is taken. vmode_edit is typically used for three-dimensional editing operations similar to the 3D Move function or the entering of slabs and polygons. These functions are valid in either an orthographic or parallel projection, but not in a perspective or oblique projection.

When the current viewing projection is equal to projtype, no action is taken. When the current viewing projection is not equal to projtype, the most recent view of that projection type is made current and the screen is refreshed.

D4D does not appear to have an equivalent to view_checkmode. I use the following procedure instead:

```
procedure view_checkmode (projtype : integer);
begin
  if projtype <> view_currmode then
    view_setmode (projtype, true);
end;
```


view_currmode

```
FUNCTION view_currmode : integer;
```

view_currmode returns an integer value indicating the current viewing projection type.

view_currmode is typically used for determining the current viewing projection without having to call view_getcurr and examine the individual fields of a view_type variable. For this purpose, view_currmode is faster and easier to use.

The return value is equal to one of the constants vmode_orth, vmode_para, vmode_pers, or vmode_oblq. These values represent orthographic, parallel, perspective, or oblique projections.

The following example prints a message indicating the current viewing projection:

```
VAR
  vmode    : integer;
  ...

  vmode := view_currmode;
  IF vmode = vmode_orth THEN
    wrterr (Orthographic.);

  ELSIF vmode = vmode_para THEN
    wrterr (Parallel.);

  ELSIF vmode = vmode_pers THEN
    wrterr (Perspective.);

  ELSIF vmode = vmode_oblq THEN
    wrterr (Oblique.);

  END;
```

view_getcurr

```
PROCEDURE view_getcurr (view : IN OUT view_type);
```

view_getcurr sets the view_type variable view to the current viewing parameters. view_getcurr does not read from or affect the list of saved views.

view_getcurr does not alter or initialize any of the following fields in a view_type variable: addr, next, prev, name, currlr, frstlr, lastlr, or togglelr.

Use the following code to load the current viewing parameters into a view variable, and then add this view to the list of saved views in a drawing database:

```
VAR
  view    : view_type;
  ...

  view_init (view);
  view_getcurr (view);
  view_add (view)
```

To read, update, add to, or delete from the list of saved views, refer to "Viewing Database Management Routines" in this chapter.

view_setcurr

```
PROCEDURE view_setcurr (view : IN OUT view_type; redraw : IN boolean);
```

view_setcurr sets the current view to reflect the parameters and projection contained in the variable view.

The view need not be read out of the database, but must contain a valid set of viewing parameters. When the view is not read from the database, it should be initialized using view_init prior to modifying the fields of the view.

When redraw is true, the screen is refreshed after setting the current viewing parameters. When redraw is false, the current viewing parameters are altered, but the screen is not refreshed. In this case, if the user presses (Esc), or any subsequent operation is performed which implicitly forces a refresh of the screen, the screen is refreshed using the new viewing parameters.

Typically, the view variable is initialized using view_init, then one of the view calculation routines is called, followed by a call to view_setcurr with refresh set to true. During a call to view_setcurr, some of the fields of the view may be changed depending upon the projection specified and the status of certain system variables. This is because some of the view parameters may be derived from these system parameters depending upon the type of projection. In any case, the fields addr, next, prev, name, lyrcurr, lyrfrst, lyrlast, flag1 and flag2 are not altered by view_setcurr.

view_setmode

```
PROCEDURE view_setmode (projtype : IN integer; refresh : IN boolean);
```

view_setmode explicitly sets the current viewing projection to the type passed by projtype.

When the parameter refresh is true, the screen is refreshed (even if the current viewing projection is the same as projtype). When refresh is false, the screen is not refreshed, but the current viewing projection is still updated. In this case, if the user presses (Esc), or performs any other operation which automatically forces a refresh, the viewing projection contained in projtype is used.

view_setmode explicitly changes among the four current viewing projections. Unlike view_checkmode, view_setmode takes an action even when the current viewing projection is equal to projtype.

Viewing Calculation Routines

The routines described in this section calculate a view of a specific projection based upon a given set of input parameters. These routines operate only upon the view_type variable passed to them. These routines do not affect the current viewing parameters (use view_setcurr) nor do these routines affect any view which was saved in the drawing database

(use view_add or view_update).

view_calcoblq

```
PROCEDURE view_calcoblq (view : IN OUT view_type; center : IN point; planang,  
shearang, shearfact : IN real; oblqtype, scalenum : IN integer);
```

view_calcoblq calculates an oblique viewing projection. Calculate oblique viewing projections using one of two conventions: plan oblique or elevation oblique.

When the calculation is made using the plan oblique convention, oblqtype is set to the constant oblqplan. When the calculation is made using the elevation oblique convention, oblqtype is set to the constant oblqelev.

For plan oblique calculations, the parameters to view_calcoblq have the following meanings:

center becomes the center point of the display and is the point relative to which the viewing shear is calculated.

shearang is ignored.

planang is the angle by which the drawing is rotated about the z-axis before applying the oblique shear.

shearfact is the factor by which lines parallel to the z-axis are enlarged (nominal value is 1.0).

scalenum is an integer, from 1 to 18 inclusively, that indicates which of the currently-loaded display scales is used to calculate the window to viewport mapping for the view.

For elevation calculations, the parameters to view_calcoblq have the following meanings:

center is the center point of the display and is the point relative to which the viewing shear is calculated.

planang is the angle about the z-axis by which the drawing is rotated to orient a particular vertical plane towards the viewer.

shearang is the angle up from the positive x-axis by which lines extending out of the screen are rotated as the shear is applied.

shearfact is the factor by which lines parallel to the axis of shear are enlarged (nominal value is 1.0).

scalenum is an integer, from 1 to 18 inclusively, that indicates which of the currently-loaded display scales is used to calculate the window to viewport mapping for the view.

view_calcorth

```
PROCEDURE view_calcorth (view : IN OUT view_type; center : IN point; scalenum  
: IN integer);
```

view_calcorth calculates an orthographic projection.

center is the point in world coordinates which lies at the center of the screen in the resulting view.

scalenum is an integer, from 1 to 18 inclusively, that indicates which of the currently-loaded display scales is used to calculate the window-to-viewport mapping for the view. The absolute position of the drawing in the viewport is dependent upon the user's display device. Some display devices have a much larger resolution than others and as a consequence may display more or less of a drawing accordingly.

view_calcpa

```
PROCEDURE view_calcpa (view : IN OUT view_type; center : IN point; planang,  
riseang : IN real; scalenum : IN integer);
```

view_calcpa calculates a parallel viewing projection.

center is the center point of rotation for the view and indicates where the center of the screen should be located. planang is the angle by which the drawing is rotated about the z-axis to orient the view.

riseang is the angle up from the xy-plane (horizon) by which the drawing is rotated to orient the view.

scalenum is an integer, from 1 to 18 inclusively, that indicates which currently-loaded display scale to use to calculate the window-to-viewport mapping for the view.

view_calcpers

```
PROCEDURE view_calcpers (view : IN OUT view_type; eyept, centpt : IN point;  
coneang : IN real);
```

view_calcpers calculates a perspective viewing projection.

eyept is the location of the viewer's eye.

eyept is in absolute world coordinates and the z-coordinate of eyept determines the height from the xy-plane (at z = zero) of the viewer's eye.

centpt is the point in the drawing or model at which the user is looking. centpt defines the location of the picture plane relative to eyept. The picture plane is perpendicular to a line passing from eyept to centpt, and passes through centpt. centpt as passed to view_calcpers is not necessarily equal to the field view.centpt since the cone-of-vision angle may alter this parameter.

coneang is the angle of the cone of vision and is the subtended angle between the right and left sides of the frustum of vision. coneang must be within the range 0.0 to 180.0 degrees, but may not be equal to 0.0, or 180.0. coneang determines the values of the window to viewport mapping parameters for the view. The cone of vision in the y-direction is typically less than in the x-direction since nearly all display devices have an aspect ratio which is less than 1.0. Unlike the other view calculation routines, the window-to-viewport mapping parameters for the view are derived from the cone of vision, instead of being explicitly stated.

Hidden Line Removal Routines

The following routine allows a DCAL application to call DataCAD's hidden line removal routine directly.

hide

```
FUNCTION hide (mode : IN mode_type; lyr : IN OUT layer; view : IN view_type;  
addimag, drawhidden : boolean) : boolean;
```

hide performs hidden line removal on the entities described by the mode_type variable mode.

The mode variable must be properly initialized, and may contain any valid combination of mode parameters.

view is a view_type variable which must contain a valid set of viewing parameters. view does not necessarily need to exist in the drawing database, but must be valid.

When drawhidden is true, hidden lines are drawn. When drawhidden is false, hidden lines are not drawn.

When addimag is true, the result of the Hidden Line Removal process is retained and stored on the layer passed to hide. When addimag is false, the result of the hidden line removal process is not retained, but is displayed on the screen only.

The layer represented by lyr must be previously created and exist in the database prior to calling hide with addimag set to true; otherwise an error occurs. If you create a temporary layer in the database using lyr_init, make sure you subsequently remove this layer using lyr_term. Note that lyr_init and lyr_term are used only for free layers (layers not part of the main layer/entity structure), and are distinctly different from layers created by the routines lyr_create and lyr_del which add and delete layers from the main layer/entity structure.

The following example performs hidden line removal on all layers which are currently on, using the current view and projection, and stores the result on the active layer:

```
VAR
  lyr    : layer;
  mode   : mode_type;
  view   : view_type;
...

  lyr := getlyrcurr;
  view_get_curr (view);
  mode_init (mode);
  mode_lyr (mode, lyr_on);
  IF hide (mode, lyr, view,
    true, false) THEN
    { Successful run. Resulting
      image resides on active layer. }
  ELSE
    { Process broken via DEL or END
      keys, or out of memory. }
  END;
```

Hatching Routines

The declarations for the routines in this section are not built into the DCAL compiler, but require the inclusion of the file _hatch.inc.

The following routines invoke DataCAD's hatching system from a DCAL macro. The hatching interface to DCAL is extremely flexible without compromising the performance of the system. Hatch patterns are

defined as a series of passes consisting of parallel scan lines. The scan lines can either be solid (continuous) or dashed.

hatch_mode may be called many times to create complex hatching patterns. For instance, the DataCAD hatch pattern brick consists of two calls to hatch_mode, one with a horizontal solid pattern and the second with a 90 degree rotated, dashed line pattern.

hatch_mode

```
PROCEDURE hatch_mode
(mode      : IN OUT mode_type;
sl        : IN OUT scanLineType;
zbase     : IN real;
zHITE     : IN real;
origin    : IN point;
ang       : IN real;
scale     : IN real;
hType     : IN integer;
lyr       : IN layer;
min       : IN point;
max       : IN point;
dobrk    : IN boolean;
brk       : IN OUT integer);
draw      : IN boolean;
```

hatch_mode hatches a collection of entities. hatch_mode takes a large number of parameters so you can have as much control as possible over the hatching process. This also provides you with the flexibility to create virtually any hatching pattern.

hatch_mode calls the same set of procedures that are used by the standard Hatch menu, and therefore executes at virtually the same speed.

mode is a mode_type variable that indicates which entities to hatch. mode must be initialized using procedure mode_init and refers to a valid collection of entities in the drawing database.

sl is a variable of type scanlinetype and describes the dash/space pattern for each scan line.

Refer to "scanlinetype" for the definition of each field of this record.

zbase is the z-base coordinate of any lines added to the database by hatch_mode.

zHITE is the z-height coordinate of any lines added to the database by hatch_mode.

origin is the origin of the overall hatch pattern. Be careful not to confuse the parameter origin with the .origin field of a scanlinetype. In this case, origin is the overall origin of the hatch pattern whereas the .origin field of a scanLineType is the local origin for each scan line. ang is the angle of the hatch pattern and is measured using the standard DataCAD angle conventions.

When ang is non-zero, rotation of the hatch pattern is performed about the point origin (in any event, ang should be initialized).

scale is the overall scaling factor for the hatch pattern. A value for scale of 1.0 indicates that the values contained in the .dash field of sl are in world coordinates and are used directly.

h_{type} is a flag which may take on one of the three values h_{type}_normal, h_{type}_outer, or h_{type}_ignore and indicates the manner in which hatch_mode handles interior objects in the hatching boundary.

See "Hatching" in "Chapter 2 – Constants".

l_{yr} is a variable of type layer and is the layer to which entities of type line (entlin) are added during the hatching process. l_{yr} must be a valid layer which exists in the drawing database or an error occurs.

min and max are the extents of the collection of entities to hatch as indicated by mode. The hatching entities' extents must be calculated before calling hatch_mode or hatching does not proceed correctly. The procedure ent_extents may be used in a loop for calculating the extents of a collection of entities described by a mode variable.

draw is a Boolean flag which is true when the resulting lines of the hatching process are to be drawn as they are added to the drawing database. When draw is false, lines are not drawn as they are added to the drawing database.

dobr_k is a flag which indicates when the user can interrupt the hatching process by pressing (Del) or (End). When dobr_k is true, interruption of the hatching process is allowed, otherwise it is not.

br_k is an integer containing the current status of the br_kpress state as would be returned by the function br_kpress. br_k should be initialized to zero. br_k is passed to hatch_mode as a formal parameter so that hatch_mode can be placed in a loop when more than one set of scan lines are required for a given hatch pattern. In this case, the calling macro knows if the process has been broken and by which key, through the function br_kpress. When (Del) is pressed br_k returns a value of -1; when (End) is pressed br_k returns a value of 1.

