Volume

5

DOE-2.2

Building Energy Use and Cost Analysis Program

Volume 5: Compliance Analysis

April 2005

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DOE-2.2 BUILDING ENERGY USE AND COST ANALYSIS PROGRAM

Volume 5: Compliance Analysis

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Acknowledgements

DOE-2.2, both the program and its documentation, are based upon earlier versions of DOE-2. The DOE-2 family of programs was created primarily through a partnership between James J. Hirsch & Associates (JJH) and Lawrence Berkeley National Laboratory (LBNL) with additional contributions, over a twenty five year period, from a large number of individuals and institutions around the world. Support for the continued development of DOE-2, over its two decades of wide distribution, has come from many public and private agencies, companies and educational institutions around the world. The primary support for DOE-2 development, however, has come from public funds provided by the United States Department of Energy (USDOE) and the United States electric and gas utility industry; particularly the USDOE Office of Energy Efficiency and Renewable Energy Building Technologies Program, Southern California Edison Company's Energy Efficiency Division, and the Electric Power Research Institute's Customer Systems Division.

Authorship of the DOE-2.2 program components and documentation is an ongoing team effort that has its roots in previous versions going back over twenty-five years and we expect will continue into future decades. The contributions to DOE-2, both directly as authors and indirectly in the form of advice, comment and testing or feedback, are too numerous to catalog here; however, the primary authors are mentioned below in alphabetical order. Currently, and over the past decade, Marlin Addison, Scott Criswell, Steve Gates, Jeff Hirsch, and Kevin Madison, as consulting staff for JJH, are the major contributors to DOE-2.2. Fred Buhl, Ender Erdem, Kathy Ellington and Fred Winkelmann, as staff members of the Environmental Energy Technologies Division's Simulation Research Group at LBNL, were major contributors to the initial version of DOE-2.2. The primary contributors to the previous versions of DOE-2 (2.1E, 2.1D, 2.1C, etc) were Fred Buhl, Ender Erdem, Kathy Ellington, Steve Gates, Jeff Hirsch and Fred Winkelmann, as LBNL staff and Steve Gates and Jeff Hirsch as consulting staff for JJH.

The authors of DOE-2.2 also wish to acknowledge many persons who, apart from the financial support provided by their organizations, have provided vision and insight that has been instrumental to the ongoing support of the DOE-2 family of products, including DOE-2.1, DOE-2.2, PowerDOE and eQUEST. In particular we express our thanks to Gregg Ander, and his staff, and Janith Johnson, and her staff, at Southern California Edison Company.

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Section 1

Performing Compliance Analysis

Overview

This Compliance Supplement describes the specific procedures for using eQUEST for compliance with the Energy Efficiency Standards for Nonresidential Buildings. This Compliance Supplement serves two major purposes:

- It helps building permit applicants and others use eQUEST correctly, and guides them in preparing complete documentation for compliance submittals.
- It helps building department staff plan check permit applications for compliance with the nonresidential standards.

This compliance supplement serves as a crucial performance method reference in resolving questions concerning specific eQUEST attributes, approved modeling capabilities and procedures in the context of both compliance and enforcement. This compliance supplement does not describe the internal algorithms and assumptions used in performing the compliance analysis as most of these are prescribed by the California Energy Commission and cannot be modified by the user.

This Compliance Supplement provides modeling guidelines and input reference for the topics such as:

- What surfaces to model(walls, roofs, floors, fenestration) and how to enter data about these surfaces
- Modeling exterior shading
- Appropriate zoning for compliance modeling
- Selection of occupancy types
- Modeling like HVAC systems
- Modeling buildings or portions of a building with no heating or no cooling
- Written justification and additional documentation in the design and construction documents for items listed in the Exceptional Conditions checklist of the PERF-1 compliance form.
- Correct use of the standard design modifiers including tailored lighting allotment, tailored ventilation rate, lighting control credits and display perimeter.
- Modeling limitations

REQUIRED ADDITIONAL DOCUMENTS

DOE-2.2, using the eQUEST compliance analysis functionality, may be used to show compliance with California's Energy Efficiency Standards for Nonresidential Buildings only when the following reference documents are readily available to the program user:

1. 2001 Building Energy Efficiency Standards (P400-01-001)
2. Nonresidential Manual (P400-01-005)

Both of these publications are available from:

California Energy Commission
Publications Office
1516 9th Street, MS-13
P.O. Box 944295
Sacramento, CA 94244-2950
916-654-5200

Methods for Creating a Compliance Input File

OVERVIEW OF METHODS

Using the eQUEST Building Creation Wizard

The building creation wizard enables the user to quickly generate a proposed building input file. Refer to the "Building Wizard" section of the eQUEST Tutorial for instructions on using the Wizard to create a proposed building input file. Generally, wizard inputs will be translated to detailed interface values representing minimally compliant Title 24 values, however, users should review the detailed interface to make sure all inputs represent the actual design prior to continuing with the compliance analysis.

Using the Detailed User Interface

The detailed interface may be used to create a building from scratch or to edit a building created by the wizard or imported from an existing BDL input file. Each of these three methods is described below:

Creating a Building from Scratch: When starting eQUEST, select "Create Building from Scratch." If eQUEST is already running, select New/"Blank Slate Building Description." Components of the building can then be created individually. Generally, eQUEST will default individual properties not input by the user to minimally compliant Title 24 values, however, users should review the detailed interface to make sure all inputs represent the actual design prior to continuing with the compliance analysis. In particular, each property on the "Compliance" tab for a component should be carefully reviewed to ensure it accurately reflects information in the construction documents for the proposed building.

Editing a Wizard Created Building: The wizard will create a complete and fully valid (i.e. no errors will occur during simulation or compliance analysis) building input file. This file can be edited by selecting any individual component and modifying their properties.

Editing an Imported BDL File: Once a valid BDL input file has been successfully imported into eQUEST (see next topic), individual components may be selected and edited.

Writing a DOE-2.2 BDL Input File and Reading Into eQUEST

At this time, the only way to perform compliance analysis on a DOE-2.2 BDL input file is to open it into eQUEST. Compliance analysis may be performed on an existing BDL input file within the limitations of the rules processor. In addition to DOE-2.2 documentation, users should refer to Section 2, Compliance BDL Elements, of this document for proper use of compliance analysis keywords.

When starting eQUEST, use the following procedure to open a BDL input file:

a) select "Select an Existing Project to Open"
b) set the file type to "DOE-2.2 BDL Input Files (*.inp)"
c) select the input file to import into eQUEST

If eQUEST is already open, use the following procedure to open a BDL input file:

a) select File/Open or click the open icon.
b) set the file type to "DOE-2.2 BDL Input Files (*.inp)"
c) select the input file to import into eQUEST

Generally, eQUEST will default individual properties not input by the user to minimally compliant Title 24 values, however, users should review the detailed interface to make sure all inputs represent the actual design prior to continuing with the compliance analysis. In particular, each property on the "Compliance" tab for a component should be carefully reviewed to ensure it accurately reflects information in the construction documents for the proposed building.

CREATING INPUT FILES

Conditioned Floor Area

The conditioned floor area for spaces within the building DO NOT include the area under permanent floor-to-ceiling height partitions, but the conditioned floor area for the whole building includes the area under these partitions. This conforms to the Standards, which define Conditioned Floor Area as follows:

> ... is the floor area (in square feet) of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing conditioned space.

But for internal and enclosed spaces lighting power allotments for the Area Category Method are determined from floor areas:

> ... Where areas are bounded or separated by interior partitions, the floor space occupied by those interior partitions shall not be included in any area.

Wizard Input

Conditioned floor area is automatically set by the wizard using the POLYGON feature of eQUEST. Once the wizard has completed creating the building, users should review each occupied space to ensure the polygons accurately reflect the construction documents for the building. The rules processor will include the space in the conditioned floor area whenever the value of the "Conditioning" property equals "Conditioned" or "Indirectly Conditioned – Occupied."

Detailed Interface

Create conditioned spaces in the detailed interface through selecting a Floor component, then Right Mouse Click/Create Child Component/Create Child Space. Any existing and newly created space can be edited in the space properties dialog. Ensure that the shape and dimensions of the space match the construction documents for the proposed building. The rules processor will include the space in the conditioned floor area whenever the value of the "Conditioning" property equals "Conditioned" or "Indirectly Conditioned – Occupied."

BDL Input File

Refer to the DOE-2.2 documentation for "Loads" for information on creating conditioned spaces in BDL input files. Additionally, refer to the discussion of the SPACE command compliance analysis keywords in the DOE-2.2 California Compliance Addenda. In particular, the rules processor will include the space in the conditioned floor area whenever the value of the "C-CONDITIONING" keyword equals "Conditioned" or "Indirectly Conditioned – Occupied."

The rules processor considers any SPACE to be conditioned, and therefore include the area of that space in the conditioned floor area of the building, if either of the following two conditions is met:

1. ZONE-TYPE = CONDITIONED
2. ZONE-TYPE = PLENUM and C-CONDITIONING = "Indirectly Conditioned – Occupied"

If ZONE-TYPE equals UNCONDITIONED or if ZON-TYPE = PLENUM and C-CONDITIONING does not equal "Indirectly Conditioned – Occupied" the area will not be included when determining conditioned floor area.

Wall Characteristics

Surface Orientation and Tilt

Wizard

Surface orientation and tilt are determined by the wizard according to the shape and configuration of the building established by the user in the first three screens of the wizard. The user should review the Azimuth and Tile properties in the Wall, Roof and Floor dialogs of the detailed interface to ensure they match the construction documents for the proposed building.

Detailed Interface

Walls, roofs and floors are created in the detailed interface by selecting a Space, then Right Mouse Click/Create Child Component/Create Exterior Wall. Input values for Azimuth and Tilt according to the construction documents for the proposed building. Refer to DOE-2.2 documentation for LOADS, SPACE command, AZIMUTH and TILT keywords for more information.

BDL Input File

Refer to DOE-2.2 LOADS documentation for instructions on creating exterior walls, roofs and floors. Use the AZIMUTH and TILT keywords to specify surface orientation and tilt.

Absorptance

The user may specify opaque exterior wall or roof/ceiling absorptance between 0.90 and 0.20. A message will be printed to the PERF-1 compliance form whenever the absorptance is less than 0.50 for an opaque exterior partition.

Wizard

The absorptance of exterior walls and roofs is not explicitly input in the wizard. Instead, exterior colors may be specified in the Building Constructions screen of the Wizard. The wizard will then assign a value for absorptance to the constructions in the detailed interface. The user should ensure that values shown in the detailed interface for absorptance match the construction documents for the proposed building.

IMPORTANT: The rules processor limits the absorptance of any construction to values from 0.20 to 0.90 inclusive. The rules processor will adjust any values outside of this range to the lowest (or highest) limit. The adjusted value will be output to the compliance forms, not the value shown in the detailed interface.

Detailed Interface

Absorptance is specified in the Construction/Basic Specifications dialog. If a new construction is created (see next topic), and the Absorptance property is not input by the user, the rules processor will default the absorptance to 0.70.

BDL Input File

The absorptance is specified using the ABSORPTANCE keyword of the CONSTRUCTION command. Refer to the DOE-2.2 documentation for this command for more information. If ABSORPTANCE is not input by the user, the rules processor will automatically set its value to 0.70.

Construction Assemblies

In eQUEST and DOE-2.2 interior and exterior walls, roofs and floors as well as underground walls and floors must reference a "Construction" which defines how the wall, roof or floor is constructed. Constructions can be created in two ways, described below:

LAYERS
The user specifies layers of materials that comprise the construction. See discussion of materials later in this chapter. If the user desire to simulate the mass of a construction, then the construction must be specified using layers. Otherwise, the rules processor will assume the wall has a heat capacity of zero.

U-VALUE
The user specifies the U-value of the assembly not including exterior air film resistances.

Wizard

Based on user inputs in the Building Constructions screens of the Wizard, eQUEST will automatically create assemblies in the detailed interface. Each exterior wall, roof and floor will reference one of these constructions. The user should review the constructions in the detailed interface to ensure they match the construction documents for the proposed building.

Detailed Interface

If LAYERS will be input, then a Layers component must be created first. Right mouse click on "Layers" in the detailed tree to create a new layers component. The ensuing dialogs allow the user to enter up to 10 materials for the component.

To create a construction, first right mouse click on "Constructions" in the detailed tree. The ollow the dialogs to create a construction. If "Layers" has been specified as the wall specification method, a dialog will appear requiring the user to select the applicable layers component. Based on user inputs in the initial creation dialogs, eQUEST will assign default values to all other construction properties. The user should review all information in the construction and layers tab dialogs of the detailed interface to ensure they match the construction documents for the proposed building.

BDL Input File

Refer to the DOE-2.2 LOADS documentation for complete instructions on creating LAYERS and CONSTRUCTION commands in BDL input files.

Heat Capacity and Wall Type

Heat capacity of walls, roofs and floors is automatically determined by the rules processor depending on the materials of the layers component. If heat capacity is to be considered in the compliance analysis,

constructions must be specified using a layers component. Otherwise, the rules processor assumes a value of zero for heat capacity.

The standards also specify different minimum U-value requirements for lightweight wood-framed walls and metal-framed walls. For this purpose, eQUEST also allows users to specify the "construction type" for each construction.

Wizard

Based on user inputs in the Building Constructions screens of the Wizard, eQUEST will automatically create assemblies in the detailed interface. Each exterior wall, roof and floor will reference one of these constructions, and each construction will reference a layers component. The user should review the constructions in the detailed interface to ensure they match the construction documents for the proposed building.

The user should ensure that the value for the property "Construction Type" represents the type of framing (metal or wood) for the construction (see Detailed Interface) below.

Detailed Interface

Heat capacity is automatically calculated by the rules processor based on materials of the layers component for each construction.

The user should ensure that the value for the property "Construction Type" represents the type of framing (metal or wood) for the construction (see Detailed Interface) below. Right click on any Construction component to view its detailed properties.

BDL Input File

Any CONSTRCUCTION command with TYPE equal to "LAYERS" will have a heat capacity automatically calculated by the rules processor. If TYPE equals "U-VALUE", the heat capacity will be set to zero.

Refer to the DOE-2.2 California Compliance Addenda, CONSTRUCTION compliance analysis keyword discussion for information on specifying the type of framing (metal or wood) in a lightweight framed walls.

Materials

Each layers component is comprised of one or more materials. eQUEST materials properties include *thickness* (feet), *density* (pounds per cubic foot), *specific heat* (Btu per pound per degree F) and *thermal conductivity* (Btu-ft per hour per square foot per degree F).

Wizard

eQUEST creates materials based on inputs to the Building Constructions screen of the wizard. The user should review all materials in the detailed interface to ensure they match the construction documents for the proposed building.

Detailed Interface

Materials can be created in the detailed interface using right mouse click on "Materials" in the detailed tree. To edit a material, right mouse click on the material name and select "properties." Any material in the detailed tree may be referenced by a layers component.

BDL Input File

Refer to the DOE-2.2 LOADS documentation for information on creating MATERIAL commands and referencing them with LAYERS commands.

Exterior Walls

Modeling Exterior Walls

Exterior walls must be modeled with the following rules:

1. The conditioned floor area of all conditioned space (i.e., all directly or indirectly conditioned space) must be included in the performance analysis. For a definition of conditioned space, see Section 101(b) of the Standards.
2. All directly or indirectly conditioned volume must be included in the analysis.
3. Every exterior partition of the proposed building must be modeled.

   The Standards define an exterior partition as:

   > *... an opaque, translucent, or transparent solid barrier that separates conditioned space from ambient air or space that is not enclosed.*

4. All slab-on-grade and underground walls and floors of the proposed building must be modeled.
5. Partitions separating the conditioned space from the courtyard are exterior partitions and must be input as such by the user.
6. Demising partitions are defined in the Standards as:

   > *... solid barriers that separate conditioned space from enclosed unconditioned space.*

   Demising partitions may not be modeled as exterior partitions. They are modeled as interior walls constructed according to the plans and specifications for the building. If the enclosed unconditioned space is not included in the permit, the demising partition must be modeled as an adiabatic partition for both the standard and the proposed buildings.

Wizard

eQUEST automatically creates exterior walls, constructions, layers and materials based on user inputs in the Building Constructions screen of the wizard. The user should review these components in the detailed interface to ensure they match the construction documents for the proposed building.

Detailed Interface

To create exterior walls in the detailed interface, select any Space in the detailed tree, then right mouse click/create child component/create child exterior wall. The ensuing dialogs will require the user to input critical information about the walls such as the construction, dimensions, orientation, etc.

To edit exterior walls in the detailed interface, right mouse click on any exterior wall component in the detailed tree and select "Properties." All properties of exterior walls can be edited, including surface orientation, tilt and construction.

BDL Input File

Refer to DOE-2.2 LOADS documentation, EXTERIOR-WALL command, for complete information on creating exterior walls.

Exterior Doors

Exterior doors are "children" of exterior wall components. eQUEST and DOE-2.2 will automatically reduce the area of the wall by the area of all its child doors. The user must specify and account for the heat capacity of all exterior doors in the proposed design. Exterior doors may be grouped together as one area if they have the same orientation, tilt, construction and materials.

Wizard

Information about exterior doors is entered in the Exterior Doors screen of the wizard. This information is then translated by eQUEST into individual door components that can be edited in the detailed interface.

Detailed Interface

To create exterior doors in the detailed interface, select any Exterior Wall in the detailed tree, then right mouse click/create child component/create child exterior door. The ensuing dialogs will require the user to input critical information about the walls such as the construction, dimensions, etc.

To edit exterior walls in the detailed interface, right mouse click on any exterior door component in the detailed tree and select "Properties." All properties of exterior doors can be edited, including surface orientation, tilt and construction.

BDL Input File

Refer to DOE-2.2 LOADS documentation, DOOR command, for complete information on creating exterior walls.

Interzone Walls

Interior walls separating conditioned spaces are automatically simulated by eQUEST as "airwalls" with no heat capacity and U-value of 1 Btu/h-ft^2-^{o}F. Users must enter information about location and adjacent conditioned spaces, but all other information is not needed and, in fact, ignored by the rules processor.

Wizard

Interior wall information is entered in the Interior Surfaces portion of the Building Constructions screen. Orientation, dimensions and adjacent conditioned spaces will be automatically determined by eQUEST based on the building shape, zone dimensions and overall building dimensions selected by the user earlier in the wizard. eQUEST will populate the detailed interface with default information about interior partitions.

Detailed Interface

To create interior walls in the detailed interface, select any Space in the detailed tree, then right mouse click/create child component/create child interior wall. The ensuing dialogs will require the user to input critical information about the walls such as the construction, dimensions, orientation, etc.

To edit interior walls in the detailed interface, right mouse click on any interior wall component in the detailed tree and select "Properties." All properties of interior walls can be edited, including surface orientation, tilt and construction.

BDL Input File

Refer to DOE-2.2 LOADS documentation, INTERIOR-WALL command, for complete information on creating interior walls.

Underground Walls & Floors, Slab-On-Grade Floors

All underground walls, underground floors and slab-on-grade floors must be input. These types of constructions must be input and identified separately from walls and floors exposed to ambient exterior conditions (air). Underground walls, underground floors and slab-on-grade floors must be created using Layers components and cannot use U-Value constructions (a processing error will occur causing the compliance analysis to terminate.)

Wizard

Information about underground walls, underground floors and slab-on-grade floors is entered in the Ground Coupled Surfaces section of the Building Constructions screen. eQUEST will automatically generate underground walls and floors (using Layers components) from this information.

Detailed Interface

To create underground walls, underground floors and slab-on-grade floors in the detailed interface, select any Space in the detailed tree, then right mouse click/create child component/create child underground wall. The ensuing dialogs will require the user to input critical information about the walls such as the construction, dimensions, orientation, etc.

To edit underground walls/floors in the detailed interface, right mouse click on any underground wall/floor component in the detailed tree and select "Properties." All properties of underground walls/floors can be edited, including surface orientation, tilt and construction.

BDL Input File

Refer to DOE-2.2 LOADS documentation, UNDERGROUND-WALL/FLOOR command, for complete information on creating underground walls, underground floors and slab-on-grade floors.

Exterior Roofs/Ceilings

Exterior roofs and ceilings are identical to Exterior Walls (described above) and may be created by the user referencing a Layers component or may be specified using an overall U-Value. When U-Values are specified, back-up calculations, matching the construction documents for the proposed building, are needed in addition to the compliance forms. (Refer to instructions for completing ENV-3 forms in the Nonresidential Manual for additional information.) Exterior roofs that have the same heat transfer and mass characteristics, are in the same occupancy and system areas, and are exposed to the same outside conditions may be combined for the purposes of entering the area of the roof assembly.

The standard assembly used in creating the budget building is a wood framed roof with rafters/joists spaced at 24" on centers and fiberglass batt insulation. Insulation levels and necessary rafter/joist depth are determined from tables 1-I and 1-J of the Standards.

Wizard

eQUEST automatically creates exterior roofs/ceilings, constructions, layers and materials based on user inputs in the Building Constructions screen of the wizard.

Roofs defined in the detailed building description solely to facilitate the modeling of skylights in spaces with plenums above are assigned a construction with virtually no heat transfer (U-value = 0.001) and the resulting compliance analysis will maintain this characteristic for both the proposed and standard building descriptions.

Detailed Interface

To create roofs/ceilings in the detailed interface, select any Space in the detailed tree, then right mouse click/create child component/create child roof. The ensuing dialogs will require the user to input critical information about the walls such as the construction, dimensions, orientation, etc.

To edit roofs/ceilings in the detailed interface, right mouse click on any roof component in the detailed tree and select "Properties." All properties of roofs can be edited, including surface orientation, tilt and construction.

BDL Input File

Refer to DOE-2.2 LOADS documentation, EXTERIOR-WALL/ROOF command, for complete information on creating roofs and ceilings.

Exterior Raised Floors

Exterior Raised Floors are identical to Exterior Walls (described above), except for tilt, and may be created by the user referencing a Layers component or may be specified using an overall U-Value. When U-Values are specified, back-up calculations, matching the construction documents for the proposed building, are needed in addition to the compliance forms. (Refer to instructions for completing ENV-3 forms in the Nonresidential Manual for additional information.) Exterior Raised Floors that have the same heat transfer and mass characteristics, are in the same occupancy and system areas, and are exposed to the same outside conditions may be combined for the purposes of entering the area of the floor assembly.

The standard design raised floor assemblies are dependent on the heat capacity (HC) of the proposed exterior raised floor. And are determined as follows:

HC < 7.0: The standard assembly is a wood framed, lightweight raised floor with a U-value matching the requirement listed in Table 1-I or 1-J of the Standards for wood framed floors and the applicable climate zone.

HC $\geq$ 7.0: The standard assembly is three layers:

a) Carpet and pad, R-value = 2.03

b) 100 lb./cubic foot concrete slab with a thickness such that the total heat capacity of the standard assembly matches the heat capacity of the proposed floor assembly overall U-value including carpet and pad matches the applicable value listed in Table 1-I or 1-J of the standards for the applicable climate zone.

c) Adequate rigid insulation so that overall U-value including carpet and pad matches the applicable value listed in Table 1-I or 1-J of the standards for the applicable climate zone.

IMPORTANT: HC is automatically determined by the rules processor. In order for heat capacity to be considered, a floor component must reference a Layers component. If the floor references a U-Value, the rules processor will automatically set HC to zero.

Wizard

At this time, only underground and slab-on-grade floors may be created in the wizard. Raised floors must be created in the detailed interface or by editing the BDL input file.

Detailed Interface

To create floors in the detailed interface, select any Space in the detailed tree, then right mouse click/create child component/create child floor. The ensuing dialogs will require the user to input critical information about the walls such as the construction, dimensions, orientation, etc.

To edit floors in the detailed interface, right mouse click on any floor component in the detailed tree and select "Properties." All properties of roofs can be edited, including surface orientation, tilt and construction.

BDL Input File

Refer to DOE-2.2 LOADS documentation, EXTERIOR-WALL/ROOF command, for complete information on creating roofs and ceilings.

Fenestration Characteristics

Fenestration products are created as "children" of either Exterior Wall or Exterior Roof components. Windows are children of Exterior Walls and skylights are children of Exterior Roofs. Windows and skylights both appear in the detailed interface as child Window components to exterior walls (for windows) and roofs (for skylights). Each Window component must reference a Glass Type component that describes the construction and thermal characteristics of the glass used in the fenestration assembly. Additionally, each Window component has several of it's own unique characteristics. It is important to remember that Glass Type properties apply to any Window that references the Glass Type (a one-to-many relationship) while Window properties apply only to individual Window components (a one-to-one relationship).

Fenestration – Creating Glass Type Components

Each Window component in eQUEST must reference a Glass Type component. A Glass Type component may be referenced by more than one Window component. Window and Glass Type components share certain properties. In the Window component, values for these shared properties default to the values found in the Glass Type component referenced by the Window component. Refer to the discussion "Fenestration – Creating Windows, Glass Doors and Skylights" for further information.

IMPORTANT: DOE-2.2 supports simulation of fenestration using one of the three following methods:

1. GLASS-TYPE-CODEs that provide coefficients representing the performance of the glass based on whether tape parameters including solar angle of incidence, wind speed, incident direct and diffuse solar radiation and indoor and outdoor temperatures.
2. WINDOW-LAYERS that allow users to create the actual construction of the glazing assembly, which DOE-2.2 ultimately converts to coefficients serving the same purpose as in GLASS-TYPE-CODEs.
3. ASHRAE METHOD where a conductance and shading coefficient are entered for the glazing.

The Standards require the use of the ASHRAE method for simulating the thermal performance of glazing. The rules processor will ignore any inputs for GLASS-TYPE-CODEs or WINDOW-LAYERS. If inadequate information is entered by the user for proper simulation using the ASHRAE method, a combination of BDL defaulting rules and rules processor instructions will automatically establish ASHRAE

glazing performance properties that are reasonably close to prescriptive requirements listed in Table 1-I and 1-J of the Standards.

Wizard

eQUEST automatically generates Glass Type components as well as window references to Glass Types, based on information entered by the user in the Exterior Windows and Shades and Roof Skylight screens of the Wizard. Glass Types cannot be directly created in the wizard. Select Glass Types in the column provided. These are actual GLASS-TYPE-CODEs available in the eQUEST/DOE-2.2 library. Once wizard input is complete and the Finish button is pushed, the wizard will automatically create Glass Type components based on the various properties contained in the GLASS-TYPE-CODEs selected in the wizard. **It is very important that the user review each Glass Type component in the detailed interface to ensure that all of the properties match the construction documents for the proposed building.**

Detailed Interface

To create a Glass Type component, select Glass Types in the detailed tree, then Right Mouse Click/Create Glass Type. The ensuing dialogs prompt the user for inputs about the glass type. Whenever "simplified" is selected as the Glass Type Specification Method, the user must enter a shading coefficient for the glass. This value will also serve as the default for "SHGC Center" in the Window component (See Creating Windows and Skylights below). To edit a Glass Type component, right mouse click on the Glass Type in the detailed tree and select "Properties."

For compliance analysis, most properties in the Glass Type tab dialog are ignored by rules processor except in the following cases:

Window Property U-Factor Method Equals Title 24 Default – In this case, the rules processor references the following Glass Type properties to determine the default U-factor of the Window Component:

- Number of Panes
- Air Space
- Low-E Coating

The following Glass Type properties, referenced by the rules processor to determine the default U-factor, become defaults for the Window properties of the same name when Window properties are not input by the user:

- Product Type
- Product Source
- Frame Type
- Dividers
- Divided Lites

Window Property SHGC Method Equals Title 24 Default – In this case, the rules processor references the following Glass Type properties to determine the default SHGC of the Window component:

- Number of Panes
- Tint

The following Glass Type properties, referenced by the rules processor to determine the default SHGC, become defaults for the Window properties of the same name when Window properties are not input by the user:

- Product Type
- Frame Type

Window Property SHGC Method Equals "Manufacturer's Data" – In this case, if the user has selected "Simplified" as the specification method, the value for Shading Coefficient will serve as the default for the Window property SHGC Center..

Refer to "Fenestration – Creating Windows and Skylights" below for more information on Window properties.

BDL Input File

Refer to DOE-2.2 Loads program documentation for the GLASS-TYPE command for information on creating GLASS-TYPEs. Refer to the documentation on the same command in Section 2, Compliance BDL Elements, of this document for complete information on compliance analysis keywords available in the GLASS-TYPE command.

Fenestration – Creating Windows, Glass Doors and Skylights

Wizard

Glass doors are automatically created by the wizard if the user selects "Glass Door" as the door type for any of the three doors defined in the Exterior Doors screen of the wizard. Windows are automatically created by the wizard based on user inputs in the Exterior Windows and Shades screen of the wizard. Skylights are automatically created by the wizard based on user inputs in the Roof Skylights screen of the wizard.

Detailed Interface

To create a window or skylight while in the detailed user interface, right click on the ceiling or wall and select Create Child Component/Create Child Window. In the resulting dialog, enter a name for the window or skylight and select the creation option. If "Create From Scratch" is selected, two additional dialogs will appear. The first dialog prompts the user to enter the dimensions of the new window or skylight; the second dialog prompts the user to select the GLASS-TYPE for the new window or skylight. Once the GLASS-TYPE has been selected, the window or skylight creation process will be completed. While the eQUEST defaulting system will always provide default values for properties needed to determine default SHGCs, users should ensure that all properties on the COMPLIANCE tab of the WINDOW tab dialog represent proposed fenestration characteristics before continuing with the compliance analysis.

BDL Input File

Refer to DOE-2.2 Loads documentation for the WINDOW command for complete information on creating windows, skylights and glass doors. Additionally, the user is directed to next section on specifying thermal performance of fenestration in BDL input files as well as discussions of the

WINDOW and GLASS-TYPE commands in Section 2, Compliance BDL Elements, of this document.

Fenestration – Orientation and Tilt

Fenestration (windows, glass-doors and skylights) properties are input as children of exterior walls and roofs. Orientation and tilt of any window, glass door or skylight will be identical to its parent roof or wall.

Fenestration – Thermal and Solar Properties

There are many fenestration properties available to the user regardless of the method used to create the compliance input file (wizard, detailed interface or DOE2.2 BDL text file). Regardless of the input method, only a few of the inputs are used in performing the compliance analysis; all other inputs are ignored are ignored by the rules processor.

U-Factor

For factory assembled fenestration products, the user should generally input the fenestration's overall U-factor from the fenestration product's NFRC label. For field-fabricated products the user may input the NFRC U-factor or may use the CEC default values, which are automatically generated by the rules processor. The rules processor automatically determines the standard design U-factor based on appropriate values from Table 1-I or 1-J of the Standards.

Solar Heat Gain Coefficient (SHGC)

For factory assembled fenestration products, the user should generally input the fenestration's overall SHGC from the fenestration product's NFRC label. For field-fabricated products, the user may input the NFRC SHGC or the center-of-glass SHGC as reported in manufacturer's literature or may use CEC default values. If either of the latter two methods is used, the rules processor automatically generates the simulated SHGC based on methods approved by the California Energy Commission.

The rules processor automatically determines the standard design SHGC based on the appropriate maximum RSHG values from Tables 1-I and 1-J of the Standards according to occupancy type, climate zone and orientation. The maximum RSHG is different for north oriented glass; and that, for the purposes of establishing standard design RSHG, north glass is glass in exterior walls and doors facing from 45^{O} west (not inclusive) to 45^{O} east (inclusive) of true north.

For nonresidential buildings, high-rise residential buildings and hotels and motels, approved methods for accounting for the shading effects of field-fabricated fenestration assemblies are the information reported on an approved NFRC label, CEC's default Table (Table 1-E of the standards), and the value calculated by a Commission approved method. This shading information which includes the effects of glass, framing and mullions applies to the entire window area. Effects such as the buildup of dirt on windows are not considered differential effects between the proposed and standard design which result in energy savings. These effects are intentionally neglected by the rules processor and are therefore considered by eQUEST to be the same in proposed and standard designs.

Wizard

Glazing thermal properties are automatically generated by the wizard based on user inputs in the Exterior Doors screen (for glass doors), the Exterior Windows and Shades screen (for windows) and the Roof Skylights screen (for skylights. Generally, wizard inputs will be translated to detailed interface

values representing Title 24 default values, however, users should review the detailed interface to make sure fenestration inputs represent the actual design prior to continuing with the compliance analysis.

Detailed Interface

Once a window, glass door or skylight is created (See Fenestration – Creating Windows, Glass Doors and Skylights, above), the following procedures are used to edit/enter thermal properties of fenestration.

NFRC U-Factor: In the COMPLIANCE tab of the WINDOW tab dialog, select "NFRC" as the U-factor method and fill in the certified U-Factor in the field provided.

CEC Default U-Factor: In the COMPLIANCE tab of the WINDOW tab dialog, select "CEC Default" as the U-factor method. In the BASIC SPECIFICATIONS tab of the GLASS-TYPE tab dialog, select the number of panes for the GLASS-TYPE referenced by the WINDOW. While the eQUEST defaulting system will always provide default values for properties needed to determine default U-factors, users should ensure that all properties on the COMPLIANCE tab of the WINDOW tab dialog represent proposed fenestration characteristics before continuing with the compliance analysis.