Menu Routines

The routines in this section call the appropriate DataCAD menu. The user is taken to the menu and stays there until exiting the menu, at which time the macro continues. These are convenient for digitizer menus as well as for incorporating the default menus into your own macros. All menu procedures are defined in the include file _menu.inc which must be included in any source file that calls any of these routines.

```
menu1ltrim  
menu2ltrim  
menu2ltrim  
menu3dline  
menuarc2pt  
menuarc3pt  
menuarccentang  
menuarccentarc  
menuarccentchrd  
menuarctan  
menuarraycirc  
menuarrayrect  
menuchamfer  
menuchange  
menucleanup  
menuclipcube
```

menucontrols
menucopy
menucrc3pt
menucrcdia
menucrcrad
menucurves
menucutwall
menuDataCAD3
menudirectry
menudisplay
menudivide
menudmension
menudoorswng
menueditplane
menuelevation
menuellipse
menuenlarge
menuerase
menufileio
menufillets
menufreehand
menugoodies
menugotoview
menugotoview3d
menugrids
menuhatch
menuhide
menuidentify
menuintrsect
menulayers
menulinetype
menulinkline
menulintsct
menumeasures
menumirror
menumove
menumovedrag
menuobjsnap
menuobjsnap
menuplanesnap
menuplotter
menupolygons
menurotate
menusaveimage
menusetobliq
menusetpersp
menusettings
menusettings3d
menuss
menustretch
menutangents
menutemplate
menutext
menutintsct
menutoscale
menuviewer

menuwalkthru
menuweldline
menuwindowin
menuwindows

3D Menus

menublocks
menuchange3d
menucone
menucopy3d
menucylnhori
menucylinvert
menudome
menuedit3d
menuenlarge3d
menuentity3d
menuerase3d
menuexplode3d
menumarker
menumeshsurf
menumove3d
menupartial
menupolygon
menupolyhori
menupolyincl
menupolyrect
menupolyvert
menurevsurf
menurotate3d
menuslab
menuslabhori
menuslabincl
menuslabrect
menuslabvert
menustretch3d
mentorus
menutrunccone
menuvoids

Miscellaneous Routines

The routines in this section do not fall into any other category presented in this manual.

addr2ints

```
PROCEDURE addr2ints (addr : entaddr; int1, int2 : OUT integer);
```

addr2ints converts an address to two integers.

Use this when you write the address out to a file and must write out type integer. While the address of an entity does not change, you have no way of knowing when an entity was deleted and its location used for another entity.

assignProc

```
PROCEDURE assignProc (proc : procedure; x, y : integer);
```

assignProc assigns a procedure given by proc to a given box on the digitizer menu. The procedure must have no parameters. It must be declared at the outermost lexical level – it cannot be a nested procedure.

x and y are the location of the box to which the procedure is assigned. When the user picks the box (x, y), procedure proc executes.

For example, look at the following code fragment.

```
PROCEDURE callMove;

BEGIN
  menumove;
END callMove;

BEGIN { main program }
  configTab (11.0 * 32.0, 11.0 * 32.0,
    22, 22, 9, 10, 17, 16);
  assignProc (callMove, 0, 0);
END main.
```

The procedure proc given as a parameter cannot be one of the built-in procedures, so a small wrapper is needed, such as callMove.

beep

```
PROCEDURE beep;
```

This procedure causes a beep or warning tone.

bitclear

```
FUNCTION bitclear (int, bitnum : integer) : integer;
```

bitclear clears bit number bitnum in int.

bitnum is a value from 0 to 15.

The return value is int with the specified bit cleared.

```
num := bitclear (num, 5);
```

clears the fifth bit of num.

```
bitclear (100, 6) returns 68
bitclear (100, 5) returns 100
```

bitset

```
FUNCTION bitset (int, bitnum : integer) : integer;
```

bitset is identical in usage to bitclear, but the corresponding bit number is set, not cleared.

bittest

```
FUNCTION bittest (int, bitnum : integer) : boolean;
```

bittest is similar to bitclear and bitset, but it tests to see if a particular bit is set.

When the number bitnum bit is set in int, bittest returns true; otherwise, bittest returns false.

```
bittest (100, 6)    returns true
bittest (100, 5)    returns false
```

brkpress

```
FUNCTION brkpress : integer;
```

DataCAD defines two break keys, (End) and (Del).

brkpress returns one of three possible values. It returns 0 when neither break key is pressed, 1 when (End) is pressed, and -1 when (Del) is pressed. Unfortunately, the keyboard buffer is cleared whenever brkpress is called, regardless of what the return value is.

calcDim

```
PROCEDURE CalcDim (ent : IN OUT entity; pt1, pt2, pt3 : point); BUILTIN 494;
```

Calculates an associative dimension entity based upon current DataCAD settings.

calcText

```
PROCEDURE CalcText (ent : IN OUT entity; which : integer); BUILTIN 493;
```

Calculates a text entity based upon current DataCAD settings.

```
{ which = 0 - regular text }
{ which = 1 - dimension text }
{ which = 2 - forms text }
```

clrGetName

```
PROCEDURE clrGetName (clr : IN integer; clrname : OUT string);
```

clrGetName reads the name of one of the 15 built-in colors.

In the standard (English) version of DataCAD, color 1 returns White, color 2 returns Red, etc. This procedure is useful to build menus that use the color name.

Note: clrGetName works for colours beyond the first 15, but will only return an 8 character string. This is fine for the 15 built-in colours, but not so for some of the other colours where the name gets truncated (e.g. 'Color_185' gets truncated to 'Color_18' which does change the meaning a bit)

clrGetPen

```
FUNCTION clrGetPen (clr : IN integer) : integer;
```

clrGetPen returns the pen to use with a certain color when the drawing is plotted.

clrSetName

```
PROCEDURE clrSetName (clr : IN integer; clrname : IN string);
```

clrSetName sets the name of one of the 15 built-in colors.

clrSetPen

```
PROCEDURE clrSetPen (clr, pennum : IN integer;
```

clrSetPen sets the pen pennum that color clr is plotted in.

configTab

```
PROCEDURE configTab (xsize, ysize : real; xmax, ymax, xlft, ybot, xrht, ytop  
: integer);
```

This procedure, along with assignProc, sets up digitizer menus within DataCAD.

The physical dimensions of the overall tablet are given by xsize and ysize, in 32nds of an inch.

xmax is the total number of boxes in the x dimension, and ymax is the total number of boxes in the y dimension.

The lower left corner of the area reserved for the screen is xlft, ybot; the upper right corner of the screen area is xrht, ytop.

For example, to divide an 11 x 11 inch digitizer into half inch squares, you could use:

```
configTab (11.0 * 32.0, 11.0 * 32.0,  
          22, 22, 9, 10, 17, 16);
```

cutout

```
FUNCTION cutout (pt1, pt2 : IN OUT point; pt3, pt4 : OUT point; addr1, addr2,  
addr3, addr4, addr5, addr6 : OUT entaddr; doCut : boolean) : boolean;
```

cutout cuts an opening in a wall.

The three input parameters are pt1, pt2, and doCut. pt1 and pt2 are the two points that define the edges of the cut in the wall. As in DataCAD, these points do not have to be on the wall.

When doCut is true, the two lines that form the wall are broken into two pieces with an opening between them. This is useful for inserting a window or door into an existing wall. When doCut is false, the wall lines are not cut, but cutout finds the walls lines anyway. When cutout finds a wall to put an opening in, it returns true.

On exit, pt1, pt2, pt3, and pt4 define the four corners of the opening in the wall. These points are on the wall that was found. pt3 is opposite pt1, and pt4 is opposite pt2. The meanings of the addresses depend on whether the wall was cut, that is, if doCut was true or false.

When the wall is cut, addr1 is the address of the line that ends at pt1. addr2 is the address of the line that ends at pt2.

addr3 and addr4 are the addresses of the lines ending at pt3 and pt4, respectively.

addr5 is the address of the line that was added between pt1 and pt3.

addr6 is the address of the line that was added between pt2 and pt4.

As an example, this piece of code deletes the two small lines added at the jamb:

```
IF cutout (pt1, pt2, pt3, pt4, addr1,
  addr2, addr3, addr4, addr5,
  addr6, true) THEN
  IF ent_get (ent, addr5) THEN
    { this is always true }
    ent_draw (ent, drmode_black);
    ent_del (ent);
  END;
  IF ent_get (ent, addr6) THEN
    { this is always true }
    ent_draw (ent, drmode_black);
    ent_del (ent);
  END;
END;
```

If the wall was not cut, addr1 is the address of the line that pt1 and pt2 are on, and addr2 is the address of the line that pt3 and pt4 are on. In this case, addr3, addr4, addr5, and addr6 are undefined.

DataCAD_Version (added in DataCAD 19)

```
FUNCTION DataCAD_Version : real; BUILTIN 669;
```

dwgname

```
PROCEDURE dwgname (str : OUT string);
```

dwgname sets its parameter to the current drawing name without the path or extension.

For example, if you are in a drawing named c:\dcad\dwg\spiral.dwg, dwgname sets str to spiral.

ent_explode

```
FUNCTION ent_explode (ent : IN OUT entity; lyr : layer; expMode : integer);
boolean;
```

ent_explode explodes an entity into lines or polygons.

The resulting lines or polygons are created on layer lyr, which can be a regular or temporary layer as described under lyr_init. Any existing entities on lyr are deleted first.

When expMode is 0, the entity is exploded into lines; when expMode is 1, the entity is exploded into polygons.

ent_explode works for any type of entity, including an instance of a symbol. When this operation is completed successfully, it returns true.

Note: Do not rely on the boolean result of ent_explode. It often seems to return true when in fact nothing has been exploded (e.g. if you try to explode a text entity with an SHX font to polygons it returns

true even though no polygons have been created).

Ent_Explode_With_Matrix (added in DataCAD 19.03)

```
PROCEDURE Ent_Explode_With_Matrix(ent : In Out entity;  
                                   mat : modmat); BUILTIN 676;
```

envget

```
PROCEDURE envget (find : string; val : OUT string);
```

envget reads the DOS environment.

This procedure looks for an environment variable with a name like find.

When find is found, the parameter val is set to its value. When find is not found, val is set to an empty string (length zero).

execAndWait (added in DataCAD 9)

```
PROCEDURE execAndWait (prog : str255; Visibility: integer; returnCode : OUT  
integer); BUILTIN 632;
```

Executes prog with the programs windows displayed according to the setting of visibility as shown below:

```
Hidden (SW_HIDE) = 0;  
Normal (SW_SHOWNORMAL) = 1;  
Minimized (SW_SHOWMINIMIZED) = 2;  
Maximized (SW_SHOWMAXIMIZED) = 3;
```

After prog is terminated returnCode will contain an integer value describing the results. This code will vary according to the application run but standard values are 0 for successful execution and termination or -1 for failure to run the program. Additional values are possible depending on the application called. DataCAD will be paused until the application called terminates. If you simply wish to spawn another program and continue with DataCAD use ExecProg.

execProg

```
FUNCTION ExecProg (path, prog, parameters : str255;  
                  ret : OUT integer) : integer;
```

Executes the specified program. Not sure what value ret returns (?). Function (and ret) appears to return a value of 1 when successful in my experience.

Explode_Symbol_Entity (added in DataCAD 19.03)

```
PROCEDURE Explode_Symbol_Entity(Syment : In Out entity; Where : integer);  
BUILTIN 677;
```

The 'Where' parameter can take the following values:

0 = The Active layer

- 1 = The Symbol's insertion layer
- 2 = The symbol's entity's original layers

getcurrfont

```
PROCEDURE getcurrfont (font : IN OUT string);
```

getcurrfont reads the current font that DataCAD is using. This is a string of up to eight characters that represents the font file without path or extension. The string may be null.

D4D: use pgSavevar^.fontname to access the font (now a string of up to 80 characters)

See the DataCAD Reference Manual for further information on fonts.

getCurrInMat

```
PROCEDURE getCurrInMat (mat : OUT modmat);
```

getCurrInMat gets a modeling matrix which is the mathematical inverse of the current viewing matrix. getCurrInMat returns a valid matrix only when the current projection is either orthographic or parallel.

mat is the inverse of the viewing matrix in these cases.

getCurrInMat is typically used when entering and editing entities in a parallel projection and is faster and simpler than using the procedure view_getcurr and extracting the field inptmat from the view_type variable.

getCustomerAddress1 (added in DataCAD 21)

DO NOT USE: This function causes a crash (last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerAddress1(CustomerAddress1 : IN OUT string); BUILTIN 689;
```

getCustomerAddress2 (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)

(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerAddress2(CustomerAddress2 : IN OUT string); BUILTIN 670;
```

getCustomerCity (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)

(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerCity(CustomerCity : IN OUT string); BUILTIN 671;
```

getCustomerCompany (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)

(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerCompany(CustomerCompany : IN OUT string); BUILTIN 685;
```

getCustomerCountry (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)

(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerCountry(CustomerCountry : IN OUT string); BUILTIN 674;
```

getCustomerEmail (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerEmail(CustomerEmail : IN OUT string); BUILTIN 675;
```

getCustomerFax (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerFax(CustomerFax : IN OUT string); BUILTIN 677;
```

getCustomerFirstName (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerFirstName(CustomerFirstName : IN OUT string);  
BUILTIN 686;
```

getCustomerID (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerID(CustomerID : IN OUT string); BUILTIN 681;
```

getCustomerLastName (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerLastName(CustomerLastName : IN OUT string); BUILTIN 687;
```

getCustomerName (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerName(CustomerName : IN OUT string); BUILTIN 688;
```

getCustomerPhone (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerPhone(CustomerPhone : IN OUT string); BUILTIN 676;
```

getCustomerStateProv (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerStateProv(CustomerStateProv : IN OUT string);  
BUILTIN 672;
```

getCustomerZip (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetCustomerZip(CustomerZip : IN OUT string); BUILTIN 673;
```


getInstallationName (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetInstallationName (InstallationName : IN OUT string); BUILTIN 683;
```

getLatestVersionNumber (added in DataCAD 21)

DO NOT USE: This function causes a crash in D4D (uncertain about Classic DCAL or C++versions)
(last tested in ver 21.02.04 ... may be fixed in later versions ??)

```
PROCEDURE GetLatestVersionNumber (LatestVersionNumber : IN OUT string);  
BUILTIN 682;
```

D4D: FUNCTION `get_latest_version_number` : string;

GetLicenseID (added in DataCAD 16.04)

```
PROCEDURE GetLicenseID (LiceseID : IN OUT string); BUILTIN 655;
```

D4D: GetLicenseID was only added to D4D in DataCAD 21 (it is a function returning the LicenseID string)

getLicenseType (added in DataCAD 21)

```
PROCEDURE GetLicenseType (LicenseType : IN OUT integer); BUILTIN 680;
```

getpath

```
PROCEDURE getpath (str : OUT string; num : integer);
```

getpath reads one of DataCAD's internal pathnames. *Note that if the path is longer than 81 characters it seems to be truncated in the returned string (tested in Classic DCAL, not sure about D4D)*

DataCAD maintains several pathnames internally and uses them when it opens or creates several types of files. Examples are the pathnames for symbol files and the path where layer files are kept. Notice that the user can change most of these at the get filename prompts. The constants used for the various paths (used for the parameter num) are given in the "Constants" chapter.

getrefpnt

```
PROCEDURE getrefpnt (pt : OUT point);
```

getrefpnt reads the point from which DataCAD is displaying distances. This point is used in relative distance output mode.

getrubpnt

```
PROCEDURE getrubpnt (pt : OUT point);
```

getrubpnt reads the point from which DataCAD is rubber banding. This is typically the last point entered. This point is valid whether or not rubln or rubbx is true.

get_InpStyl (uncertain of version added, probably around DataCAD 13)

```
FUNCTION Get_InpStyl : integer; BUILTIN 638;
```

This function returns the index of the current input style where:

0 = Relative Polar

- 1 = Absolute Polar
- 2 = Relative Cartesian
- 3 = Absolute Cartesian
- 4 = Direction/Distance

GetPrinterNames (uncertain of version added, probably around DataCAD 13)

```
PROCEDURE GetPrinterNames(PrinterNamesArray : IN OUT TPrinterNamesArr;  
                           NumPrinters : IN OUT integer); BUILTIN 650;
```

PrinterNamesArray will contain the names of the printers available to the system. The type PrinterNamesArr is declared as:

```
TPrinterNamesArr = ARRAY[1..50] of str80;
```

NumPrinters is the number of printers found

high

```
FUNCTION high (param : ARRAY) : integer;
```

high, and the corresponding procedure low, handle arrays of indeterminate bounds (conformant arrays).

For example:

```
FUNCTION sum (a : ARRAY OF integer) : integer;
```

```
VAR  
  i      : integer;  
  sum1   : integer;  
  
BEGIN  
  sum1 := 0;  
  FOR i := low (a) TO high (a) DO  
    sum1 := sum1 + a [i];  
  END;  
  RETURN sum1;  
END sum;
```

This function can be called with any array of integers. At run-time, low and high, return the bounds of the actual parameter. Many of the string routines do essentially this, taking an array of characters.

NOTE : There is a difference in indeterminate arrays between Classic DCAL & DCAL for Delphi. They have a lower bound of 1 in Classic DCAL, but of 0 in DCAL for Delphi

ints2addr

```
FUNCTION ints2addr (int1, int2 : integer) : entaddr;
```

ints2addr converts two integers into an address. This procedure is the reverse of addr2ints.

The two integer parameters must be in the same order as in addr2ints.

isnil

```
FUNCTION isnil (adr : entaddr) : boolean;
```

isnil tests for the address of adr. It returns true when adr points to nothing, that is, it is nil. isnil returns false when adr points to something.

NOTE: Even when adr is pointing to invalid data isnil returns true.

isTrial (added in DataCAD 21)

```
PROCEDURE IsTrial(Trial : IN OUT boolean); BUILTIN 679;
```

keypress

```
FUNCTION keypress : boolean;
```

keypress returns true when a key is waiting in the keyboard buffer, and false when one is not.

light

```
PROCEDURE light (onoff : boolean);
```

light toggles the asterisk in the lower left corner of the screen.

DataCAD typically uses this to let the user know some time-consuming task is underway.

When onoff is true, the asterisk is visible, otherwise it is off.

LoadLinetype (added in DataCAD 16.03)

```
FUNCTION LoadLinetype (name : string) : integer; BUILTIN 653;
```

low

```
FUNCTION low (param : ARRAY) : integer;
```

low, and the corresponding procedure high, handle arrays of indeterminate bounds (conformant arrays).

NOTE : There is a difference in indeterminate arrays between Classic DCAL & DCAL for Delphi. They have a lower bound of 1 in Classic DCAL, but of 0 in DCAL for Delphi

lyr_init

```
PROCEDURE lyr_init (lyr : OUT layer);
```

lyr_init is similar to lyr_create, creating a layer in the database.

The layer, however, is not one of the standard DataCAD layers that the user has access to. The layer is considered a temporary layer. The layer can be used for a short period of time, but should never exist while the user has control, that is, during any of the get or dget procedures because the user can terminate the macro with [Ctrl] + [C] leaving the temporary layer in the database. It must never be the current layer when the user has control.

The macro can set lyr as the current layer to add entities to it, as long as the user is not given control to make changes to lyr. Set some other layer as the current layer before returning control to the user.

D4D Equivalent: `FUNCTION lyr_init = function(var rlyr: lyraddr): boolean;`

lyr_term

```
PROCEDURE lyr_term (lyr : layer);
```

lyr_term destroys a layer that was created using lyr_init.

This procedure should never be called with a layer that DataCAD created or one the macro created with lyr_create. All entities must be deleted from the layer with lyr_clear before lyr_term is called.

msg_OK (added in DataCAD 9)

```
PROCEDURE msg_OK (msg : str255); BUILTIN 245;
```

msg is displayed in a simple dialog box with an OK button.

msg_dlg (added in DataCAD 9)

```
FUNCTION msg_dlg (msg : str255; msgDlgType : integer; msgDlgButtons : integer) : integer; BUILTIN 246;
```

msg is displayed in a dialog box.

msgDlgType can be one of the following:

- | | |
|------------------|---|
| 1 = Warning | A message box containing a yellow exclamation point symbol. |
| 2 = Error | A message box containing a red stop sign. |
| 3 = Information | A message box containing a blue "i". |
| 4 = Confirmation | A message box containing a green question mark. |
| 5 = Custom | A message box containing no bitmap. |

msgDlgButtons can be one of the following:

- | | |
|----------------------|---|
| 1 = YESNOCANCEL | Yes, No & Cancel buttons are used. |
| 2 = OKCANCEL | OK & Cancel buttons are used. |
| 3 = ABORTRETRYIGNORE | Abort, Retry & Ignore Buttons are used. |

The caption of the message box will be DataCAD for windows.

The function returns an integer corresponding to the following values:

- 1 = Yes
- 2 = No
- 3 = Cancel
- 4 = OK
- 5 = Abort
- 6 = Retry
- 7 = Ignore
- 8 = None. (User exited by closing the dialog without selecting a button.)

These values are also defined in msgDlg.inc.

pause

```
PROCEDURE pause (secs : real);
```

pause stops the system for the specified number of seconds.

D4D Note: The D4D Pause procedure has a parameter named 'ms' which led me to believe that it was milliseconds. In fact, like Classic Delphi, it appears to be seconds, so don't be fooled by the parameter name – otherwise you will be left waiting for over 8 minutes instead of half a second when you pass a parameter of 500!

plotClose10 (uncertain of version added, probably around DataCAD 13)

```
PROCEDURE plotClose10; BUILTIN 647;
```

This procedure should be called after calling plotMode10

plotMode10 (uncertain of version added, probably around DataCAD 13)

```
FUNCTION plotMode10(Mode : IN OUT mode_type;  
    PaperMin, PaperMax, WindowMin, WindowMax, RotationCenter : point;  
    RotationAngle : real; MaintainAspect : boolean;  
    ErrorMessage : IN OUT str80) : boolean; BUILTIN 646;
```

Mode is what will be plotted

PaperMin and PaperMax specifies the custom paper size in millimeters

WindowMin and WindowMax specify the real-world coordinates of the viewport to be plotted

RotationCenter is the real-world coordinate of the center of rotation if the printer is setup to rotate the print

MaintainAspect should be set to True if no distortion of the X or Y axis is desired

ErrorMessage is a string to receive any error message

This function returns True if no errors were encountered

plotOpen10 (uncertain of version added, probably around DataCAD 13)

```
FUNCTION plotOpen10(PenWidth : integer; WinPaperSize : integer;  
    PaperSizeX, PaperSizeY : integer; NumCopies : integer;  
    PlotToFileName : str80;  
    ErrorMessage : IN OUT str80) : boolean; BUILTIN 645;
```

PenWidth specifies the pen width in millimeters

WinPaperSize is the index into the available paper sizes

PaperSizeX/PaperSizeY specify the custom paper size in millimeters

NumCopies is the number of copies

PlotToFileName is the name of the plot file to create if plotting to file

ErrorMessage is a string to receive any error message (e.g. the printer doesn't support the paper size specified in PaperSizeX/PaperSizeY)

Random (added in DataCAD 9)

```
FUNCTION random : real; BUILTIN 247;
```

Returns a real number between 0 and 1

random_seed (added in DataCAD 9)

```
FUNCTION random_seed (seed : integer) : integer; BUILTIN 248;
```

Returns an integer between 0 and seed. Note seed is limited to a valid integer with a max of 32767. Values beyond this will give unpredictable results.

readclock

```
PROCEDURE ReadClock (year, month, day,  
                    hours, minutes,  
                    seconds, hundreths : IN OUT integer); BUILTIN 495;
```

ReadClock returns the system time in the appropriate parameters.

Note: In my experience hundreths returns a much smaller increment than hundredths (may depend on computer clock speed??). The value returned can vary from -32k to +32k : Logic that assumes a positive value between 0 and 99 may fail with values outside that range.

sercheck

```
FUNCTION serCheck (str : IN string) : boolean;
```

serCheck returns true when str is the serial number of the copy of DataCAD the macro is running under.

SetBusy (d4d, DataCAD 23 onwards only)

```
PROCEDURE SetBusy (onoff : Boolean);
```

Enables/Disables the busy cursor. The busy cursor is specified in the General Section or DCADWIN.ini

setcurrfont

```
PROCEDURE setcurrfont (font : string);
```

setcurrfont sets the current font to font.

font is the filename, without path or extension, for a font file. The font file specified should exist in the path specified by the system constant pathchr.

D4D: use `pgSavevar^.fontname` to access the font.

See the DataCAD Reference Manual for further information on fonts.

setMSPSheetToPlotByName (uncertain of version, probably added about DataCAD 13)

```
FUNCTION setMSPSheetToPlotByName(Name : str80) : boolean; BUILTIN 641;
```

Makes the sheet with matching name current. Returns true is a sheet with the specified name exists.

setMSPSheetToPlotByNum (uncertain of version, probably added about DataCAD 13)

```
FUNCTION setMSPSheetToPlotByNum(SheetNum : integer) : boolean; BUILTIN 642;
```

Makes SheetNum the current MSP sheet (1-256). Returns True if a valid SheetNum was passed in.

setnil