NFRC SHGC: In the COMPLIANCE tab of the WINDOW tab dialog, select "NFRC" as the SHGC method and fill in the certified SHGC in the field provided.

CEC Default SHGC: In the COMPLIANCE tab of the WINDOW tab dialog, select "CEC Default" as the SHGC method. In the BASIC SPECIFICATIONS tab of the GLASS-TYPE tab dialog, select the number of panes for the GLASS-TYPE referenced by the WINDOW. While the eQUEST defaulting system will always provide default values for properties needed to determine default SHGCs, users should ensure that all properties on the COMPLIANCE tab of the WINDOW tab dialog represent proposed fenestration characteristics before continuing with the compliance analysis.

Manufacturer's Data SHGC: In the COMPLIANCE tab of the WINOW tab dialog, select "Manufacturer's Data" as the SHGC method and fill in the field labeled "SHGC Center" which is the center-of-glass SHGC as reported in manufacturer's literature.

BDL Input File

Thermal performance properties of fenestration may be input as properties of the GLASS-TYPE command or as properties of the WINDOW command. The following keywords may be input in the GLASS-TYPE command:

- C-PRODUCT-TYPE
- C-TYPE
- C-NUM-PANES
- C-AIR-SPACE
- C-LOW-E-COATING
- C-TINT

- C-DIVIDERS
- C-DIVIDED-LITES
- C-FRAME-TYPE

Refer to the Title 24 Compliance Addenda to the DOE-2.2 dictionary for valid values and defaults for these keywords. The following keywords of the GLASS-TYPE command are also keywords of the WINDOW command.

- C-PRODUCT-TYPE
- C-TYPE
- C-DIVIDERS
- C-DIVIDED-LITES
- C-FRAME-TYPE

If no values are input at the WINDOW command, they will default to the values assigned (or defaulted) for the GLASS-TYPE command. In addition to the keywords listed above, the following keywords may be input for the WINDOW command:

- C-GLASS-DOOR
- C-UFACTOR-METHOD
- C-SHGC-METHOD
- C-FEN-SPEC-METH
- C-UFACTOR
- C-SHGC
- C-SHGC-CENTER

Refer to the Title 24 Compliance Addenda to the DOE-2.2 dictionary for valid values and defaults for compliance analysis keywords.

Fenestration Area - Windows, Glass Doors and Glazing in Doors

The user must model the exposed surface area of each transparent or translucent surface. Fenestration surfaces include openings in the walls and vertical doors of the building. For each glazing surface, the user must enter the area of glazing surface associated with a zone. This area is the rough-out opening for the window(s). The areas of fenestration in walls and doors shall only be grouped when they have the same U-value, orientation, tilt, shading coefficient, relative solar heat gain and relationship to shading from exterior devices such as overhangs or side fins. Fenestration in demising walls may not be grouped with fenestration in exterior walls or doors.

The rules processor calculates the standard glazing/fenestration area as:

> … *the greater of (1) or (2): (1) the window area of the proposed building excluding the window area in demising walls, or 40% of the gross exterior wall area of the standard building, whichever is less; or (2) 6 feet times the display perimeter.* (See Section 141(a)1A of the Standards)

The rules processor automatically calculates gross exterior wall area as well as the standard building glazing area.

Fenestration Area in Walls

Wizard

The wizard automatically populates the Height and Width properties of each Window component in the detailed tree based on user inputs in the Exterior Windows and Shades screen of the wizard.

Detailed Interface

Fenestration area in walls is input using the Height and Width properties (Area = Height * Width) of each Window component in the detailed tree.

BDL Input File

Refer to DOE-2.2 Loads documentation for the WINDOW command for information on using HEIGHT and WIDTH keywords for setting fenestration area in walls.

Fenestration Area in Doors

Fenestration area in doors (not glass doors which are described below) must be input as Window components. It is recommended that these window components be named so that they can easily be identified in the compliance forms as glazing in doors.

Glass Door Area

Glass doors are represented in the detailed interface as Window components. It is recommended that these window components be named such that they can easily be identified in the compliance forms as glass doors.

Wizard

The wizard automatically creates Window components, with appropriate height and width values, that represent glass doors as input by the use in the Exterior Doors screen of the wizard.

Detailed Interface

Glass doors are represented in the detailed tree as Window components. Refer to the documentation on creating windows and entering their areas for information on setting areas for glass doors.

BDL Input File

Refer to DOE-2.2 Loads documentation for the WINDOW command for information on using HEIGHT and WIDTH keywords for setting fenestration area in walls.

Display Perimeter

Display Perimeter is defined in the Standards as:

> *.. the length of an exterior wall in a B-2 occupancy that immediately abuts a public sidewalk, measured at the sidewalk level for each story that abuts a public sidewalk.*

To claim display perimeter, a public sidewalk must be surfaced with a material considered acceptable for sidewalks by the local codes, and the fenestration must be readily accessible to the public view. The display perimeter is intended for applications where retail merchandise needs to be viewed by the passing public.

Wizard

At this time, there are no fields in the wizard that enable the user to input display perimeter. Display perimeter must be input in the detailed interface or by editing a BDL input file.

Detailed Interface

To enter display perimeter for a floor, right mouse click on any Floor component in the detailed tree, then select properties. Enter the value for display perimeter in the field labeled "Display Perimeter (compliance):"

BDL Input File

Display perimeter is assigned through the keyword C-DISPLAY-PERIM of the FLOOR command. Refer to Section 2, Compliance BDL Elements, of this document for more information.

Fenestration – Exterior Shading

Exterior shading may be modeled as part of the proposed building. If credit is to be taken for exterior shading, the device or feature providing the shading must be attached to the building and may include devices and features such as:

- Overhangs over windows, glass doors and doors with windows
- Side fins on windows, glass doors and doors with windows
- Setbacks of windows, glass doors and doors with windows inside the main plane of the building façade such that overhangs and side fins are created.

Credit may not be taken for characteristics of the building footprint that cause the building to "shade itself" such as buildings in the shape of an "L", "U", "H" or donut.

Fenestration – Exterior Shading – Overhangs

The user must input the following information when simulating overhangs:

- Overhang projection. The distance the overhang projects horizontally from the plane of the window.
- Height above window. The distance from the top of the window to the overhang.
- Window height. The height of the top of the window from the bottom of the window, to which the overhang is applied.
- Overhang Extension. The distance the overhang extends past the edge of the window jams.

Overhangs must be simulated for each window as they are shown in the construction documents. Overhangs may not be grouped unless they apply to windows facing the same direction, having the same window height, and having same overhang projection, height above window, and the overhang is continuous from one window in the group to another.

Wizard

The wizard automatically creates overhangs for windows as described by the user in the Exterior Windows and Shades screen of the wizard.

Detailed Interface

To enter/edit information about overhangs, select any Window component in the detailed tree, then right mouse click/properties. Select the Fins – Overhang tab. Dimensions and configuration of overhangs can be edited/entered.

BDL Input File

Refer to DOE-2.2 Loads documentation in the WINDOW command for complete information on entering dimensions and configurations of overhangs.

Fenestration – Exterior Shading – Vertical Shading Fins

The user must input the following information when simulating overhangs:

- Vertical fin projection. The distance the overhang projects horizontally from the plane of the window.
- Vertical distance from window. The distance from the top of the window to the top of the vertical fin.
- Horizontal distance from window. The distance from the outside edge of the jam to the plane of the vertical fin.
- Fin Height. The vertical length of the vertical fin.
- Window height. The height of the top of the window from the bottom of the window, to which the vertical fin is applied.
- Window width. The width of the window to which the vertical fin is applied.
- Vertical Fin Extension. The distance the overhang extends past the edge of the window jams.

Vertical fins must be simulated for each window as they are shown in the construction documents and may not be combined.

Wizard

The wizard automatically creates vertical fins for windows as described by the user in the Exterior Windows and Shades screen of the wizard.

Detailed Interface

To enter/edit information about overhangs, select any Window component in the detailed tree, then right mouse click/properties. Select the Fins – Overhang tab. Dimensions and configuration of vertical fins can be edited/entered.

BDL Input File

Refer to DOE-2.2 Loads documentation in the WINDOW command for complete information on entering dimensions and configurations of vertical fins.

Fenestration – Exterior Shading – Setbacks

The user may input a window setback which defines how far the window is set back into the wall. The effect of a setback is to create an overhang immediately above the window and vertical fins immediately to each side. Setbacks must be simulated for each window as they are shown in the construction documents.

Setbacks may not be grouped unless they apply to windows facing the same direction, having the same window height, and having same setback.

Wizard

The wizard automatically creates overhangs for windows as described by the user in the Exterior Windows and Shades screen of the wizard.

Detailed Interface

To enter/edit information about setbacks, select any Window component in the detailed tree, then right mouse click/properties. Select the Basic Specs tab and enter/edit the value for Setback..

BDL Input File

Refer to DOE-2.2 Loads documentation in the WINDOW command for complete information on entering setbacks.

Fenestration – Window Management

The rules processor creates window management characteristics that are identical for the standard and proposed designs and include the following:

- intelligent drapery operation so that draperies are usually closed when bright sun is shining through the windows
- draperies with a solar heat gain multiplier of 0.8

Fenestration Area in Exterior Roofs (Skylights)

The user must model the exposed surface area of each transparent or translucent surface. Fenestration surfaces in roofs include openings in roofs and horizontal roof doors of the building. This area is the rough-out opening for the skylights(s). The areas of skylights shall only be grouped when they have the same U-value, orientation, tilt, shading coefficient, relative solar heat gain and light thermodynamically similar zones of the proposed. Fenestration in demising roofs may not be grouped with fenestration in exterior roofs.

The rules processor automatically calculates the standard design skylight area as:

> … *the skylight area of the proposed building, or five percent of the gross exterior roof/ceiling area of the proposed building, whichever is less.*
> (See Section 141(a)1E of the Standards)

The rules processor automatically calculates the gross exterior roof area of the proposed building.

Occupancy Characteristics

Most occupancy characteristics are automatically assigned by the rules processor. The occupancy (or use) of each modeled space is a required input and must match the intended use of the space in the proposed building. The following occupancy characteristics are automatically determined by the rules processor:

- Occupant loads
- Receptacle loads
- Water heating demand

- Installed lighting power if no lighting compliance is performed for the space
- Minimum outdoor air ventilation rate

The following occupancy characteristics may be input by the user provided supporting documentation is provided:

- Process energy
- Tailored (or process) outdoor air ventilation requirements
- Tailored lighting allowance
- Lighting control credits

Occupancy Type

The user must enter at least one occupancy for each space. See next section, Mixed Occupancy, for entering more than one occupancy type for a space. Occupancy type must be selected from the following list:

Auditorium: The part of a public building where an audience sits in fixed seating, or a room, area, or building with fixed seats used for public meetings or gatherings not specifically for the viewing of dramatic performances.

Auto Repair Workshop: The portion of a building used to repair automotive equipment and/or vehicles, exchange parts, and may include work using an open flame or welding equipment.

Bank/Financial Institution: An area in a public establishment for conducting financial transactions including the custody, loan, exchange, or issue of money, for the extension of credit, and for facilitating the transmission of funds.

Bar, Cocktail Lounge and Casino: Space, room or building for gambling or serving and consuming beverages.

Beauty Shop: Commercial establishment for beauty care including hair cutting, dying and curling, as well as other beauty care activities.

Barber Shop: Commercial establishment for hair cutting.

Classroom: A room or area where an audience or class receives instruction.

Commercial/Industrial Storage: A room, area, or building used for storing items.

Commercial/Industrial Work - General, High Bay: A room, area, or building in which an art, craft, assembly or manufacturing operation is performed. Luminaires are 25 feet or more above the floor.

Commercial/Industrial Work - General, Low Bay: A room, area, or building in which an art, craft, assembly or manufacturing operation is performed. Luminaires are less than 25 feet above the floor.

Commercial/Industrial Work - Precision: A room, area, or building in which an art, craft, assembly or manufacturing operation is performed involving visual tasks of small size or fine detail such as electronic assembly, fine woodworking, metal lathe operation, fine hand painting and finishing, egg processing operations, or tasks of similar visual difficulty.

Convention, Conference and Meeting Center: An assembly room, area, or building that is used for meetings, conventions and multiple purposes including, but not limited to, dramatic performances, and that has neither fixed seating nor fixed staging.

Corridor, Restroom and Support Area: A passageway or route into which compartments or rooms open.

Courtrooms: Room in a building where legal proceedings occur, and are presided over by a judge.

Dining Area: A room or rooms in a restaurant or hotel/motel (other than guest rooms) where meals that are served to the customers will be consumed.

Dry Cleaning (Coin Operated): A self service dry cleaning establishment.

Dry Cleaning (Full Service Commercial): A full service dry cleaning establishment.

Electrical, Mechanical Rooms: A room in which the building's electrical switchbox or control panels, and/or HVAC controls or equipment is located.

Exercising Rooms and Gymnasium: A room or building equipped for gymnastics, exercise equipment, or indoor athletic activities.

Exhibit Display Area and Museum: A room or area that is used for exhibitions that has neither fixed seating nor fixed staging.

Grocery Sales Area: A room, area, or building that has as its primary purpose the sale of foodstuffs requiring additional preparation prior to consumption.

High-Rise Residential: Any UBC Type R space, room or building that has four or more stories.

Hotel Function Area: A hotel room or area such as a hotel ballroom, meeting room, exhibit hall, or conference room, together with function areas and other spaces ancillary to its function.

Hotel/Motel Guest Room: A lodging room of a hotel or motel.

Kitchen and Food Preparation: A room or area with cooking facilities and/or an area where food is prepared.

Laundry: A place where laundering activities occur.

Library - Reading Area: Patron reading area of a repository for literary materials, such as books, periodicals, newspapers, pamphlets and prints, kept for reading or reference.

Library - Stacks: The storage/shelving area of a repository for literary materials, such as books, periodicals, newspapers, pamphlets and prints, kept for reading or reference.

Lobby - Hotel: The contiguous spaces in a hotel/motel between the main entrance and the front desk, including waiting and seating areas, and other spaces encompassing the activities normal to a hotel lobby function.

Lobby - Main Entry: The lobby of a building that is directly located by the main entrance of the building and includes the reception area, sitting areas, and public areas.

Lobby - Office Reception/Waiting: The lobby of any building space or room of a UBC group B occupancy other than restaurants.

Locker/Dressing Room: A room or area for changing clothing, sometimes equipped with lockers.

Lounge/Recreation: A room used for leisure activities which may be associated with a restaurant or bar.

Mall, Arcade and Atrium: A public passageway or concourse that provides access to rows of stores or shops.

Medical and Clinical Care: A room, area, or building that does not provide overnight patient care and that is used to promote the condition of being sound in body or mind through medical, dental, or psychological examination and treatment, including, but not limited to, laboratories and treatment facilities.

Office: A room, area, or building of UBC group B occupancy other than restaurants.

Other: Any room, space or building not meeting the criteria of any of these definitions.

Religious Worship: A room, area, or building for worship.

Retail Sales, Wholesale Showroom: A room, area, or building in which the primary activity is the sale of merchandise, or a room where samples of merchandise are displayed.

Smoking Lounge: Any supplemental/auxiliary room with the express purpose of smoking/inhaling tobacco and other incendiary products.

Theater (Motion Picture): An assembly room, hall, or building with tiers of rising seats or steps for the showing of motion pictures.

Theater (Performance): An assembly room, hall, or building with tiers of rising seats or steps for the viewing of dramatic performances, lectures, musical events and similar live performances.

Unknown: A room, space or building where the occupancy is not known at the time a building permit is issued.

Wizard

While the Activity Areas Allocation screen of the wizard allows the user to enter occupancy characteristics of the building, these inputs are not translated by the wizard into valid occupancy types for compliance analysis purposes. Occupancies must be assigned in the detailed interface as described below.

Detailed Interface

To edit occupancy type in the detailed interface, right mouse click on any space in the detailed tree and click Properties. In the Occupancy section of the Basic Specifications tab, select and occupancy type for the first row in the table (Refer to Mixed Occupancy, next for entering more than one occupancy in a space.).

BDL Input File

Refer to discussion of compliance analysis keywords in the SPACE command in the DOE-2.2 California Compliance Supplement, for information on assigning occupancy types in BDL input files.

Mixed Occupancy

eQUEST allows the simulation of individual spaces with a mix of up to ten occupancy types. The rules processor will not allow the user to enter occupancy types with different operating schedules (e.g. Hotel /Motel Guest Room and any nonresidential occupancy type). Occupancy types may be mixed only if they are in the same zone of the proposed building and if none of the occupancies includes process loads.

The areas of all "sub-occupancies" in the space must sum to the value input in the Area property for the Space component. The rules processor will automatically check to see that the sum of all sub-spaces matches the area of the space. If not, the rules processor will automatically terminate the compliance analysis and post an error message to the computer screen.

Wizard

While the Activity Areas Allocation screen of the wizard allows the user to enter occupancy characteristics of the building, these inputs are not translated by the wizard into valid occupancy types for compliance analysis purposes. Occupancies must be assigned in the detailed interface as described below.

Detailed Interface

To edit occupancy type in the detailed interface, right mouse click on any space in the detailed tree and click Properties. In the Occupancy section of the Basic Specifications tab, select and occupancy type for any row in the .

BDL Input File

Refer to discussion of compliance analysis keywords in the SPACE command in the DOE-2.2 California Compliance Supplement, for information on assigning occupancy types in BDL input files.

Occupant Loads

Occupant loads are automatically assigned by the rules processor regardless of values input by the user in the wizard, detailed interface or BDL input file. All user input values are ignored by the rules processor.

Receptacle Loads

Receptacle loads are automatically assigned by the rules processor regardless of values input by the user in the wizard, detailed interface or BDL input file. All user input values are ignored by the rules processor.

Process Energy

Process energy is limited to the energy (heat) produced by equipment whose locations are specified on the plans or other construction documents for the proposed building. Energy (heat) produced by plugged-in devices such as office equipment must not be modeled as process energy; this energy is included in the Receptacle Loads (See previous topic).

Wizard

At this time, there is not a method to input Process Energy in the Wizard. Process Energy loads must be input in the detailed interface or in the BDL input file.

Detailed Interface

Right mouse click on any Space component in the detailed tree, then select Properties. Enter process energy in the Process Energy Use section of the Compliance tab.

BDL Input File

Refer to discussion of compliance analysis keywords in the SPACE command in the DOE-2.2 California Compliance Supplement, for information on assigning process loads in BDL input files.

Ventilation

The minimum outdoor air ventilation rate for each space is automatically assigned by the rules processor, based on selected occupancies, and cannot be altered by the user. Tailored ventilation rates may input by the user that account for higher required ventilation rates. Compliance documentation for the proposed building must justify, to the satisfaction of the local enforcement agency, the need for ventilation that is higher than the minimum required by the Standards.

Wizard

At this time, there is not a method to input Tailored Ventilation rates in the Wizard. Tailored Ventilation rates must be input in the detailed interface or in the BDL input file.

Detailed Interface

Right mouse click on any Space component in the detailed tree, then select Properties. Enter Tailored Ventilation in Tailored Vent and Lighting & Control Credits section of the Compliance tab.

BDL Input File

Refer to discussion of compliance analysis keywords in the SPACE command in the DOE-2.2 California Compliance Supplement, for information on assigning Tailored Ventilation in BDL input files.

Water Heating

Water heating demands are automatically assigned by the rules processor, based on selected occupancies, and cannot be altered by the user.

Lighting – Permit Scope

In order for lighting compliance to be performed for any portion of a building using eQUEST, the Permit Scope for the proposed building must be equal to one of the following:

- Envelope/Mechanical/Lighting
- Lighting Only
- Mechanical/Lighting
- Envelope/Lighting

If the Permit Scope is not equal to one of the above values, lighting power levels for all spaces in the building will be automatically assigned values equal to the maximum allowed by the Standards; The rules processor will ignore user inputs for lighting, including Tailored Lighting levels and Lighting Control Credits.

Wizard

The Permit Scope is input in the Compliance Analysis Settings screen of the wizard.

Detailed Interface

Right mouse click on the Compliance Data component in the detailed tree and select Properties. Enter/Edit the Permit Scope property in the Compliance Analysis Data section of the Basic Specifications tab.

BDL Input File

Refer to discussion of compliance analysis keywords in the COMPLIANCE command in the DOE-2.2 California Compliance Supplement, for information on assigning the Permit Scope in BDL input files.

Lighting Compliance By Space

In order for eQUEST to perform lighting compliance for any space, the user must indicate that lighting plans are included in the construction documents for the building for any space included in the analysis. If lighting plans are not included for a space, the rules processor will automatically assign and installed lighting power equal to the maximum allowed by the Standards, based on the selected occupancies; the rules processor will ignore user inputs for lighting, including Tailored Lighting levels and Lighting Control Credits.

Wizard

If the Permit Scope includes lighting, the wizard will automatically flag all spaces as including lighting plans.

Detailed Interface

Right mouse click on and Space component in the detailed tree and select Properties. Check (or uncheck) the Includes Lighting Plans box in the Compliance Settings of the Basic Specifications tab.

BDL Input File

Refer to discussion of compliance analysis keywords in the SPACE command in the DOE-2.2 California Compliance Supplement, for information on how to indicate if a space's lighting plans are included in BDL input files.

Installed Lighting Power

The installed lighting power density for each space shall be calculated according to Section 146(a) of the Standards. Actual fixture descriptions and counts must be included in the Installed Lighting Schedule section of the LTG-1 compliance form. eQUEST supports numerous inputs for installed lighting power, including task lighting, total connected lighting load, lighting power densities by space and sub-space, lighting fixtures and lighting systems. Generally, the rules processor assumes that all inputs to all of the lighting properties are part of the proposed design and therefore includes them in the proposed building simulation. Refer to the eQUEST Tutorial, the eQUEST on-line help system and the DOE-2.2 loads documentation for complete information on specifying installed lighting power. Users should carefully review the detailed interface or BDL input file to ensure that lighting properties accurately represent the construction documents for the proposed building.

Wizard

The wizard automatically assigns installed lighting power for each space based on user inputs to the Occupied Loads by Activity Area screen of the wizard.

Detailed Interface

Installed lighting power information can be input/edited through two tabs of the Space tabbed dialog: the Lighting tab and the Compliance tab, each described below:

Lighting Tab: Installed lighting power can be input in the following ways

- Power Definition
- Luminaire Count
- Illuminance
- Refer to the eQUEST on-line help system for further information on specifying installed lighting power by any of these three methods.
- ***Compliance Tab:*** Lighting power density (watts/square foot), task lighting connected load (kW) and task lighting power density may be entered for the space (and for each sub-space of a mixed occupancy) in the Lighting Loads by Occupancy Type section of this tab.

BDL Input File

Refer to the DOE-2.2 Loads documentation for complete information on specifying installed lighting power using Power Definition, Luminaire Count or Illuminance methods. Refer to the SPACE command discussion in the DOE-2.2 California Compliance Supplement for complete information on specifying installed lighting power for sub-spaces using compliance analysis keywords.

Tailored Lighting Allotment

Users may choose to enter the Total Allowed Watts from Line 4, Part 1 of the LTG-4 Tailored Lighting Compliance Form as a *Tailored Lighting Allotment.* In order to input the *Tailored Lighting Allotment* the user

must submit the *Tailored LPD Summary and Worksheet Forms*, LTG-4, and completing lighting plans for each space for which the allotment is input.

Wizard

At this time, *Tailored Lighting Allotments* may not be input in the wizard, and must be input in the detailed interface of in a BDL input file.

Detailed Interface

Tailored lighting allotments for a space or sub-space are entered in the Tailored Vent & Lighting and Control Credits section of the Compliance tab in the Space Properties tabbed dialog.

BDL Input File

Refer to the SPACE command discussion in the DOE-2.2 California Compliance Supplement for complete information on specifying Tailored Lighting Allotments for sub-spaces using compliance analysis keywords.

Lighting Control Credits

Users may choose to enter the Lighting Control Credits for a space from form LTG-3 Lighting Controls Credit Worksheet. In order to input the Lighting Control Credits, the user must submit the *Lighting Controls Credit Worksheet*, LTG-3, and completing lighting plans for each space for which the credits are input.

Wizard

At this time, *Lighting Control Credits* may not be input in the wizard, and must be input in the detailed interface of in a BDL input file.

Detailed Interface

Lighting Control Credits for a space or sub-space are entered in the Tailored Vent & Lighting and Control Credits section of the Compliance tab in the Space Properties tabbed dialog.

BDL Input File

Refer to the SPACE command discussion in Section 2, Compliance BDL Elements, of this document for complete information on specifying Lighting Control Credits for sub-spaces using compliance analysis keywords.

Light Heat to Zone or Return Air

Users may specify a portion of the heat from lights in a space be rejected to an adjacent space and/or a portion be rejected to the return air of the HVAC system. Whenever the user inputs that light heat is rejected to an adjacent space or to the return air, a message is printed to the exceptional conditions output compliance form.

Wizard

At this time, light heat rejected to adjacent spaces or the return air stream may not be input in the wizard, and must be input in the detailed interface of in a BDL input file.

Detailed Interface

Rejected light heat is entered in the Lighting tab of the Space tabbed dialog. Refer to the eQUEST on-line help information for complete details on identifying spaces and/or return air path as the sink for rejected light heat.

BDL Input File

Refer to SPACE command discussion in the DOE-2.2 Loads documentation for complete information on specifying rejected light heat to adjacent spaces and/or return air stream.

Unconditioned and Semi-Conditioned Spaces

The following definitions apply to unconditioned and semi-conditioned spaces:

> ***SEMI-CONDITIONED SPACE*** *is an enclosed nonresidential space that is provided with wood heating, cooling by direct or indirect evaporation of water, mechanical heating that has a capacity of 10 Btu/(hr-ft²) or less, mechanical cooling that has a capacity of 5 Btu/(hr-ft²) or less, or is maintained for a process environment as set forth in the definition of DIRECTLY CONDITIONED SPACE.*
>
> ***UNCONDITIONED SPACE*** *is enclosed space within a building that is not directly conditioned, indirectly conditioned, or semi-conditioned space.*
>
> - From Section 101 of the Standards

Users, at their discretion, explicitly simulate unconditioned and semi-conditioned spaces. If unconditioned or semi-conditioned spaces are not included in the inputs, the walls separating them from the conditioned space must be flagged as demising walls.

Semi-conditioned and unconditioned spaces are input exactly the same as conditioned spaces, except that they must be identified as unconditioned.

Wizard

At this time, semi-conditioned and unconditioned spaces may not be input in the wizard, and must be input in the detailed interface of in a BDL input file.

Detailed Interface

To identify spaces as semi-conditioned or unconditioned, select "Unconditioned", select "Unconditioned" as the value for the Conditioning property in the Compliance Settings section of the Basic Specifications tab of the Space tabbed dialog.

BDL Input File

Refer to the SPACE command discussion in the DOE-2.2 California Compliance Supplement for complete information on semi-conditioned and unconditioned spaces using compliance analysis keywords.

Indirectly Conditioned Spaces

All indirectly conditioned spaces must be included in the compliance input file. Indirectly conditioned spaces may be simulated as part of directly conditioned spaces provided that the total volume and area of indirectly conditioned spaces included are each less than 15% of the total volume and area of the total indirectly and directly conditioned volume and area.

Indirectly conditioned spaces that are explicitly input must be identified as either occupied, unoccupied or plenum. Plenums are treated by the rules processor as unoccupied, indirectly conditioned spaces, but they are identified for the simulation engine as plenums (See discussion of plenums in DOE-2.2 documentation).

Wizard

The only type of indirectly conditioned space that can be created from the wizard are plenums between ceilings and floors. Plenums are created whenever the difference between the Flr-To-Flr height and Flr-To-Clg height properties in the Building Footprint screen of the wizard is greater than one foot.

All other types of indirectly conditioned spaces must be input/edited in the detailed interface or in a BDL input file.

Detailed Interface

Indirectly conditioned spaces are created and edited exactly the same as any other spaces. They are identified as indirectly conditioned spaces by selecting "Indirectly Conditioned – Occupied", "Indirectly Conditioned – Unoccupied" or "Plenum" as the value for the property Conditioning in the Compliance Settings section of the Basic Specifications tab of the Space tabbed dialog.

BDL Input File

Refer to the SPACE command discussion in the DOE-2.2 California Compliance Supplement for complete information on specifying indirectly conditioned spaces using compliance analysis keywords.

Thermal Zoning

Users can simulate up to 1,024 zones thermal zones using eQUEST. If a proposed building has twenty thermostats or less, the user must model the same number of zones as there are independent thermostats. Hence, zones may only be combined when there are more than twenty HVAC zones in a proposed building design. Zones may only be combined in a manner consistent with the definition *ZONE, SPACE CONDITIONING* in Section 101(b) of the Standards, repeated below:

> ***ZONE, SPACE CONDITIONING*** *is a space or group of spaces within a building with sufficiently similar comfort conditioning requirements so that comfort conditions, as specified in 144(b)3 or 150(h), as applicable, can be maintained throughout the zone by a single controlling device.*

Combining Zones for Simulation

HVAC zoning recognizes that load profiles seen by different spaces in a building differ. Identifying those areas with similar load profiles and grouping them under the same thermostat control improves comfort and may reduce energy. For example, imagine measuring indoor air temperatures at many locations throughout a building during hours when the HVAC fans are turned off. Internal gains, solar gains, and envelope gains/losses would cause the temperatures to vary with time. If, after some number of hours or days, you carefully examined the temperature histories, grouping together those that shared similar profiles, you would have effectively grouped together those areas of the building that share similar load characteristics. Each such area or "zone" could, therefore, be adequately controlled by a single thermostat. In other words, HVAC thermal zoning seeks to group together those areas (rooms) in a building that share similar load and usage characteristics, for purposes of control. Of course, this imagined procedure is not how HVAC engineers actually zone any building. Rather, the rules listed below are followed. The same rules apply when zoning a simulation model.

- when modeling existing buildings, refer to the actual zoning indicated by the HVAC plans, if available
- for new buildings and when simplifying the zoning of an existing building consider:
- magnitude and schedule of internal loads
- magnitude and schedule of solar gains
- schedule of fan system operations
- outside air requirements
- intended efficiency measures (ECM's)
- location of thermostats called out on the HVAC plans

In general, provide:

- one exterior zone per major orientation (12 to 18 feet deep)
- one internal zone per use schedule
- one plenum zone (if plenum returns) for each air handler to be modeled separately
- one zone for each special use (e.g., conference rooms, cafeterias, etc.)
- separate ground and top floor zones

Currently, eQUEST provides the user with two zoning schemes, one-zone-per-floor, and simple core-vs-perimeter zoning. Based on this user selection, eQUEST will automatically zone your model for you.

Simplified HVAC Zoning

In an effort to keep a simulation model as simple as possible, experienced modelers often find it possible and desirable to simplify the actual zoning (i.e., combine zones). Simplifying the HVAC zoning in a model will generally make the model smaller, and simpler to manage and maintain.

A host of reasons may cause the actual HVAC zoning to be more detailed than indicated by the rules above, or required to adequately represent the necessary thermodynamic conditions. These would include,

- Tenant and leasing flexibility may dictate that the building be divided up in a manner that facilitates flexible leasing of space assignment requirements.
- Ceiling space limitations or manufacture terminal equipment size limitations may cause a larger number of smaller units to be specified than strictly required by the rules on the previous page.
- Acoustical privacy requirements may separate supply to adjacent areas.
- Code requirements may separate supply to adjacent areas (e.g., separate return for smoking areas).

Common ways that modelers simplify the zoning and size of their models include the following.

- In multiple floor high rise-type buildings, intermediate "typical" floors are modeled as only one floor in the simulation model and a floor multiplier is applied in the model to permit the modeled typical floor to represent the true, larger, number of floors.

- All actual perimeter zones along similar orientations are combined into one zone with the same common orientation. This assumes that all of the perimeter zones so combined behave in a very similar manner.
- Separate core zones are usually combined, again, on the assumption that the separate core zones actually behave in an indistinguishable manner.

An important consequence of this type of zoning simplification is that the number of modeled HVAC air-handler systems is often smaller than the number of actual HVAC systems in the actual building. In effect, two or more actual HVAC systems are combined in the model, i.e., represented by a "composite" system whose capacity is equal to the sum of the actual systems, and whose performance characteristics (i.e., efficiency) are the average of the actual systems.

Zones for Buildings Without HVAC Systems

Any building or separately permitted space smaller than 2500 ft2 in conditioned floor area without an HVAC system or design may be modeled as having only a single HVAC zone. However, for buildings or permitted spaces 2500 ft2 and greater, each floor of the building shall be divided into multiple thermal zones according to the following procedure:

1. Determine the ratio (R) of the floor's total conditioned area to the gross exterior wall area associated with the conditioned space.
2. For each combination of occupancy type and exterior wall orientation, create a perimeter zone. The floor area of each perimeter zone shall be the gross exterior wall area of the zone times R or 1.25, whichever is smaller.
3. Model the exterior space adjacent to each wall orientation as a separate exterior zone. Spaces adjacent to walls that are within 45 degrees of each orientation shall be included in the zone belonging to that orientation.
4. For cases where R is greater than 1.25, create an interior zone for each occupancy type. For each occupancy type, the floor area of the interior zone shall be the total area less the floor area of the perimeter zones created in paragraphs 2 and 3 above.
5. Prorate the roof area and the floor area among the zones according to the floor area of each zone. Prorate the roof and floor areas among the perimeter zones created in paragraphs 2 and 3 above according to the floor area of each exterior zone.
6. Assign skylights to interior zones. If the skylight area is larger than the roof area of the interior zone, then the skylight area in the interior zone must be equal to the roof area in the interior zone and the user must prorate the remaining skylight area among the perimeter zones based on the floor area.
7. If the area of the zone is less than 300 ft2, combine it with its adjacent zone of the same occupancy type and zone type (interior or exterior).
8. Courtyards are considered outside or ambient air. Walls, floors, and roofs separating conditioned spaces from courtyards are exterior walls, floors, and roofs. Create an exterior zone for each wall orientation separating the conditioned space from the courtyard. The user shall not combine these exterior zones with other exterior zones even if their exterior walls have the same orientation.
9. Model spaces adjacent to demising walls as interior zones. Combine these zones with other interior zones within the same occupancy type.

10. Ignore all interior walls and model partitions separating thermal zones as air walls with U-value of 1.0 Btu/h-ft2-oF.

Since the Commission considers a larger number of modeled HVAC zones to be a more accurate representation, the ACM Compliance Documentation must inform ACM users that the local enforcement agency may (at its own discretion) require the applicant to model additional HVAC zones.

Wizard

The wizard automatically creates Space components and corresponding HVAC zones based on user inputs in the following wizard screens:

General Information: For buildings with more than three total floors, the wizard will combine all floors except the bottom and top floors into a single group of zones and assign a multiplier equal to the total number of floors represented by the group.

Building Footprint: The Building Footprint property allows users to select from several typical footprint shapes for the building. The Zoning Pattern allows the user to select "One Per Floor" or "Perimeter/Core" as the zoning pattern. The footprint graphic on this screen will display the perimeter zoning pattern if "Perimeter/Core" is selected. The Perimeter Zone Depth allows the user to enter the depth of perimeter zones occurring in the project. The size of the perimeter zones shown in the footprint graphic will change to reflect the value for Perimeter Zone Depth.

Detailed Interface

Zone and Space components essentially represent the same thing in the detailed interface. To create a new HVAC zone through the detailed interface, use the following procedure:

1. Create a new Space component in the Building Shell detailed tree. Select any Floor component, then right mouse click/Create Child Component/Create Child Space. Configure the space (shape), exterior walls, occupancy characteristics, etc.

2. Create a new HVAC Zone. Select any HVAC System component in the Air Side HVAC detailed tree. Select the Corresponding Space in the field provided. All other properties of the HVAC zone should be configured as described in the following sections.

BDL Input File

Refer to the SPACE command section of the DOE-2.2 Loads documentation and the ZONE command section of the DOE-2.2 Systems documentation for complete information on creating spaces and zones in a BDL input file.

Primary HVAC System Characteristics

System Type

The following DOE-2.2 HVAC systems types may be modeled for compliance analysis

- PSZ
- PMZS
- PVAVS
- PVVT
- PTAC
- HP (WLHP)
- SZRH
- VAVS
- RHFS
- DDS
- MZS
- PIU

- FC
- UVT
- UHT
- HVSYS
- EVAP-COOL
- RESYS2
- RESVVT
- RESYS

- Refer to the DOE-2.2 Systems documentation for complete information on these system types. The document "HVAC System Types" provides general background on system applications and typical configurations. Users should also review the discussion of compliance analysis keywords for the SYSTEM command in the DOE-2.2 California Compliance Addenda.

Wizard

Systems are automatically created by the wizard according to inputs in the HVAC System Definitions screen according to the following table:

eQUEST Wizard System Type	DOE-2.2 System Type
Gas or Fuel Furnace	UVT
Electric Furnace	UVT
Hot Water Furnace	UVT
2-Pipe Fan Coils	FC
Electric Baseboards	UVT
Hot Water Baseboards	UVT
Packaged Single Zone DX	PSZ
Split System Single Zone DX	PSZ
Packaged Terminal AC	PTAC
Packaged VAV	PVAVS
Packaged Multizone	PMZS
Packaged Single Zone Heat Pump	PSZ
Split System Single Zone Heat Pump	PSZ
Packaged Terminal Heat Pump	PTAC
Standard VAV	VAVS
Parallel Fan-Powered VAV	PIU
Series Fan-Powered VAV	PIU
Single Zone Air Handler	SZRH
Multizone Air Handler	MZS
Reheat Fan System (elec reheat)	RHFS
Dual Duct Air Handler	DDS
4-Pipe Fan Coils	FC
Indirect/Direct Evaporative Cooler	EVAP-COOL
Direct Evaporative Cooler	EVAP-COOL

Detailed Interface

To create a new system in the detailed interface, select the Project in the Air Side HVAC detailed tree, then right mouse click/Create HVAC System. Select the primary system type in the System Type field of the Basics screen of the Air-Side HVAC System Parameters tabbed dialog. The following table shows how values in the detailed interface for System Type translate to DOE-2.2 system types:

eQUEST Detailed Interface System Type	DOE-2.2 System Type
Pkgd Single Zone	PSZ

eQUEST Detailed Interface System Type	DOE-2.2 System Type
Pkgd Multizone	PMZS
Pkgd Var Vol	PVAVS
Pkgd Var Vol Var Temp	PVVT
Pkgd Terminal AC	PTAC
Water Loop HP	HP
Single Zone Reheat	SZRH
Variable Air Volume	VAVS
Reheat Fan System	RHFS
Dual Duct	DDS
Multi-Zone	MZS
Powered Induction Unit	PIU
Fan Coil	FC
Induction Unit	IU
Unit Ventilator	UVT
Unit Heater	UHT
Heating / Ventilating Sys	HVSYS
Evaporative Cool	EVAP-COOL
Residential System 2	RESYS2

BDL Input File

Refer to the DOE-2.2 Systems documentation for complete information on creating primary systems in BDL input files. The document "HVAC System Types" provides general background on system applications and typical configurations. Users should also review the discussion of compliance analysis keywords for the SYSTEM command in the DOE-2.2 California Compliance Addenda.

Available Central Cooling Equipment

The following table lists the available cooling equipment for each DOE-2.2 system type:

DOE-2.2 System Type	None	Add-On Evap Clg	Evap Cooling	DX Coils	Chilled Water Coils
PSZ		X		X	
PMZS		X		X	
PVAVS		X		X	
PVVT		X		X	
PTAC				X	
HP				X	
SZRH	X	X			X
VAVS	X	X			X
RHFS	X	X			X
DDS	X	X			X
MZS	X	X			X
PIU	X	X			X
FC	X				X
UVT	X				
UHT	X				
HVSYS	X				
EVAP-COOL			X		
RESSYS2		X		X	
RESVVT		X		X	
RESYS		X		X	

As the table above indicates, the DOE-2.2 system dictates the type of cooling equipment in the system. For example, a PSZ system, by definition, has DX cooling; a FC system has chilled water cooling; and, a UHT system has no cooling.

Wizard

As described above, the type of cooling equipment in the system is dictated by the type of system selected in the HVAC System Description screen of the wizard.

Detailed Interface

As described above, the type of cooling equipment in the system is dictated by the type of system selected in the Basics tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to DOE-2.2 Systems documentation for complete information on assigning system TYPEs.

Available Central Heating Equipment

The following table lists the available cooling equipment for each DOE-2.2 system type:

DOE-2.2 System Type	None	Furnace	Heat Pump	Hot Water Coils	Electric Resistance
PSZ	X	X	X	X	X
PMZS	X	X		X	X
PVAVS	X	X		X	X
PVVT	X	X	X	X	X
PTAC	X	X	X	X	X
HP			X		
SZRH	X	X		X	X
VAVS	X	X		X	X
RHFS	X	X		X	X
DDS	X	X		X	X
MZS	X	X		X	X
PIU	X	X		X	X
FC	X	X		X	X
UVT	X	X		X	X
UHT	X	X		X	X
HVSYS	X	X		X	X
EVAP-COOL	X	X		X	X
RESYS2	X	X	X	X	X
RESVVT	X	X	X	X	X
RESYS	X	X	X	X	X

The user must specify the type of central heating equipment for each system in the proposed building input file.

Wizard

The wizard assigns heat sources to system based on user inputs in the HVAC System Description screen of the wizard.

Detailed Interface

HVAC system heat source is entered in the Basics tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to DOE-2.2 Systems documentation for complete information on assigning system HEAT-SOURCE.

Packaged Cooling Equipment Configurations

eQUEST supports the following air conditioner and heat pump configurations:

- Packaged terminal air conditioners
- Packaged terminal heat pumps
- Room air conditioners with louvered sides, without reversing cycle
- Room air conditioners without louvered sides, with reversing cycle
- Room air conditioners with louvered sides, with reversing cycle
- Room air conditioners without louvered sides, with reversing cycle
- Split system, air-cooled air conditioners
- Single package, air-cooled air conditioners
- Split system, air-cooled heat pumps
- Single package, air-cooled heat pumps
- Air-cooled packaged condensing units
- Split system, water-cooled air conditioners
- Single package, water-cooled air conditioners
- Split system, water-cooled heat pumps
- Single package, water-cooled heat pumps
- Water-cooled packaged condensing units
- Water loop heat pumps
- Evaporative cooling systems
- Any air conditioning systems with add-on evaporative cooling

Wizard

The wizard enables users to make some limited distinctions of cooling equipment configurations. Equipment configuration is specified in the HVAC System Definitions screen of the wizard, where the user can specify the system(s) as one of the following:

- Packaged terminal air conditioner
- Packaged terminal heat pump
- Split system, air-cooled air conditioner
- Single package, air-cooled air conditioner
- Split system, air-cooled heat pump

- Single package, air-cooled heat pump
- Air-cooled packaged condensing unit

The wizard will automatically create systems in the detailed interface, all having the same configuration. The user should carefully review system configurations in the detailed interface and ensure they match the construction documents for the proposed building prior to performing the compliance analysis.

Detailed Interface

Air conditioner and heat pump configuration is specified in the Basic Specifications sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to discussion of the SYSTEM command in Section 2, Compliance BDL Elements, of this document for complete information on specifying packaged cooling equipment configuration in BDL input files.

Packaged Heating Equipment Configuration

eQUEST supports the following the following heating equipment configurations:

- Unit heater
- Duct furnace
- Rooftop central furnace
- Indoor central furnace

Wizard

The wizard enables users to make some limited distinctions of combustion heating equipment configurations. Equipment configuration is specified in the HVAC System Definitions screen of the wizard, where the user can specify the system(s) as one of the following:

- Unit Heater
- Rooftop central furnace
- Indoor central furnace

The wizard will automatically create systems in the detailed interface, all having the same configuration. The user should carefully review system configurations in the detailed interface and ensure they match the construction documents for the proposed building prior to performing the compliance analysis.

Detailed Interface

Furnace configuration is specified in the Basic Specifications sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to discussion of the SYSTEM command in Section 2, Compliance BDL Elements, of this document for complete information on specifying combustion heating equipment configuration in BDL input files.

Equipment Capacities

Capacities of heating and cooling equipment, as well as flow rates of fans and pumps are not required inputs. If capacities and/or flow rates are not input by the user, eQUEST will automatically size the equipment based on system sizing runs. These automatically sized capacities and flow rates will be reported in the compliance forms for HVAC systems and will serve as the basis for the rules processor to determine standard building efficiencies of HVAC equipment. It is highly unlikely that automatically sized equipment will match the capacities for equipment reported in the construction documents for the building. Since information reported on the compliance forms must match the construction documents for the building, the user is strongly encourage to enter capacities and flow rates for all HVAC equipment including:

- air conditioners
- chilled water cooling coils
- chillers
- condensing units
- furnaces
- electric and hot water heating coils
- heat pumps
- boilers
- fans
- pumps

Wizard

The wizard populates heating and cooling capacities of HVAC systems, chillers and boilers and flow rates of fans and pumps based on internal, highly simplified sizing equations. Users should thoroughly review the detailed interface to ensure all capacities match the construction documents for the proposed building.

Detailed Interface

The table below describes where in the detailed interface to enter equipment capacities and flow rates for compliance analysis purposes:

Equipment	Units	Tab Dialog	Tab	Sub-Tab	Property
Air Conditioner	Btu/hr	Air Side HVAC System Parameters	Compliance	Cooling	Total Cooling Capacity
Chilled Water Coil	Btu/hr	Air Side HVAC System Parameters	Compliance	Cooling	Total Cooling Capacity
Condensing Unit	Btu/hr	Air Side HVAC System Parameters	Compliance	Cooling	Total Cooling Capacity
Heat Pump (Cooling)	Btu/hr	Air Side HVAC System Parameters	Compliance	Cooling	Total Cooling Capacity
Water Chiller	million Btu/hr	Chiller	Basic Specifications	- none -	Capacity

Equipment	Units	Tab Dialog	Tab	Sub-Tab	Property
Furnace	Btu/hr	Air Side HVAC System Parameters	Compliance	Heating	Total Heating Capacity
Heat Pump (Heating)	Btu/hr	Air Side HVAC System Parameters	Compliance	Heating	Total Heating Capacity
Electric or Hot Water Coil	Btu/hr	Air Side HVAC System Parameters	Compliance	Heating	Total Heating Capacity
Boiler	million Btu/hr	Boiler	Basic Specifications	- none -	Capacity
Supply Fan	cfm	Air Side HVAC System Parameters	Fans	Flow Parameters	Design cfm
Return Fan	cfm	Air Side HVAC System Parameters	Compliance	Fans	(Return Fan) Total Flow
Exhaust Fan	cfm	Air Side HVAC Zone Parameters	Outdoor Air	- none -	(Exhaust Air) Flow

Where systems have been combined (See discussion of combining equipment below), the capacity of the piece of equipment for the purposes of determining standard design efficiency criteria is calculated as:

$$unit\,capacity = \frac{property(Btu/hr,\ cfm,\ etc.)}{number\,of\,units}$$

BDL Input File

The table below describes appropriate commands and keywords for equipment capacities and flow rates for compliance analysis purposes:

Equipment	Units	Command	Keyword
Air Conditioner	Btu/hr	SYSTEM	C-TOTAL-CLG-CAP
Chilled Water Coil	Btu/hr	SYSTEM	C-TOTAL-CLG-CAP
Condensing Unit	Btu/hr	SYSTEM	C-TOTAL-CLG-CAP
Heat Pump (Cooling)	Btu/hr	SYSTEM	C-TOTAL-CLG-CAP
Water Chiller	million Btu/hr	CHILLER	CAPACITY
Furnace	Btu/hr	SYSTEM	C-TOTAL-HTG-CAP
Heat Pump	Btu/hr	SYSTEM	C-TOTAL-CLG-CAP
Electric or Hot Water Coil	Btu/hr	SYSTEM	C-TOTAL-HTG-CAP
Boiler	million Btu/hr	BOILER	CAPACITY
Supply Fan	cfm	SYSTEM	SUPPLY-FLOW
Heating Supply Fan	cfm	SYSTEM	HSUPPLY-FLOW
Return Fan	cfm	SYSTEM	C-TOT-RET-FLOW
Exhaust Fan	cfm	ZONE	EXHAUST-FLOW

HVAC Equipment Efficiency

Efficiencies of cooling and heating equipment are not required inputs. If equipment efficiencies are not input by the user, eQUEST will automatically assign values that minimally comply with the Standards based on the configuration and capacity. These automatically assigned values will be reported in the compliance forms for HVAC systems. It is highly unlikely that automatically assigned equipment efficiencies will match the efficiencies for equipment reported in the construction documents for the building. Since information reported on the compliance forms must match the construction documents for the building, the user is strongly encourage to enter efficiencies for all HVAC equipment including:

- air conditioners
- heat pumps
- condensing units
- chillers
- furnaces
- boilers
- water heaters

In order for the rules processor to properly determine standard design equipment efficiencies, equipment must be categorized into certain efficiency categories, listed below:

Air Conditioners, Heat Pumps, Furnaces and Fuel Fired Boilers: DOE covered vs. non-DOE covered

Water Heaters: DOE Covered vs. non-DOE Covered storage, DOE Covered vs. non-DOE Covered instantaneous and DOE Covered vs. non-DOE Covered heat pump.

The rules processor is capable of determining these categories, with some exceptions. User input of efficiency categories is required when the rules processor cannot distinguish them. Rules processor capabilities depend on whether a building input file is created with the wizard, using the detailed interface or by writing a BDL input file.

It is important that the user input appropriate efficiency descriptors for types of equipment included in the proposed building input file. If efficiency descriptors are left blank, the rules processor will assign values that minimally comply with the standards and report these values in the compliance documentation for the building. The rules processor will ignore all efficiency descriptors that are not applicable to the particular type of packaged cooling equipment. For example, if the cooling equipment capacity and configuration dictate that the appropriate efficiency for the equipment is an EER, but the user has input an SEER in the detailed interface, the rules processor will ignore the value input for SEER and assign a minimally complying EER for the system.

Combining Equipment

Users may model like systems together as one system provided the systems serve the same thermal zone or the thermal zones served by the individual units are similar and are being combined. The equipment being combined must also be of the same category. Multiple units of the same type fall into the following categories:

Cooling Equipment:

- Single package < 65,000 Btuh

- Split system < 65,000 Btuh
- All package > 65,000 and < 75,000 Btuh
- All package > 75,000 and < 135,000 Btuh
- All package > 135,000 and < 760,000 Btuh
- Condensing Units, Air-Cooled > 135,000 Btuh
- Condensing Units, Water or Evaporatively Cooled > 135,000

Heating Equipment:

- Heat pumps, single package < 65,000 Btuh
- Heat pumps, split system < 65,000 Btuh
- Heat pumps, all > 65,000 and < 75,000 Btuh
- Heat pumps, all > 75,000 and < 135,000 Btuh
- Heat pumps, all > 135,000 Btuh
- Furnaces, all fossil fuel fired < 225,000 Btuh
- Furnaces, gas fired > 225,000 Btuh
- Furnaces, oil fired > 225,000 Btuh

Packaged Cooling Equipment Efficiency

(and Heating Efficiency of Heat Pumps)

Equipment efficiencies are specified by entering efficiency descriptors that are determined through applicable ARI testing standards for the configuration and capacity of the equipment.

Wizard

The wizard provides some generalized inputs for specifying the efficiency of packaged cooling equipment that result in all cooling equipment having the same efficiency and efficiency category. Users should review efficiency information in the detailed interface and ensure it matches the construction documents for the proposed building prior to performing the compliance analysis.

All packaged cooling equipment (including heat pumps) with nominal cooling capacities less than 135,000 Btu/hr is covered by DOE efficiency standards. However, the efficiency descriptors are different depending on the capacity. Packaged cooling equipment efficiency information is entered in the Packaged HVAC Equipment screen of the wizard. Procedures for identifying if the equipment is covered by DOE efficiency standards are given below:

Nominal Cooling Capacity < 65 kBtuh: Select "< 65 kBtuh or 5.4 tons" as the Typical Unit Size. Select "SEER" as the Efficiency descriptor. Enter the typical SEER of the air conditioners in the building.

Nominal Cooling Capacity ≥ 65 and < 135 kBtuh: Select "65-135 kBtuh or 5.4-11.25 tons" as the Typical Unit Size. The efficiency descriptor will automatically be set to "EER". Enter the typical EER of the air conditioner in the building.

The wizard does not support inputs for air conditioners that have been combined. Combined systems must be edited/input in the detailed interface.

Detailed Interface

The table below lists applicable efficiency descriptors for packaged air conditioning equipment as well as the related fields in the detailed interface. (Note that inputs for EER, SEER and IPLV must be entered in the Cooling sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog. Inputs for COP and HSPF must be input on the Heating sub-tab.)

Equipment Type	Size Category	Sub-Category or Rating Condition	Efficiency Descriptor	eQUEST Property
Packaged terminal air conditioner	- none -	95 deg. 82 deg	EER @ 95F EER @ 82F	EER 95 EER 82
Packaged terminal heat pump	- none -	95 deg 82 deg 47 db/43 wb	EER @ 95F EER @ 82F COP @ 47F	EER 95 EER 82 COP 47
Room air conditioners		95 deg	EER @ 95F	EER 95
Central heat pumps	< 65 kBtu/hr	- none -	SEER HSPF	SEER HSPF
Central heat pumps	≥ 65 kBtu/hr	95 deg - none - 47 db/43 wb 17 db/15 wb	EER @ 95F IPLV COP @ 47F COP @ 17F	EER 95 IPLV COP 47 COP 17
Central air conditioners	< 65 kBtu/hr	- none -	SEER	SEER
Central air conditioner	≥ 65 kBtu/hr	95 deg - none -	EER @ 95F IPLV	EER 95 IPLV

When combining equipment, the efficiency of the proposed equipment must be calculated by the user, prior to input, as follows:

$$Efficiency\,Descriptor = 1 \Big/ \left(\frac{\sum Capacity / Efficiency\,Descriptor}{\sum Capacity} \right)$$

BDL Input File

Refer to discussion of the SYSTEM command in Section 2, Compliance BDL Elements, of this document for complete information on specifying combustion heating equipment configuration in BDL input files.

Water Chilling Equipment Efficiency

Equipment efficiencies are specified by entering efficiency descriptors that are determined through applicable ARI testing standards for the configuration and capacity of the equipment.

Wizard

Users may enter the efficiency of chillers by specifying a value for kW/ton in the Cooling Primary Equipment screen of the wizard. This value is automatically converted to COP by eQUEST using the following formula:

$$COP = \frac{12{,}000\,Btuh/ton}{kW/ton * 3413\,Btuh/kW}$$

Detailed Interface

Chiller efficiency is specified by entering the COP and IPLV in the Basic Specifications tab of the Chiller Properties tabbed dialog. When chillers are combined, the average efficiency is calculated as following equation:

$$Efficiency\,Descriptor = 1 \Big/ \left(\frac{\sum Capacity / Efficiency\,Descriptor}{\sum Capacity} \right)$$

BDL Input File

Refer to the discussion of the CHILLER command in Section 2, Compliance BDL Elements, of this document for complete information on specifying chiller efficiency using compliance analysis keywords in BDL input files.

Furnace Efficiency

Equipment efficiencies are specified by entering efficiency descriptors as applicable and described in the Standards for the configuration and capacity of the equipment.

Wizard

The wizard allows the user to specify if combustion heating equipment efficiency is in the form of AFUE or Thermal Efficiency. If the user does not input values for AFUE or Thermal Efficiency in the detailed interface, as described below, the rules processor will automatically assign AFUE based on wizard inputs. While the wizard does not restrict input for the type of efficiency descriptors, users should be mindful that only central fan-type furnaces with capacities of less than 225,000 Btu/hr are rated with an AFUE, while all other combustion furnaces are rated with a Thermal Efficiency.

Detailed Interface

Equipment efficiencies for combustion furnaces are entered on the Heating sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog. For combined equipment, the user must input the Pre-calculated Heat Input Ratio as follows:

- HIRs for individual furnaces shall be calculated as follows:
- Single Package Units, < 225,000 Btu/hr
- HIR = 1 / (0.5163 * AFUE + 0.4033)
- Split System Units, < 225,000 Btu/hr, AFUE $\leq$ 83.5:
- HIR = 1 / (0.2907 * AFUE + 0.5787)
- Split System Units, < 225,000 Btu/hr, AFUE > 83.5:
- HIR = 1 / (1.1116 * AFUE – 0.098185)
- All other furnaces:
- HIR = 1 / Thermal Efficiency

The value for Pre-calculated Heat Input Ratio is:

$$Calculated\,Heat\,Input\,Ratio = \frac{\sum HIR * FurnaceOutput}{\sum FurnaceOutput}$$

BDL Input File

Refer to the discussion of the SYSTEMs command in Section 2, Compliance BDL Elements, of this document for complete information on specifying combustion furnace efficiency in BDL input files using compliance analysis keywords.

Boiler Efficiency

Equipment efficiencies are specified by entering efficiency descriptors as applicable and described in the Standards for the configuration and capacity of the equipment.

Wizard

The wizard allows the user to specify if combustion heating equipment efficiency is in the form of Thermal Efficiency. If the user does not input values for Thermal Efficiency in the detailed interface, as described below, the rules processor will automatically assign AFUE or Thermal Efficiency based on wizard inputs. While the wizard does not restrict input for the type of efficiency descriptors, users should be mindful that only central fan-type boilers with capacities of less than 300,000 Btu/hr are rated with an AFUE, while all other combustion furnaces are rated with a Thermal Efficiency.

Detailed Interface

Equipment efficiencies for combustion fired boilers are entered on the Basic Specifications tab of the Boiler Properties tabbed dialog. For combined equipment, the user must input the Pre-calculated Heat Input Ratio as follows:

- HIRs for individual furnaces shall be calculated as follows:
- < 300,000 Btu/hr, 75 ≤ AFUE ≤ 80:
- HIR = 1 / (0.1 * AFUE + .725)
- < 300,000 Btu/hr, 80 ≤ AFUE ≤ 100:
- HIR = 1 / (0.875 * AFUE + .105)
- All other boilers:
- HIR = 1 / Thermal Efficiency

The value for Pre-calculated Heat Input Ratio is:

$$Calculated\,Heat\,Input\,Ratio = \frac{\sum HIR * BoilerOutput}{\sum BoilerOutput}$$

BDL Input File

Refer to the discussion of the BOILER command in Section 2, Compliance BDL Elements, of this document for complete information on specifying combustion boiler efficiency in BDL input files using compliance analysis keywords.

Water Heater Efficiency

Wizard

The wizard allows the user to specify if water heater efficiency is in the form of Thermal Efficiency and Standby Loss or Energy Factor. Additionally, the wizard allows the user to enter storage capacity and input rating of the water heater. The wizard will determine from the user input values for Heater Fuel, Heater Type, Input Rating and Tank Capacity, if the water heater is covered by DOE appliance efficiency regulations. While the wizard does not restrict input for the type of efficiency descriptors, users should be mindful that only certain types of water heaters are regulated by DOE appliance standards that require minimum Energy Factors. All other water heaters are covered by either Thermal Efficiency alone (for instantaneous water heaters) or Thermal Efficiency and Standby Loss (for storage water heaters).

Detailed Interface

Water heaters of the same category may be combined and simulated as a single unit provided they are the same type of water heater (See description for C-CATEGORY, below). The table below lists the possible values for C-CATEGORY and the required inputs for each category.

Equipment Type (C-CATEGORY)	Fuel	Storage Capacity	Input Capacity	Efficiency Descriptor	eQUEST Property
DOE Covered Storage	Electric	- none -	<= 12 kW	Energy Factor	C-ENERGY-FACTOR
	Gas	>= 20 gal	<= 75 kBtuh	Energy Factor	C-ENERGY-FACTOR
DOE Covered Instantaneous	Gas	< 2 gal	>50kBtuh, <200kBtuh	Energy Factor	C-ENERGY-FACTOR
Other Direct Fired Storage	Electric	- all -	> 12 kW	Standby Loss	C-STDBY-LOSS-FRAC
	Gas	- all -	> 75 kBtuh	Thermal Efficiency Standby Loss	C-RECOV-EFF C-STDBY-LOSS-FRAC
Other Instantaneous >= 10 gallons	Electric	>= 10 gal	> 12 kW	Standby Loss	C-STDBY-LOSS-FRAC
	Gas	>= 10 gal	> 200 kBtuh	Thermal Efficiency Standby Loss	C-RECOV-EFF C-STDBY-LOSS-FRAC
Other Instantaneous < 10 gallons	Gas	< 10 gal	> 200 kBtuh	Thermal Efficiency	C-RECOV-EFF
Indirect Fired	- n/a -	- all -	- n/a -	Standby Loss	C-STDBY-LOSS-FRAC
DOE Covered Heat Pump	Electric	- all -	<= 12 kW	Energy Factor	C-ENERGY-FACTOR
Other Heat Pump	Electric	- all -	> 12 kW	Electric Input Ratio	ELEC-INPUT-RATIO

BDL Input File

Refer to the discussion of the DW-HEATER command in Section 2, Compliance BDL Elements for complete information on specifying water heater efficiency in BDL input files using compliance analysis keywords.

Fan System Power

There are three ways to enter fan system power using eQUEST: system static pressure, fan brake horsepower and watts per cfm. Each of these methods is described below. For compliance purposes, the rules processor converts all input forms to brake horsepower and fan motor efficiency. It is highly

recommended that the user review the compliance documentation to ensure that reported brake horsepower values match the construction documents for the proposed building.

Fan Power Using Static Pressure

To input fan power for supply and return fans using static pressure, the following three values are required for the fan:

- Static pressure of the fan at design flow rate
- Overall supply efficiency of the supply fan, motor and drive
- Efficiency of the fan alone at design conditions

Wizard

Select "in. WG" as the fan power method in the HVAC System Fans screen of the wizard. Enter the static pressure for the fan system. The user should review the information in the detailed interface for system mechanical efficiency and fan efficiency to ensure they match the design documents for the proposed building.

Detailed Interface

Static pressure (Static in WG), total fan system efficiency (Tot Eff Frac) and fan efficiency (Mech Eff Frac) are entered on the Fan Power and Control sub-tab of the Fans tab of the Air-Side HVAC System Parameters tab dialog. The rules processor will automatically convert static pressure and system efficiency to brake horsepower according to the following equation:

$$BrakeHP = \frac{Static * cfm}{6356 * FanSystemEfficiency} * FanMotorEfficiency$$

BDL Input File

Refer to the discussion of the SYSTEM-FANS command in the DOE-2.2 Systems documentation for complete information for describing supply and return fan power using static pressure, fan system efficiency, and fan efficiency.

Using Fan Power Indices

A single value, with units of kW/cfm, is required for each fan when describing fan power using a fan power index.

Wizard

At this time, fan power indices may only be input in the detailed interface.

Detailed Interface

Enter the fan power index (Design kW /cfm) on the Fan Power and Control sub-tab of the Fans tab of the Air-Side HVAC System Parameters tab dialog. The rules processor will automatically convert fan power indices to brake horsepower according to the following equation:

$$BrakeHP = FanPowerIndex / 0.746 * FanMotorEfficiency$$

BDL Input File

Refer to the discussion of the SYSTEM-FANS command in the DOE-2.2 Systems documentation for complete information for describing supply and return fan power using fan power indices. (keywords: SUPPLY-KW/FLOW and RETURN-KW/FLOW)

Using Brake Horsepower

A single value, with units of HP, is required for each fan when describing fan power using brake horsepower.

Wizard

Select "BHP" as the fan power method in the HVAC System Fans screen of the wizard. Enter the brake horsepower for the fan system.

Detailed Interface

Brake horsepower is entered on the Fans sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tab dialog.

BDL Input File

Refer to the discussion of the SYSTEM command in Section 2, Compliance BDL Elements, of this document for complete information on specifying fan brake horsepower using compliance analysis keywords in BDL input files.

Fan Pressure Due to Filtration

Section 144(c) of the Standards states:

> … *total fan system power demand need not include the additional power demand caused solely be air treatment or filtering systems with final pressure drops more than 1 inch Water Column (only the energy accounted for by the amount of pressure drop that is over one inch may be excluded)* …

The user may enter total and filtration static pressure drops for both supply and return fans. The rules processor will automatically adjust the simulated fan power and associated standard design fan power so as not to consider fan power due to filtration in excess of 1 inch Water Column.

Wizard

At this time, the Wizard does not support inputs for filtration pressure drop. These must be input using the detailed interface.

Detailed Interface

Filtration pressure (Filtration Static Pressure) and total system pressure (Total Static Pressure) are input for both supply and return fans on the Fans sub-tab of the Compliance tab of the Air-Side HVAC System Parameters dialog box.

BDL Input File

Refer to the discussion of the SYSTEM command in Section 2, Compliance BDL Elements, of this document for complete information on specifying pressure drop for filtration using compliance analysis keywords in BDL input files.

Fan Electric Motor Efficiency

There are two methods to specify fan motor efficiency:

1. Specify the type of motor from the following categories:
   - ***CEC minimum efficiency:*** The rules processor will assign efficiencies from Table 12-10 published by the National Electrical Manufacturers Association based on the nominal horsepower of the motor.
   - ***CEE Premium Efficient:*** The rules processor will assign efficiencies from the Consortium for Energy Efficiency's Premium Efficient Motor voluntary standard based on the nominal horsepower for the motor.
2. Enter the motor efficiency. Efficiencies input by the user take precedence over the type of motor.