```
PROCEDURE setnil (addr : IN OUT entaddr);
```

setnil sets addr to the special value nil, therefore, the pointer points to nothing.

See "[isnil](#)" and "[ent_get](#)".

setpath

```
PROCEDURE setpath (str : string; num : integer);
```

setpath is related to getpath. It is used to set DataCAD's internal paths.

EXERCISE GREAT CARE IN CHANGING THESE PATHS. Some paths, such as the pathnames for drawing files, should not be changed.

SetPenSpacing (added in DataCAD 17.02)

```
PROCEDURE SetPenSpacing (PenSpacing : IN real); BUILTIN 660;
```

SetPenStyle (added in DataCAD 17.02)

```
PROCEDURE SetPenStyle (PenStyleName : string); BUILTIN 659;
```

setPenTableNameToLoad (uncertain of version added, probably around DataCAD 13)

```
FUNCTION setPenTableNameToLoad(PenTableName : str80) : boolean; BUILTIN 648;
```

PenTableName Name of Pen Table. Returns True if successful

setPrinterByName (uncertain of version added, probably around DataCAD 13)

```
FUNCTION setPrinterByName(PrinterName : str80;  
                          ErrorMessage : IN OUT str80): boolean; BUILTIN 649;
```

PrinterName Name of printer

ErrorMessage is a string to receive any error message

This function returns True if successful

setToPlotQuickLayout (uncertain of version added, probably around DataCAD 13)

```
PROCEDURE setToPlotQuickLayout(DoQuickLayout : boolean); BUILTIN 644;
```

DoQuickLayout tells DataCAD to default to plotting the Quick Layout rather than MSP

setrefpnt

```
PROCEDURE setrefpnt (pt : point);
```

setrefpnt sets the point from which DataCAD displays distances.

setrefpnt is useful when the point being rubber banded from (see setrubpnt) is not the same as the point you want distance information from, as displayed across the bottom of the window.

setrubpnt

```
PROCEDURE setrubpnt (pt : point);
```

setrubpnt sets the point from which DataCAD is rubberbanding when either rubbx or rubln is true.

set_InpStyl (uncertain of version added, probably around DataCAD 13)

```
PROCEDURE Set_InpStyl(InputStyle : integer); BUILTIN 639;
```

This function sets the index of the current input style where:

0 = Relative Polar

1 = Absolute Polar

2 = Relative Cartesian

3 = Absolute Cartesian

4 = Direction/Distance

sizeof

```
FUNCTION sizeof (variable) : integer;
```

sizeof returns the size, in bytes, of its parameter.

The parameter can be any variable or constant, but not a type.

For example:

```
VAR
  rl      : real;
  addr    : entaddr;
  str     : str80;

sizeof (1)      returns 2
sizeof (rl)     returns 4
sizeof (addr)   returns 4
sizeof (str)    returns 81
```

NOTE: A string has an extra byte which contains the dynamic length of the string.

trialDaysLeft (added in DataCAD 21)

```
PROCEDURE TrialDaysLeft(DaysLeft : IN OUT integer); BUILTIN 684;
```

txtbox

```
PROCEDURE txtbox (ent : IN OUT entity; pt1, pt2, pt3, pt4 : IN OUT point);
```

txtbox finds the four corners of an entity of type enttxt.

Use this procedure to justify text.

The entity ent must be of type enttxt.

On exit pt1 is the lower left corner of the text, that is, it is the same as ent.txtpt.

pt2 is the lower right corner of the text.

pt3 is the upper left corner of the text.

pt4 is the upper right corner of the text.

UndoStartTransaction, UndoEndTransaction (uncertain, but probably around DataCAD 13)

```
PROCEDURE UndoStartTransaction; BUILTIN 634;
```

```
PROCEDURE UndoEndTransaction; BUILTIN 635;
```

These procedures mark the beginning and end of what the undo system sees as a "transaction".

For example, when creating a single line, the undo system sees the following:

- An entity was added
- It was drawn to the screen

- It was marked as the end of a "group"

These 3 steps are seen as a single "transaction" and will be "un-done" together.

D4D: UndoStartTransaction and UndoEndTransaction were added to D4D in DataCAD 21.00.01 (they do not exist in D4D in earlier versions).

Chapter 9 – Compiling and Linking

Note that the DCAL compiler is a 32 bit program that will not work on modern 64 bit versions of Windows. If it will not run on your computer you can install a 32 bit Virtual Machine, or install a utility such as [DOSBox](#)¹ which will provide a suitable environment where you can run the compiler.

The following exe files are found in the DCAL folder of your DataCAD installation:

```
DCC.exe  
DCC1.exe  
DCC2.exe  
DCL.exe
```

(You will want to add the DCAL folder to your environment path variable to facilitate the use of these files.)

There are 2 steps involved in creating a simple dcx macro file. You first need to compile it using DCC.exe and then need to link it using DCL.exe as shown in the example below:

```
C:\DCAL>\Samples\Arrow>DCC Arrow
```

Followed by (if no errors on first command):

```
C:\DCAL>\Samples\Arrow>DCL Arrow;
```

The DCC command accepts only 1 parameter (the name of the dcs source file). The DCL command can accept multiple parameters (the names of multiple object files) and the last parameter must be followed by a semi-colon as shown in the example above.

In some instances (primarily for long/complex source files), the DCC command might give errors such as 'heap overflow'. This can be caused if the compiler runs out of memory and may not necessarily indicate a syntax error in your source file. If you experience problems compiling your macro and have made as much RAM available as possible, you may wish to try running each pass of the compiler separately as follows:

```
C:\DCAL>\Samples\Arrow>DCC1 Arrow
```

Followed by (if no errors on first command):

```
C:\DCAL>\Samples\Arrow>DCC2 Arrow
```

¹ I use DOSBox for compiling my DCAL macros. Note that it was primarily written to enable the playing of old DOS games on modern computers (which sometimes also requires it to simulate a slower CPU speed). To ensure your DCAL compiles at a reasonable speed be sure to have `cycles=max` in the config file.

You can also include an [autoexec] section in the config file and you can use this to mount a drive as well as set path varia

Followed by (if no errors on the above command):

```
C:\DCAL>\Samples\Arrow>DCL Arrow;
```

If you still experience problems and your macro is large, you may have to break it into smaller modules. Also, avoid using nested procedures and functions wherever possible by instead passing the necessary data to the function in its parameter list.

Where you have multiple modules you need to run the compiler (DCC) to create an object file for each individual module. You then run the linker (DCL) just the once to link all the objects together and produce the final DCX file. You can type all the file names on the command line as shown below:

```
C:\DCAL>\Samples\LyrUtil>DCL LyrUtil LyrLoad LyrSave ..\wrtutl\wrtutl;
```

Or you could create a .lnk file which contains the object file names separated by a '+' character and ending in a semicolon (e.g. LyrUtil.lnk might contain "lyrutil+lyrsave+lyrload+..\wrtutl\wrtutl;"). You then pass the link file name to the DCL command as shown below:

```
C:\DCAL>\Samples\LyrUtil>dcl <lyrutil.lnk
```

Many of the sample macros installed with DCAL include .lnk files and also batch files to completely automate the compiling/linking process. E.g. the LyrUtil macro provided in the samples includes a lyrutil.lnk file and also a go.bat file that contains the following commands:

```
del *.dco
del lyrutil.dcx
dcc lyrutil
dcc lyrsave
dcc lyrload
dcl <lyrutil.lnk
```

Chapter 10 – Sample Macros

The following is a listing of the several sample macros included with your DCAL development kit. They are found in the individual directories under the DCAL/Samples folder of your DataCAD installation. A short description is included for each macro so that you may more easily find those which apply to your development task.

ARROW

Specifically designed as an introduction to DCAL for the beginner. The macro enters a simple arrow into a drawing made up of lines. The macro is extensively commented, explaining virtually every line of code in detail.

ATR

Demonstrates how to create symbols in a drawing, and how to add attributes to entities, symbol descriptions, and to a drawing at the system level.

CONCRETE

3D parametric macro using entities of type slab as a basic building block. The macro also contains some good examples of dragging cases.

CROP

Demonstrates how the function CLIP may be used as an editing tool, as well as how to perform a basic editing operation on the database.

DAFILE

Demonstrates all basic techniques necessary for operating upon a direct access, binary data file. It uses FORMLIB for capturing and editing input data.

DOORLABL

Complete source code to the DataCAD DOORLABL macro.

DRAG

Demonstrates nearly all dragging routines available in DCAL.

ENTER3D

Demonstrates the techniques used for entering 3D entities from parallel projections (such as elevations).

FORMLIB

A reusable toolkit for entering and editing collections of data via a forms type screen input system. This library is used by the sample macros FORM, FORMATR, and DAFILE.

FORMATR

Allows the editing of system, symbol, and entity attributes via a forms-like interface.

FORM

Outlines the steps required for using FORMLIB to create custom input screens.

GETARC

Demonstrates the use of the function getarc which is used in many DC-Modeler menus.

HATCH

Demonstrates how to use the hatch_mode function.

LYRUTIL

Allows saving and reloading collections of layers. Primarily designed for packing large drawing files or recovering corrupted data files.

MENU3D

Demonstrates all menu calls to the 3D Viewer and DC-Modeler.

PLOT

Demonstrates the use of the plot_mode procedure.

POLYLINE

Demonstrates polyvert procedures and functions as well as polyline input.

REVSURF

Demonstrates techniques for creating surfaces of revolution.

READTEXT

Demonstrates techniques for reading text files and adding their contents to a drawing.

SPIRAL

The parametric SPIRAL stair macro included with DataCAD.

STAIR

The parametric STAIR macro included with DataCAD.

STUD

The parametric STUD macro for creating drawings of stud wall construction.

SYMEXP

Takes the instance of a symbol in a drawing and explodes it into individual entities.

SYMTMPLT

Examines all of the symbols in a drawing and creates a template file from the information. Particularly useful for DXF-IN operations.

VIEWMAST

Complete source code to the VIEWMAST macro included with the DC- Modeler. Demonstrates nearly all of the functions and procedures related to viewing and saved views.

WNDWLABL

The WNDWLABL macro included with DataCAD.

WRITE

Demonstrates how to scan a database and write out the entire contents of each entity to a text file. May be used as a skeleton for macros which interrogate the database and write its contents to a file in one or another form for post processing.

WRTUTL

A set of utilities for creating messages. WRTUTL is used by many of the sample macros in this collection.

Each macro is in a separate sub-directory. Many macros include a .lnk or a .bat file. The .lnk file contains the linker statement used by the dcl.exe linker. When there are more than one object file, the .lnk file simplifies the linking process. Take for example the CONCRETE macro, to link it, use the command:

```
dcl <concrete.lnk
```

The .bat files are like MAKE files in that they recompile all modules of the macro and then relink the macro. To recompile and relink the entire CONCRETE macro, type:

Compiling the sample macros

The batch and linker files provided with the sample macros assume that each sample macro is in a separate sub-directory, and that the system include files are in a sub- directory at the same directory level. As well, macros which use the WRTUTL library also assume that the WRTUTL subdirectory is at the same directory level.

```
DCAL      | INC          System include files
          | WRTUTL       Message Utilities
          | ARROW       Arrow macro
          | CONCRETE    Concrete macro
          |
          | .          etc.
          | .
```

In each macro and in each .lnk file, the pathnames for system includes files, and for object files are designed with the above directory structure in mind. All pathnames are relative, such that the name of the DCAL subdirectory is unimportant, only the location of the INC and WRTUTL directories relative to the macro source code.

As the DataCAD installation will place the samples within a “samples” folder which is at the same level as the “Inc” folder, it may be necessary to move the entire folder for any sample that you wish to actually compile up one level (so that it is at the same level as the “Inc” folder – you will also need to move the “WrtUtil” folder to the same level and ensure you compile wrtutil.dcs as it is not automatically compiled by the provided batch files).

Copy the compiled macros to your DataCAD Macros directory.

Chapter 9 – Alphabetical Listings

This is an alphabetical listing of the routines available through DCAL, with their parameters and return values if appropriate. A printout of this listing might be a handy computer-side reference for those who are familiar with DCAL but who do not like to memorize parameters.