If the motor type is specified, and nominal horsepower is not input by the user, the rules processor will use the brake horsepower to look up the efficiency.

Wizard

Only the motor type can be specified in the wizard. Motor efficiency is input as "High"(for CEC minimum efficiency) or "Premium"(for CEE Premium Efficient) in the HVAC System Fans screen of the wizard.

Detailed Interface

The motor type is input as Motor Efficiency Category in the Fans sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog. Motor Efficiency may also be input on the same tab.

BDL Input File

Refer to the discussion of the SYSTEM command in Section 2, Compliance BDL Elements, of this document for complete information on specifying fan motor efficiency using compliance analysis keywords in BDL input files.

Fan Operation Schedules

Fan operation schedules are automatically determined by the rules processor. Nonresidential occupancies (including Hotel Function areas) operate with continuous fans during occupied hours while residential occupancies (High-Rise Residential and Hotel/Motel Guest Room) have fans that only operate when heating or cooling is needed.

Fan Volume Control Types

The following types of fan volume control are available on variable air volume systems (DOE-2.2 system types PVAVS and VAVS):

- Forward curved centrifugal fan with discharge dampers
- Forward curved centrifugal fan with inlet vanes
- Air foil centrifugal fan with discharge dampers
- Air foil centrifugal fan with inlet vanes

- Variable speed drive fan
- Vane-axial fan with variable pitched blades
- Custom fan curve
- The rules processor will automatically configure the part-load curve for any of these fan volume control types except for the custom fan curve. If a custom fan curve is specified, this curve must be created in the detailed interface or in a BDL input file. Engineering documentation for any fan volume control must be submitted with the compliance documentation to support the fan control performance represented by the curve.
- Supply and return fans may have different fan volume control types.

Wizard

Fan volume control is specified using the Fan Type field in the HVAC System Fans screen of the wizard. Note that the wizard will never create a return fan for a single-duct variable air volume system, therefore information about return fans must be entered in the detailed interface. Custom fan curves cannot be specified in the wizard.

Detailed Interface

Fan volume control for compliance analysis is entered in the Fan Type field on the Fans sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog. If "Custom Curve" is selected, then the simulated fan performance curve will be the curve listed in Fan EIR = f(PLR) field of the Fan Power and Control sub-tab of the Fans tab of the Air-Side HVAC System Parameters.

BDL Input File

Refer to the discussion of the SYSTEM command in the DOE-2.2 California Compliance Supplement for complete information on specifying fan volume control using compliance analysis keywords in a BDL input file. If "Custom Curve" is assigned as the compliance fan volume control, then a CURVE-FIT command, generated by the user, must be included in the BDL input file and referenced as the fan part-load curve for the supply or return fan as applicable. Refer to the discussion of CURVE-FIT and SYSTEM-FANS commands in the DOE-2.2 Systems documentation for more information.

Air Economizers

eQUEST supports the following economizer characteristics:

Economizer Type

Temperature: Outside drybulb temperature is measured to determine if outside air should be used for cooling.

Enthalpy: Total outside air enthalpy is measured to determine if outside air should be used for cooling.

Drybulb High Limit

This is the outside air drybulb temperature above which an air economizer closes to the minimum position. If the user does not specify this value, DOE-2.2 use the return air temperature as the high-limit, or differential temperature control. In cases where a drybulb limit should not be used, such as when using enthalpy only, the drybulb limit should be set to a very high value (over 100 degrees) so that the limit is never reached during hours when economizer cooling would likely be available.

Enthalpy High Limit

This is the total outside air enthalpy above which an air economizer closes to the minimum position.

Compressor Lockout

Compressor lockout indicates that the air conditioning compressor(s) cannot operated whenever the outside air dampers are open beyond their minimum position.

Economizer Low Limit

The economizer low limit, applicable to packaged cooling equipment only, is outside air drybulb below which the outside air dampers close to their minimum position.

Maximum Outside Air Fraction

The maximum outside air fraction is the maximum amount of outside air, as a fraction of total design supply air, that can be provided as outside air. This property should only be used if the economizer is not capable of providing 100% outside air.

Standard Design Economizer

The rules processor will create an air economizer for the standard design building whenever a proposed building HVAC system meets the following criteria:

- space(s) served are nonresidential or hotel function area occupancy types; and
- nominal cooling capacity greater than 75,000 Btu/hr; and
- design supply air flow rate greater than 2,500 cfm

The standard design economizer will be a temperature economizer with an outside temperature limit of 75 degrees.

Wizard

Economizer properties are entered in the HVAC Zone Heating and Economizers screen of the wizard. Users may enter economizer type (Type), temperature high limit (High Limit) and compressor lockout (Compressor). The user should review all other economizer properties in the detailed interface to ensure they match the design and construction documents for the building prior to continuing with the compliance analysis.

Detailed Interface

Economizer properties are input/edited in the Outside Air Economizer sub-tab of the Outdoor Air tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to the discussion of the SYSTEM-CONTROL and SYSTEM-AIR commands in the DOE-2.2 Systems documentation for complete information on specifying air economizers in the BDL input files.

Water Economizers

eQUEST supports water-side economizers that are part of central air conditioning systems with the following features:

Coil Head

The pressure drop through the water economizer coil.

Additional Fan Power Requirements

The additional amount of fan power (kW/cfm) needed due to the added static pressure of the water economizer coil

Water Economizer Valve Type

Two-way or three-way valve can be specified indicating variable or constant water economizer flow, respectively.

Wizard

The wizard does not support the creation of water-side economizers.

Detailed Interface

Waterside economizer properties are input/edited in the Economizer sub-tab of the Cooling tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to the discussion of the Waterside Economizer properties in the DOE-2.2 Systems documentation for complete information on specifying waterside economizers in the BDL input files.

Water Cooled Condensers

eQUEST supports water cooled condensers for all direct expansion cooling equipment.

Wizard

The wizard does not support the creation of water cooled condensers.

Detailed Interface

Water cooled condenser properties are input/edited in the Condenser sub-tab of the Cooling tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to the discussion of the Water Cooled Condensers properties in the DOE-2.2 Systems documentation for complete information on specifying air water cooled condensers in the BDL input files.

Add-On Evaporative Cooling

eQUEST supports add on indirect and direct evaporative cooling for all except zonal systems.

Wizard

The wizard does not support the creation of add-on evaporative cooling.

Detailed Interface

Evaporative cooling properties are input/edited in the Add-on Evaporative Cooling sub-tab of the Preconditioner tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to the discussion of the Evaporative Cooling properties in the DOE-2.2 Systems documentation for complete information on specifying add-on evaporative cooling in the BDL input files.

Energy Recovery Ventilation

eQUEST supports the following energy recovery ventilators:

- Sensible controlled air-to-air heat exhanger
- Enthalpy controlled air-to-air heat exchanger
- Sensible heat-wheel
- Enthalpy heat-wheel
- Heat pipe

Energy recovery ventilators shall be modeled according to the plans and specifications provided for the building. Refer to the DOE-2.2 Dictionary for comprehensive instructions for modeling energy recovery ventilators.

Wizard

The wizard does not support the creation of energy recovery ventilators.

Detailed Interface

Energy recovery ventilators inputs can be accessed using the heat recovery spreadsheet controls for air side systems.

BDL Input File

Refer to the discussion of the Energy Recovery Ventilator properties in the DOE-2.2 Systems documentation for complete information on specifying waterside economizers in the BDL input files.

Default Heating and Cooling Systems

There are many cases where all or portions of HVAC system(s) are not included in the compliance analysis. In these cases, the rules processor will automatically generate the appropriate system(s) or system components. The following input conditions will cause the rules processor an entire default system:

Mechanical Compliance Not Performed

- The user indicates that mechanical compliance is not to be performed as part of the compliance analysis. **IMPORTANT:** The input file must be a complete file including mechanical system inputs, even though mechanical compliance will not be performed.

Invalid System Selection

- The proposed system is currently not supported by the compliance rules processor. The following system table lists supported and unsupported system types:

Value for TYPE keyword in DOE-2.2 SYSTEM Command	eQUEST System Description	Currently Supported?	Includes Cooling?
UVT	Unit Ventilator (no heating or cooling)	Yes	No
UVT	Gas or Fuel Furnace with zone ventilation	Yes	No
UHT	Gas or Fuel Furnace with NO zone ventilation	Yes	No
UVT	Electric Furnace with zone ventilation	Yes	No
UHT	Electric Furnace with NO zone ventilation	Yes	No
UVT	Hot Water Furnace with zone ventilation	Yes	No
UHT	Hot Water Furnace with NO zone ventilation	Yes	No
FC	2-Pipe Fan Coils (heating only)	Yes	No
UVT	Electric Baseboards (only) with zone ventilation	No	No
UHT	Electric Baseboards (only) with NO zone ventilation	No	No
UVT	Hot Water Baseboards (only) with zone ventilation	No	No
UHT	Hot Water Baseboards (only) with NO zone ventilation	No	No
PSZ	Packaged Single Zone DX (no heating)	Yes	Yes
PSZ	Split System Single Zone DX (no heating)	Yes	Yes
PTAC	Packaged Terminal AC (no heating)	Yes	Yes
PVAVS	Packaged VAV (no heating)	Yes	Yes
PSZ	Packaged Single Zone DX with Furnace	Yes	Yes
PSZ	Split System Single Zone DX with Furnace	Yes	Yes
PMZ	Packaged Multizone with Furnace	Yes	Yes
PSZ	Packaged Single Zone DX with Elec Resist Heat	Yes	Yes
PSZ	Split System Single Zone DX with Elec Resist Heat	Yes	Yes
PTAC	Packaged Terminal AC (no heating)	Yes	Yes
PVAVS	Packaged VAV with Elec Resist Reheat	Yes	Yes
PMZ	Packaged Multizone with Elec Resist Heat	Yes	Yes
PSZ	Packaged Single Zone Heat Pump	Yes	Yes
PSZ	Split System Single Zone Heat Pump	Yes	Yes
PTAC	Packaged Terminal Heat Pump	Yes	Yes
HP	Water-Source Heat Pump	Yes	Yes
PMZ	Packaged Multizone Heat Pump	No	Yes
VAVS	Standard VAV (no reheat)	Yes	Yes
PIU	Parallel Fan-Powered VAV (no reheat)	Yes	Yes
PIU	Series Fan-Powered VAV (no reheat)	Yes	Yes
SZRH	Single Zone Air Handler (cooling only)	Yes	Yes
FC	2-Pipe Fan Coils (cooling only)	Yes	Yes
MZS	Multizone Air Handler (cooling only)	Yes	Yes
DDS	Dual Duct Air Handler (no heating)	Yes	Yes
PIU	Parallel Fan-Powered VAV (elec reheat)	Yes	Yes
VAVS	Standard VAV (elec reheat)	Yes	Yes
PIU	Series Fan-Powered VAV (elec reheat)	Yes	Yes
SZRH	Single Zone Air Handler (elec heat)	Yes	Yes
RHFS	Reheat Fan System (elec reheat)	Yes	Yes
MSZ	Multizone Air Handler (elec heat)	Yes	Yes
DDS	Dual Duct Air Handler (elec heat)	Yes	Yes
PIU	Parallel Fan-Powered VAV (hot water reheat)	Yes	Yes
VAVS	Standard VAV (hot water reheat)	Yes	Yes
PIU	Series Fan-Powered VAV (hot water reheat)	Yes	Yes
SZRH	Single Zone Air Handler (hot water heat)	Yes	Yes
RHFS	Reheat Fan System (hot water reheat)	Yes	Yes
FC	4-Pipe Fan Coils (hot water heat)	Yes	Yes
MZS	Multizone Air Handler (hot water heat)	Yes	Yes
DDS	Dual Duct Air Handler (hot water heat)	Yes	Yes
EVAP-COOL	Indirect/Direct Evaporative Cooler	Yes	No

Value for TYPE keyword in DOE-2.2 SYSTEM Command	eQUEST System Description	Currently Supported?	Includes Cooling?
EVAP-COOL	Direct Evaporative Cooler	Yes	No
EVAP-COOL	Indirect/Direct Evaporative Cooler	Yes	No
EVAP-COOL	Direct Evaporative Cooler	Yes	No
EVAP-COOL	Indirect/Direct Evaporative Cooler	Yes	No
EVAP-COOL	Direct Evaporative Cooler	Yes	No
PVAVS	Packaged VAV with Hot Water Reheat	Yes	Yes

Wizard

Select "Envelope Only", "Lighting Only" or "Envelope/Lighting" as the Scope of Permit in the Compliance Analysis Settings screen of the wizard to indicate that mechanical compliance is not included for the proposed project. Upon beginning of the compliance analysis, the rules processor will automatically create defaults for all systems created by the wizard.

System types are entered in the HVAC System Definitions screen of the wizard. The rules processor will regenerate any systems listed in the table above with "No" in the Currently Supported column.

Detailed Interface

Select "Envelope Only", "Lighting Only" or "Envelope/Lighting" as the Scope of Permit in the Basic Specifications tab of the Compliance Data tabbed dialog to indicate that mechanical compliance is not included for the proposed project. Upon beginning of the compliance analysis, the rules processor will automatically create defaults for all systems created by the wizard.

System types are entered in the Basics tab of the Air-Side HVAC System Parameters tabbed dialog. The rules processor will regenerate any systems listed in the table above with "No" in the Currently Supported column.

The detailed interface also allows the user to identify individual systems to be excluded from the analysis by identifying the system as "Existing System" in the System Used For property of the Basic Specifications sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to the discussion of the COMPLIANCE command, C-PERMIT-SCOPE keyword, in Section 2, Compliance BDL Elements, of this document for information on indicating that HVAC systems are not included in the compliance analysis in BDL input files.

System type is assigned through the TYPE keyword of the SYSTEM command. Any system TYPE that is not currently supported ("No" in Currently Supported? column of the table above) will be regenerated by the rules processor to be a default system.

No Heating Installed

If an HVAC system has no heating capability, the rules processor will automatically create heating components for the system.

Wizard

"No Heating" may be selected in the Heating Equipment field of the General Information screen of the wizard or in the Heating Source field of the HVAC System Definitions. Additionally, specifying a

size of zero in the size field of the Heating section of the Packaged HVAC Equipment screen of the wizard.

Detailed Interface

The detailed interface also allows the user to identify individual systems without heating capacity identifying the system as "Cooling Only" in the System Used For property of the Basic Specifications sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog. Additionally, if the heating capacity is zero, the rules processor will assume that no heating is installed.

BDL Input File

Refer to the SYSTEM command discussion in Section 2, Compliance BDL Elements, of this document for complete information on identifying the system as having no heating using compliance analysis keywords.

No Cooling Installed

If an HVAC system has no cooling capability, the rules processor will automatically create cooling components for the system. Additionally, any systems listed in the table above where cooling is not included will also be assigned default cooling components.

Wizard

"No Cooling" may be selected in the Cooling Equipment field of the General Information screen of the wizard or in the Cooling Source field of the HVAC System Definitions. Additionally, specifying a size of zero in the size field of the Cooling section of the Packaged HVAC Equipment screen of the wizard.

Detailed Interface

The detailed interface also allows the user to identify individual systems without heating capacity identifying the system as "Heating Only" in the System Used For property of the Basic Specifications sub-tab of the Compliance tab of the Air-Side HVAC System Parameters tabbed dialog. Additionally, if the cooling capacity is zero, the rules processor will assume that no heating is installed.

BDL Input File

Refer to the SYSTEM command discussion in Section 2, Compliance BDL Elements, of this document for complete information on identifying the system as having no cooling using compliance analysis keywords.

Supply Air Temperature Control

eQUEST allow the following types of cooling supply air temperature control:

- Constant temperature
- Warmest zone reset
- Outside air reset

Wizard

Supply air temperature control is entered in the HVAC System Hot/Cold Deck Resets screen of the wizard.

Detailed Interface

Supply air temperature control, including reset schedules, are entered in the Cooling Control and Reset section of the Coil Capacity/Control sub-tab of the Cooling tab of the Air-Side HVAC System Parameters tabbed dialog.

BDL Input File

Refer to DOE-2.2 SYSTEMs documentation for complete information on entering reset control methods in BDL input files.

Zone Terminal Controls

Constant volume reheat and standard variable air volume controls are available for variable air volume systems.

Wizard

Any time a variable air volume system is created using the wizard, all zones will be created assuming variable volume terminal controls with reheat.

Detailed Interface

Flow properties in the Air Flow tab of the Air-Side HVAC Zone Parameters serve to determine the amount of air flow variation of a zone terminal control.. For example, a Minimum Flow Ratio less than one indicates a VAV zone terminal unit.

BDL Input File

Refer to DOE-2.2 Systems documentation for complete information on specifying zone terminal controls for variable air volume systems.

Pump Energy

eQUEST supports the following features of pumping systems:

- Primary and secondary piping systems hot water, chilled water, condenser water, and WLHP cirulation systems
- Fixed, two-speed and variable flow pumping systems
- Pipe and static head
- Multiple, parallel-piped pumps
- Cooling tower inlet pipe size – condenser water and WLHP circulation loops only

Wizard

Pumping system configuration, circulation loop flow (constant or variable flow), pump head, flow rate and motor type (standard or premium) are entered in the Heating Primary Equipment, Cooling Primary Equipment and Primary Equipment Heat Rejection screens of the wizard.

Detailed Interface

Pumping system configuration: Primary and secondary loops are created in the interface using right mouse click/create circulation loop. Secondary loop can then be specified in the ensuing dialog boxes by specifying the subtype as "Secondary" and specifying the parent primary loop.

Circulation Loop Flow: The type of flow control is specified in the tabbed dialog for the Pump in the Capacity Control property of the Basic Specifications tab.

Pump Head: The following table lists where to enter different head values associated with various components of hydronic systems.

Property	Tabbed Dialog	Tab	Sub-Tab
(See Note #1 for Zonal Systems)			
Zone Reheat Coil	Air-Side HVAC Zone Parameters	Heating	n/a
Zonal CHW Coil Head	Air-Side HVAC Zone Parameters	Cooling	n/a
Zonal HW Coil Head	Air-Side HVAC Zone Parameters	Heating	n/a
Zonal Baseboard Coil Head	Air-Side HVAC Zone Parameters	Heating	n/a
Zonal Water Side (WSE) Economizer Coil Head	Air-Side HVAC Zone Parameters	Cooling	n/a
Zonal Condenser (CW) Head	Air-Side HVAC Zone Parameters	Cooling	n/a
System HW Coil Head	Air-Side HVAC System Parameters	Heating	Coil Capacity/Control
System Preheat (PHW) Coil Head	Air-Side HVAC System Parameters	Heating	Preheat/Baseboard
System CHW Coil Head	Air-Side HVAC System Parameters	Cooling	Coil Capacity/Control
System Water Side Economizer (WSE) Coil Head	Air-Side HVAC System Parameters	Cooling	Economizer
System Condenser (CW) Head	Air-Side HVAC System Parameters	Cooling	Condenser
Loop Pipe Head	Circulation Loop Properties	Basic Specifications	n/a
Boiler Head	Boiler Properties	Loop Attachments	n/a
Boiler Static Head	Boiler Properties	Loop Attachments	n/a
(See Note #2 for chillers)			
Chiller CHW Head	Chiller Properties	Loop Attachments	n/a
Chiller CHW Static Head	Chiller Properties	Loop Attachments	n/a

Property	Tabbed Dialog	Tab	Sub-Tab
Chiller CW Head	Chiller Properties	Loop Attachments	n/a
Chiller CW Static Head	Chiller Properties	Loop Attachments	n/a
Chiller HW Head	Chiller Properties	Loop Attachments	n/a
Chiller HW Static Head	Chiller Properties	Loop Attachments	n/a
Chiller Heat Recovery (HtRec) Head	Chiller Properties	Loop Attachments	n/a
Chiller Heat Recovery (HtRec) Static Head	Chiller Properties	Loop Attachments	n/a
Tower Head	Heat Rejection Properties	Attachments	n/a
Tower Static Head	Heat Rejection Properties	Attachments	n/a

Notes:
1. HW head and Baseboard head are applicable to all zone commands. CHW, WSE and CW head are only applicable to zones of zonal DOE-2 systems (FC, HP, PTAC)
2. HW head and static head are only applicable to indirect fired absorption chillers and heat recovery chillers. HtRec head and static head are only applicable to heat recovery and engine driven chillers.

Multiple Parallel Pumps: Parallel pumping systems can be created by attaching more than one pump to a circulation loop. eQUEST automatically treats multiple pumps on any circulation loop as parallel. Series pumping configurations are not supported.

Tower Inlet Pipe Size: The tower inlet pipe size is entered on the Basic Specifications tab of the Circulation Loop Properties tabbed dialog for the condenser water circulation loop attached to the cooling tower.

BDL Input File

Refer to DOE-2.2 Systems documentation for SYSTEM, CIRCULATION-LOOP, ZONE and PUMP commands for complete information on specifying head for pumping systems.

Cooling Towers

At this time, eQUEST only supports fan operation options for cooling towers. All other cooling tower properties are automatically set by the rules processor. User inputs for other properties will be ignored by the rules processor. eQUEST supports the following forms of fan volume (capacity) control:

- One speed fan
- Two speed fan
- Variable speed fan
- Fluid bypass
- Discharge dampers

Wizard

Enter the capacity control for the cooling tower in the Primary Equipment Heat Rejection screen of the wizard.

Detailed Interface

Enter the capacity control in the Basic Specifications tab of the Heat Rejection Properties tabbed dialog.

BDL Input File

Refer to the DOE-2.2 Systems documentation for the HEAT-REJECTION command for complete information on creating cooling towers in BDL input files.

Water Heating

eQUEST supports the following water heating system configurations:

- Conventional water heating systems with an electric or fuel fired water heating tank and point-to-point distributions systems. Individual conventional water heating systems may not serve High-Rise Residential occupancies and either Nonresidential, Hotel Function or Hotel/Motel Guest Room occupancies. Separate water heating systems are required for High-Rise Residential water heating systems.
- Combined hydronic water heating systems where the water heating load is met by a hot water circulation loop that also provides space heating instead of a conventional water heating system.

The "Compliance DHW" Component

A Compliance DHW component is required for any of the following:

- High-Rise Residential water heating systems
- Combined hydronic water heating systems where the water heating load is met by a hot water loop that also provides space heating
- Any Nonresidential, Hotel Function or Hotel/Motel Guestroom building with more than one conventional water heating system.

Wizard

At this time the wizard does not support any High-Rise Residential occupancies, combined hydronic water heating systems, nor multiple nonresidential water heating systems and therefore will not create Compliance DHW components.

Detailed Interface

Compliance DHW components can be added/edited in the Internal Loads detailed tree. The following properties are available in the Compliance DHW tabbed dialog:

- **Number of Units:** For High-Rise Residential occupancies only, this is the total number of dwelling units represented by the Compliance DHW component.

- **HW/DHW Circulation Loops:** This section allows the user to specify the circulation loops that serve the Compliance DHW component. Only High-Rise Residential occupancies may have more than one circulation loop assigned.

If a Compliance DHW component is needed to represent domestic water heating systems, each zone of the building must reference a Compliance DHW component, even if only on Compliance DHW component is specified. Compliance DHW for each zone is specified in the heating tab of the Air-Side HVAC Zone Parameters tabbed dialog.

BDL Input File

Refer to DOE-2.2 Systems documentation for the COMPLIANCE-DHW command in Section 2, Compliance BDL Elements, of this document for complete information on creating COMPLIANCE-DHW components.

Combined Hydronic Systems and CIRCULATION-LOOP Properties

A combined hydronic water heating system is created when a hot water (not domestic hot water) circulation loop is attached to a Compliance DHW component. The following properties of the water heating system must be entered as properties of the circulation loop:

- **Tank Volume:** The volume of the indirect fired water heater tank for the DHW system.
- **Tank Insulation R-Value:** The insulation R-Value of the indirect fired tank. This is not necessary if the indirect fired water heater has no storage capacity.
- **Number of Water Heaters:** The number of indirect fired water heaters used in the system.
- **Total Capacity:** The total input capacity in Btu/hr of all of the indirect fired water heaters used in the system.

Wizard

At this time, the wizard does not support the creation of combined hydronic water heating systems.

Detailed Interface

Combined hydronic water heating properties are entered in the DHW Compliance section of the Process/DHW Loads tab of the Circulation Loop Properties tabbed dialog for a hot water circulation loop.

BDL Input File

Refer to the discussion of the CIRCULATION-LOOP command in Section 2, Compliance BDL Elements, of this document for complete information on describing combined hydronic water heating systems using compliance analysis keywords.

High-Rise Residential Water Heating and CIRCULATION-LOOP Properties

In order to properly estimate calculate the energy use in High-Rise Residential water heating systems, the distribution system type must be selected from the following list:

- **Standard –** Standard system without any pumps for distributing hot water

- **Point of Use (POU) –** System with no more than 8 feet horizontal distance between the water heater and hot water fixtures, except laundry. (Not allowed with central systems in multi-family buildings)
- **Hot Water Recovery (HWR) –** System which reclaims hot water from the distribution piping by drawing it back to the water heater or other insulated storage tank. (Not used with central systems in multi-family buildings.)
- **Pipe Insulation –** R-4 (or greater) insulation applied to ¾ inch or larger, non-recirculating hot water mains in addition to insulation required by the Standards, Section 150(j) (first five feet from water heater on both hot and cold water pipes).
- **Parallel Piping –** Individual pipes from the water heater to each point of use.
- **Continuous Recirculating (Recirc/NoControl) –** Distribution system using a pump to recirculate hot water to branch piping through a looped hot water main with no control of the pump, such that water flow is continuous. (Not used with instantaneous water heaters.) Pipe insulation is required.
- **Timer Controlled Recirculation (Recirc/Timer) –** Ricirculation system that uses a timer control to cycle pump operation based on time of day. (Not used with instantaneous water heaters or with central systems in multi-family buildings.) Pipe insulation is required.
- **Temperature Controlled Recirculation (Recirc/Temp) –** Ricirculation system that uses temperature controls to cycle pump operation to maintain recirculated water temperatures within certain limits. (Not used with instantaneous water heaters.) Pipe insulation is required.
- **Demand Controlled Recirculation (Recirc/Demand) –** Recirculation system that uses brief pump operation to recirculate hot water to fixtures just prior to hot water use when a demand for hot water is indicated. (Not used with instantaneous water heaters or with central systems in multi-family buildings.)
- **Time and Temperature Controlled Recirculation (Recirc/Time + Temp) –** Recirculation system that uses both temperature and timer controls to regulate pump operation. (Not used with instantaneous water heaters or with central systems in multi-family buildings.) Pipe insulation is required.
- **Demand Controlled Recirculation with Hot Water Recovery (Recirc/Demand + HWR) –** Combined system consisting of a Demand Controlled Recirculation system with Hot Water Recovery. (Not used with instantaneous water heaters or with central systems in multi-family buildings.)
- **Demand Controlled Recirculation with Pipe Insulation (Recirc/Demand + Pipe Insulation) –** Combined system consisting of a Demand Controlled Recirculation system with Pipe Insulation. (Not used with instantaneous water heaters or with central systems in multi-family buildings.)

Wizard

At this time, the wizard does not support the automatic generation of High-Rise Residential water heating systems.

Detailed Interface

Distribution system type is entered in the DHW Compliance section of the Process/DHW Loads tab of the Circulation Loop Properties tabbed dialog for a hot water circulation loop.

BDL Input File

Refer to the discussion of the CIRCULATION-LOOP command in Section 2, Compliance BDL Elements, of this document for complete information on describing distribution system type using compliance analysis keywords.

Water Heater Properties

There are several water heating properties that must be entered in order for the rules processor to correctly determine the proposed and standard design water heating performance characteristics. The table below lists water heater characteristics and the efficiency descriptors that must be entered for each.

Storage/ Instantaneous	Fuel	Input	Volume (gals)	Input/Vol (Btuh/gal)	DOE Covered?	Efficiency Descriptor	Standby Loss Required?
Storage	Gas	<=75 kBtuh	>= 20	all	Yes	E.F.	No
Storage	Gas	> 75 kBtuh and <= 155 kBtuh	All	< 4,000	No	Therm. Eff.	Yes
Storage	Gas	> 155 kBtuh	All	< 4,000	No	Therm. Eff.	Yes
Storage	Gas	> 155 kBtuh	>= 10	>= 4,000	No	Therm. Eff.	Yes
Instantaneous	Gas	<= 200 kBtuh	All	All	Yes	E.F.	No
Instantaneous	Gas	> 200 kBtuh	< 10	>= 4,000	No	Therm. Err.	No
Instantaneous	Gas	> 200 kBtuh	>= 10	>= 4,000	No	Therm. Eff.	Yes
All	Electric	<= 12 kW	>= 20	All	Yes	E.F.	No
Storage	Electric	> 12 kW	>= 20	All	No	None	Yes
Storage	Oil	<= 105 kBtuh	>= 20	All	Yes	E.F.	No
Storage	Oil	> 105 kBtuh < 155 kBtuh	All	< 4,000	No	Therm. Eff.	Yes
Storage	Oil	>= 155 kBtuh	All	< 4,000	No	Therm. Eff.	Yes
Instantaneous	Oil	<= 210 kBtuh	All	All	Yes	E.F.	No
Instantaneous	Oil	> 210 kBtuh	< 10	>= 4,000	No	Therm. Eff.	No
Instantaneous	Oil	> 210 kBtuh	>= 10	>= 4,000	No	Therm. Eff.	Yes

Wizard

At this time, only Fuel, Input and Volume may be input in the Wizard. These are entered in the Domestic Water Heating Screen of the wizard. The rules processor will ignore all other inputs from the wizard.

IMPORTANT: In addition to the inputs available through the wizard, the user must enter the water heater category in the detailed interface in order for water heating simulation to be performed correctly.

Detailed Interface

In order for water heating simulation to be performed correctly, the user must enter the Category of the water heater. The table above may be used as a guide to selecting the type of water heater. Valid choices are given below:

- DOE Covered Storage
- DOE Covered Instantaneous
- DOE Covered Heat Pump
- Other Direct Fired Storage
- Other Instantaneous >= 10 Gallons
- Other Instantaneous < 10 Gallons
- Other Heat Pump

The following inputs are also available to the user. The table above should be used in determining which inputs are appropriate for the category of water heater selected.

- Capacity (Input)
- Tank Volume (Volume)
- Type (Fuel or Heat Pump)
- Number of Heaters
- Recovery Efficiency (Thermal Efficiency)
- Energy Factor
- Pilot Energy
- Standby Loss Fraction
- Tank External R-Value (Water Heater Blanket)
- Tank Internal R-Value (residential systems only)

IMPORTANT: The rules processor will ignore all inputs of the Domestic Water Heater Properties tabbed dialog that not listed above. Additionally, the rules processor will ignore properties listed above that are not applicable to the category of water heater. It is important to review the compliance forms to ensure that the water heater(s) simulated match the proposed water heating equipment as shown in the design and construction documents for the proposed building.

BDL Input File

Refer to the discussion of the DW-HEATER command in the DOE-2.2 Systems documentation for information on entering volume and input rating. Refer to the discussion of the DW-HEATER command in the DOE-2.2 California Compliance Supplement for information on entering all other water heater properties using compliance analysis keywords.

Preparing Submittals

PERFORMING COMPLIANCE ANALYSIS

To perform compliance analysis, click on the "Perform Compliance Analysis" button on the actions tab of the main interface. Depending on the speed of the computer and the complexity of the input file, the compliance analysis can take several minutes to complete. At the end of the analysis, a message box appears notifying the use if the building complies or does not comply with the Energy Efficiency Standards. At that time, the user may choose to view the compliance analysis reports and forms or return to the detailed interface.

In order for the compliance analysis rules processor to function properly, there are a limited number of properties that must be supplied by the user. Additionally, the Title 24 standards and ACM Manual require specific information about a project to be input in order for the compliance analysis to be acceptable for permit submittal. Once the selects to perform compliance analysis, a dialog appears prompting user to indicate whether the run is "Preliminary" or for "Permit Submittal" (Figure 1-1). If the user selects "Preliminary", the rules processor will review the project files for all inputs needed for proper ruleset function. If the user selects "Permit Submittal", the rules processor will review the project files for all inputs needed for proper ruleset function and for any inputs required by Title 24 standards for permit submittal.

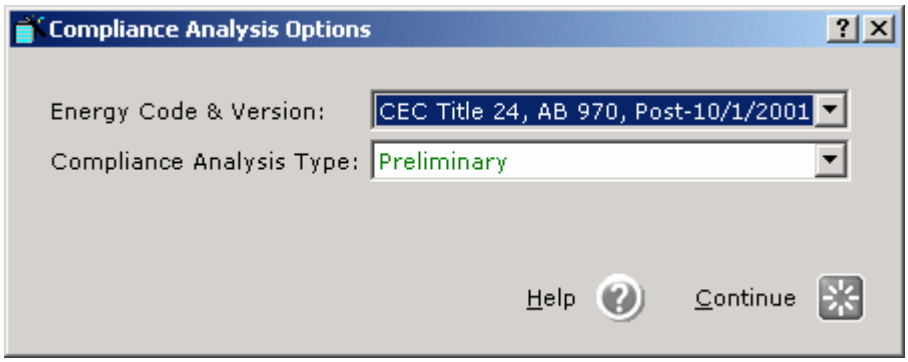

Figure 1-1

If the rules processor encounters any missing user inputs that are required for proper ruleset function or for permit submittal, a dialog will appear that prompts the user for inputs to these required properties (Figure 1-2). Once the user closes this dialog, the rules processor will repeat its review of the project files. If missing properties are still encountered, then the dialog will appear again, informing the user of missing properties and prompting for inputs.

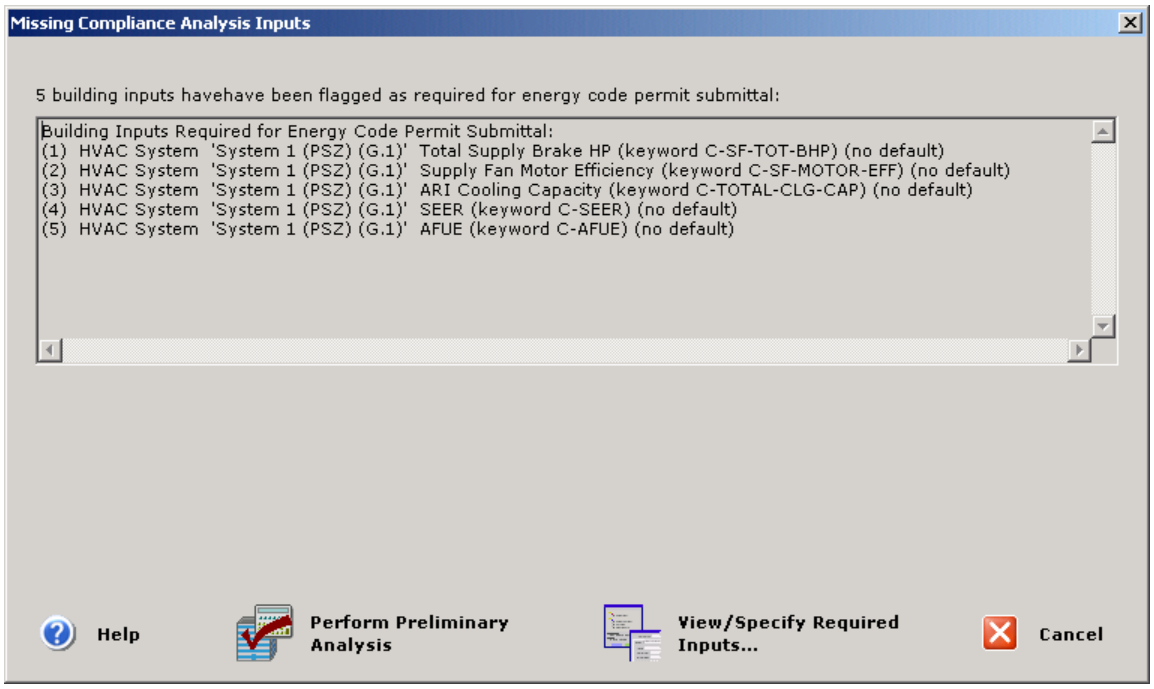

Figure 1-2

Refer to Section 2, Compliance BDL Elements in this document for a complete listing of required inputs for proper ruleset function and permit submittal.

Automatically Generated Compliance Forms

Certificate of Compliance

The Certificate of Compliance includes the following forms:

- PERF-1
- ENV-1
- LTG-1
- MECH-1

The Certificate of Compliance which is divided into four sections: the Performance Summary (PERF-1 forms), Envelope (ENV-1 form), lighting (LTG-1 form) and mechanical (MECH-1 forms). The Certificate of Compliance is required by Title 10, Section 1403(a)2.A, B and C(2) of the California Code of Regulations. For the performance approach, all signature blocks for the Certificate of Compliance are combined onto the first page of the PERF-1 compliance output form. Normally all of these signature blocks must be signed by the responsible designers. However, when an ACM is approved for optional partial compliance features and the partial compliance option is being used, only one or two of the signature blocks need be filled in. However, when this occurs the signatures must be consistent with the type of partial compliance indicated on the Certificate of Compliance - PERF-1 forms and information reported on other output reports.

The PERF-1 lists all optional capabilities utilized by the user and identifies the zone(s), system(s) and/or plant(s) to which the optional capabilities apply. The PERF-1 also itemizes the use of any of the following

exceptional building compliance features on the exceptional conditions checklist, identifying the zone(s), systems(s) and or plant(s) to which the feature(s) apply.

- Absorptance < 0.40
- Exterior Surface Emmissivity Different from DOE2.1E defaults.
- Any User-Defined Materials, Layers, Constructions, Assemblies
- Window-wall-ratio > 0.40
- Skylight-roof-ratio > 0.05
- Solar Heat Gain Coefficient (vertical or horizontal) < 0.40
- Fenestration U-value (vertical or horizontal) < 0.50
- Use of "Industrial/Commercial Work - Precision" occupancy
- Process Fan Power
- Process Loads
- Tailored lighting input
- Task lighting input
- Lighting control credits
- Electric Resistance Heating or Reheating
- Hydronic (water source heat pumps)
- Economizer installed on equipment below 75,000 Btuh and 2500 cfm
- Variable speed drive fans
- Other high efficiency fan drive motors
- Any optional capabilities used

One consequence of partial compliance is that fewer forms are required and fewer forms will be printed. The forms, the total number of pages, and the runcode and initiation time printed on each of the forms must be consistent with the fewer number of pages allowed for partial compliance.

The PERF-1 form also provides information on the service water heating system, including the system type, the efficiency of the water heating system or its components, pipe insulation specifications, and the fuel source used for service hot water.

Supporting Compliance Forms

eQUEST also produces the following additional supporting forms for HVAC systems:

- **MECH-2:** Provides a summary of each piece of mechanical equipment included in the compliance analysis.
- **MECH-3:** Summarizes user input mechanical ventilation rates and documents transfer air requirements for zones without adequate direct supply of ventilation air.

Reviewing the Compliance Forms

eQUEST automatically generates compliance forms in Adobe Acrobat format. Acrobat reader must be installed on the computer in order to view and print the compliance forms. All compliance forms may be printed; however, if the building does not comply the words "Building Does Not Comply, Forms Not for Permit Submittal" are printed on each form.

Portions of Compliance Forms That Must Be Completed by Hand

Generally, all information required on the compliance forms is populated from information entered by the user in the wizard and detailed interface. The user should input this information in the detailed interface whenever it is known. Missing information will likely result in a refusal, by the building department, to accept the construction documents for permit review. The table below lists the forms and their sections as well as where each can be located in the detailed interface so that the information can be entered.

Form	Section	Detailed Tree	Tab Dialog	Tab
PERF-1	Project and General Information	Project & Site	Compliance Data	Basic Specifications
PERF-1	Envelope, Mechanical and Lighting Compliance	Project & Site	Compliance Data	Envelope/Lighting/ Mechanical
LTG-1	Mandatory Lighting Controls & Lighting Controls for Credit (Number of records in each section)	Internal Loads	Space Properties	Compliance
MECH-1	System Features	Air-Side HVAC	Air-Side HVAC System Properties	Compliance

Additionally, the following compliance forms/portions of compliance forms must be completed by hand by the compliance documentation author and included with the submittal:

- **ENV-3:** This form documents unique constructions of opaque walls, roofs and floors occurring in the building. A ENV-3 form must be completed for each unique assembly occurring in the project.
- **LTG-1, Mandatory Automatic Lighting Controls:** While eQUEST will produce this form, the compliance documentation author must complete it by hand.
- **LTG-1, Lighting Controls for Credit:** The documentation author must complete this portion of the LTG-1 form any time lighting controls are used as a credit in the compliance analysis.
- **LTG-1, Part 2 of 2 Installed Lighting Schedule:** This form must be completed any time lighting is included in the compliance analysis. It is available from the Commission and is included with the Nonresidential Manual.
- **LTG-3, Lighting Controls Credit Worksheet:** This form must be completed for each space where lighting control credits are used. It is available from the Commission and is included with the Nonresidential Manual.

- **LTG-4, Tailored Lighting Forms and Worksheets & LTG-5, Room Cavity Ratio Worksheet:** These forms must be completed for each space where Tailored Lighting values have been entered by the user. They are available from the Commission and are included with the Nonresidential Manual.

Preliminary Analysis Report

Once the selects to perform compliance analysis, a dialog appears prompting user to indicate whether the run is "Preliminary" or for "Permit Submittal" (Figure 1-2). If the user selects “Preliminary”, the rules processor will review the project files for all inputs needed for proper ruleset function. If no missing properties are encountered, eQUEST will continue with the preliminary compliance analysis. At the end of the analysis, a message box appears notifying the use if the preliminary design meets or does not meet Title 24 requirements. At that time, the user may choose to view the preliminary analysis report or return to the detailed interface. The preliminary analysis report clearly states that it is a preliminary report and that it may not be submitted with a permit application.

Sample Program Output

The following pages include examples of a a preliminary analysis report, compliance report, and a TDV energy report..

PRELIMINARY ANALYSIS REPORT

The following pages are an example of first two pages of a preliminary analysis report, compliance report, and a TDV energy report.

PRELIMINARY REPORT (Part 1 of 3)

Project Name: Sample Compliance Building			Date: 20-Apr-2005
Project Address: 12345 East Sample Steet, Anywhere California			Enforcement Agency Use
Principal Designer-Envelope: eQUEST compliance sample		Telephone: n/a	Building Permit #
Documentation Author: JJ Hirsch & Associates		Telephone: 805 553-9000	Checked by/Date

GENERAL INFORMATION

Date of Plans	Building Conditioned Floor Area	Climate Zone
October 10, 2004		

BUILDING TYPE	☒	NONRESIDENTIAL	☐	HIGH RISE RESIDENTIAL	☐	HOTEL/MOTEL GUEST	
PHASE OF CONSTRUCTION	☒	NEW CONSTRUCTION	☐	ADDITION	☐	ALTERATION	☐ EXISTING + ADDITION

STATEMENT OF COMPLIANCE

This Certificate of Compliance lists the building features and performance specifications needed to comply with Title 24, Parts 1 and 6 of the State Building Code. This certificate applies only to a building using the performance compliance approach.

Documentation Author	Signature	Date

The Principal Designers hereby certify that the proposed building design represented in the construction documents and modeled for this permit application are consistent with all other forms and worksheets, specifications, and other calculations submitted with this permit application. The proposed building as designed meets the energy efficiency requirements of the State Building Code. Title 24, Part 6.

ENV.	LTG.	MECH.	
☐	☐	☐	1. I hearby affirm that I am eligible under the provisions of Division 3 of theBusiness and Professions Code to sign this document as the person responsible for its preparation; and that I am licensed in the State of California as a civil engineer, mechanical engineer (envelope & mechanical only), or electrical engineer (lighting only) or I am a licensed architect.
☐	☐	☐	2. I affirm that I am eligible under the provisions of Division 3 of the Business and Professions Code Section 5537.2 or 6737.3 to sign this document as the person responsible for its preparation; and that I am a licensed contractor performing this work.
☐	☐	☐	3. I affirm that I am eligible under Division 3 of the Business and Professions Code to sign this document because it pertains to a structure or type of work described as exempt pursuant to Business and Professions Code Sections 5537, 5538, and 6737.1. (These sections of the Business and Professions Code are printed in full in the Nonresidential Manual.)

ENVELOPE COMPLIANCE

Indicate location on plans of Note Block for Required Measures: not included

Required Forms: ENV-1, -3		Telephone: n/a	
Licensed Engineer/Architect/Contractor - Name: eQUEST compliance sample	Signature	Lic. No.	Date

LIGHTING COMPLIANCE

Indicate location on plans of Note Block for Required Measures: not included

Required Forms: LTG-1, -2		Telephone: n/a	
Licensed Engineer/Architect/Contractor - Name: eQUEST compliance sample	Signature	Lic. No.	Date

MECHANICAL COMPLIANCE

Indicate location on plans of Note Block for Required Measures: not included

Required Forms: MECH-1, -2, -3		Telephone: n/a	
Licensed Engineer/Architect/Contractor - Name: eQUEST compliance sample	Signature	Lic. No.	Date

PRELIMINARY REPORT (Part 2 of 3)

Project Name	Date
Sample Compliance Building	20-Apr-2005

ANNUAL SOURCE ENERGY USE SUMMARY (kBtu/sqft-yr)

ENERGY COMPONENT	Standard Design	Proposed Design	Compliance Margin
Space Heating	2.28	2.01	0.27
Space Cooling	14.84	6.99	7.85
Indoor Fans	12.93	11.77	1.16
Heat Rejection	0.00	0.00	0.00
Pumps	0.00	0.00	0.00
Domestic Hot Water	10.59	10.61	-0.02
Lighting	33.96	33.96	-0.00
Receptacle	19.54	19.54	0.00
Process	0.00	0.00	0.00
TOTALS:	94.13	84.87	9.26

BUILDING COMPLIES

GENERAL INFORMATION

Building Orientation	North	Conditioned Floor Area	24,998
Number of Stories	2	Unconditioned Floor Area	0
Number of Systems	10		

	Conditioned	Unconditioned	Plenum
Number of Zones	10	0	10

	Orientation	Gross Area		Glazing Area		Glazing Ratio
Front Elevation	North	2,683	sqft	1,066	sqft	0.397
Left Elevation	East	2,683	sqft	1,066	sqft	0.397
Rear Elevation	South	2,683	sqft	1,066	sqft	0.397
Right Elevation	West	2,683	sqft	1,066	sqft	0.397
Total		10,733	sqft	4,263	sqft	0.397
Roof		12,499	sqft	0	sqft	0.000

	Standard		Proposed	
Lighting Power Density	1.157	W/sqft	1.157	W/sqft

COMPLIANCE REPORT

The following pages are an example of a compliance report.

PERFORMANCE CERTIFICATE OF COMPLIANCE (Part 1 of 3) PERF-1

Project Name: Sample Compliance Building			Date: 20-Apr-2005
Project Address: 12345 East Sample Steet, Anywhere California			Enforcement Agency Use
Principal Designer-Envelope: eQUEST compliance sample		Telephone: n/a	Building Permit #
Documentation Author: JJ Hirsch & Associates		Telephone: 805 553-9000	Checked by/Date

GENERAL INFORMATION

Date of Plans	Building Conditioned Floor Area	Climate Zone
October 10, 2004		

BUILDING TYPE	☒	NONRESIDENTIAL	☐	HIGH RISE RESIDENTIAL	☐	HOTEL/MOTEL GUEST	
PHASE OF CONSTRUCTION	☒	NEW CONSTRUCTION	☐	ADDITION	☐	ALTERATION	☐ EXISTING + ADDITION

STATEMENT OF COMPLIANCE

This Certificate of Compliance lists the building features and performance specifications needed to comply with Title 24, Parts 1 and 6 of the State Building Code. This certificate applies only to a building using the performance compliance approach.

Documentation Author	Signature	Date

The Principal Designers hereby certify that the proposed building design represented in the construction documents and modeled for this permit application are consistent with all other forms and worksheets, specifications, and other calculations submitted with this permit application. The proposed building as designed meets the energy efficiency requirements of the State Building Code. Title 24, Part 6.

ENV.	LTG.	MECH.	
☐	☐	☐	1. I hearby affirm that I am eligible under the provisions of Division 3 of theBusiness and Professions Code to sign this document as the person responsible for its preparation; and that I am licensed in the State of California as a civil engineer, mechanical engineer (envelope & mechanical only), or electrical engineer (lighting only) or I am a licensed architect.
☐	☐	☐	2. I affirm that I am eligible under the provisions of Division 3 of the Business and Professions Code Section 5537.2 or 6737.3 to sign this document as the person responsible for its preparation; and that I am a licensed contractor performing this work.
☐	☐	☐	3. I affirm that I am eligible under Division 3 of the Business and Professions Code to sign this document because it pertains to a structure or type of work described as exempt pursuant to Business and Professions Code Sections 5537, 5538, and 6737.1. (These sections of the Business and Professions Code are printed in full in the Nonresidential Manual.)

ENVELOPE COMPLIANCE

Indicate location on plans of Note Block for Required Measures: not included

Required Forms: ENV-1, -3		Telephone: n/a	
Licensed Engineer/Architect/Contractor - Name: eQUEST compliance sample	Signature	Lic. No.	Date

LIGHTING COMPLIANCE

Indicate location on plans of Note Block for Required Measures: not included

Required Forms: LTG-1, -2		Telephone: n/a	
Licensed Engineer/Architect/Contractor - Name: eQUEST compliance sample	Signature	Lic. No.	Date

MECHANICAL COMPLIANCE

Indicate location on plans of Note Block for Required Measures: not included

Required Forms: MECH-1, -2, -3		Telephone: n/a	
Licensed Engineer/Architect/Contractor - Name: eQUEST compliance sample	Signature	Lic. No.	Date

Run Initiation Time: 20-Apr-2005 @ 08:45:39 AM **Run Code: 1114011950**

PERFORMANCE CERTIFICATE OF COMPLIANCE (Part 2 of 3) PERF-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

ANNUAL SOURCE ENERGY USE SUMMARY (kBtu/sqft-yr)

ENERGY COMPONENT	Standard Design	Proposed Design	Compliance Margin
Space Heating	2.28	2.01	0.27
Space Cooling	14.84	6.99	7.85
Indoor Fans	12.93	11.77	1.16
Heat Rejection	0.00	0.00	0.00
Pumps	0.00	0.00	0.00
Domestic Hot Water	10.59	10.61	-0.02
Lighting	33.96	33.96	-0.00
Receptacle	19.54	19.54	0.00
Process	0.00	0.00	0.00
TOTALS:	94.13	84.87	9.26

BUILDING COMPLIES

GENERAL INFORMATION

Building Orientation	North	Conditioned Floor Area	24,998
Number of Stories	2	Unconditioned Floor Area	0
Number of Systems	10		

	Conditioned	Unconditioned	Plenum
Number of Zones	10	0	10

	Orientation	Gross Area		Glazing Area		Glazing Ratio
Front Elevation	North	2,683	sqft	1,066	sqft	0.397
Left Elevation	East	2,683	sqft	1,066	sqft	0.397
Rear Elevation	South	2,683	sqft	1,066	sqft	0.397
Right Elevation	West	2,683	sqft	1,066	sqft	0.397
Total		10,733	sqft	4,263	sqft	0.397
Roof		12,499	sqft	0	sqft	0.000

	Standard		Proposed	
Lighting Power Density	1.157	W/sqft	1.157	W/sqft

PERFORMANCE CERTIFICATE OF COMPLIANCE (Part 3 of 3) PERF-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

ZONE INFORMATION

System Name	Zone Name	Occupancy Type	Floor Area (sqft)	Installed LPD (W/sf)[1]	Control Credits (W/sf)[1]	Tailored LPD (W/sf)[2]	Tailored Vent (cfm/sf)[2]	Process Loads (W/sf)[3]
Sys1 (PSZ) (G.S1)	South Perim Zn (G.S1)	Mixed	1,452	1.26	0.00	0.00	0.00	0.00
Sys1 (PSZ) (G.E2)	East Perim Zn (G.E2)	Mixed	1,452	1.26	0.00	0.00	0.00	0.00
Sys1 (PSZ) (G.N3)	North Perim Zn (G.N3)	Mixed	1,452	1.26	0.00	0.00	0.00	0.00
Sys1 (PSZ) (G.W4)	West Perim Zn (G.W4)	Mixed	1,452	1.26	0.00	0.00	0.00	0.00
Sys1 (PSZ) (G.C5)	Core Zn (G.C5)	Mixed	6,691	1.02	0.00	0.00	0.00	0.00
Sys1 (PSZ) (T.S11)	South Perim Zn (T.S11)	Office	1,452	1.30	0.00	0.00	0.00	0.00
Sys1 (PSZ) (T.E12)	East Perim Zn (T.E12)	Office	1,452	1.30	0.00	0.00	0.00	0.00
Sys1 (PSZ) (T.N13)	North Perim Zn (T.N13)	Office	1,452	1.30	0.00	0.00	0.00	0.00
Sys1 (PSZ) (T.W14)	West Perim Zn (T.W14)	Office	1,452	1.30	0.00	0.00	0.00	0.00
Sys1 (PSZ) (T.C15)	Core Zn (T.C15)	Mixed	6,691	1.08	0.00	0.00	0.00	0.00

Notes: 1.See LTG-1 2.Provide Tailored Lighting Forms & Lighting Plans for Tailored LPO 3.Provide Supporting Documentation

EXCEPTIONAL CONDITIONS COMPLIANCE CHECKLIST

The local enforcement agency should pay special attention to this checklist. These items require special written justification and documentation, and special verification to be used with the performance approach. The local enforcement agency determines the adequacy of the justification, and may reject a building or design that otherwise complies based on the adequacy of the special justification and documentation submitted.

COMMENTS	PLAN	FIELD
Proposed Building Materials:		
'EWall Cons Mat 2 (8.6)'		
'Roof Cons Mat 4 (12.81)'		
'UFMat (G.S1.U2.M1)'		
'UFMat (G.E2.U3.M1)'		
'UFMat (G.N3.U4.M1)'		
'UFMat (G.W4.U5.M1)'		
'UFMat (G.C5.U6.M1)'		
'Plywd 5/8in (PW04)'		
'Bldg Paper Felt (BP01)'		
'GypBd 1/2in (GP01)'		
'Blt-Up Roof 3/8in (BR01)'		
'Polyurethane 1in (IN43)'		
'Conc HW 140lb 6in (HF-C13)'		
'Linoleum Tile (LT01)'		
'Light Soil, Damp 12in'		
Proposed Building Layers:		
'EWall Cons Layers'		
'Roof Cons Layers'		
'IFlr Cons Layers'		
'UFLyrs (G.S1.U2)'		
'UFLyrs (G.E2.U3)'		
'UFLyrs (G.N3.U4)'		
'UFLyrs (G.W4.U5)'		
'UFLyrs (G.C5.U6)'		
Proposed Building Constructions:		
'EWall Construction'		
'Roof Construction'		

The exceptional features listed in this performance approach application have specifically been reviewed. Adequate written justification and documentation for their use have been provided by the applicant.

Authorized Signature or Stamp _____

Run Initiation Time: 20-Apr-2005 @ 08:45:39 AM **Run Code: 1114011950**

PERFORMANCE CERTIFICATE OF COMPLIANCE (Part 3 of 3) PERF-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

EXCEPTIONAL CONDITIONS COMPLIANCE CHECKLIST

The local enforcement agency should pay special attention to this checklist. These items require special written justification and documentation, and special verification to be used with the performance approach. The local enforcement agency determines the adequacy of the justification, and may reject a building or design that otherwise complies based on the adequacy of the special justification and documentation submitted.

COMMENTS	PLAN	FIELD
'Ceilg Construction'		
'IWall Construction'		
'IFlr Construction'		
'UFCons (G.S1.U2)'		
'UFCons (G.E2.U3)'		
'UFCons (G.N3.U4)'		
'UFCons (G.W4.U5)'		
'UFCons (G.C5.U6)'		
Fenestration SHGC < 0.40: Space = 'South Perim Spc (G.S1)', Fenestration = 'South Win (G.S1.E1.W1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'South Perim Spc (G.S1)', Fenestration = 'South Win (G.S1.E1.W2)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'South Perim Spc (G.S1)', Fenestration = 'South Door (G.S1.E1.D1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'East Perim Spc (G.E2)', Fenestration = 'East Win (G.E2.E2.W1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'East Perim Spc (G.E2)', Fenestration = 'East Win (G.E2.E2.W2)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'East Perim Spc (G.E2)', Fenestration = 'East Door (G.E2.E2.D1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'North Perim Spc (G.N3)', Fenestration = 'North Door (G.N3.E3.D1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'West Perim Spc (G.W4)', Fenestration = 'West Win (G.W4.E4.W1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'West Perim Spc (G.W4)', Fenestration = 'West Win (G.W4.E4.W2)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'West Perim Spc (G.W4)', Fenestration = 'West Door (G.W4.E4.D1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'South Perim Spc (T.S11)', Fenestration = 'South Win (T.S11.E9.W1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'East Perim Spc (T.E12)', Fenestration = 'East Win (T.E12.E10.W1)', SHGC = 0.34		
Fenestration SHGC < 0.40: Space = 'West Perim Spc (T.W14)', Fenestration = 'West Win (T.W14.E12.W1)', SHGC = 0.34		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (G.S1)', Clg Cap = 52000 Btuh		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (G.E2)', Clg Cap = 45000 Btuh		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (G.N3)', Clg Cap = 36000 Btuh		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (G.W4)', Clg Cap = 50000 Btuh		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (T.S11)', Clg Cap = 60000 Btuh		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (T.E12)', Clg Cap = 52000 Btuh		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (T.N13)', Clg Cap = 43000 Btuh		
Econo Installed, Capacity < 75 kBtuh: System = 'Sys1 (PSZ) (T.W14)', Clg Cap = 60000 Btuh		
Proposed Air Economizers:		
System 'Sys1 (PSZ) (G.S1)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (G.E2)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (G.N3)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (G.W4)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (G.C5)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (T.S11)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (T.E12)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (T.N13)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (T.W14)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		
System 'Sys1 (PSZ) (T.C15)': Temperature Econo, 75 Max Temp, no Enthalpy Limit		

The exceptional features listed in this performance approach application have specifically been reviewed. Adequate written justification and documentation for their use have been provided by the applicant.

Authorized Signature or Stamp _____

ENVELOPE COMPLIANCE SUMMARY Performance ENV-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

OPAQUE SURFACES

#	Surface Type	Construction Type(e.g., Block, Wood, Metal)	Area	U-Factor	Azimuth	Tilt	Solar Gains	Form 3 Reference	Location (Space)
1	Above Grade Wall	EWall Construction	477	0.093	180°	90°	yes		South Peri...Spc (G.S1)
2	Above Grade Wall	EWall Construction	477	0.093	90°	90°	yes		East Perim Spc (G.E2)
3	Above Grade Wall	EWall Construction	477	0.093	0°	90°	yes		North Perim Spc (G.N3)
4	Above Grade Wall	EWall Construction	477	0.093	270°	90°	yes		West Perim...pc (G.W4)
5	Above Grade Wall	EWall Construction	335	0.093	180°	90°	yes		South Peri...lnm (G.S6)
6	Above Grade Wall	EWall Construction	335	0.093	90°	90°	yes		East Perim...lnm (G.E7)
7	Above Grade Wall	EWall Construction	335	0.093	0°	90°	yes		North Peri...lnm (G.N8)
8	Above Grade Wall	EWall Construction	335	0.093	270°	90°	yes		West Peri...nm (G.W9)
9	Above Grade Wall	EWall Construction	470	0.093	180°	90°	yes		South Peri...pc (T.S11)
10	Above Grade Wall	EWall Construction	470	0.093	90°	90°	yes		East Perim Spc (T.E12)
11	Above Grade Wall	EWall Construction	470	0.093	0°	90°	yes		North Peri...pc (T.N13)
12	Above Grade Wall	EWall Construction	470	0.093	270°	90°	yes		West Perim...c (T.W14)
13	Above Grade Wall	EWall Construction	335	0.093	180°	90°	yes		South Peri...nm (T.S16)
14	Roof	Roof Construction	1,452	0.048	180°	0°	yes		South Peri...nm (T.S16)
15	Above Grade Wall	EWall Construction	335	0.093	90°	90°	yes		East Perim...m (T.E17)
16	Roof	Roof Construction	1,452	0.048	90°	0°	yes		East Perim...m (T.E17)
17	Above Grade Wall	EWall Construction	335	0.093	0°	90°	yes		North Peri...nm (T.N18)
18	Roof	Roof Construction	1,452	0.048	0°	0°	yes		North Peri...nm (T.N18)
19	Above Grade Wall	EWall Construction	335	0.093	270°	90°	yes		West Peri...m (T.W19)
20	Roof	Roof Construction	1,452	0.048	270°	0°	yes		West Peri...m (T.W19)
21	Roof	Roof Construction	6,691	0.048	180°	0°	yes		Core Plnm (T.C20)

VERTICAL FENESTRATION SURFACES WITH NFRC U-FACTORS

Site Assembled Glazing

☐ Check box if Building is >= 100,000 ft of CFA and >= 10,000 ft of vertical glazing then NFRC Certification is required.
Follow NFRC 100-SB Procedures and submit NFRC Label Certificate Form

#	Fenestration Type	Area (ft^2)	U-Factor	Azimuth	SHGC	Glazing Type	Location (Space)
1	Fld, Oprbl, Cstm Frm	244	0.810	180°	0.34	No Dvdrs, No..., NFRC SHGC	South Perim Spc (G.S1)
2	Fld, Oprbl, Cstm Frm	244	0.810	180°	0.34	No Dvdrs, No..., NFRC SHGC	South Perim Spc (G.S1)
3	Fld Gl Dr, Cstm Frm	42	0.810	180°	0.34	No Dvdrs, No..., NFRC SHGC	South Perim Spc (G.S1)
4	Fld, Oprbl, Cstm Frm	244	0.810	90°	0.34	No Dvdrs, No..., NFRC SHGC	East Perim Spc (G.E2)
5	Fld, Oprbl, Cstm Frm	244	0.810	90°	0.34	No Dvdrs, No..., NFRC SHGC	East Perim Spc (G.E2)
6	Fld Gl Dr, Cstm Frm	42	0.810	90°	0.34	No Dvdrs, No..., NFRC SHGC	East Perim Spc (G.E2)
7	Fld, Oprbl, Cstm Frm	244	0.810	0°	0.61	No Dvdrs, No..., NFRC SHGC	North Perim Spc (G.N3)
8	Fld, Oprbl, Cstm Frm	244	0.810	0°	0.61	No Dvdrs, No..., NFRC SHGC	North Perim Spc (G.N3)
9	Fld Gl Dr, Cstm Frm	42	0.810	0°	0.34	No Dvdrs, No..., NFRC SHGC	North Perim Spc (G.N3)
10	Fld, Oprbl, Cstm Frm	244	0.810	270°	0.34	No Dvdrs, No..., NFRC SHGC	West Perim Spc (G.W4)
11	Fld, Oprbl, Cstm Frm	244	0.810	270°	0.34	No Dvdrs, No..., NFRC SHGC	West Perim Spc (G.W4)
12	Fld Gl Dr, Cstm Frm	42	0.810	270°	0.34	No Dvdrs, No..., NFRC SHGC	West Perim Spc (G.W4)
13	Fld, Oprbl, Cstm Frm	537	0.810	180°	0.34	No Dvdrs, No..., NFRC SHGC	South Perim Spc (T.S11)
14	Fld, Oprbl, Cstm Frm	537	0.810	90°	0.34	No Dvdrs, No..., NFRC SHGC	East Perim Spc (T.E12)
15	Fld, Oprbl, Cstm Frm	537	0.810	0°	0.61	No Dvdrs, No..., NFRC SHGC	North Perim Spc (T.N13)
16	Fld, Oprbl, Cstm Frm	537	0.810	270°	0.34	No Dvdrs, No..., NFRC SHGC	West Perim Spc (T.W14)

ENVELOPE COMPLIANCE SUMMARY Performance ENV-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

VERTICAL FENESTRATION EXTERIOR SHADING

(dimensions in feet)

Fen #	Exterior Shade Type	Window		Overhang				Left Fin				Right Fin			
		Height	Width	Depth	Width	LExt.	RExt.	Depth	Height	TExt.	BExt.	Depth	Height	TExt.	BExt.

LIGHTING COMPLIANCE SUMMARY Performance LTG-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

INSTALLED LIGHTING SCHEDULE

NOTE: A manually completed LTG-1, such as can be found in the Nonresidential Compliance Manual, must be completed by the user and attached.