```
FUNCTION absi (i : integer) : integer;
FUNCTION absr (rl : real) : real;
FUNCTION acos (rl : real) : real;
PROCEDURE addpnt (pt1, pt2 : point; respnt : OUT point);
PROCEDURE addr2ints (addr : entaddr; int1, int2 : OUT integer);
FUNCTION angle (pt1, pt2 : point) : real;
PROCEDURE AngNormalize (ang : IN OUT real); BUILTIN 491;
FUNCTION answer (i : integer) : boolean;
PROCEDURE arc_to_bulge (center : IN point; radius, begang, endang : IN real;
                        ccw : IN boolean; pnt1, pnt2 : OUT point;
                        bulge : OUT real);

FUNCTION asin (rl : real) : real;
PROCEDURE assignProc (proc : procedure; x, y : integer);
FUNCTION atan (rl : real) : real;
FUNCTION atan2 (dx, dy : real) : real;
PROCEDURE atr_2str (atr : IN OUT attrib; str : OUT string);
PROCEDURE atr_add2ent (ent : IN OUT entity; atr : IN OUT attrib);
PROCEDURE atr_add2lyr (lyr : IN OUT layer; atr : IN OUT attrib);
PROCEDURE atr_add2sym (sym : IN OUT symbol; atr : IN OUT attrib);
PROCEDURE atr_add2sys (atr : IN OUT attrib);
PROCEDURE atr_delent (ent : IN OUT entity; atr : attrib);
PROCEDURE atr_dellyr (lyr : IN OUT layer; atr : IN OUT attrib);
PROCEDURE atr_delsym (sym : IN OUT symbol; atr : attrib);
PROCEDURE atr_delsys (atr : IN OUT attrib);
FUNCTION atr_entfind (ent : IN OUT entity; aName : string; atr : OUT attrib)
: boolean;
FUNCTION atr_entfirst (ent : IN OUT entity) : atraddr;
FUNCTION atr_get (atr : OUT attrib; addr : atraddr) : boolean;
PROCEDURE atr_init (atr : IN OUT attrib; atrtype : IN integer);
FUNCTION atr_lyrFind (lyr : IN layer; atr : OUT attrib; str : IN string) :
boolean;
FUNCTION atr_lyrfirst (lyr : IN layer) : atraddr;
FUNCTION atr_next (atr : IN OUT attrib) : atraddr;
FUNCTION atr_symfind (sym : IN OUT symbol; aName : string;
                        atr : OUT attrib) : boolean;
FUNCTION atr_symfirst (sym : IN OUT symbol) : atraddr;
FUNCTION atr_sysfind (atr : OUT attrib; str : IN string) : boolean;
FUNCTION atr_sysfirst : atraddr;
PROCEDURE atr_update (atr : IN OUT attrib);
PROCEDURE beep;
FUNCTION between (pt1, pt2, testpt : point) : integer;
FUNCTION betweenang (tstang, angl, ang2 : real);
FUNCTION bitclear (int, bitnum : integer) integer;
FUNCTION bitset (int, bitnum : integer) : integer;
FUNCTION bittest (int, bitnum : integer) : boolean;
FUNCTION brkpress : integer;
PROCEDURE bulge_to_arc (pnt1, pnt2 : IN point; bulge : IN real;
                        center : OUT point; radius, begang, endang : OUT real;
                        ccw : OUT boolean);
```



```

PROCEDURE CalcDim (ent : IN OUT entity; pt1, pt2, pt3 : point); BUILTIN 494;
PROCEDURE CalcText (ent : IN OUT entity; which : integer); BUILTIN 493;
PROCEDURE cart_cylind (x, y, z : real; rad, planang, zdis : OUT real);
PROCEDURE cart_sphere (x, y, z : real; rad, planang, riseang : OUT real).
PROCEDURE catenlrel (mat : IN OUT modmat; Xsc, Ysc, Zsc : real; pt : point);
PROCEDURE catmat (mat1 : IN OUT modmat; mat2 : modmat);
PROCEDURE catrotate (mat : IN OUT modmat; ang : real; axis : integer);
PROCEDURE catotrel (mat : IN OUT modmat; ang : real;
                    axis : integer; pt : point);
PROCEDURE catscale (mat : IN OUT modmat; Xsc, Ysc, Zsc : real);
PROCEDURE cattran (mat : IN OUT modmat; dx, dy, dz : real);
FUNCTION chdir (path : string) : integer;
FUNCTION chr (i : integer) : char;
FUNCTION circ3pt (pt1, pt2, pt3 : point; cent : OUT point;
                rad : OUT real) : boolean;
FUNCTION clip (pt1, pt2 : IN OUT point;
              min, max : point; doZ boolean) : boolean;
PROCEDURE clrGetName (clr : IN integer; clrname : OUT string);
PROCEDURE clrGetPen (clrnum : IN integer; pennum : OUT integer);
PROCEDURE clrSetName (clr : IN integer; clrname : IN string);
PROCEDURE clrSetPen (clrnum, pennum : IN integer);
PROCEDURE configTab (xsize, ysize : real;
                    xmax, ymax, xlft, ybot, xrht, ytop : integer);
FUNCTION cos (angle : real) : real;
FUNCTION Contour_Offset (cursor : IN point; Offset_Dis : IN real;
                        color : IN integer;
                        pln : IN OUT entity) : boolean; BUILTIN 658;
FUNCTION Contour_Search (cursor : IN point;
                        Boundary : IN OUT ptarr) : integer; BUILTIN 657;
FUNCTION crossZ (pt1, pt2, pt3 : point) : real;
PROCEDURE currwndw (lowleft, upright : IN OUT point);
FUNCTION cutout (pt1, pt2 : IN OUT point; pt3, pt4 : OUT point;
                addr1, addr2, addr3, addr4, addr5, addr6 : OUT entaddr;
                doCut : boolean) : boolean;
PROCEDURE cvangst (ang : real; str : OUT string);
PROCEDURE cvdisst (dis : real; str : OUT string);
PROCEDURE cvintst (i : integer; str : OUT string);
PROCEDURE cvlntst (li : longint; str : OUT string);
PROCEDURE cvrllst (rl : real; str : OUT string);
FUNCTION cvstint (str : string; i : OUT integer) : boolean;
FUNCTION cvstlnt (str : IN string; li : OUT longint) : boolean;
FUNCTION cvstrll (str : string; rl : OUT real) : boolean;
PROCEDURE cylind_cart (rad, planang, zdis : real; x, y, z : OUT real);
FUNCTION degrees (angle : real) : real;
FUNCTION dgetang (ang : IN OUT real; key OUT : integer) : integer;
FUNCTION dgetdis (dis : IN OUT real; key : OUT integer) : integer;
FUNCTION dgetint (int : IN OUT integer; key : OUT integer) : integer;
FUNCTION dgetrl (rl : IN OUT real; key : OUT integer) : integer;
FUNCTION dgetstr (str : IN OUT string; len : integer;
                 key : OUT integer) : integer;
FUNCTION dis_from_arc (center : IN point; radius, begang, endang : IN real;
                     testpnt : IN point) : real;
FUNCTION dis_from_line (pt1, pt2, tstpt : point) : real;
FUNCTION disfrompolyvert (pv : IN OUT polyvert; tstpnt : IN point) : real;
FUNCTION dis_from_seg (pt1, pt2, tstpt : point) : real;
FUNCTION distance (pt1, pt2 : point) : real;
FUNCTION do_Get_Active_SSet : integer; BUILTIN 672;
PROCEDURE do_ChangePlotScale (NewScale : integer); BUILTIN 654;
FUNCTION dotprod (pt1, pt2, pt3 : point) : real;

```

```

PROCEDURE drag2pt (pt1, pt2 : IN point; ortho : IN boolean;
  clr : IN integer);
PROCEDURE dragBar (pt : IN point; lftofs, rhtofs, pntofs, curofs : IN real;
  ortho : IN boolean; clr : IN integer);
PROCEDURE dragBoxMove (pt, min, max : IN point; clr : IN integer);
PROCEDURE dragCrc3 (pt1, pt2 : IN point; doline, ortho : IN boolean;
  clr : IN integer);
PROCEDURE dragDia (pt : IN point; doline, ortho : IN boolean;
  clr : IN integer);
PROCEDURE dragPly (pnt : IN pntarr; startIdx, endIdx : IN integer;
  ref : IN point; close, ortho : IN boolean;
  clr : IN integer);
PROCEDURE dragPlyRot (pnt : IN pntarr; startIdx, endIdx : IN integer;
  cent, ofs, ref : IN point;
  close, ortho, doline : IN boolean;
  clr : IN integer);
PROCEDURE dragModeMove (mode : IN OUT mode_type; pt : IN point);
PROCEDURE dragModeRot (mode : IN OUT mode_type; cent, ofs, ref : IN point);
PROCEDURE dragRad (pt : IN point; doline, ortho : IN boolean;
  clr : IN integer);
PROCEDURE drawcursor (pt : point);
PROCEDURE dwgname (str : OUT string);
PROCEDURE ent_add (ent : IN OUT entity);
PROCEDURE ent_copy (oldent, newent : IN OUT entity;
  toCurr, doAttr : boolean);
PROCEDURE ent_del (ent : IN OUT entity);
PROCEDURE ent_draw (ent : IN OUT entity; drmode : integer);
PROCEDURE ent_draw_2d (ent : IN entity; drmode : IN integer);
PROCEDURE ent_draw_dl (ent : IN entity; drmode : IN integer;
  todl : boolean ); BUILTIN 476
FUNCTION ent_drawmode (mode : IN mode_type; drmode : IN integer;
  todl, clearscr : IN integer) : integer;
PROCEDURE ent_enlarge (ent : IN OUT entity; cent : point;
  Xsc, Ysc, Zsc : real);
FUNCTION ent_explode (ent : IN OUT entity; lyr : layer;
  expMode : integer) : boolean;
PROCEDURE Ent_Explode_With_Matrix(ent : In Out entity;
  mat : modmat); BUILTIN 676;
PROCEDURE ent_extent (ent : IN OUT entity; lowleft, upright : OUT point);
FUNCTION ent_first (mode : IN OUT mode_type) : entadr;
FUNCTION ent_get (ent : OUT entity; adr : entadr) : boolean;
FUNCTION ent_incirc (ent : IN OUT entity; center : IN point;
  radius : IN real) : boolean; BUILTIN 228;
PROCEDURE ent_init (ent : IN OUT entity; enttype : integer);
FUNCTION Ent_IsLockSize (Ent : IN OUT entity) : boolean; BUILTIN 667;
PROCEDURE Ent_Mirr(ent : In Out entity; pt1, pt2 : point;
  FixText : boolean); BUILTIN 675;
PROCEDURE ent_move (ent : IN OUT entity; dx, dy, dz : real);
FUNCTION ent_near (ent : OUT entity; x, y : real; mode : IN OUT mode_type;
  errmsg : boolean) : boolean;
FUNCTION ent_next (ent : IN OUT entity; mode : IN OUT mode_type) : entadr;
PROCEDURE ent_relink (ent1, ent2 : IN OUT entity);
PROCEDURE ent_rotate (ent : IN OUT entity; cent : point; ang : real);
PROCEDURE Ent_SetLockSize (LockSize : boolean;
  Ent : IN OUT entity); BUILTIN 666;

```

```

PROCEDURE Ent_SetPenStyle (PenStyleName : string;
                          Ent : IN OUT entity); BUILTIN 661;
PROCEDURE Ent_SetPenSpacing (PenSpacing : IN real;
                              Ent : IN OUT entity); BUILTIN 662;
PROCEDURE ent_setunused (ent : IN OUT entity);
PROCEDURE ent_tran (ent : IN OUT entity; mat : IN modmat; update, doatr : IN
boolean);
FUNCTION ent_tranok (ent : IN OUT entity) : boolean;
FUNCTION ent_update (ent : IN OUT entity);
PROCEDURE ent2polyvert (ent : IN entity; pv : OUT polyvert);
PROCEDURE envget (find : string; val : OUT string);
PROCEDURE execAndWait ( prog : str255; Visibility: integer;
                       returnCode : OUT integer); BUILTIN 632;
FUNCTION ExecProg (path, prog, parameters : str255;
                  ret : OUT integer) : integer;
FUNCTION exp (x : real) : real;
PROCEDURE Explode_Symbol_Entity (Syment : In Out entity;
                                  Where : integer); BUILTIN 677;
PROCEDURE ExportAutoCADFile (acadfname: string;
                              vernum, lyrmodenum: integer); BUILTIN 652;
FUNCTION expt (a, x : real) : real;
PROCEDURE extents (min, max : OUT point; recalc : IN boolean);
FUNCTION f_close (fl : IN OUT file) : integer;
FUNCTION f_create (fl : OUT file; fname : string; text : boolean) : integer;
FUNCTION f_eof (fl : IN OUT file) : boolean;
FUNCTION fGetLyr (offset : IN OUT integer;
                 key : IN OUT integer;
                 lyr : IN OUT layer;) : integer; BUILTIN 226;
FUNCTION file_copy (oldname, newname : string) : integer;
FUNCTION file_del (fname : string) : integer;
FUNCTION file_exist (fname : string) : boolean;
FUNCTION file_find (str : OUT string; attr : OUT integer;
                  buf : IN OUT dosbuf) : boolean;
PROCEDURE file_pattern (pat : string; attr : integer; buf : IN OUT dosbuf);
FUNCTION file_ren (oldname, newname : string) : integer;
PROCEDURE FixAngs (begang, endang : IN OUT real); BUILTIN 488;
FUNCTION float (i : integer) : real;
FUNCTION fnKeyConv (key : integer) : integer;
FUNCTION f_open (fl : OUT file; fname : string; text : boolean;
               mode : integer) : integer;
FUNCTION f_rdchar (fl : IN OUT file; ch : OUT char) : integer;
FUNCTION f_rdint (fl : IN OUT file; i : OUT integer) : integer;
FUNCTION f_rdlrn (fl : IN OUT file) : integer;
FUNCTION f_rdreal (fl : IN OUT file; rl : OUT real) : integer;
FUNCTION f_rdstr (fl : IN OUT file; str : OUT string) : integer;
FUNCTION f_seek (fl : IN OUT file; recnum : integer) : integer;
FUNCTION f_setrec (fl : IN OUT file; len : integer) : integer;
FUNCTION f_wrchar (fl : IN OUT file; ch : char) : integer;
FUNCTION f_wrint (fl : IN OUT file; int : integer) : integer;
FUNCTION f_wrlrn (fl : IN OUT file) : integer;
FUNCTION f_wrreal (fl : IN OUT file; rl : real) : integer;
FUNCTION f_wrstr (fl : IN OUT file; str : string) : integer;
PROCEDURE getang (ang : IN OUT real);
FUNCTION getarc (msg : IN string; init : IN OUT boolean; center : OUT point;
                radius, bang, eang : OUT real; key : OUT integer) : integer;
PROCEDURE getchar (key : OUT integer);
PROCEDURE getclr (clr : IN OUT integer);
PROCEDURE getcurrfont (font : IN OUT string);
PROCEDURE getCurrInMat (mat : OUT modmat);

```