Total Building Watts		Less Control Credit Watts (From LTG-3)		Adjusted Actual Watts
28,923.3	−	0.0	=	28,923.3

MANDATORY AUTOMATIC CONTROLS

Control Location (Room#)	Control Identification	Control Type (Auto Time Switch, Exterior, etc.)	Space Controlled	Note to Field

CONTROLS FOR CREDIT

Control Location (Room# or Dwg.#)	Control Identification	Control Type (Occupant, Daylight, Dimming, etc.)	Luminaires Controlled		Note to Field
			Type	# of Luminaires	

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LIGHTING COMPLIANCE SUMMARY Performance LTG-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

CONTROLS FOR CREDIT

Control Location (Room# or Dwg.#)	Control Identification	Control Type (Occupant, Daylight, Dimming, etc.)	Luminaires Controlled		Note to Field
			Type	# of Luminaires	

NOTES TO FIELD - For Building Department Use Only

MECHANICAL COMPLIANCE SUMMARY Performance MECH-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

SYSTEM FEATURES

	Mechanical Systems			
System Name	Sys1 (PSZ) (G.S1)	Sys1 (PSZ) (G.E2)	Sys1 (PSZ) (G.N3)	**Note to Field**
Time Control	S	S	S	
Setback Control	B	B	B	
Isolation Zones	1	1	1	
Heat Pump Thermostat?	N	N	N	
Electric Heat?	N	N	N	
Fan Control	Constant Volume	Constant Volume	Constant Volume	
VAV Minimum Position Control?	No	No	No	
Simulataneous Heat/Cool?	n	n	n	
Heating Supply Reset?	No	No	No	
Cooling Supply Reset?	No	No	No	
Ventilation	Air Balance	Air Balance	Air Balance	
Outdoor Damper Control?	A	A	A	
Economizer Type	OA Temperature	OA Temperature	OA Temperature	
Design O.A. CFM (Mech-3, Column H)	217.800	217.800	217.800	
Heating Equipment Type	Intgrl to Pkg Unit	Intgrl to Pkg Unit	Intgrl to Pkg Unit	
Heating Equipment Efficiency	0.780 AFUE	0.780 AFUE	0.780 AFUE	
Cooling Equipment Type	Pkge DX Clg	Pkge DX Clg	Pkge DX Clg	
Cooling Equipment Efficiency	12.00 SEER	12.00 SEER	12.00 SEER	
Make and Model Number				
Heating Duct Location	Ceiling Plenum	Ceiling Plenum	Ceiling Plenum	
Heating Duct R-Value	7.000	7.000	7.000	
Cooling Duct Location	Ceiling Plenum	Ceiling Plenum	Ceiling Plenum	
Cooling Duct R-Value	7.000	7.000	7.000	
Duct Tape Allowed?	0	0	0	
Pipe Type (Supply, Return, Etc...)	-	-	-	
Pipe Insulation R-Value				
Verified Sealed Ducts in %Fan Flow Ceiling/Roof Space	no	no	no	

CODE TABLES: Enter code from table below into columns above.

Heat Pump Thermostat?	Y: Yes N: No
Electric Heat?	
VAV Minimum Position Control?	
Simulataneous Heat/Cool?	
Heat and Cool Supply Reset?	
Outdoor Damper Control?	
High Efficiency?	
Duct Tape Allowed?	
Pipe Insulation Required?	
Sealed Ducts in Ceiling/Roof Space?	

Time Control	**Setback Control**	**Isolation Zones**	**Fan Control**
S: Prog Switch O: Occupancy Sensor M: Manual Timer	H: Heating C: Cooling B: Both	Enter number of Isloation Zones	I: Inlet Vanes P: Variable Pitch V: VFD O: Other C: Curve

Ventilation	**Outdoor Damper**	**Economizer**	**Design O.A. CFM**
B: Air Balance C: Outside Air Cert. M: Out. Air Measure D: Demand Control N: Natural	A: Auto G: Gravity	A: Air W: Water N: Not Required	Enter Design Outdoor Air CFM. Note: This shall be no less than Column H on MECH-3.

Run Initiation Time: 20-Apr-2005 @ 08:45:39 AM **Run Code: 1114011950**

MECHANICAL COMPLIANCE SUMMARY Performance MECH-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

SYSTEM FEATURES

	Mechanical Systems			
System Name	Sys1 (PSZ) (G.W4)	Sys1 (PSZ) (G.C5)	Sys1 (PSZ) (T.S11)	**Note to Field**
Time Control	S	S	S	
Setback Control	B	B	B	
Isolation Zones	1	1	1	
Heat Pump Thermostat?	N	N	N	
Electric Heat?	N	N	N	
Fan Control	Constant Volume	Constant Volume	Constant Volume	
VAV Minimum Position Control?	No	No	No	
Simulataneous Heat/Cool?	n	n	n	
Heating Supply Reset?	No	No	No	
Cooling Supply Reset?	No	No	No	
Ventilation	Air Balance	Air Balance	Air Balance	
Outdoor Damper Control?	A	A	A	
Economizer Type	OA Temperature	OA Temperature	OA Temperature	
Design O.A. CFM (Mech-3, Column H)	217.800	1,164.547	217.800	
Heating Equipment Type	Intgrl to Pkg Unit	Intgrl to Pkg Unit	Intgrl to Pkg Unit	
Heating Equipment Efficiency	0.780 AFUE	0.780 AFUE	0.780 AFUE	
Cooling Equipment Type	Pkge DX Clg	Pkge DX Clg	Pkge DX Clg	
Cooling Equipment Efficiency	12.00 SEER	9.50 EER	12.00 SEER	
Make and Model Number				
Heating Duct Location	Ceiling Plenum	Ceiling Plenum	Ceiling Plenum	
Heating Duct R-Value	7.000	7.000	7.000	
Cooling Duct Location	Ceiling Plenum	Ceiling Plenum	Ceiling Plenum	
Cooling Duct R-Value	7.000	7.000	7.000	
Duct Tape Allowed?	0	0	0	
Pipe Type (Supply, Return, Etc...)	-	-	-	
Pipe Insulation R-Value				
Verified Sealed Ducts in %Fan Flow Ceiling/Roof Space	no	no	no	

CODE TABLES: Enter code from table below into columns above.

Heat Pump Thermostat?	Y: Yes N: No
Electric Heat?	
VAV Minimum Position Control?	
Simulataneous Heat/Cool?	
Heat and Cool Supply Reset?	
Outdoor Damper Control?	
High Efficiency?	
Duct Tape Allowed?	
Pipe Insulation Required?	
Sealed Ducts in Ceiling/Roof Space?	

Time Control	**Setback Control**	**Isolation Zones**	**Fan Control**
S: Prog Switch O: Occupancy Sensor M: Manual Timer	H: Heating C: Cooling B: Both	Enter number of Isloation Zones	I: Inlet Vanes P: Variable Pitch V: VFD O: Other C: Curve

Ventilation	**Outdoor Damper**	**Economizer**	**Design O.A. CFM**
B: Air Balance C: Outside Air Cert. M: Out. Air Measure D: Demand Control N: Natural	A: Auto G: Gravity	A: Air W: Water N: Not Required	Enter Design Outdoor Air CFM. Note: This shall be no less than Column H on MECH-3.

Run Initiation Time: 20-Apr-2005 @ 08:45:39 AM **Run Code: 1114011950**

MECHANICAL COMPLIANCE SUMMARY Performance MECH-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

SYSTEM FEATURES

	Mechanical Systems			
System Name	Sys1 (PSZ) (T.E12)	Sys1 (PSZ) (T.N13)	Sys1 (PSZ) (T.W14)	**Note to Field**
Time Control	S	S	S	
Setback Control	B	B	B	
Isolation Zones	1	1	1	
Heat Pump Thermostat?	N	N	N	
Electric Heat?	N	N	N	
Fan Control	Constant Volume	Constant Volume	Constant Volume	
VAV Minimum Position Control?	No	No	No	
Simulataneous Heat/Cool?	n	n	n	
Heating Supply Reset?	No	No	No	
Cooling Supply Reset?	No	No	No	
Ventilation	Air Balance	Air Balance	Air Balance	
Outdoor Damper Control?	A	A	A	
Economizer Type	OA Temperature	OA Temperature	OA Temperature	
Design O.A. CFM (Mech-3, Column H)	217.800	217.800	217.800	
Heating Equipment Type	Intgrl to Pkg Unit	Intgrl to Pkg Unit	Intgrl to Pkg Unit	
Heating Equipment Efficiency	0.780 AFUE	0.780 AFUE	0.780 AFUE	
Cooling Equipment Type	Pkge DX Clg	Pkge DX Clg	Pkge DX Clg	
Cooling Equipment Efficiency	12.00 SEER	12.00 SEER	12.00 SEER	
Make and Model Number				
Heating Duct Location	Ceiling Plenum	Ceiling Plenum	Ceiling Plenum	
Heating Duct R-Value	7.000	7.000	7.000	
Cooling Duct Location	Ceiling Plenum	Ceiling Plenum	Ceiling Plenum	
Cooling Duct R-Value	7.000	7.000	7.000	
Duct Tape Allowed?	0	0	0	
Pipe Type (Supply, Return, Etc...)	-	-	-	
Pipe Insulation R-Value				
Verified Sealed Ducts in %Fan Flow Ceiling/Roof Space	no	no	no	

CODE TABLES: Enter code from table below into columns above.

Heat Pump Thermostat?	Y: Yes N: No
Electric Heat?	
VAV Minimum Position Control?	
Simulataneous Heat/Cool?	
Heat and Cool Supply Reset?	
Outdoor Damper Control?	
High Efficiency?	
Duct Tape Allowed?	
Pipe Insulation Required?	
Sealed Ducts in Ceiling/Roof Space?	

Time Control	**Setback Control**	**Isolation Zones**	**Fan Control**
S: Prog Switch O: Occupancy Sensor M: Manual Timer	H: Heating C: Cooling B: Both	Enter number of Isloation Zones	I: Inlet Vanes P: Variable Pitch V: VFD O: Other C: Curve

Ventilation	**Outdoor Damper**	**Economizer**	**Design O.A. CFM**
B: Air Balance C: Outside Air Cert. M: Out. Air Measure D: Demand Control N: Natural	A: Auto G: Gravity	A: Air W: Water N: Not Required	Enter Design Outdoor Air CFM. Note: This shall be no less than Column H on MECH-3.

Run Initiation Time: 20-Apr-2005 @ 08:45:39 AM **Run Code: 1114011950**

MECHANICAL COMPLIANCE SUMMARY Performance MECH-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

SYSTEM FEATURES

	Mechanical Systems		Note to Field
System Name	Sys1 (PSZ) (T.C15)		
Time Control	S		
Setback Control	B		
Isolation Zones	1		
Heat Pump Thermostat?	N		
Electric Heat?	N		
Fan Control	Constant Volume		
VAV Minimum Position Control?	No		
Simulataneous Heat/Cool?	n		
Heating Supply Reset?	No		
Cooling Supply Reset?	No		
Ventilation	Air Balance		
Outdoor Damper Control?	A		
Economizer Type	OA Temperature		
Design O.A. CFM (Mech-3, Column H)	1,192.803		
Heating Equipment Type	Intgrl to Pkg Unit		
Heating Equipment Efficiency	0.780 AFUE		
Cooling Equipment Type	Pkge DX Clg		
Cooling Equipment Efficiency	9.50 EER		
Make and Model Number			
Heating Duct Location	Ceiling Plenum		
Heating Duct R-Value	7.000		
Cooling Duct Location	Ceiling Plenum		
Cooling Duct R-Value	7.000		
Duct Tape Allowed?	0		
Pipe Type (Supply, Return, Etc...)	-		
Pipe Insulation R-Value			
Verified Sealed Ducts in %Fan Flow Ceiling/Roof Space	no		

CODE TABLES: Enter code from table below into columns above.

Heat Pump Thermostat?	Y: Yes N: No
Electric Heat?	
VAV Minimum Position Control?	
Simulataneous Heat/Cool?	
Heat and Cool Supply Reset?	
Outdoor Damper Control?	
High Efficiency?	
Duct Tape Allowed?	
Pipe Insulation Required?	
Sealed Ducts in Ceiling/Roof Space?	

Time Control	Setback Control	Isolation Zones	Fan Control
S: Prog Switch O: Occupancy Sensor M: Manual Timer	H: Heating C: Cooling B: Both	Enter number of Isloation Zones	I: Inlet Vanes P: Variable Pitch V: VFD O: Other C: Curve

Ventilation	Outdoor Damper	Economizer	Design O.A. CFM
B: Air Balance C: Outside Air Cert. M: Out. Air Measure D: Demand Control N: Natural	A: Auto G: Gravity	A: Air W: Water N: Not Required	Enter Design Outdoor Air CFM. Note: This shall be no less than Column H on MECH-3.

NOTES TO FIELD - For Building Department Use Only

Run Initiation Time: 20-Apr-2005 @ 08:45:39 AM **Run Code: 1114011950**

MECHANICAL EQUIPMENT SUMMARY Performance (Part 1 of 2) MECH-2

Project Name	Date
Sample Compliance Building	20-Apr-2005

CIRCULATION LOOP SUMMARY

		CIRCULATION LOOP PUMPS					
Name	Description	Qty.	GPM	BHP	Motor Eff.	Drive Eff.	Pump Control
Domestic...ter Loop	Nonres DHW Loop	0	n/a	0.0	n/a	n/a	n/a

DOMESTIC WATER HEATER SUMMARY

								Tank Insulation	
Name	Circulation Loop	Description	Qty.	Rtd Input (MBtu/h)	Volume (Gals.)	E.F. or Rec. Eff.	Stdby or Pilot	Int. R-Val	Ext. R-Val
Domestic...r Heater	Domestic...ter Loop		1	197,652	148.3	1.00 EF	n/a	0.00	12.00

CENTRAL SYSTEM RATINGS

				HEATING			COOLING			
System Name	Circulation Loop	Description	Qty.	Output (kBtu/h)	Aux. kW	Efficiency	Output (kBtu/h)	EER	SEER	Economizer Type
Sys1 (PSZ) (G.S1)	- none -	Pkgd Single Zone	1	70	0.00	0.78 AFUE	52	n/a	12.00	OA Te...ture
Sys1 (PSZ) (G.E2)	- none -	Pkgd Single Zone	1	60	0.00	0.78 AFUE	45	n/a	12.00	OA Te...ture
Sys1 (PSZ) (G.N3)	- none -	Pkgd Single Zone	1	50	0.00	0.78 AFUE	36	n/a	12.00	OA Te...ture
Sys1 (PSZ) (G.W4)	- none -	Pkgd Single Zone	1	65	0.00	0.78 AFUE	50	n/a	12.00	OA Te...ture
Sys1 (PSZ) (G.C5)	- none -	Pkgd Single Zone	1	150	0.00	0.78 AFUE	102	9.50	n/a	OA Te...ture
Sys1 (PSZ) (T.S11)	- none -	Pkgd Single Zone	1	75	0.00	0.78 AFUE	60	n/a	12.00	OA Te...ture
Sys1 (PSZ) (T.E12)	- none -	Pkgd Single Zone	1	65	0.00	0.78 AFUE	52	n/a	12.00	OA Te...ture
Sys1 (PSZ) (T.N13)	- none -	Pkgd Single Zone	1	55	0.00	0.78 AFUE	43	n/a	12.00	OA Te...ture
Sys1 (PS...(T.W14)	- none -	Pkgd Single Zone	1	75	0.00	0.78 AFUE	60	n/a	12.00	OA Te...ture
Sys1 (PSZ) (T.C15)	- none -	Pkgd Single Zone	1	160	0.00	0.78 AFUE	120	9.50	n/a	OA Te...ture

CENTRAL FAN SUMMARY

	SUPPLY FAN						RETURN FAN					
System Name	Description	Qty.	CFM	BHP	Motor Eff	Drive Eff	Description	Qty.	CFM	BHP	Motor Eff	Drive Eff
Sys1 (PSZ) (G.S1)	Constant Volume	1	2,933	0.80	0.97	0.97	n/a	0	2,332	0.00	0.80	0.97
Sys1 (PSZ) (G.E2)	Constant Volume	1	2,530	0.66	0.97	0.97	n/a	0	1,982	0.00	0.80	0.97
Sys1 (PSZ) (G.N3)	Constant Volume	1	1,955	0.60	0.97	0.97	n/a	0	1,482	0.00	0.80	0.97
Sys1 (PSZ) (G.W4)	Constant Volume	1	2,760	0.80	0.97	0.97	n/a	0	2,182	0.00	0.80	0.97
Sys1 (PSZ) (G.C5)	Constant Volume	1	4,715	1.30	0.97	0.97	n/a	0	2,935	0.00	0.80	0.97
Sys1 (PSZ) (T.S11)	Constant Volume	1	3,450	0.90	0.97	0.97	n/a	0	2,782	0.00	0.80	0.97
Sys1 (PSZ) (T.E12)	Constant Volume	1	2,760	0.80	0.97	0.97	n/a	0	2,182	0.00	0.80	0.97
Sys1 (PSZ) (T.N13)	Constant Volume	1	2,300	0.66	0.97	0.97	n/a	0	1,782	0.00	0.80	0.97
Sys1 (PS...(T.W14)	Constant Volume	1	2,990	0.90	0.97	0.97	n/a	0	2,382	0.00	0.80	0.97
Sys1 (PSZ) (T.C15)	Constant Volume	1	5,175	1.30	0.97	0.97	n/a	0	3,307	0.00	0.80	0.97

MECHANICAL EQUIPMENT SUMMARY Performance (Part 2 of 2) MECH-2

Project Name	Date
Sample Compliance Building	20-Apr-2005

VAV SUMMARY

	VAV				
Zone Name	System Type	Qty.	Min. CFM Ratio	Reheat Type	Reheat Delta-T

EXHAUST FAN SUMMARY

	EXHAUST FAN					
Zone Name	Description	Qty.	CFM	BHP	Motor Eff.	Drive Eff.

MECHANICAL VENTILATION Performance MECH-3

Project Name	Date
Sample Compliance Building	20-Apr-2005

MECHANICAL VENTILATION

A	B	C	D	E	F	G	H	I	J	K
	AREA BASIS			OCCUPANCY BASIS						
Zone Name	Cond Area (sf)	CFM per sf	Min. CFM (BxC)	No. of People	CFM Per Person	Min. CFM (ExF)	Reg'd O.A. (Max. of D or G)	Design Outdoor Air CFM	VAV Min. CFM	Transfer Air CFM
South Perim Zn (G.S1)	1,452	0.15	218	7	15.0	109	218	218	2,932.50	0
East Perim Zn (G.E2)	1,452	0.15	218	7	15.0	109	218	218	2,530.00	0
North Perim Zn (G.N3)	1,452	0.15	218	7	15.0	109	218	218	1,955.00	0
West Perim Zn (G.W4)	1,452	0.15	218	7	15.0	109	218	218	2,760.00	0
Core Zn (G.C5)	6,691	0.17	1,165	42	15.0	634	1,165	1,165	4,715.00	0
South Perim Zn (T.S11)	1,452	0.15	218	7	15.0	109	218	218	3,450.00	0
East Perim Zn (T.E12)	1,452	0.15	218	7	15.0	109	218	218	2,760.00	0
North Perim Zn (T.N13)	1,452	0.15	218	7	15.0	109	218	218	2,300.00	0
West Perim Zn (T.W14)	1,452	0.15	218	7	15.0	109	218	218	2,990.00	0
Core Zn (T.C15)	6,691	0.18	1,193	48	15.0	719	1,193	1,193	5,175.00	0

C Minimum ventilation rate per Section 121, Table 1-F.

E Base on expected number of occupants or at least 50% of Chapter 10 1997 UBC occupant density.

I Must be greater that or equal to H, or use Transfer Air. Design outdoor air includes ventilation from supply air system & exhaust fans which operate at design conditions.

K Must be greater than or equal to (H-I), and, for VAV, greater than or equal to (H-J).

TDV ENERGY REPORT

The following page is an examples of a TDV energy report.

Time Dependent Valuation Report — TDV-1

Project Name	Date
Sample Compliance Building	20-Apr-2005

ANNUAL TDV ENERGY USE SUMMARY (TDV-kBtu/sqft-yr)

ENERGY COMPONENT	Standard Design	Proposed Design	Compliance Margin
Space Heating	2.05	1.80	0.24
Space Cooling	37.56	20.50	17.05
Indoor Fans	26.86	24.45	2.41
Heat Rejection	0.00	0.00	0.00
Pumps	0.00	0.00	0.00
Domestic Hot Water	10.00	10.02	-0.02
Lighting	73.82	73.82	-0.00
Receptacle	41.91	41.91	0.00
Process	0.00	0.00	0.00
Exterior Usage	0.00	0.00	0.00
TOTALS:	192.20	172.51	19.69

BUILDING WOULD COMPLY (based on TDV results)

Run Initiation Time: 20-Apr-2005 @ 08:45:39 AM

Section 2

Compliance BDL Elements

Overview

The California Compliance Addenda (Addenda) documents the valid input as well as important usage information for all compliance analysis keywords necessary to demonstrate compliance of nonresidential buildings with California's Efficiency Standards for Residential and Nonresidential Buildings (Standards) using the performance approach (See Section 141 of the Standards).

The rules processor is currently only available for use as part of the compliance analysis version of eQUEST. In order to perform compliance analysis on a standard DOE-2.2 input file (*.inp), the file must be read into eQUEST first. Compliance analysis can then be performed using the "Perform Compliance Analysis" button on the Actions tab of the main interface. Refer to eQUEST help system for further information.

This section describes how the DOE-2.2 Rules Processor references compliance analysis keywords, as well as standard DOE-2.2 keywords, to generate proposed and reference building files meeting the requirements of the 1998 Alternative Calculations Method Approval Manual (ACM Manual) for the Standards. The Rules Processor has certain limitations in terms of the types of buildings, systems and plant equipment that can be included for compliance analysis. These are listed in the first section of this document.

REQUIRED ADDITIONAL DOCUMENTS

DOE-2.2, using the eQUEST compliance analysis functionality, may be used to show compliance with California's Energy Efficiency Standards for Nonresidential Buildings; two additional documents may be required:

1. 2001 Building Energy Efficiency Standards (P400-01-001)
2. Nonresidential Manual (P400-01-005)

Both of these publications are available from:

California Energy Commission
Publications Office
1516 9th Street, MS-13
P.O. Box 944295
Sacramento, CA 94244-2950
916-654-5200

COMPLIANCE ANALYSIS KEYWORDS

Compliance analysis keywords are keywords that begin with "C-" (e.g. C-PERMIT-SCOPE) and are only referenced by the rules processor. They are used for generating the proposed building, creating the budget building based on budget conversion rules and reporting. Compliance analysis keywords are not directly referenced by the DOE-2.2 simulation engine.

Usage of Compliance Analysis Keywords

Compliance analysis keywords are listed in this addenda as follows:

Keyword (<default>, <input type> or <valid range>, <data type>)

default This is the value assigned to the keyword if not input by the user. If no value is assigned, "none" will be listed here.

input type Some keywords **MUST** have integer inputs which, in turn, represent characteristics of the particular command. For these types of keywords, either "integer symbol" or "integer flag" will be listed here. (See discussion of "Rounded Numeric Keywords," below.)

valid range The valid range of input for the keyword including units (e.g. 0 – 9,999,999 Btuh).

data type For keywords where the default is "none," this denotes if a user input for this keyword is "required"(must be input by the user), "optional"(may be input by the user) or "prescribed"(automatically assigned by the rules processor – user input ignored).

Rounded Numeric Keywords

Many of the compliance analysis keywords **REQUIRE** rounded numeric inputs (or integers). In most cases this integer is a symbol representing a feature or characteristic of the component being modeled. For example, C-PRODUCT-TYPE is a compliance analysis keyword in the WINDOW command that requires an integer input. The integers represent WINDOW properties as given in the following table:

Value	Product Type
0	"Operable Window"
1	"Fixed Window"
2	"Greenhouse/Garden Window"
3	"Operable Door"
4	"Operable Transparent Skylight"
5	"Operable Transluscent Skylight"
6	"Fixed Transparent Skylight"
7	"Fixed Transluscent Skylight"

This type of keyword is identified as "integer symbol" in the space where the valid range of inputs would typically be found. Because symbol values are dependent on the particular ruleset being applied to the input file, the symbols listed in this Addenda are most likely not valid for other rulesets (i.e. performing compliance analysis for energy standards other than California's).

In some cases, the range of inputs for rounded numeric keywords is limited to zero or one. For example, C-DEMISING-WALL is a keyword enables the user to identify if an EXTERIOR-WALL is a demising wall as defined in the Standards. This type of keyword is identified as "integer flag" in the space where the valid range of inputs would typically be found. As with "integer symbol" keywords, values assigned to these types of keywords will likely represent completely different characteristics when used in rulesets other than the California compliance ruleset.

IMPORTANT: Do not use text string characteristics as for rounded numeric keywords. Errors will result. Use only the integer representing the characteristic as listed for the particular rounded numeric keyword.

Required Keywords

In order for the compliance analysis rules processor to function properly, there are a limited number of properties that must be supplied by the user. Additionally, the Title 24 standards and ACM Manual require specific information about a project to be input in order for the compliance analysis to be acceptable for permit submittal. The following table lists all of these required keywords, denoting if they are required for proper ruleset function, permit submittal or other specific conditions.

DOE-2 Command	DOE-2 Keyword	Required for Ruleset Function	Required for Permit Submittal	Other Requirements
SITE-PARAMETERS	C-REGION	X	X	
	C-LOCATION	X	X	
GLASS-TYPE	C-PRODUCT-TYPE	X	X	
	C-NUM-PANES	X	X	
	C-FRAME-TYPE	X	X	
	C-LOW-E-COATING	X	X	
	C-AIR-SPACE	X	X	
WINDOW	C-PRODUCT-TYPE	X	X	
	C-FRAME-TYPE	X	X	
	C-UFACTOR-METHOD	X	X	
	C-SHGC-METHOD	X	X	
SYSTEM	C-NUM-OF-UNITS		X	
	C-HAS-HTG-CLG		X	
	SUPPLY-FLOW		X	
	C-SF-TOT-BHP		X	
	C-SF-MOTOR-EFF		X	
	C-SF-DRIVE-EFF		X	
	RETURN-FLOW		X	If system has return fan

	C-RF-TOT-BHP		X	
	C-RF-MOTOR-EFF			
	C-RF-DRIVE-EFF			
	HSUPPLY-FLOW			For TYPE = MZS, PMZS and DDS only
	C-HFAN-TOT-BHP		X	''
	C-HFAN-MTR-EFF		X	''
	C-HFAN-DRIVE-EFF		X	''
	C-TOTAL-CLG-CAP		X	if system has cooling
	C-TOTAL-HTG-CAP		X	
	C-AC-CONFIG		X	If DX cooling
	C-EER95		X	If air-cooled DX cooling and not covered by DOE SEER requirement
	C-SEER		X	If air-cooled DX cooling and covered by DOE SEER requirement
	C-EER85EWT		X	If TYPE = HP
	C-HP-CONFIG		X	If HEAT-SOURCE = HEAT-PUMP
	C-COP47		X	If HEAT-SOURCE = HEAT-PUMP and air-cooled and not covered by DOE HSPF requirement
	C-HSPF		X	If HEAT-SOURCE = HEAT-PUMP and air-cooled and covered by DOE HSPF requirement
	C-COP70EWT		X	If TYPE = HP
	C-FURN-CONFIG		X	If HEAT-SOURCE = FURNACE
	C-AFUE		X	If HEAT-SOURCE = FURNACE and furnace covered by DOE AFUE requirement
	C-THERM-EFF-MAX		X	If HEAT-SOURCE = FURNACE and furnace not covered by DOE AFUE requirement
	C-DUCT-SEALING		X	
CHILLER	C-NUM-OF-UNITS		X	

	CAPACITY		X	
	C-COP		X	
BOILER	C-NUM-OF-UNITS		X	
	CAPACITY		X	
	C-AFUE		X	
	C-THERM-EFF-MAX		X	
PUMP	MOTOR-EFF		X	
CIRCULATION-LOOP	C-DHW-TANK-VOL		X	If combined hydronic DHW system
	C-TANK-INS-RVAL		X	''
DW-HEATER	CAPACITY		X	
	TANK-VOLUME		X	
	C-TYPE		X	
	C-CATEGORY		X	
	C-RECOV-EFF		X	If water heater is gas and is not covered by DOE Energy Factor requirements
	C-ENERGY-FACTOR		X	If water heater is covered by DOE Energy Factor requirements
	C-STBY-LOSS-FRAC		X	If water heater is not small instantaneous type and is not covered by DOE Energy Factor requirements

BDL INPUT FILES GENERATED BY THE RULES PROCESSOR

The eQUEST rules processor automatically generates four BDL input files during the compliance analysis process. Though not valid for any compliance submittal for a building permit, they can help the user to understand how the building input file is modified by the rules processor during the compliance analysis process. The input files are described below:

<*project name*> T24 Proposed HVAC Sizing.inp - created first, this file is used to perform the sizing calculations for the proposed building.

<*project name*> T24 Proposed Building.inp - created second, this file is used to generate the energy use of the proposed building

<*project name*> T24 Standard HVAC Sizing.inp - created third, this file is used to perform sizing calculations for the budget building

<*project name*> T24 Standard Building.inp -	created last, this file is used to generate the energy use of the budget building

Loads

This section lists the enhancements to the LOADS portion of DOE-2.2. The following commands have compliance analysis keywords:

COMPLIANCE
SITE-PARAMETERS
SPACE
CONSTRUCTION
EXTERIOR-WALL
INTERIOR-WALL
FLOOR
GLASS-TYPE
WINDOW

COMPLIANCE

The COMPLIANCE command has been added to enable compliance analysis with DOE-2.2. All keywords of this command are intended for storage information that is pertinent to the compliance analysis. These keywords are referenced by the rules processor during compliance analysis. The COMPLIANCE command includes the following keywords:

C-PROJ-NAME
C-PROJ-ADDRESS
C-PERMIT-SCOPE
C-BUILDING-TYPE
C-CONS-PHASE
C-NUM-OF-STORIES
C-NR-DHW-INCL
C-RES-DHW-INCL
C-DATE-OF-PLANS
C-DOCU-AUTHOR
C-DOCU-AUTHOR-PH
C-DESIGNER-ENV
C-DESIGNER-PHONE
C-DESIGNER-MECH
C-DSNR-MECH-PH
C-DESIGNER-LTG
C-DSNR-LTG-PH
C-ENV-MAND-LOC
C-MECH-MAND-LOC
C-LTG-MAND-LOC
C-RESULT-1
C-RESULT-2
C-RESULT-3
C-RESULT-4
C-RESULT-5
C-CODE-VERSION

C-PROJ-NAME (none, Text String – 96 Characters Max, Optional)
The name of the compliance analysis project.

C-PROJ-ADDRESS (none, Text String – 96 Characters Max, Optional)
The address of the compliance analysis project.

C-PERMIT-SCOPE (none, Integer Symbol, required)
An integer representing the scope of the building permit covered by this compliance analysis. Valid inputs are giving in the following table:

Value	Permit Scope
0	"Envelope/Mechanical/Lighting"
1	"Envelope Only"
2	"Mechanical Only"
4	"Envelope/Mechanical"
5	"Mechanical/Lighting"
6	"Envelope/Lighting"

C-BUILDING-TYPE (none, Integer Symbol, Required)
An integer representing the type of building for the compliance analysis input file. Valid inputs are given in the following table:

Value	Building Type
0	"Nonresidential"
1	"High-Rise Residential – Multi-Falmily"
7	"High-Rise Residential – Single Family"
2	"Hotel/Motel Guest Room"
3	"Nonres + High-Rise Res – Multi-Family"
8	"Nonres + High-Rise Res – Single Family"
4	"Hotel/Motel Gst Rm + High-Rise Res - Multi-Fam"
9	"Hotel/Motel Gst Rm + High-Rise Res - Single-Fam"
5	"Nonresidential + Hotel/Motel Guest Room"
6	"Nonres + High-Rise Res/Multi-Fam+ Hotel/Motel G/R"
10	"Nonres + High-Rise Res/Single-Fam + Hotel/Motel G/R"

C-CONS-PHASE (none, Integer Symbol, Required)
An integer representing the phase of construction for the compliance analysis input file. Valid inputs are given in the following table:

Value	Construction Phase
0	"New Building"
1	"Addition"
2	"Alteration"
3	"Existing + Addition"

C-NUM-OF-STORIES (none, Integer 0 - 1000, Required)
The number of above grade stories of the building represented by the compliance analysis input file. A value of zero means the building has no above grade floors.

C-NR-DHW-INCL (none, Integer 0 or 1, Required)
A flag indicating if nonresidential water heating shall be included in the compliance analysis. A value of 1 indicates that nonresidential water heating shall be included in the compliance analysis.

C-RES-DHW-INCL (none, Integer Symbol, Required)
A flag indicating if residential water heating shall be included in the compliance analysis. A value of 1 indicates that residential water heating shall be included in the compliance analysis.

C-DATE-OF-PLANS (none, Text String – 32 Characters Max, Prescribed)
The date of the plans and other construction documents represented by the compliance analysis input file.

C-DOCU-AUTHOR (none, Text String – 96 Characters Max, Optional)
The person responsible for performing the compliance analysis and preparing the compliance documentation.

C-DOCU-AUTHOR-PH (none, Text String – 32 Characters Max, Optional)
The phone number of the person responsible for performing the compliance analysis and preparing the compliance documentation.

C-DESIGNER-ENV (none, Text String – 96 Characters Max, Optional)
The person responsible for the design of the building envelope.

C-DESIGNER-PHONE (none, Text String – 32 Characters Max, Optional)
The phone number of the person responsible for the design of the building envelope.

C-DESIGNER-MECH (none, Text String – 96 Characters Max, Optional)
The person responsible for the design of the building's mechanical systems.

C-DSNR-MECH-PH (none, Text String – 32 Characters Max, Optional)
The phone number of the person responsible for the design of the building's mechanical systems.