```

PROCEDURE getCurrLbl (keynum : IN integer; lbl : IN OUT string); BUILTIN 497;
PROCEDURE GetCustomerAddress1(CustomerAddress1 : IN OUT string); BUILTIN 689;
PROCEDURE GetCustomerAddress2(CustomerAddress2 : IN OUT string); BUILTIN 670;
PROCEDURE GetCustomerCity(CustomerCity : IN OUT string); BUILTIN 671;

PROCEDURE GetCustomerCompany(CustomerCompany : IN OUT string); BUILTIN 685;
PROCEDURE GetCustomerCountry(CustomerCountry : IN OUT string); BUILTIN 674;
PROCEDURE GetCustomerEmail(CustomerEmail : IN OUT string); BUILTIN 675;

PROCEDURE GetCustomerFax(CustomerFax : IN OUT string); BUILTIN 677;
PROCEDURE GetCustomerFirstName(CustomerFirstName : IN OUT string);
    BUILTIN 686;

PROCEDURE GetCustomerID(CustomerID : IN OUT string); BUILTIN 681;
PROCEDURE GetCustomerLastName(CustomerLastName : IN OUT string); BUILTIN 687;
PROCEDURE GetCustomerName(CustomerName : IN OUT string); BUILTIN 688;
PROCEDURE GetCustomerPhone(CustomerPhone : IN OUT string); BUILTIN 676;
PROCEDURE GetCustomerStateProv(CustomerStateProv : IN OUT string);
    BUILTIN 672;

PROCEDURE GetCustomerZip(CustomerZip : IN OUT string); BUILTIN 673;
PROCEDURE GetDimTxtPnt (Ent : IN OUT entity;
    dmTxtPt : IN OUT point); BUILTIN 668;

PROCEDURE getdis (dis : IN OUT real);
PROCEDURE getesc (key : OUT integer);
FUNCTION getflname (fname, path : IN OUT string; ext : string;
    entire : OUT string; addext : boolean) : boolean;

PROCEDURE GetInstallationName(InstallationName : IN OUT string); BUILTIN 683;
PROCEDURE getint (i : IN OUT integer);
PROCEDURE GetLicenseID (LiceseID : IN OUT string); BUILTIN 655;
PROCEDURE GetLicenseType(LicenseType : IN OUT integer); BUILTIN 680;
PROCEDURE GetLongLayerName (lyr : layer; name : OUT str255); BUILTIN 636;
PROCEDURE getlyr (lyr : OUT layer);
FUNCTION getlyrcurr : layer;
PROCEDURE getlyrname (lyr : layer; name : OUT string);
FUNCTION getmode (action : string; mode : IN OUT mode_type;
    key : integer) : integer;
PROCEDURE getpath (str : OUT string; num : integer);
FUNCTION getpoint (pt : OUT point; key OUT integer) : integer;
FUNCTION getpointp (pnt : OUT point; key : OUT integer; vmode : IN integer;
    doesc : IN boolean) : integer;
FUNCTION getpoly (msg : IN string; init : IN OUT boolean;
    pnt : IN OUT polyarr; npnt : IN OUT integer;
    key : OUT integer) : integer;
FUNCTION getpolyline (msg : IN str80; viewmode : IN integer;
    dodraw, doclosed : IN boolean;
    init, isclosed : IN OUT boolean;
    frst, last : IN OUT pvtaddr;
    key : OUT integer) : integer;
PROCEDURE GetPrinterNames(PrinterNamesArray : IN OUT TPrinterNamesArr;
    NumPrinters : IN OUT integer); BUILTIN 650;
PROCEDURE getrefpnt (pt : OUT point);
PROCEDURE GetSetLayerFilter(Filter : IN OUT str8;
    ReadOnly : boolean); BUILTIN 671;
PROCEDURE getrll (rl : IN OUT real);
PROCEDURE getrubpnt (pt : OUT point);
PROCEDURE getstr (str : IN OUT string; len : integer);
PROCEDURE Get_DimFont(Ent : Entity; FontName : IN OUT str80); BUILTIN 640;
FUNCTION Get_InpStyl : integer; BUILTIN 638;
PROCEDURE grafmode;
PROCEDURE gridCalc (origin : IN point; ang : IN real;
    gridIn, gridOut : OUT modmat);

```

```

PROCEDURE gridSnapTo (pnt : IN OUT point; gridSize : IN point;
    gridIn, gridOut : IN modmat);
PROCEDURE hatch_mode (mode : IN OUT mode_type;
    sl : IN OUT scanLineType;
    zbase, zwhite : IN real;
    origin : IN point;
    ang, scale : IN real;
    htype : IN integer;
    lyr : IN layer;
    min, max : IN point;
    dobrk : IN boolean;
    brk : IN OUT integer;
    draw : IN boolean);
FUNCTION hide (mode : IN mode_type; lyr : IN OUT layer;
    view : IN view_type; addimag, drawhidden : boolean) : boolean;
FUNCTION high (param : ARRAY) : integer;
PROCEDURE inputAt (col, row : IN integer);
PROCEDURE inputWhere (col, row : OUT integer);
FUNCTION intand (int1, int2 : integer) : integer;
FUNCTION intor (int1, int2 : integer) : integer;
FUNCTION intr_arcarc (cent1, cent2 : point;
    rad1, rad2, bang1, eang1, bang2, eang2 : real;
    int1, int2 : OUT point) : integer;
FUNCTION intr_crcarc (cent1, cent2 : point; rad1, rad2, bang, eang : real;
    int1, int2 : OUT point) : integer;
FUNCTION intr_crcrc (cent1, cent2 : point; rad1, rad2 : point;
    int1, int2 : OUT point) : integer;
FUNCTION intr_linarc (center : point; radius, bang, eang : real;
    pt1, pt2 : point; int1, int2 : OUT point;
    segment : boolean) : integer;
FUNCTION intr_lincrc (center : point; radius : real; pt1, pt2 : point;
    int1, int2 : OUT point; segment : boolean) : integer;
FUNCTION intr_linlin (pt1, pt2, pt3, pt4 : point; intr : OUT point;
    segments : boolean) : boolean;
FUNCTION ints2addr (int1, int2 : integer) : entaddr;
FUNCTION intxor (int1, int2 : integer) : integer;
FUNCTION invert (matin : modmat; matout : OUT modmat;
    det : OUT real) : boolean;
FUNCTION islower (ch : char) : boolean;
FUNCTION isnil (adr : lgl_addr) : boolean;
FUNCTION isupper (ch : char) : boolean;
FUNCTION keyForceExit (key : IN integer) : boolean;
FUNCTION keypress : boolean;
PROCEDURE lblmsg (key : integer; str : string);
PROCEDURE lblsettf (KeyNum : integer; str : string;
    state : integer); BUILTIN 633;
PROCEDURE lblset (key : integer; str : string);
PROCEDURE lblsett (key : integer; str : string; toggle : boolean);
PROCEDURE lblsinit;
PROCEDURE lblson;
PROCEDURE light (onoff : boolean);
FUNCTION linelen3 (pt1, pt2 : point) : real;
FUNCTION LoadLinetype (name : string) : integer; BUILTIN 653;
FUNCTION log (x : real) : real;
FUNCTION low (param : ARRAY) : integer;
PROCEDURE lyr_clear (lyr : layer);
FUNCTION lyr_create (lname : string; lyr : OUT layer) : boolean;
PROCEDURE lyr_del (lyr : IN layer);
FUNCTION lyr_find (lname : string; lyr : OUT layer) : boolean;

```

```

FUNCTION Lyr_Find_LongName (Name : str80;
                             lyr : OUT layer): boolean; BUILTIN 637;

FUNCTION lyr_first : layer;
PROCEDURE lyr_init (lyr : OUT layer);
FUNCTION lyr_ison (lyr : layer) : boolean;
FUNCTION lyr_next (lyr : layer) : layer;
FUNCTION lyr_nil (lyr : layer) : boolean;
FUNCTION lyr_read (lyr : IN layer; filename : IN string;
                  clearlyr, drawlyr : IN boolean) : integer;
PROCEDURE lyr_set (lyr : layer);
PROCEDURE lyr_seton (lyr : layer; onoff : boolean; redraw : boolean);
PROCEDURE lyr_term (lyr : layer);
PROCEDURE lyr_viewfile (filename : IN string; refresh, extents : IN boolean;
                       imagesize : IN real);
FUNCTION lyr_write (lyr : IN layer; filename : IN string) : integer;
PROCEDURE matmmat (mat1, mat2 : modmat; result : OUT modmat);
FUNCTION max (a, b : real) : real;
PROCEDURE MeanPnt (pt1, pt2 : point; meanpt : IN OUT point); BUILTIN 489;
PROCEDURE menu1lntrim;
PROCEDURE menu2lntrim;
PROCEDURE menu3dLine;
PROCEDURE menuArc2pt;
PROCEDURE menuArc3pt;
PROCEDURE menuArccentang;
PROCEDURE menuArccentarc;
PROCEDURE menuArccentchrd;
PROCEDURE menuArctan;
PROCEDURE menuArraycirc;
PROCEDURE menuArrayrect;
PROCEDURE menuBlocks;
PROCEDURE menuChamfer;
PROCEDURE menuChange;
PROCEDURE menuChange3d;
PROCEDURE menuCleanup;
PROCEDURE menuClipCube;
PROCEDURE menuCone;
PROCEDURE menuControls;
PROCEDURE menuCopy;
PROCEDURE menuCopy3d;
PROCEDURE menuCrc3pt;
PROCEDURE menuCrcdia;
PROCEDURE menuCrcrad;
PROCEDURE menuCurves;
PROCEDURE menuCutwall;
PROCEDURE menuCylnHori;
PROCEDURE menuCylnVert;
PROCEDURE menuDataCAD3;
PROCEDURE menuDirectry;
PROCEDURE menuDisplay;
PROCEDURE menuDivide;
PROCEDURE menuDmension;
PROCEDURE menuDome;
PROCEDURE menuDoorswng;
PROCEDURE menuEdit3d;
PROCEDURE menuEditPlane;
PROCEDURE menuElevation;
PROCEDURE menuEllipse;
PROCEDURE menuEnlarge;

```


PROCEDURE menuEnlarge3d;
PROCEDURE menuEntity3d;
PROCEDURE menuErase;
PROCEDURE menuErase3d;
PROCEDURE menuExplode3d;
PROCEDURE menuFileio;
PROCEDURE menuFilletts;
PROCEDURE menuFreehand;
PROCEDURE menuGoodies;
PROCEDURE menuGotoview;
PROCEDURE menuGotoView3d;
PROCEDURE menuGrids;
PROCEDURE menuHatch;
PROCEDURE menuHide;
PROCEDURE menuIdentify;
PROCEDURE menuIntrsect;
PROCEDURE menuLayers;
PROCEDURE menuLinetype;
PROCEDURE menuLinkline;
PROCEDURE menuLintsct;
PROCEDURE menuMarker;
PROCEDURE menuMeasures;
PROCEDURE menuMeshSurf;
PROCEDURE menuMirror;
PROCEDURE menuMove;
PROCEDURE menuMove3d;
PROCEDURE menuMovedrag;
PROCEDURE menuObjsnap;
PROCEDURE menuPartial;
PROCEDURE menuPlaneSnap;
PROCEDURE menuPlotter;
PROCEDURE menuPolygon;
PROCEDURE menuPolygons;
PROCEDURE menuPolyHori;
PROCEDURE menuPolyIncl;
PROCEDURE menuPolyRect;
PROCEDURE menuPolyVert;
PROCEDURE menuRevSurf;
PROCEDURE menuRotate;
PROCEDURE menuRotate3d;
PROCEDURE menuSaveImage;
PROCEDURE menuSetObliq;
PROCEDURE menuSetPersp;
PROCEDURE menuSettings;
PROCEDURE menuSettings3d;
PROCEDURE menuSlab;
PROCEDURE menuSlabHori;
PROCEDURE menuSlabIncl;
PROCEDURE menuSlabRect;
PROCEDURE menuSlabVert;
PROCEDURE menuSS;
PROCEDURE menuStretch;
PROCEDURE menuStretch3d;
PROCEDURE menuTangents;
PROCEDURE menuTemplate;
PROCEDURE menuText;
PROCEDURE menuTintsct;
PROCEDURE menuTorus;
PROCEDURE menuToscale;