C-DESIGNER-LTG (none, Text String – 96 Characters Max, Optional)
The person responsible for the design of the building's lighting systems.

C-DSNR-LTG-PH (none, Text String – 32 Characters Max, Optional)
The phone number of the person responsible for the design of the building's lighting systems.

C-ENV-MAND-LOC (none, Text String – 96 Characters Max, Optional)
The location in the construction documents of envelope mandatory measures pursuant to Section XXX of the Standards.

C-MECH-MAND-LOC (none, Text String – 96 Characters Max, Optional)
The location in the construction documents of HVAC mandatory measures pursuant to Section XXX of the Standards.

C-LTG-MAND-LOC (none, Text String – 96 Characters Max, Optional)
The location in the construction documents of lighting mandatory measures pursuant to Section XXX of the Standards.

C-RESULT-1 (none, Text String – 80 Characters Max, Prescribed)
Compliance results set by the rules processor.

C-RESULT-2 (none, Text String – 80 Characters Max, Prescribed)
Compliance results set by the rules processor.

C-RESULT-3 (none, Text String – 80 Characters Max, Prescribed)
Compliance results set by the rules processor.

C-RESULT-4 (none, Text String – 80 Characters Max, Prescribed)
Compliance results set by the rules processor.

C-RESULT-5 (none, Text String – 80 Characters Max, Prescribed)
Compliance results set by the rules processor.

C-CODE-VERSION (none, Integer Symbol – 80 Characters Max, Prescribed)
Compliance results set by the rules processor.

SITE-PARAMETERS

The following compliance analysis keywords are available in the SITE-PARAMETERS command:

C-STATE	**C-LOCATION**	**C-CLIMATE-REGION**
C-REGION	**C-CLIMATE-ZONE**	**C-WEATHER-FILE**

C-STATE (none, Integer Symbol, Prescribed)
For California Compliance analysis, the rules processor will automatically assign an integer value representing "California" to this keyword.

C-REGION (none, Integer Symbol, Required)
Represents the county where the project is located. The valid symbols are:

Symbol	County	Symbol	County	Symbol	County
1	"Alameda"	21	"Marin"	41	"San Mateo"
2	"Alpine"	22	"Mariposa"	42	"Santa Barbara"
3	"Amador"	23	"Mendocino"	43	"Santa Clara"
4	"Butte"	24	"Merced"	44	"Santa Cruz"
5	"Calavaras"	25	"Modoc"	45	"Shasta"
6	"Colusa"	26	"Mono"	46	"Sierra"
7	"Contra Costa"	27	"Monterey"	47	"Siskiyou"
8	"Del Norte"	28	"Napa"	48	"Solano"
9	"El Dorado"	29	"Nevada"	49	"Sonoma"
10	"Fresno"	30	"Orange"	50	"Stanislaus"
11	"Glenn"	31	"Placer"	51	"Sutter"
12	"Humboldt"	32	"Plumas"	52	"Tehama"
13	"Imperial"	33	"Riverside"	53	"Trinity"
14	"Inyo"	34	"Sacramento"	54	"Tulare"
15	"Kern"	35	"San Benito"	55	"Tuolumne"
16	"Kings"	36	"San Bernardino"	56	"Ventura"
17	"Lake"	37	"San Diego"	57	"Yolo"
18	"Lassen"	38	"San Francisco"	58	"Yuba"
19	"Los Angeles"	39	"San Joaquin"		
20	"Madera"	40	"San Luis Obispo"		

C-LOCATION (none, Integer Symbol, Required)
Represents the city where the project is located. The available values for this keyword are dependent on the input for C-REGION as described in the table below:

	Value	City
C-REGION = 1		
	2	"Alameda Naval Air Station"
	4	"Albany"
	48	"Berkeley"
	102	"Castro Valley"
	110	"Cherryland"
	168	"Dublin"
	215	"Fremont"
	246	"Hayward"
	315	"Livermore"
	387	"Newark"
	399	"Oakland Airport"
	400	"Oakland Museum"
	435	"Piedmont"
	445	"Pleasanton"
	508	"San Leandro"
	509	"San Lorenzo"
	595	"Union City"
	598	"Upper San Leandro"
C-REGION = 2		
	634	"Woodfords"
C-REGION = 3		
	184	"Electra Power House"
	576	"Tiger Creek Power House"

	Value	City
C-REGION = 4		
	106	"Centerville Power House"
	112	"Chico Experiment Station"
	150	"De Sabla"
	305	"Las Plumas"
	412	"Oroville Ranger Station"
	424	"Paradise"
C-REGION = 5		
	490	"Salt Springs Power House"
	87	"Camp Pardee"
C-REGION = 6		
	126	"Colusa"
	173	"East Park Reservoir"
	628	"Williams"
	632	"Willows"
C-REGION = 7		
	3	"Alamo"
	16	"Antioch"
	129	"Concord"
	138	"Crockett"
	178	"El Cerrito"
	293	"Lafayette"
	341	"Martinez Fire Station"
	370	"Moraga"
	374	"Mount Diablo"
	409	"Orinda"
	437	"Pinole"
	439	"Pittsburg"
	444	"Pleasant Hill"
	451	"Port Chicago Navy Depot"
	472	"Richmond"
	487	"Saint Mary's College"
	515	"San Pablo"
	611	"Walnut Creek"
C-REGION = 8		
	137	"Crescent City"
	185	"Elk Valley"
	262	"Idlewild"
	283	"Klamath"
C-REGION = 9		
	222	"Georgetown Ranger Station"
	441	"Placerville"
	442	"Placerville Inst. of Forestry Genetics"
	551	"South Lake Tahoe"
C-REGION = 10		
	29	"Auberry"
	84	"Calwa"
	121	"Clovis"
	123	"Coalinga"
	198	"Five Points"
	216	"Fresno Airport"
	217	"Friant Gov Camp"
	260	"Huntington Lake"
	299	"Lakeshore"
	314	"Little Panoche"
	406	"Orange Cove"

	Value	City
	469	"Reedley"
	519	"Sanger"
	537	"Selma"
C-REGION = 11		
	410	"Orland"
	561	"Stony Gorge Reservoir"
C-REGION = 12		
	5	"Alderpoint"
	20	"Arcata"
	76	"Butler Valley"
	190	"Eureka"
	196	"Ferndale"
	258	"Hoopa"
	408	"Orick Prairie Creek"
	411	"Orleans"
	534	"Scotia"
	540	"Shelter Cove"
	631	"Willow Creek"
C-REGION = 13		
	66	"Brawley 2 SW"
	82	"Calexico"
	177	"El Centro"
	230	"Gold Rock Rch"
	265	"Imperial Airport"
	267	"Imperial City/County Office"
C-REGION = 14		
	53	"Bishop Airport"
	151	"Death Valley"
	152	"Deep Springs College"
	237	"Haiwee"
	268	"Independence"
	627	"Wildrose Ranger Station"
C-REGION = 15		
	24	"Arvin"
	34	"Bakersfield Airport"
	54	"Blackwells Corner"
	62	"Boron Air Force Station"
	77	"Buttonwillow"
	92	"Cantil"
	113	"China Lake"
	155	"Delano"
	174	"Edwards Air Force Base"
	229	"Glenville"
	253	"Hillcrest Center"
	271	"Inyokern Naval Air Station"
	280	"Kern River Power House 3"
	302	"Lamont"
	338	"Maricopa"
	360	"Mojave"
	402	"Oildale"
	463	"Randsburg"
	473	"Ridgecrest"
	538	"Shafter"
	568	"Tehachapi"
	614	"Wasco"

	Value	City
C-REGION = 16		
	130	"Corcoran"
	240	"Hanford"
	279	"Kern River Power House 1"
	281	"Kettleman Station"
	311	"Lemoore Naval Air Station"
C-REGION = 17		
	119	"Clearlake Highlands"
	298	"Lakeport"
	597	"Upper Lake Ranger Station"
C-REGION = 18		
	165	"Doyle"
	199	"Fleming Fish & Game"
	317	"Lodgepole"
	565	"Susanville Airport"
C-REGION = 19		
	6	"Alhambra"
	8	"Alondra Park"
	10	"Altadena"
	19	"Arcadia"
	23	"Artesia"
	31	"Avalon"
	32	"Azusa"
	36	"Baldwin Park"
	42	"Bell"
	43	"Bell Gardens"
	44	"Bellflower"
	50	"Beverly Hills"
	72	"Burbank Airport"
	73	"Burbank Valley Pump"
	80	"Calabasas"
	91	"Canoga Park"
	100	"Carson"
	108	"Cerritos"
	117	"Claremont"
	127	"Commerce"
	128	"Compton"
	136	"Covina"
	141	"Cudahy"
	142	"Culver City"
	154	"Del Aire"
	157	"Diamond Bar"
	163	"Downey"
	167	"Duarte"
	172	"East Los Angeles"
	180	"El Monte"
	182	"El Segundo"
	194	"Fairmont"
	200	"Florence-Graham"
	209	"Fort MacArthur"
	220	"Gardena"
	227	"Glendale"
	228	"Glendora"
	236	"Hacienda Heights"
	243	"Hawaiian Gardens"
	244	"Hawthorne"

Value	City
250	"Hermosa Beach"
257	"Hollywood"
261	"Huntington Park"
270	"Inglewood"
285	"La Canada-Flintridge"
286	"La Crescenta-Montrose"
289	"La Mirada"
291	"La Puente"
292	"La Verne"
301	"Lakewood"
303	"Lancaster"
307	"Lawndale"
312	"Lennox"
316	"Llano Shawnee"
320	"Lomita"
322	"Long Beach Airport"
323	"Long Beach City/County Office"
326	"Los Angeles Airport"
327	"Los Angeles City/County Office"
332	"Lynwood"
334	"Manhattan Beach"
344	"Maywood"
362	"Monrovia"
365	"Montebello"
368	"Monterey Park"
379	"Mount Wilson"
388	"Newhall Soledad"
394	"North Hollywood"
396	"Norwalk"
419	"Palmdale Airport"
420	"Palmdale City/County Office"
423	"Palos Verdes"
425	"Paramount"
427	"Pasadena"
434	"Pico Rivera"
450	"Pomona Cal Poly"
462	"Rancho Palos Verdes"
467	"Redondo Beach"
478	"Rolling Hills"
479	"Rosemead"
482	"Rowland Heights"
493	"San Antonio Canyon"
500	"San Dimas"
501	"San Fernando"
504	"San Gabriel Fire Department"
512	"San Marino"
516	"San Pedro"
518	"Sandberg"
525	"Santa Fe Springs"
527	"Santa Monica"
542	"Sierra Madre"
544	"Signal Hill"
548	"South El Monte"
550	"South Gate"
552	"South Pasadena"
554	"South Whittier"
563	"Sunland"

	Value	City
	569	"Tejon Rancho"
	570	"Temple City"
	571	"Termo"
	577	"Torrance"
	584	"Tujunga"
	593	"UCLA"
	600	"Valinda"
	602	"Valyermo Ranger Station"
	606	"View Park"
	610	"Walnut"
	618	"West Carson"
	619	"West Covina"
	620	"West Hollywood"
	621	"West Puente Valley"
	626	"Whittier"
	630	"Willow Brook"
C-REGION = 20		
	61	"Bonita"
	333	"Madera"
	392	"North Fork Ranger Station"
C-REGION = 21		
	133	"Corte Madera"
	192	"Fairfax"
	205	"Fort Baker"
	239	"Hamilton Air Force Base"
	278	"Kentfield"
	304	"Larkspur"
	351	"Mill Valley"
	397	"Novato"
	492	"San Anselmo"
	517	"San Rafael"
	575	"Tiburon"
C-REGION = 22		
	103	"Catheys Valley"
	169	"Dudleys"
	638	"Yosemite Park Headquarters"
C-REGION = 23		
	135	"Covelo"
	207	"Fort Bragg"
	446	"Point Arena"
	456	"Potter Valley Power House"
	594	"Ukiah"
	629	"Willits"
C-REGION = 24		
	28	"Atwater"
	101	"Castle Air Force Base"
	308	"Le Grand"
	328	"Los Banos"
	329	"Los Banos Reservoir"
	349	"Merced Airport"
	510	"San Luis Dam"
	609	"Volta Power House"
C-REGION = 25		
	1	"Adin Ranger Station"
	11	"Alturas Ranger Station"
	105	"Cedarville"

	Value	City
	206	"Fort Bidwell"
	275	"Jess Valley"
C-REGION = 26		
	60	"Bodie"
	68	"Bridgeport"
	361	"Mono Lake"
	591	"Twin Lakes"
	624	"White Mountain 1"
	625	"White Mountain 2"
C-REGION = 27		
	97	"Carmel Valley"
	210	"Fort Ord"
	282	"King City"
	339	"Marina"
	366	"Monterey Airport"
	367	"Monterey City/County Office"
	415	"Pacific Grove"
	458	"Priest Valley"
	488	"Salinas 3 E"
	489	"Salinas Airport"
	494	"San Antonio Mission"
	536	"Seaside"
C-REGION = 28		
	15	"Angwin"
	49	"Berryessa Lake"
	383	"Napa State Hospital"
	486	"Saint Helena"
C-REGION = 29		
	59	"Boca"
	153	"Deer Creek Power House"
	232	"Grass Valley"
	297	"Lake Spaulding"
	386	"Nevada City"
	583	"Truckee Ranger Station"
	161	"Donner Memorial State Park"
C-REGION = 30		
	13	"Anaheim"
	67	"Brea Dam"
	71	"Buena Park"
	134	"Costa Mesa"
	146	"Cypress"
	183	"El Toro Marine Corp. Air Station"
	213	"Fountain Valley"
	218	"Fullerton"
	219	"Garden Grove"
	259	"Huntington Beach"
	273	"Irvine"
	276	"John Wayne Airport"
	287	"La Habra"
	290	"La Palma"
	294	"Laguna Beach"
	295	"Laguna Hills"
	324	"Los Alamitos Naval Air Station"
	356	"Mission Viejo"
	390	"Newport Beach"
	405	"Orange"

	Value	City
	440	"Placentia"
	481	"Rossmoor"
	498	"San Clemente"
	520	"Santa Ana Fire Station"
	535	"Seal Beach"
	558	"Stanton"
	589	"Tustin Irvine Ranch"
	622	"Westminster"
	637	"Yorba Linda"
C-REGION = 31		
	30	"Auburn"
	56	"Blue Canyon Airport"
	64	"Bowman Dam"
	124	"Colfax"
	161	"Donner Memorial State Park"
	162	"Donner Summit"
	476	"Rocklin"
	480	"Roseville"
	556	"Squaw Valley"
	566	"Tahoe City"
	567	"Tahoe Valley Airport"
C-REGION = 32		
	93	"Canyon Dam"
	111	"Chester"
	454	"Portola"
	459	"Quincy"
C-REGION = 33		
	37	"Banning"
	41	"Beaumont"
	57	"Blythe Airport"
	58	"Blythe City/County Office"
	122	"Coachella"
	131	"Corona"
	171	"Eagle Mountain"
	186	"Elsinore"
	226	"Glen Avon"
	245	"Hayfield Pumps"
	248	"Hemet"
	264	"Idyllwild"
	269	"Indio"
	337	"March Air Force Base"
	347	"Mecca Fire Station"
	377	"Mount San Jacinto"
	391	"Norco"
	417	"Palm Desert"
	418	"Palm Springs"
	432	"Perris"
	474	"Riverside Experiment Station"
	475	"Riverside Fire Station 3"
	483	"Rubidoux"
	506	"San Jacinto"
	572	"Thermal Airport"
C-REGION = 34		
	21	"Arden"
	65	"Brannan Island"
	98	"Carmichael"

	Value	City
	116	"Citrus Heights"
	191	"Fair Oaks"
	201	"Florin"
	202	"Folsom Dam"
	343	"Mather Air Force Base"
	345	"McClellan Air Force Base"
	393	"North Highlands"
	407	"Orangevale"
	461	"Rancho Cordova"
	484	"Sacramento Airport"
	485	"Sacramento City/County Office"
	612	"Walnut Grove"
C-REGION = 35		
	256	"Hollister"
	263	"Idria"
	436	"Pinnacles National Monument"
C-REGION = 36		
	17	"Apple Valley"
	33	"Baker"
	35	"Balch Power House"
	39	"Barstow"
	52	"Big Bear Lake"
	55	"Bloomington"
	113	"China Lake"
	114	"Chino"
	125	"Colton"
	140	"Cucamonga"
	147	"Daggett Airport"
	179	"El Mirage"
	203	"Fontana"
	221	"George Air Force Base"
	252	"Highland"
	296	"Lake Arrowhead"
	319	"Loma Linda"
	331	"Lucerne Valley"
	357	"Mitchell Caverns"
	364	"Montclair"
	373	"Mount Baldy Notch"
	380	"Mountain Pass"
	385	"Needles Airport"
	395	"Norton Air Force Base"
	404	"Ontario Airport"
	426	"Parker Reservoir"
	466	"Redlands"
	470	"Rialto"
	495	"San Bernardino"
	557	"Squirrel Inn"
	582	"Trona"
	590	"Twentynine Palms"
	596	"Upland"
	605	"Victorville Pumps"
	641	"Yucaipa"
C-REGION = 37		
	9	"Alpine"
	38	"Barrett Dam"
	63	"Borrego Desert Park"

	Value	City
	78	"Cabrillo National Monument"
	90	"Campo"
	95	"Cardiff-by-the-Sea"
	96	"Carlsbad"
	115	"Chula Vista"
	132	"Coronado"
	145	"Cuyamaca"
	175	"El Cajon"
	176	"El Capitan Dam"
	187	"Encinitas"
	189	"Escondido"
	195	"Fallbrook"
	224	"Gillespie Field"
	234	"Grossmont"
	249	"Henshaw Dam"
	266	"Imperial Beach"
	277	"Julian Wynola"
	288	"La Mesa"
	300	"Lakeside"
	309	"Lemon Grove"
	355	"Miramir Marine Corp. Air Station"
	384	"National City"
	401	"Oceanside"
	413	"Otay-Castle Park"
	422	"Palomar Observatory"
	430	"Pendleton Marine Corp. Base"
	431	"Pendleton Marine Corp. Base Coast"
	457	"Poway Valley"
	460	"Ramona Spaulding"
	499	"San Diego Airport"
	530	"Santee"
	555	"Spring Valley"
	608	"Vista"
	613	"Warner Springs"
C-REGION = 38		
	502	"San Francisco Airport"
	503	"San Francisco City/County Office"
C-REGION = 39		
	81	"Calaveras Big Trees"
	318	"Lodi"
	335	"Manteca"
	559	"Stockton Airport"
	560	"Stockton Fire Station 4"
	578	"Tracy Carbona"
	579	"Tracy Pumps"
C-REGION = 40		
	22	"Arroyo Grande"
	26	"Atascadero"
	86	"Cambria Air Force Station"
	88	"Camp Roberts"
	235	"Grover City"
	372	"Morro Bay Fire Department"
	382	"Nacimiento Dam"
	428	"Paso Robles Airport"
	429	"Paso Robles City/County Office"
	438	"Pismo Beach"

	Value	City
	449	"Point Piedras Blancas"
	511	"San Luis Obispo"
	592	"Twitchell Dam"
C-REGION = 41		
	27	"Atherton"
	45	"Belmont"
	74	"Burlingame"
	148	"Daly City"
	212	"Foster City"
	238	"Half Moon Bay"
	254	"Hillsborough"
	348	"Menlo Park"
	352	"Millbrae"
	416	"Pacifica"
	468	"Redwood City"
	496	"San Bruno"
	497	"San Carlos"
	505	"San Gregorio 2 SE"
	513	"San Mateo"
	553	"South San Francisco"
	636	"Woodside"
C-REGION = 42		
	79	"Cachuma Lake"
	99	"Carpinteria"
	144	"Cuyama"
	274	"Isla Vista"
	321	"Lompoc"
	447	"Point Arguello"
	521	"Santa Barbara Airport"
	522	"Santa Barbara City/County Office"
	526	"Santa Maria Airport"
	603	"Vandenburg Air Force Base"
C-REGION = 43		
	7	"Almaden Air Force Station"
	12	"Alum Rock"
	89	"Campbell"
	143	"Cupertino"
	225	"Gilroy"
	325	"Los Altos"
	330	"Los Gatos"
	353	"Milpitas"
	359	"Moffett Field Naval Air Station"
	371	"Morgan Hill"
	375	"Mount Hamilton"
	381	"Mountain View"
	421	"Palo Alto"
	507	"San Jose"
	523	"Santa Clara University"
	531	"Saratoga"
	564	"Sunnyvale"
C-REGION = 44		
	18	"Aptos"
	46	"Ben Lomond"
	94	"Capitola"
	214	"Freedom"
	524	"Santa Cruz"

	Value	City
	615	"Watsonville"
C-REGION = 45		
	14	"Anderson"
	75	"Burney"
	188	"Enterprise"
	242	"Hat Creek Power House 1"
	272	"Iron Mountain"
	336	"Manzanita Lake"
	443	"Platina"
	465	"Redding Fire Station 4"
	539	"Shasta Dam"
	588	"Turntable Creek"
	623	"Whiskeytown Reservoir"
C-REGION = 46		
	164	"Downieville Ranger Station"
	541	"Sierra City"
	543	"Sierraville Ranger Station"
C-REGION = 47		
	83	"Callahan"
	104	"Cecilville"
	208	"Fort Jones Ranger Station"
	241	"Happy Camp Ranger Station"
	255	"Hilts"
	306	"Lava Beds"
	346	"McCloud"
	363	"Montague"
	376	"Mount Hebron Ranger Station"
	378	"Mount Shasta"
	533	"Sawyer's Bar Ranger Station"
	586	"Tulelake"
	617	"Weed Fire Department"
	639	"Yreka"
C-REGION = 48		
	47	"Benicia"
	159	"Dixon"
	170	"Duttons Landing"
	193	"Fairfield Fire Station"
	340	"Markley Cove"
	369	"Monticello Dam"
	599	"Vacaville"
	601	"Vallejo"
C-REGION = 49		
	120	"Cloverdale"
	211	"Fort Ross"
	233	"Graton"
	247	"Healdsburg"
	433	"Petaluma Fire Station 2"
	477	"Rohnert Park"
	529	"Santa Rosa"
	532	"Sausalito"
	546	"Sonoma"
	580	"Travis Air Force Base"
C-REGION = 50		
	107	"Ceres"
	139	"Crows Landing"
	156	"Denair"

	Value	City
	284	"Knights Ferry"
	358	"Modesto"
	389	"Newman"
	398	"Oakdale"
	587	"Turlock"
C-REGION = 51		
	640	"Yuba City"
C-REGION = 52		
	350	"Mill Creek"
	354	"Mineral"
	464	"Red Bluff Airport"
C-REGION = 53		
	51	"Big Bar Ranger Station"
	204	"Forest Glen"
	471	"Richardson Grove"
	491	"Salyer Ranger Station"
	581	"Trinity Dam"
	616	"Weaverville Ranger Station"
C-REGION = 54		
	25	"Ash Mountain"
	158	"Dinuba"
	223	"Giant Forest"
	231	"Grant Grove"
	310	"Lemoncove"
	313	"Lindsay"
	453	"Porterville"
	455	"Posey 3 E"
	574	"Three Rivers Power House 1"
	585	"Tulare"
	607	"Visalia"
C-REGION = 55		
	251	"Hetch Hetchy"
	109	"Cherry Valley Dam"
	547	"Sonora Ranger Station"
	549	"South Entr Yosemite"
	562	"Strawberry Valley"
C-REGION = 56		
	85	"Camarillo"
	166	"Dry Canyon Reservoir"
	181	"El Rio"
	197	"Fillmore"
	403	"Ojai"
	414	"Oxnard Air Force Base"
	448	"Point Mugu"
	452	"Port Hueneme"
	514	"San Nicholas Island"
	528	"Santa Paula"
	545	"Simi Valley"
	573	"Thousand Oaks"
	604	"Ventura"
C-REGION = 57		
	69	"Broderick-Bryte"
	70	"Brooks Ranch"
	118	"Clarksburg"
	149	"Davis"
	633	"Winters"

	Value	City
	635	"Woodland"
C-REGION = 58		
	40	"Beale Air Force Base"
	160	"Dobbins"
	342	"Marysville"

C-CLIMATE-ZONE (none, Integer Symbol, Prescribed)

Represents the California climate zone as described in Section 101(b) of the Standards. This value is determined by the rules processor according to the following table:

C-LOCATION	C-CLIMATE-ZONE	C-LOCATION	C-CLIMATE-ZONE	C-LOCATION	C-CLIMATE-ZONE	C-LOCATION	C-CLIMATE-ZONE
0	0	41	10	82	15	123	13
1	16	42	8	83	16	124	11
2	3	43	8	84	13	125	10
3	12	44	8	85	6	126	11
4	3	45	3	86	5	127	8
5	2	46	3	87	12	128	8
6	9	47	12	88	4	129	12
7	3	48	3	89	4	130	13
8	6	49	2	90	14	131	10
9	10	50	9	91	9	132	7
10	9	51	16	92	14	133	2
11	16	52	16	93	16	134	6
12	4	53	16	94	3	135	2
13	8	54	13	95	7	136	9
14	11	55	10	96	7	137	1
15	2	56	16	97	3	138	12
16	12	57	15	98	12	139	12
17	14	58	15	99	6	140	10
18	3	59	16	100	6	141	8
19	9	60	16	101	12	142	8
20	1	61	13	102	3	143	4
21	12	62	14	103	12	144	4
22	5	63	15	104	16	145	7
23	8	64	11	105	16	146	8
24	13	65	12	106	11	147	14
25	13	66	15	107	12	148	3
26	4	67	8	108	8	149	12
27	3	68	16	109	10	150	11
28	12	69	12	110	3	151	14
29	13	70	12	111	16	152	16
30	11	71	8	112	11	153	16
31	6	72	9	113	14	154	6
32	9	73	9	114	10	155	13
33	14	74	3	115	7	156	12
34	13	75	16	116	12	157	9
35	14	76	2	117	9	158	13
36	9	77	13	118	12	159	12
37	15	78	7	119	2	160	11
38	10	79	5	120	2	161	16
39	14	80	9	121	13	162	16
40	11	81	12	122	15	163	8

C-LOCATION	C-CLIMATE-ZONE
164	16
165	16
166	16
167	9
168	12
169	12
170	2
171	14
172	9
173	11
174	14
175	10
176	14
177	15
178	3
179	14
180	9
181	6
182	6
183	8
184	12
185	16
186	10
187	7
188	11
189	10
190	1
191	12
192	2
193	12
194	14
195	10
196	1
197	9
198	13
199	16
200	8
201	12
202	12
203	10
204	16
205	3
206	16
207	1
208	16
209	6
210	3
211	1
212	3
213	6
214	3

C-LOCATION	C-CLIMATE-ZONE
215	3
216	13
217	13
218	8
219	8
220	8
221	14
222	12
223	16
224	10
225	4
226	10
227	9
228	9
229	16
230	15
231	16
232	11
233	2
234	7
235	5
236	9
237	16
238	3
239	2
240	13
241	16
242	16
243	8
244	8
245	14
246	3
247	2
248	10
249	14
250	6
251	16
252	10
253	13
254	3
255	16
256	4
257	9
258	2
259	6
260	16
261	8
262	1
263	4
264	16
265	15

C-LOCATION	C-CLIMATE-ZONE
266	7
267	16
268	16
269	15
270	8
271	14
272	11
273	8
274	6
275	16
276	8
277	14
278	2
279	13
280	16
281	13
282	4
283	1
284	12
285	9
286	9
287	8
288	7
289	9
290	8
291	9
292	9
293	12
294	6
295	6
296	16
297	16
298	2
299	16
300	10
301	8
302	13
303	14
304	2
305	11
306	16
307	8
308	12
309	7
310	13
311	13
312	8
313	13
314	13
315	12
316	14

C-LOCATION	C-CLIMATE-ZONE
317	16
318	12
319	10
320	6
321	5
322	6
323	6
324	8
325	4
326	6
327	9
328	12
329	12
330	4
331	14
332	8
333	13
334	6
335	12
336	16
337	10
338	13
339	3
340	2
341	12
342	11
343	12
344	8
345	12
346	16
347	15
348	3
349	12
350	16
351	3
352	3
353	4
354	16
355	7
356	8
357	16
358	12
359	4
360	14
361	16
362	9
363	16
364	10
365	9
366	3
367	3

C-LOCATION	C-CLIMATE-ZONE
368	9
369	2
370	12
371	4
372	5
373	16
374	12
375	4
376	16
377	16
378	16
379	16
380	14
381	4
382	4
383	2
384	7
385	15
386	11
387	3
388	9
389	12
390	6
391	10
392	16
393	12
394	9
395	10
396	8
397	2
398	12
399	3
400	3
401	7
402	13
403	9
404	10
405	8
406	13
407	12
408	1
409	12
410	11
411	2
412	11
413	7
414	6
415	3
416	3
417	15
418	15

C-LOCATION	C-CLIMATE-ZONE
419	14
420	14
421	4
422	14
423	6
424	11
425	8
426	15
427	9
428	4
429	4
430	7
431	7
432	10
433	2
434	9
435	3
436	4
437	3
438	5
439	12
440	8
441	12
442	12
443	11
444	12
445	12
446	1
447	5
448	6
449	5
450	9
451	12
452	6
453	13
454	16
455	13
456	2
457	10
458	4
459	16
460	10
461	12
462	6
463	14
464	11
465	11
466	10
467	6
468	3
469	13

C-LOCATION	C-CLIMATE-ZONE
470	10
471	2
472	3
473	14
474	10
475	10
476	11
477	2
478	6
479	9
480	11
481	8
482	9
483	10
484	12
485	12
486	2
487	12
488	3
489	3
490	16
491	16
492	2
493	16
494	4
495	10
496	3
497	3
498	6
499	7
500	9
501	9
502	3
503	3
504	9
505	3
506	10
507	4
508	3
509	3
510	12
511	5
512	9
513	3
514	6
515	3
516	6
517	2
518	16
519	13
520	8

C-LOCATION	C-CLIMATE-ZONE
521	6
522	6
523	4
524	3
525	9
526	5
527	6
528	9
529	2
530	10
531	4
532	3
533	16
534	1
535	6
536	4
537	13
538	13
539	16
540	1
541	16
542	9
543	16
544	6
545	9
546	2
547	12
548	9
549	16
550	8
551	16
552	9
553	3
554	9
555	10
556	16
557	16
558	8
559	12
560	12
561	11
562	16
563	9
564	4
565	16
566	16
567	16
568	16
569	16
570	9
571	16

C-LOCATION	C-CLIMATE-ZONE
572	15
573	9
574	13
575	3
576	12
577	6
578	12
579	12
580	12
581	16
582	14
583	16
584	16
585	13
586	16
587	12
588	11
589	8

C-LOCATION	C-CLIMATE-ZONE
590	14
591	16
592	5
593	9
594	2
595	3
596	10
597	2
598	3
599	12
600	9
601	3
602	14
603	5
604	6
605	14
606	9
607	13

C-LOCATION	C-CLIMATE-ZONE
608	7
609	12
610	9
611	12
612	12
613	14
614	13
615	3
616	16
617	16
618	6
619	9
620	9
621	9
622	6
623	11
624	16
625	16

C-LOCATION	C-CLIMATE-ZONE
626	9
627	16
628	11
629	2
630	8
631	2
632	11
633	12
634	16
635	12
636	3
637	8
638	16
639	16
640	11
641	10

C-CLIMATE-REGION (none, Integer, Prescribed)

Represents the column in Table 1-H or 1-I of the Standards which provides the budget envelope thermal performance criteria. The value for this keyword is set by the rules processor depending on the value for C-CLIMATE-ZONE as described in the following table:

C-CLIMATE-ZONE	C-CLIMATE-REGION
1	1
2	2
3	2
4	2
5	2

C-CLIMATE-ZONE	C-CLIMATE-REGION
6	3
7	3
8	3
9	3
10	3

C-CLIMATE-ZONE	C-CLIMATE-REGION
11	4
12	4
13	4
14	5
15	5

C-CLIMATE-ZONE	C-CLIMATE-REGION
16	1

C-WEATHER-FILE (none, Text String – 64 Characters Max, Prescribed)

Represents the California weather file that is set by the rules processor according to the following table:

C-CLIMATE-ZONE	C-WEATHER-FILE
1	CZ2\CZ01.bin
2	CZ2\CZ02.bin
3	CZ2\CZ03.bin
4	CZ2\CZ04.bin
5	CZ2\CZ05.bin
6	CZ2\CZ06.bin
7	CZ2\CZ07.bin

C-CLIMATE-ZONE	C-WEATHER-FILE
8	CZ2\CZ08.bin
9	CZ2\CZ09.bin
10	CZ2\CZ10.bin
11	CZ2\CZ11.bin
12	CZ2\CZ12.bin
13	CZ2\CZ13.bin
14	CZ2\CZ14.bin

C-CLIMATE-ZONE	C-WEATHER-FILE
15	CZ2\CZ15.bin
16	CZ2\CZ16.bin

SPACE

The following compliance analysis keywords are available in the SPACE command:

C-SCHEDULE-TYPE
C-CONDITIONING
C-SUB-AREA
C-OCC-TYPE
C-TLD-VENT-CFM/A
C-LTG-PLANS-INCL
C-TLD-LTG-W/AREA
C-SUB-TSK-LT-KW
C-SUB-LTG-W/AREA
C-SUB-SRC-BTUH
C-SUB-SRC-KW
C-SUB-SRC-LATENT
C-SUB-SRC-SENS
C-LTG-CNTRL-CRED
C-SUB-TSK-LT-W/A
C-AREA
C-NUM-MCTRL-RCDS
C-NUM-CCTRL-RCDS
C-TRNSFR-AIR-CFM
C-ACTIVITY-DESC

C-SCHEDULE-TYPE (0, integer symbol, -)

An integer representing the type of schedules for the space. Valid inputs are given in the following table:

Value	Schedule Type
0	"Nonresidential"
1	"Hotel Function"
2	"Hotel Guest Room"
3	"Residential"

C-CONDITIONING (0, integer symbol, -)

An integer representing the type of space according to definitions in Chapter 12 of the Standards. Valid inputs are given in the following table:

Value	Type of Conditioning
0	"Conditioned"
2	"Indirectly Conditioned-Occupied"
3	"Indirectly Conditioned-Unoccupied"
4	"Unconditioned"
5	"Plenum"

C-SUB-AREA (none, 0 – 100,0000 ft2, optional)

A list of up to ten values representing individual activity areas in the SPACE command. The sum of all elements of this keyword must be equal to any user input value for C-AREA and AREA.