```

PROCEDURE menuTruncCone;
PROCEDURE menuViewer;
PROCEDURE menuVoids;
PROCEDURE menuWalkThru;
PROCEDURE menuWeldline;
PROCEDURE menuWindowin;
PROCEDURE menuWindows;
FUNCTION min (a, b : real) : real;
FUNCTION mkdir (path : string) : integer;
PROCEDURE mode_llyr (mode : IN OUT mode_type; lyr : layer);
PROCEDURE mode_box (mode : IN OUT mode_type; x1, y1, x2, y2 : real);
PROCEDURE mode_enttype (mode : IN OUT mode_type; entType : integer);
PROCEDURE mode_fence (mode : IN OUT mode_type; pnt : IN pntarr;
    npnt : IN integer);
PROCEDURE mode_group (mode : IN OUT mode_type; ent : IN OUT entity);
PROCEDURE mode_ignore (mode : IN OUT mode_type);
PROCEDURE mode_init (mode : IN OUT mode_type);
PROCEDURE mode_init1 (mode : IN OUT mode_type);
PROCEDURE mode_lyr (mode : IN OUT mode_type; lyr : integer);
PROCEDURE mode_ss (mode : IN OUT mode_type; ssNum : integer);
PROCEDURE mode_sym (mode : IN OUT mode_type; sym : IN OUT symbol);
PROCEDURE mulpnt (pt : point; scale : real; respnt : OUT point);
PROCEDURE msg_OK (msg : str255); BUILTIN 245;
FUNCTION msg_dlg (msg : str255; msgDlgType : integer;
    msgDlgButtons : integer) : integer; BUILTIN 246;
FUNCTION numlayer : integer;
FUNCTION odd (i : IN integer) : boolean;
FUNCTION ord (ch : char) : integer;
PROCEDURE order (a, b : real; min, max : OUT real);
PROCEDURE pause (secs : real);
FUNCTION pixsize : real;
FUNCTION pline_area (frst, last : IN pvtaddr) : real;
PROCEDURE pline_centroid (frst, last : IN pvtaddr; totarea : IN OUT real;
    frstmoment, centroid : IN OUT point;
    first, add : IN boolean);
FUNCTION pline_perim (frst, last : IN pvtaddr) : real;
PROCEDURE PlinCovered (Plin : IN OUT entity; covered : boolean); BUILTIN 674;
PROCEDURE PlinVoidAdd (Parent, Void : IN OUT entity;
    DoDraw : boolean); BUILTIN 673;
PROCEDURE plot_close (plot : IN OUT plot_type);
PROCEDURE plot_mode (plot : IN OUT plot_type;
    mode : IN OUT mode_type;
    multipen, pensort, colors : IN boolean;
    vwptMin, vwptMax, wndwMin, wndwMax, center : IN point;
    ang : IN real);
PROCEDURE Plot_Model1 (plot : IN OUT plot_type;
    mode : IN OUT mode_type;
    multipen, pensort, colors : IN boolean;
    vwptMin, vwptMax, wndwMin, wndwMax, center : IN point;
    ang : IN real); BUILTIN 498;
FUNCTION plot_open (penwidth : IN integer;
    penspeed : IN integer;
    maxx, maxy : IN real;
    tofile : IN boolean;
    fname : IN string;
    plot : IN OUT plot_type) : integer;
PROCEDURE plotClose10; BUILTIN 647;

```



```

FUNCTION plotModel10 (Mode : IN OUT mode_type;
    paperMin, paperMax, WindowMin,
    WindowMax, RotationCenter :point;
    RotationAngle : real; MaintainAspect : boolean;
    ErrorMessage : IN OUT str80) : boolean; BUILTIN 646;
FUNCTION plotOpen10 (PenWidth : integer; WinPaperSize : integer;
    PaperSizeX, PaperSizeY : integer; NumCopies : integer;
    PlotToFileName : str80;
    ErrorMessage : IN OUT str80) : boolean; BUILTIN 645;

FUNCTION pnt_in_poly (testpnt : IN point; pnt : IN polyarr;
    npnt : IN integer; min, max : IN point) : integer;
FUNCTION PntsColinear (pt1, pt2, pt3 : point;
    epsilon : float) : boolean; BUILTIN 492;
PROCEDURE polar (pt1 : point; ang, dist : real; pt2 : OUT point);
PROCEDURE poly_fix (pnt : IN OUT pntarr; npnts : IN integer;
    min, max : IN OUT point);
PROCEDURE polyvert2ent (pv : IN polyvert; ent : OUT entity);
PROCEDURE polyvert_add (pv : IN OUT polyvert; frst, last : IN OUT pvtaddr);
PROCEDURE polyvert_copy (oldfrst, oldlast,
    newfrst, newlast : IN OUT pvtaddr);
FUNCTION polyvert_count (frst : IN pvtaddr) : integer;
PROCEDURE polyvert_del (pv : IN OUT polyvert; frst, last : IN OUT pvtaddr);
FUNCTION polyvert_get (pv : OUT polyvert;
    addr, frst, last : IN pvtaddr) : boolean;
PROCEDURE polyvert_init (pv : IN OUT polyvert);
PROCEDURE polyvert_ins (pv : IN OUT polyvert; locaddr : IN pvtaddr;
    frst, last : IN OUT pvtaddr);
PROCEDURE polyvert_update (pv : IN OUT polyvert);
PROCEDURE popview;
PROCEDURE printstr (str : string; x, y, color, cursor : integer;
    inverse : boolean);
PROCEDURE PrintStr255 (str : str255; Column, Row, Color, Curs : integer;
    Invert : boolean); BUILTIN 670;
PROCEDURE project (pt1, pt2 : point; tstpt : IN OUT point);
PROCEDURE pushview;
FUNCTION radians (ang : real) : real;
FUNCTION random : real; BUILTIN 247;
FUNCTION random_seed (seed : integer) : integer; BUILTIN 248;
PROCEDURE ReadClock (year, month, day, hours, minutes,
    seconds, hundreths : IN OUT integer);
PROCEDURE readIniBool ( IniFile, Section, Ident: str255; Default : boolean;
    ReturnBool : OUT boolean); BUILTIN 627;
PROCEDURE readIniInt ( IniFile, Section, Ident: str255; Default : integer;
    ReturnInt : OUT integer); BUILTIN 629;
PROCEDURE readIniReal ( IniFile, Section, Ident: str255; Default : real;
    ReturnReal : OUT real); BUILTIN 631;
PROCEDURE readIniStr (IniFile, Section, Ident, Default : str255;
    ReturnStr : OUT str255); BUILTIN 625;

PROCEDURE redraw;
PROCEDURE redrawall;
PROCEDURE regen;
FUNCTION rmdir (path : string) : integer;
FUNCTION round (rl : real) : integer;
FUNCTION round4 (rl : IN real) : longint;
FUNCTION scale_curr : integer;
PROCEDURE scale_get (num : IN integer; scale : OUT real; name : OUT string);
FUNCTION serCheck (str : IN string) : boolean;
PROCEDURE Set_Active_SSet (SSet : integer); BUILTIN 664;

```

```

PROCEDURE setcurrfont (font : string);
PROCEDURE setenlrel (mat : IN OUT modmat; Xsc, Ysc, Zsc : real; pt : point);
PROCEDURE setident (mat : OUT modmat);
PROCEDURE SetKnockOut(Ent : In Out entity; TurnOn : boolean); BUILTIN 678;
PROCEDURE setlyrname (lyr : layer; name : string);
FUNCTION setMSPSheetToPlotByName(Name : str80) : boolean; BUILTIN 641;
FUNCTION setMSPSheetToPlotByNum(SheetNum : integer) : boolean; BUILTIN 642;
PROCEDURE setnil (addr : IN OUT entaddr);
PROCEDURE SetMacroHints(DoHints : boolean); BUILTIN 651;
PROCEDURE setpath (str : string; num : integer);
PROCEDURE SetPenStyle (PenStyleName : string); BUILTIN 659;
PROCEDURE SetPenSpacing (PenSpacing : IN real); BUILTIN 660;
FUNCTION setPenTableNameToLoad(PenTableName : str80) : boolean; BUILTIN 648;
PROCEDURE setpoint (pt : OUT point; rl : real);
FUNCTION setPrinterByName(PrinterName : str80;
    ErrorMessage : IN OUT str80): boolean; BUILTIN 649;
PROCEDURE setrefpnt (pt : point);
PROCEDURE setrotate (mat : OUT modmat; ang : real; axis : integer);
PROCEDURE setrotrel (mat : IN OUT modmat; ang : real;
    axis : integer; pt : point);
PROCEDURE setrubpnt (pt : point);
PROCEDURE setscale (mat : OUT modmat; Xsc, Ysc, Zsc : real);
PROCEDURE settran (mat : OUT modmat; dx, dy, dz : real);
PROCEDURE setToPlotQuickLayout(DoQuickLayout : boolean); BUILTIN 644;
FUNCTION sin (ang : real) : real;
FUNCTION sizeof (variable) : integer;
PROCEDURE sphere_cart (rad, planang, riseang : real; x, y, z : OUT real);
PROCEDURE SortLayersByName; BUILTIN 656;
FUNCTION sqr (rl : real) : real;
FUNCTION sqrt (rl : real) : real;
PROCEDURE ssAdd (ssNum : integer; ent : IN OUT entity);
PROCEDURE ssClear (ssNum : integer);
FUNCTION ssDel (ssNum : integer; ent : IN OUT entity) : boolean;
PROCEDURE ssDelAll (ent : IN OUT entity); BUILTIN 227;
PROCEDURE ssGetName (ssNum : IN integer; sname : OUT string);
FUNCTION ssLength (ssNum : integer) : integer;
FUNCTION ssMember (ssNum : integer; ent : IN OUT entity) : boolean;
PROCEDURE ssSetName (ssNum : IN integer; sname : IN string);
PROCEDURE stopgroup;
PROCEDURE strassign (dest : IN OUT string; source : string);
PROCEDURE strcat (str1 : IN OUT string; str2 : string);
FUNCTION strcomp (str1, str2 : string; len : integer) : boolean;
PROCEDURE strdel (str : IN OUT string; start, len : integer);
PROCEDURE strinc (str : IN OUT string);
PROCEDURE strins (dest : IN OUT string; source : string; pos : integer);
FUNCTION strlen (str : string) : integer;
PROCEDURE strpad (str : IN OUT string; len : integer; ch : char);
FUNCTION strpos (pat, str : string; start : integer) : integer;
PROCEDURE strsub (source : string; start, len : integer;
    dest : IN OUT string);
PROCEDURE strupcase (str : IN OUT string; toupper : boolean);
PROCEDURE subpnt (pt1, pt2 : point; respnt : OUT point);
PROCEDURE SwapPnt (pt1, pt2 : IN OUT point); BUILTIN 490;
PROCEDURE sym_clearref;
PROCEDURE sym_count (mode : IN OUT mode_type);
PROCEDURE sym_create (sym : OUT symbol; mode : IN OUT mode_type; ref : point;
    sname : string; delEnts, undraw : boolean);
FUNCTION sym_find (sname : string; sym : OUT symbol) : boolean;

```

```

FUNCTION sym_first : symaddr;
FUNCTION sym_get (sym : OUT symbol; saddr : symaddr) : boolean;
FUNCTION sym_get_atr (sym : OUT symbol; saddr : symaddr; atrName : string;
    atr : OUT attrib);
FUNCTION sym_next (sym : symbol) : symaddr;
FUNCTION sym_read (fName, symName : string; sym : OUT symbol) : integer;
PROCEDURE sym_ref (mode : IN OUT mode_type);
FUNCTION sym_write (sym : symbol; fName : string) : integer;
FUNCTION tan (ang : IN real) : real;
PROCEDURE textmode;
FUNCTION tolower (ch : char) : char;
FUNCTION toupper (ch : char) : char;
PROCEDURE toview (num : integer);
PROCEDURE transpose (mat : IN OUT modmat);
PROCEDURE TrialDaysLeft(DaysLeft : IN OUT integer); BUILTIN 684;
FUNCTION trunc (rl : real) : integer;
FUNCTION trunc4 (rl : IN real) : longint;
PROCEDURE txtbox (ent : IN OUT entity; pt1, pt2, pt3, pt4 : IN OUT point);
PROCEDURE UndoStartTransaction; BUILTIN 634;
PROCEDURE UndoEndTransaction; BUILTIN 635;
PROCEDURE Unset_Active_SSet (SSet : integer); BUILTIN 665;
PROCEDURE view_add (view : IN OUT view_type);
PROCEDURE view_calcoblq (view : IN OUT view_type; center : IN point; planang,
shearang, shearfact : IN real; oblqtype, scalenum : IN integer);
PROCEDURE view_calcorth (view : IN OUT view_type; center : IN point;
    scalenum : IN integer);
PROCEDURE view_calcpara (view : IN OUT view_type; center : IN point;
    planang, riseang : IN real; scalenum : IN integer);
PROCEDURE view_calcpers (view : IN OUT view_type; eyepnt, centpnt : IN point;
    coneang : IN real);
PROCEDURE view_checkmode (projtype : IN integer);
FUNCTION view_currmode : integer;
PROCEDURE view_del (view : IN OUT view_type);
FUNCTION view_first : viewaddr;
FUNCTION view_get (view : IN OUT view_type; addr : IN viewaddr) : boolean;
PROCEDURE view_getcurr (view : IN OUT view_type);
PROCEDURE view_init (view : IN OUT view_type);
FUNCTION view_last : viewaddr;
PROCEDURE view_setcurr (view : IN OUT view_type; redraw : IN boolean);
PROCEDURE view_setmode (projtype : IN integer; refresh : IN boolean);
PROCEDURE view_update (view : IN OUT view_type);
PROCEDURE void_add (ent, void : IN OUT entity);
PROCEDURE void_del (ent, void : IN OUT entity);
PROCEDURE void_del_all (ent : IN OUT entity);
FUNCTION void_get (void : OUT entity; addr : IN entaddr) : boolean;
PROCEDURE void_get_di (void : OUT entity; addr : IN entaddr);
PROCEDURE void_init (ent, void : IN OUT entity);
PROCEDURE void_update (void : IN OUT entity);
PROCEDURE vwptclear;
PROCEDURE windowin (lowleft, upright : point);
PROCEDURE writeIniBool (IniFile, Section, Ident : str255;
    Value : boolean); BUILTIN 626;
PROCEDURE writeIniInt (IniFile, Section, Ident : str255;
    Value : integer); BUILTIN 628;
PROCEDURE writeIniReal (IniFile, Section, Ident : str255;
    Value : real); BUILTIN 630;
PROCEDURE writeIniStr (IniFile, Section, Ident, Value : str255);BUILTIN 624;
PROCEDURE wrterr (str : string);
PROCEDURE wrtLtype;

```

```
PROCEDURE wrtlvl (str : string);  
PROCEDURE wrtmsg (str : string);  
PROCEDURE wrtscl;  
PROCEDURE wrtSS;  
PROCEDURE wrtstat;  
PROCEDURE xformpt (ptin : point; mat : modmat; ptout : OUT point);
```

This is an alphabetic listing of the built in variables available through DCAL.

```
aperture : boolean;
bigcurs  : boolean;
centwall : boolean;
chamfera : real;
chamferb : real;
constref : boolean;
curssz   : integer;
docut    : boolean;
dojamb   : boolean;
doorang  : real;
doorhgt  : real;
doorthk  : real;
doorthk  : real;
drawlines : boolean;
drawmarks : boolean;
filcut   : boolean;
filrad   : real;
grid1sz  : integer;
gridang  : real;
gridclr  : integer;
gridclr1 : integer;
gridorgx : real;
gridorgy : real;
gridshow : boolean;
gridshowx : real;
gridshowy : real;
gridshw1 : boolean;
gridshw1x : real;
gridshw1y : real;
gridsnap : boolean;
gridsnapx : real;
gridsnapy : real;
headhgt  : real;
inpstyl  : integer;
jambwth  : real;
lineattr : integer;
linecolor : integer;
lineosht : real;
linespcg : real;
linetype : integer;
linewidth : integer;
lyrsearch : boolean;
missdis  : integer;
noisy    : boolean;
numdivs  : integer;
orthmode : boolean;
osnap_mode : integer;
osnap_num : integer;
ovrdraw  : boolean;
pltcentx : real;
pltcenty : real;
pltcolor : boolean;
pltpcustx : real;
pltpcusty : real;
pltpensort : boolean;
pltpenspeed : integer;
```

```
pltpenwidth : integer;
pltysize : integer;
pltrot : boolean;
pltrotang : real;
pltrotcentx : real;
pltscalenum : integer;
polycntr : boolean;
polydiam : boolean;
polyinsd : boolean;
polysides : integer;
polyvert : boolean;
rubbx : boolean;
rubln : boolean;
scrolldis : real;
sidedoor : boolean;
sillhgt : real;
sillin : real;
sillout : real;
smallgrid : integer;
symang : real;
symenlx : real;
symenly : real;
symenz : real;
txtaline : integer;
wallend : integer;
wallson : integer;
wallwidth : real;
zbase : real;
zHITE : real;
```

Appendix 1 – Useful fragments of DCAL for Delphi Code.

DisFromPolyvert

```

FUNCTION DisFromPolyvert2 (pv : polyvert; tstpnt : point) : double;
/// returns the square of the distance
VAR
  cent : point;
  radius, bang, eang, r : double;
  ccw : boolean;
BEGIN
  if pv.shape = pv_vert then begin
    result := dis_from_seg (pv.pnt, pv.nextpnt, tstpnt);
  end
  else begin
    bulge_to_arc (pv.pnt, pv.nextpnt, pv.bulge, cent, radius, bang, eang, ccw);
    if not ccw then begin
      r := bang;
      bang := eang;
      eang := r;
    end;
    result := dis_from_arc (cent, radius, bang, eang, tstpnt);
  end;
END;

FUNCTION DisFromPolyvert (pv : polyvert; tstpnt : point) : double;
BEGIN
  Result := Sqrt (DisFromPolyvert2 (pv, tstpnt));
END;

```

DisFromPln

```

FUNCTION DisFromPln (tstpnt : point; pln : entity) : double;
VAR
  pv : polyvert;
  adr : lgl_addr;
  d : double;
BEGIN
  adr := pln.plnfrst;
  result := MaxDouble;
  while polyvert_get (pv, adr, pln.plnfrst) do begin
    adr := pv.Next;
    result := Min (result, DisFromPolyvert2 (pv, tstpnt));
  end;
  result := sqrt(result);
END;

```

Appendix 2 – DataCAD Fault Codes

When DataCAD crashes (whether as the result of a faulty macro or whatever), it will display 2 numeric codes. The first number indicates the fault type, whereas the second number indicates the location in the logic where the error occurred. The lists below detail the meanings of these numeric codes.

Fault Type Codes

1. Error in procedure mark_ent, the page to mark entity on is not in ram
2. Error in procedure mark_ent, bit is already set
3. Error in procedure mark_ent, bit is already clear
4. Error in function get_pg_frm
5. Error in procedure get_ent, page not in ram
6. Error in procedure get_ent, no room on page
7. Error in procedure get_ent, bit overflow
8. Error in procedure get_ent, offset overflow
9. Error in function real_addr, addr.page has null pointer
10. Error in function real_addr, addr.page is out of range
11. Error in procedure lyr_get_di_v, lyr_get_v(addrSpc, addr, lyr) exception thrown
12. Error in procedure put_lyr2, isnil(ram_lyr.addr) true
12. Error in procedure put_lyr_priority, isnil(ram_lyr.addr) true
13. Error in function num_ent, entity type unknown
14. Error in procedure ent_put2, entity type unknown
17. Error in function new_page
18. Error in procedure dispose_ent, valid_addr was not true
19. Error in function real_addr, addr ofs is out of range
21. Error in procedure wr_pages, write error
27. Error in procedure ent_del, eq_lgl_addr(ent.ptr, lyr.firstln) not true
28. Error in procedure ent_del, eq_lgl_addr(ent.ptr, lyr.lastln) not true
32. Error in procedure ent_chglyr, eq_lgl_addr(ent.ptr, lyrCurr.firstln) not true
33. Error in procedure ent_chglyr, eq_lgl_addr(ent.ptr, lyrCurr.lastln) not true
35. Error in function ssDel12, not a member of the selection set
36. Error in procedure get_page
37. Error in function adj_list, isnil(rp^.sw [0].addr) not true
38. Error in procedure sym_get_di, sym_get not true
39. Error in procedure atr_link_v, atr_get_v(atr1, addrSpc, last) not true
40. Error in function atr_entries, atr.typ unknown
42. Error in procedure atr_del, eq_lgl_addr(atr.addr, frst) not true
43. Error in procedure atr_del, eq_lgl_addr(atr.addr, last) not true
44. Error in procedure sym_del, eq_lgl_addr not true (first)
45. Error in procedure sym_del, eq_lgl_addr not true (last)
47. Error in procedure sym_get_di_v, sym_get_v not true
47. Error in function ssDel12, eq_lgl_addr not true

- 49. Error in procedure ent_relink, eq_lgl_addr(lyr.lastln, newent.ptr) not true
- 50. Error in procedure ent_relink, eq_lgl_addr(lyr.firstln, newent.ptr) not true
- 51. Error in procedure ent_relink, eq_lgl_addr(lyr.lastln, oldent.ptr) not true
- 100. Error in procedure poly3_symbol (commented out)
- 301. Error in procedure ent_get_di_v, ent_get_v(ent, addr, addrSpC) false
- 701. Error in pvert_add_v, error from 72
- 701. Error in pvert_link, error from 71 (commented out)
- 702. Error in procedure list_del, eq_lgl_addr not true, error from 805
- 703. Error in procedure list_del, eq_lgl_addr (list.addr, last) not true, error from 77
- 704. Error in pvert_get_di, pvert_get not true
- 704. Error in pvert_get_v_di, pvert_get_v not true
- 731. Error in procedure void_link, void_get (tmpvoid, last, addrspc) not true, error from 732
- 731. Error in procedure plvoid_link, plvoid_get (tmpvoid, last, addrspc) not true, error from 732
- 738. Error in void_get_di, void_get (void, addr, addrspc) not true
- 738. Error in procedure plvoid_get_di, plvoid_get (plvoid, addr, addrspc) not true
- 804. Error in function list_add_v, error from 804
- 820. Error in procedure view_get_di, view_get false, error from 820
- 1000. Error in function push, odd (stackPtr) true
- 1001. Error in procedure pop, odd (currPtr) true
- 1002. Error in procedure pop, currPtr is outside of stack

Location Codes

- 1. Error in function getPlinVoid,
- 1. Error in function gethole3,
- 7. Error in procedure add_plin_void,
- 7. Error in procedure add_void,
- 8. Error in procedure add_plin_voids,
- 8. Error in procedure add_voids,
- 71. Error in procedure pvert_link,
- 72. Error in function pvert_add_v,
- 72. Error in function pvert_ins_v,
- 73. Error in function pvert_get_v_FixIt,
- 73. Error in function pvert_get_v,
- 73. Error in function pvert_get_v_new,
- 74. Error in function pvert_get_v_new,
- 74. Error in function pvert_get_v_new,
- 74. Error in function pvert_get_v_FixIt,
- 75. Error in function pvert_get_v_new,
- 76. Error in procedure pvert_del,
- 77. Error in procedure pvert_del,
- 77. Error in procedure list_del,
- 79. Error in function pvert_get_v_new,
- 79. Error in function pvert_get_v_new,
- 79. Error in function pvert_get_v_new,

79. Error in function pvert_get_v_Fixlt,
79. Error in function pvert_get_v_Fixlt,
732. Error in procedure void_link,
732. Error in procedure pvoid_link,
733. Error in function void_add,
733. Error in function void_add_v,
733. Error in function pvoid_add,
733. Error in function pvoid_add_v,
734. Error in procedure void_put2,
734. Error in procedure pvoid_put2,
735. Error in procedure void_put2,
735. Error in procedure pvoid_put2,
736. Error in function void_get,
736. Error in function pvoid_get,
737. Error in procedure void_del,
737. Error in procedure pvoid_del,
738. Error in function void_del,
738. Error in procedure pvoid_del,
739. Error in procedure void_del_all,
739. Error in procedure pvoid_del_all,
740. Error in function void_copy,
801. Error in procedure list_init,
803. Error in function list_get_v,
804. Error in function list_add_v,
805. Error in procedure list_del,
806. Error in procedure list_del_all_v,
807. Error in procedure doview3,
808. Error in function view_get_v,
809. Error in procedure view_put,
810. Error in function view_add_v,
811. Error in procedure view_del,
812. Error in function view_ins,
813. Error in function view_add_free,
820. Error in procedure view_get_di,
8081. Error in function view_get_v,
8082. Error in function view_get_v,