C-OCC-TYPE (none, integer symbol, required)

An integer representing the occupancy type of the space or activity area. If any elements of C-SUB-AREA are greater than zero, then values must be input for corresponding elements in C-OCC-TYPE. If no elements of C-SUB-AREA are input, then only the first element of C-OCC-TYPE must be entered and is assumed to represent the occupancy type for the entire space. Valid inputs are dependent on the value of C-SCHEDULE-TYPE and are given in the following table:

	Value	Occupancy Type
C-SCHEDULE-TYPE = 0		
	0	"- undefined -"
	2	"Auditorium"
	3	"Auto Repair Workshop"
	4	"Bank/Financial Institution"
	5	"Bar, Cocktail Lounge and Casino"
	6	"Barber & Beauty Shop"
	7	"Classroom"

	Value	Occupancy Type
	8	"Commercial/Industrial Storage"
	9	"Commercial/Industrial Work-General High Bay"
	10	"Commercial/Industrial Work-General Low Bay"
	11	"Commercial/Industrial Work-Precision"
	12	"Convention, Conference and Meeting Center"
	13	"Corridor, Restroom and Support Area"
	14	"Courtrooms"
	15	"Dining Area"
	16	"Dry Cleaning (Coin Operated)"
	17	"Dry Cleaning (Full Service Commercial)"
	18	"Electrical/Mechanical Room"
	19	"Exercising Centers and Gymansium"
	20	"Exhibit Display Area"
	21	"Grocery Sales Area"
	25	"Kitchen and Food Preparation"
	26	"Laundry"
	27	"Library – Reading Area"
	28	"Library – Stacks"
	29	"Lobby - Hotel"
	30	"Lobby - Main Entry and Assembly"
	31	"Lobby - Office Reception/Waiting Room"
	32	"Locker and Dressing Room"
	33	"Mall, Arcade and Atrium"
	34	"Medical and Clinical Care"
	35	"Office"
	36	"Police Station and Fire Station"
	37	"Religious Worship"
	38	"Retail Sales, Wholesale Showroom"
	39	"Smoking Lounge"
	40	"Theater (Motion Picture)"
	41	"Theater (Performance)"
	42	"Unknown"
	1	"All Others"
C-SCHEDULE-TYPE = 1		
	0	"- undefined -"
	2	"Auditorium"
	5	"Bar, Cocktail Lounge and Casino"
	12	"Convention, Conference and Meeting Center"
	13	"Corridor, Restroom and Support Area"
	15	"Dining Area"
	20	"Exhibit Display Area"
	23	"Hotel Function Area"
	29	"Lobby - Hotel"
	41	"Theater (Performance)"
C-SCHEDULE-TYPE = 2		
	0	"- undefined -"
	13	"Corridor, Restroom and Support Area"
	24	"Hotel/Motel Guest Room"
C-SCHEDULE-TYPE = 3		
	0	"- undefined -"
	13	"Corridor, Restroom and Support Area"
	22	"High-Rise Residential"

C-TLD-VENT-CFM/A (0, 0 – 100.0 cfm/ft2, -)
A list of up to 10 values for the tailored ventilation rates corresponding to the values for C-SUB-AREA (activity areas). The tailored ventilation rate is any outdoor air ventilation rate that is higher than maximum outdoor air ventilation rate allowed by Section 141 of the Standards and can be justified by the designer as necessary due to exceptional ventilation requirements of the space. Note that if the corresponding value (i.e. the value with the same element index) of C-SUB-AREA is zero, the rules processor ignores its corresponding value for this keyword.

C-LTG-PLANS-INCL (1, integer symbol, -)
Flag indicating if lighting plans are included for the space. A value of 1 indicates that lighting plans are included. This keyword may equal zero even if the compliance analysis includes the lighting system, indicating that lighting compliance shall not be performed for any spaces where C-LTG-PLANS-INCL is zero.

C-TLD-LTG-W/AREA (0, 0 – 100.0 W/ft2, -)
A list of up to 10 values for the tailored lighting levels rates corresponding to the values for C-SUB-AREA (activity areas). The tailored lighting level is any lighting power level determined according to Section 146(b)3 of the Standards. When values are input for this keyword, Tailored Lighting compliance forms must be included with the compliance documentation. Note that if the corresponding value (i.e. the value with the same element index) of C-SUB-AREA is zero, the rules processor ignores its corresponding value for this keyword.

C-SUB-TSK-LT-KW (0, 0 – 100.0 kW, -)
A list of up to 10 values for task lighting power corresponding to the values for C-SUB-AREA (activity areas).

C-SUB-LTG-W/AREA (0, 0 – 100.0 w/ft2, -)
A list of up to 10 values for lighting power density corresponding to the values for C-SUB-AREA (activity areas). Note that if the corresponding value (i.e. the value with the same element index) of C-SUB-AREA is zero, the rules processor ignores its corresponding value for this keyword.

C-SUB-TSK-LT-W/A (0, 0 – 100.0 w/ft2, -)
A list of up to 10 values for task lighting power density corresponding to the values for C-SUB-AREA (activity areas). Note that if the corresponding value (i.e. the value with the same element index) of C-SUB-AREA is zero, the rules processor ignores its corresponding value for this keyword.

C-SUB-SRC-BTUH (0, 0 – 100.0 Btuh, -)
A list of up to 10 values for additional source (or process) energy corresponding to the values for C-SUB-AREA (activity areas). According to Section 146(b)10, process energy inputs must be based on actual information of the actual use of the building. Any values input for this keyword will be added by the rules processor to corresponding values for C-SUB-SRC-KW.

C-SUB-SRC-KW (0, 0 – 100.0 kW, -)
A list of up to 10 values for additional source (or process) energy corresponding to the values for C-SUB-AREA (activity areas). According to Section 146(b)10, process energy inputs must be based on actual information of the actual use of the building.

C-SUB-SRC-SENS (0, 0 – 1, -)
The fraction of C-SUB-SRC-BTUH and C-SUB-SRC-KW added to the space as sensible load. The sum of C-SUB-SRC-SENS and C-SUB-SRC-LATENT for any corresponding element of C-SUB-AREA (activity area) must not be greater than 1 and may be less than 1 if the entire load is not added to the space.

C-SUB-SRC-LATENT (0, 0 – 1, -)
The fraction of C-SUB-SRC-BTUH and C-SUB-SRC-KW added to the space as latent load. The sum of C-SUB-SRC-SENS and C-SUB-SRC-LATENT for any corresponding element of C-SUB-AREA (activity area) must not be greater than 1 and may be less than 1 if the entire load is not added to the space.

C-LTG-CNTRL-CRED (0, 0 – 100.0 w/ft2, -)
The lighting control credits for the corresponding value of C-SUB-AREA (activity area). This value will be subtracted from the overall installed lighting power for the activity area. Note that if the corresponding value (i.e. the value with the same element index) of C-SUB-AREA is zero, the rules processor ignores its corresponding value for this keyword. Any value input for C-LTG-CNTRL-CRED must be supported by a completed Lighting Control Credits compliance form.

C-AREA (none, 0 – 1,000,000 ft2, prescribed)
The sum of all of the elements of C-SUB-AREA. C-AREA must equal AREA or an error will occur.

C-NUM-MCTRL-RCDS (none, 0 – 1,000, optional)
The number of blank records to be printed for the space in the Mandatory Lighting Controls form of the compliance documentation.

C-NUM-CCTRL-RCDS (none, 0 – 1,000, optional)
The number of blank records to be printed for the space in Lighting Controls for Credit form of the compliance documentation.

C-TRNSFR-AIR-CFM (0, -9,999,999.0 – 9,999,999.0 cfm, -)
The amount of outside ventilation air transferred into (positive value) from another zone or out of a zone (negative value) to another zone. Transfer air is calculated according to the exception to Section 121(b)2 of the standards.

CONSTRUCTION

The following compliance analysis keywords are available in the CONSTRUCTION command:

C-WALL-TYPE **C-FORM-THREE-REF**

C-WALL-TYPE (0, integer symbol, -)
The wall type of the construction for budget determination purposes. Tables 1-H and 1-I of the Standards specify budget thermal performance characteristics depending on whether a framed wall has metal or wood framing or is of some "other" construction. This is input is required so that the budget u-value can be properly set by the rules processor. This information will be output to the compliance forms; the user is advised to ensure that information on the compliance forms match the construction documents for the proposed building. Valid inputs for this keyword are given in the following table:

Value	Wall Type
0	"Non-Metal Framing"
1	"Metal Framing"

C-FORM-THREE-REF (none, character string – 96 characters max, optional)
The reference to a Form CF-3 Compliance Form (completed by hand by the documentation author) for the CONSTRUCTION command.

EXTERIOR-WALL

The following compliance analysis keywords are available in the EXTERIOR-WALL command:

C-DEMISING-WALL **C-COOL-ROOF** **C-SKYLIGHT-ROOF**

C-DEMISING-WALL (0, 0 – 1, -)
Flag identifying if the EXTERIOR-WALL is a demising wall (see Section 101(b) Definitions of the Standards). A value of one indicates the EXTERIOR-WALL is a demising wall. Constructions of all demising walls are modified by the rules processor to have no heat gain or heat loss. Additionally, the area of demising walls is not included in the calculation of the Gross Exterior Wall Area, which is used to calculate the glazing area as a percentage of overall wall area.

C-COOL-ROOF (0, 0 – 1, -)
Flag identifying if the EXTERIOR-WALL is a cool roof as defined in the Standards (see Section 10-113 of the Standards). A value of one indicates the EXTERIOR-WALL is a cool roof. CONSTRUCTION commands referenced by EXTERIOR-WALLs with C-COOL-ROOF of one may not be referenced by EXTERIOR-WALLS with C-COOL-ROOF of zero.

C-SKYLIGHT-ROOF (0, 0 – 1, -)
Flag indicating whether or not the EXTERIOR-WALL is defined simply to facilitate the modeling of skylights above a space that is located below a plenum. The default value will be set to 1 if the wall has the tilt of a roof (-60° <= tilt <= 60°) and the assigned construction is defined with simplified properties with a U-value of < 0.0011.

INTERIOR-WALL

The following compliance analysis keywords are available in the INTERIOR-WALL command:

C-DEMISING-WALL

C-DEMISING-WALL (0, 0 – 1, -)
Flag identifying if the INTERION-WALL is a demising wall (see Section 101(b) Definitions of the Standards). A value of one indicates the INTERIOR-WALL is a demising wall. Constructions of all demising walls are modified by the rules processor to have no heat gain or heat loss.

FLOOR

The following compliance analysis keywords are available in the FLOOR command:

C-DISPLAY-PERIM

C-DISPLAY-PERIM (0, 0 – 9,999,999 ft, -)
Display perimeter of the floor of the building as defined in Section 101(b) – Definitions – of the Standards. The display perimeter will be output to the compliance forms. The compliance documentation author should ensure that information reported on the compliance forms matches the construction documents for the proposed building.

GLASS-TYPE

The following compliance analysis keywords are available in the GLASS-TYPE command:

C-PRODUCT-TYPE
C-TYPE
C-NUM-PANES
C-TRANSPARENCY
C-AIR-SPACE
C-LOW-E-COATING
C-TINT
C-DIVIDERS
C-DIVIDED-LITES
C-FRAME-TYPE

All of the following compliance analysis keywords in the GLASS-TYPE command have default values, and out of range inputs will yield errors in BDL processing. However, the rules processor only references these values under certain conditions (inputs for compliance analysis keywords in the WINDOW command). Refer to the WINDOW command for further discussion of when compliance analysis keywords in the GLASS-TYPE command are utilized.

C-PRODUCT-TYPE (0, integer symbol, -)

The product type as needed to determine default U-factor or SHGC. Valid inputs are giving in the following table:

Value	Product Type
0	"Operable Window"
1	"Fixed Window"
2	"Greenhouse/Garden Window"
3	"Operable Door"
4	"Operable Transparent Skylight"
5	"Operable Transluscent Skylight"
6	"Fixed Transparent Skylight"
7	"Fixed Transluscent Skylight"
11	"Operable Glass Skylight With Curb"
12	"Operable Glass Skylight Without Curb"
13	"Operable Plastic Skylight With Curb"
14	"Operable Plastic Skylight Without Curb"
15	"Fixed Glass Skylight With Curb"
16	"Fixed Glass Skylight Without Curb"
17	"Fixed Plastic Skylight With Curb"
18	"Fixed Plastic Skylight Without Curb"

C-TYPE (0, integer symbol, -)

The type of assembly of the GLASS-TYPE command. Valid inputs are given in the following table:

Value	Assembly Type
0	"Manufactured"
1	"Field-Assembled"

C-NUM-PANES (0, integer symbol, -)

The number of panes of the GLASS-TYPE. Valid inputs are given in the following table:

Value	Number of Panes
1	"Single Pane"
2	"Double Pane"
3	"Triple Pane"
4	"Quadruple Pane"
5	"Other Design"
12	"Single 1/4 in. Acrylic/Polycarbonate"
13	"Single 1/8 in. Acrylic/Polycarbonate"

14	"Single 1/8 in. glass"

C-TRANSPARENCY (0, integer symbol, -)
Used to specify whether the glazing is transparent or translucent. Valid inputs are given in the following table:

Value	Transparency
0	"Translucent"
1	"Transparent"

C-AIR-SPACE (0, integer symbol, -)
The size of the air space of a GLASS-TYPE where C-NUM-PANES is "Double Pane" or more. Valid inputs are given in the following table:

Value	Size of Air Space
0	"< 7/16"
1	">= 7/16"
11	">= 7/16 and < 1/2"
12	">= 1/2"
13	"< 7/16 Argon Fill"
14	"< 7/16 Krypton Fill"
15	">= 7/16 and < 1/2 Argon Fill"
16	">= 7/16 and < 1/2 Krypton Fill"
17	">= 1/2 Argon Fill"

C-LOW-E-COATING (0, integer symbol, -)
The type of low emmissivity coating for the GLASS-TYPE. Valid inputs are given in the following table:

Value	Type of Low Emmisivity Coating
0	"No Low Emmissivity Coating"
1	"Low Emmissivity Coating"
11	"e = 0.60 on surface 2 or 3"
12	"e = 0.40 on surface 2 or 3"
13	"e = 0.20 on surface 2 or 3"
14	"e = 0.10 on surface 2 or 3"
15	"e = 0.050 on surface 2 or 3"

C-TINT (0, integer symbol, -)
The type of tint or coating for the GLASS-TYPE. Valid inputs are given in the following table:

Value	Type of Tint
0	"No Coating or Tinting"
1	"Tinted"

C-DIVIDERS (0, integer flag, -)
A flag indicating if the GLASS-TYPE has dividers between the individual panes of glass (as opposed to the GLASS-TYPE having true divided lites). A value of one means the GLASS-TYPE has dividers.

C-DIVIDED-LITES (0, integer flag, -)
A flag indicating if the GLASS-TYPE has true divided lites. A value of one means the GLASS-TYPE has divided lites.

C-FRAME-TYPE (0, integer symbol, -)
The type of fenestration framing for the GLASS-TYPE. California compliance analysis is performed without consideration of inputs for standard DOE-2.2 keywords for frames in the WINDOW command.

Instead, the rules processor adjusts the value of GLASS-CONDUCTANCE in consideration of the value for C-FRAME-TYPE. Valid inputs for this keyword are given in the following table:

Value	Type of Fenestration Frame
0	"Metal"
1	"Metal w/ Thermal Break"
2	"Non-metal"
3	"Non-metal w/ metal cladding"
4	"Other Design"

WINDOW

The following compliance analysis keywords are available in the WINDOW command:

C-UFACTOR-METHOD
C-SHGC-METHOD
C-PRODUCT-TYPE
C-TYPE
C-GLASS-DOOR
C-IS-SKYLIGHT
C-DIVIDERS
C-DIVIDED-LITES
C-UFACTOR
C-FRAME-TYPE
C-SHGC
C-SHGC-CENTER
C-WELL-DEPTH
C-WELL-HEIGHT
C-WELL-WIDTH
C-WELL-WALL-REFL
C-WELL-TOP-REFL

C-UFACTOR-METHOD (0, integer symbol, -)

The method for determining the U-factor of the WINDOW command. Valid inputs are given in the following table:

Value	U-factor Method
0	"Title 24 Default Table"
1	"NFRC"
2	"ACM Appendix I"

C-SHGC-METHOD (0, integer symbol, -)

The method for determining the Solar Heat Gain Coefficient (SHGC) for the WINDOW command. Valid inputs are given in the following table:

Value	SHGC Method
0	"Title 24 Default Table"
1	"NFRC"
2	"Manufacturer's Data"

C-PRODUCT-TYPE (none, integer symbol, required)

Refer to C-PRODUCT-TYPE in the GLASS-TYPE command. In the absence of user input this value will default to the value of the same keyword in the GLASS-TYPE command. The rules processor references this keyword only when C-UFACTOR-METHOD equals zero ("Title 24 Default Table") or C-SHGC-METHOD equals zero ("Title 24 Default Table").

C-TYPE (none, integer symbol, required)

Refer to C-TYPE in the GLASS-TYPE command. In the absence of user input this value will default to the value of the same keyword in the GLASS-TYPE command. The rules processor references this keyword only when C-UFACTOR-METHOD equals zero ("Title 24 Default Table") or C-SHGC-METHOD equals zero ("Title 24 Default Table").

C-GLASS-DOOR (0, integer flag, -)
Flag indicating if the WINDOW is a glass door. A value of 1 indicates that the WINDOW is a glass door.Glass doors are reported separately on the compliance forms. The compliance documentation author should ensure that the compliance documentation matches the construction documents for the proposed building.

C-IS-SKYLIGHT (none, integer flag, prescribed)
Flag indicating if the WINDOW is a skylight. The rules processor automatically sets this keyword based on the value of TILT of the parent EXTERIOR-WALL.

C-DIVIDERS (none, integer symbol, required)
Refer to C-DIVIDERS in the GLASS-TYPE command. In the absence of user input this value will default to the value of the same keyword in the GLASS-TYPE command. The rules processor references this keyword only when C-UFACTOR-METHOD equals zero ("Title 24 Default Table") or C-SHGC-METHOD equals zero ("Title 24 Default Table").

C-DIVIDED-LITES (none, integer symbol, required)
Refer to C-DIVIDED-LITES in the GLASS-TYPE command. In the absence of user input this value will default to the value of the same keyword in the GLASS-TYPE command. The rules processor references this keyword only when C-UFACTOR-METHOD equals zero ("Title 24 Default Table") or C-SHGC-METHOD equals zero ("Title 24 Default Table").

C-FRAME-TYPE (none, integer symbol, required)
Refer to C-FRAME-TYPE in the GLASS-TYPE command. In the absence of user input this value will default to the value of the same keyword in the GLASS-TYPE command. The rules processor references this keyword only when C-UFACTOR-METHOD equals zero ("Title 24 Default Table") or C-SHGC-METHOD equals zero ("Title 24 Default Table").

C-UFACTOR (none, 0.0 – 10.0 Btu/hr-Ft-F, required)
The NFRC certified U-factor for the WINDOW. This keyword is referenced by the rules processor only if C-UFACTOR-METHOD equals 1 ("NFRC"). This value is reported in the compliance forms and must be identical to the value for U-factor appearing the label affixed to the actual fenestration assembly delivered to the construction site. The compliance documentation author should confirm that information reported in the compliance forms matches the construction documents for the proposed building as well as labels affixed to the actual fenestration products installed in the building during construction.

C-SHGC (none, 0.0 – 10.0, required)
The NFRC certified Solar Heat Gain Coefficient for the WINDOW. This keyword is referenced by the rules processor only if C-SHGC-METHOD equals 1 ("NFRC"). This value is reported in the compliance forms and must be identical to the value for SHGC appearing the label affixed to the actual fenestration assembly delivered to the construction site. The compliance documentation author should confirm that information reported in the compliance forms matches the construction documents for the proposed building as well as labels affixed to the actual fenestration products installed in the building during construction.

C-SHGC-CENTER (none, 0.0 – 10.0, required)
The center-of-glass Solar Heat Gain Coefficient for the WINDOW as reported in the manufacturer's literature for the fenestration. This keyword is referenced by the rules processor only if C-SHGC-METHOD equals 2 ("Manufacturer's Data"). This value is reported in the compliance forms and must be identical to the value for SHGC appearing in the manufacturer's literature. The compliance documentation author should confirm that information reported in the compliance forms matches the construction documents for the proposed building.

C-WELL-DEPTH (-, 0.0 – 1000.0, required)
The depth of a skylight well in feet. The default is the larger of 0.5 and the difference of the [great grandparent] FLOOR:FLOOR-HEIGHT and the [grandparent] SPACE:HEIGHT. This keyword is only referenced when C-IS-SKYLIGHT > 1 (window is a skylight) and DOE-2.2 daylighting is being simulated.

C-WELL-HEIGHT (defaults to window height, 0.0 – 1000.0, required)
The height (or length) of a skylight well in feet. The default is WINDOW:HEIGHT. This keyword is only referenced when C-IS-SKYLIGHT > 1 (window is a skylight) and DOE-2.2 daylighting is being simulated.

C-WELL-WIDTH (defaults to window width, 0.0 – 1000.0, required)
The width of a skylight well in feet. The default is WINDOW:WIDTH. This keyword is only referenced when C-IS-SKYLIGHT > 1 (window is a skylight) and DOE-2.2 daylighting is being simulated.

C-WELL-WALL-REFL (0.50, 0.0 – 1.0, required)
The wall reflectance of a skylight well. This keyword is only referenced when C-IS-SKYLIGHT > 1 (window is a skylight) and DOE-2.2 daylighting is being simulated.

C-WELL-TOP-REFL (0.75, 0.0 – 1.0, required)
The reflectance of the top of the skylight well. This keyword is only referenced when C-IS-SKYLIGHT > 1 (window is a skylight) and DOE-2.2 daylighting is being simulated.

HVAC

This section lists the enhancements to the LOADS portion of DOE-2.2. The following commands have compliance analysis keywords:

SYSTEM
ZONE
CIRCULATION-LOOP
PUMP
CHILLER
BOILER
DW-HEATER
HEAT-REJECTION
COMPLIANCE-DHW

The COMPLIANCE-DHW command consists only of compliance analysis keywords and must be utilized under the following conditions:

1. The compliance input file includes any water heating systems serving residential occupancies.

2. The compliance input file includes more than one CIRCULATION-LOOP with TYPE of DHW and each of these loops serves spaces with nonresidential occupancies.

SYSTEM

The following compliance analysis keywords are available in the SYSTEMS command:

C-NUM-OF-UNITS
C-HAS-HTG-CLG
C-TOTAL-CLG-CAP
C-TOTAL-HTG-CAP
C-HP-HTG-CAP17
C-AC-CONFIG
C-HP-CONFIG
C-SUPP-HEAT
C-CONDENSER-TYPE
C-EER95
C-IPLV
C-SEER
C-COP47
C-COP17
C-HSPF
C-EER82
C-EER85EWT
C-EER75EWT
C-EER70EWT
C-EER50EWT
C-COP70EWT
C-COP50EWT
C-FURN-CONFIG
C-AFUE
C-THERM-EFF-MAX
C-THERM-EFF-MIN
C-USER-INPUT-HIR
C-SUPP-FAN-TYPE
S-SUP-FAN-QTY
C-SF-TOT-BHP
C-SF-TOT-NOM-HP
C-SF-MTR-TYPE
C-SF-MTR-ENCL
C-SF-MTR-SNC-SPD
C-SF-MOTOR-EFF
C-SF-DRIVE-EFF
C-SF-FILTRATION
C-SF-FILT-SP
C-SF-TOT-SP
C-TOT-RET-FLOW
C-RET-FAN-TYPE
C-RET-FAN-QTY
C-RF-TOT-BHP
C-RF-TOT-NOM-HP
C-RF-MTR-TYPE
C-RF-MTR-ENCL
C-RF-MTR-SNC-SPD
C-RF-MOTOR-EFF
C-RF-DRIVE-EFF
C-RF-FILTRATION
C-RF-FILT-SP
C-RF-TOT-SP
C-HFAN-FAN-TYPE
C-HFAN-QTY
C-HFAN-TOT-BHP
C-HFAN-TOT-NM-HP
C-HFAN-MTR-TYPE
C-HFAB-MTR-ENCL
C-HFAN-MTR-SPD
C-HFAN-MTR-EFF
C-HFAN-DRIVE-EFF
C-HF-FILTRATION
C-HF-FILT-SP
C-HF-TOT-SP
C-SYS-ZONE-TYPE
C-TIME-CONTROL
C-SETBK-CONTROL
C-NUM-ISO-ZONES
C-HT-PUMP-TSTAT

C-VENT-METHOD
C-OSA-DMPR-CTRL
C-HTG-EQUIP-MFRG
C-HTG-EQUIP-MNUM
C-CLG-EQUIP-MFRG
C-CLG-EQUIP-MNUM
C-HTG-DUCT-LOCN
C-HTG-DUCT-RVAL
C-CLG-DUCT-LOCN
C-CLG-DUCT-RVAL
C-DUCT-TAPE-OK
C-PIPE-TYPE
C-PIPE-INS-RVAL
C-DUCT-SEALING
C-DUCT-LEAK-FRAC
C-SUP-DUCT-RVAL
C-RET-DUCT-RVAL

C-NUM-OF-UNITS (1, 1 – 1,000,000, -)

The total number of systems combined to make up this SYSTEM command. The rules processor will divide the cooling and heating capacities by C-NUM-OF-UNITS to determine the average unit capacities. These average capacities are used by the rules processor to determine the budget heating and cooling equipment efficiencies.

C-HAS-HTG-CLG (0, integer symbol, -)

Symbol indicating if the system includes heating and/or cooling and whether the system is served by an existing or new chilled water or hot water plant. Valid inputs depend on values for TYPE and HEAT-SOURCE keywords. Refer to values for TYPE and HEAT-SOURCE keywords. Valid values for this keyword are dependent on the system type and are given in the following table:

	Value	C-HAS-HTG-CLG
TYPE = HP		
	0	"Existing System"
	1	"Heating and Cooling"
	5	"Heating and Cooling/Exist'g Plant"
	7	"Heating and Cooling/Exist'g Htg Plant"
	6	"Heating and Cooling/Exist'g Clg Plant"
	2	"Cooling Only"
	8	"Cooling Only/Exist'g Clg Plant"
	3	"Heating Only"
	4	"Heating Only/Exist'g Htg Plant"
TYPE = PSZ, PMZ, PVAVS, PVVT, PTAC, RESYS2, RESVVT, RESYS		
HEAT-SOURCE = HOT-WATER	0	"Existing System"
	1	"Heating and Cooling"
	7	"Heating and Cooling/Exist'g Htg Plant"
	2	"Cooling Only"
	3	"Heating Only"
	4	"Heating Only/Exist'g Htg Plant"
HEAT-SOURCE = Any except HOT-WATER	0	"Existing System"
	1	"Heating and Cooling"
	2	"Cooling Only"
	3	"Heating Only"
TYPE = FC, PIU, SZRH, VAVS		
HEAT-SOURCE = HOT-WATER	0	"Existing System"
	1	"Heating and Cooling"
	5	"Heating and Cooling/Exist'g Plant"
	7	"Heating and Cooling/Exist'g Htg Plant"
	6	"Heating and Cooling/Exist'g Clg Plant"
	2	"Cooling Only"
	8	"Cooling Only/Exist'g Clg Plant"
	3	"Heating Only"
	4	"Heating Only/Exist'g Htg Plant"

HEAT-SOURCE =	0	"Existing System"
Any except	1	"Heating and Cooling"
HOT-WATER	6	"Heating and Cooling/Exist'g Clg Plant"
	2	"Cooling Only"
	8	"Cooling Only/Exist'g Clg Plant"
	3	"Heating Only"
TYPE = UHT, UVT, HVSYS		
	0	"Existing System"
	3	"Heating Only"
	4	"Heating Only/Exist'g Htg Plant"

C-TOTAL-CLG-CAP (0, 0 – 99,999,999 Btu/hr, -)
The total of the nominal cooling capacities of all units that are combined together to make up this SYSTEM command. For many types of packaged equipment, the nominal capacity is capacity reported in summary manufacturer's literature and includes the detrimental effects of fan power at testing conditions.

C-TOTAL-HTG-CAP (0, 0 – -99,999,999 Btu/hr, -)
The total of the nominal heating capacities of all units that are combined together to make up this SYSTEM command. For most types of packaged heat pumps, the nominal capacity is capacity reported in summary manufacturer's literature and includes the additional effects of fan power at testing conditions.

C-HP-HTG-CAP17 (0,0 - -99,999,999 Btu/hr, -)
The nominal heat pump heating capacity at 17F outside air temperature.

C-AC-CONFIG (0, integer symbol, -)
The configuration of the DX air conditioner for this system. This keyword is referenced by the rules processor only if the DOE-2.2 system type has DX cooling. Refer to values for TYPE keyword. Valid values for this keyword are dependent on the system type and are given in the following table:

	Value	Air Conditioner Configuration
TYPE = PTAC		
	2	"Pkg Terminal Air Conditioner"
	3	"Room AC w/ Louvered Sides"
	4	"Room AC w/o Louvered Sides"
TYPE = ALL OTHERS		
	0	"Single Package"
	1	"Split System"
	5	"Condensing Unit"

C-HP-CONFIG (0, integer symbol, -)
The configuration of the heat pump for this system. This keyword is referenced by the rules processor only if HEAT-SOURCE equals HEAT-PUMP. Refer to values for HEAT-SOURCE keyword. Valid inputs for this keyword are dependent on the system type and are given in the following table:

	Value	Air Conditioner Configuration
TYPE = PTAC		
	2	"Pkg Terminal Heat Pump"
	3	"Room HP w/ Louvered Sides"
	4	"Room HP w/o Louvered Sides"
TYPE = ALL OTHERS		
	0	"Single Package"
	1	"Split System"

C-SUPP-HEAT (0, integer flag, -)
Flag indicating if the heat pump has a supplemental heat source. A value of one indicates that the heat pump has supplemental heat.

C-CONDENSER-TYPE (0, integer symbol, -)
The type of condenser for a DX air conditioner. This keyword is referenced by the rules processor only if the DOE-2.2 system type has DX cooling. Refer to values for TYPE keyword. Valid values for this keyword are dependent on the system type and are given in the following table:

Value	Condenser Type
0	"Air Cooled"
1	"Water Cooled"
2	"None"

C-EER95 (none, 0.0 – 50.0, optional)
The energy efficiency ratio (EER) of any packaged central air conditioner with a nominal cooling capacity greater than 65,000 Btu/hr. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-IPLV (none, 0.0 – 50.0, optional)
The integrated part-load value (IPLV) of any packaged central air conditioner with a nominal cooling capacity greater than 65,000 Btu/hr. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-SEER (none, 0.0 – 50.0, optional)
The seasonal energy efficiency ratio (SEER) of any packaged central air conditioner with a nominal cooling capacity not greater than 65,000 Btu/hr. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-COP47 (none, 0.0 – 50.0, optional)
The coefficient of performance (COP) at 47F outside drybulb of any packaged central heat pump with a nominal cooling capacity greater than 65,000 Btu/hr. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-COP17 (none, 0.0 – 50.0, optional)
The coefficient of performance (COP) at 17F outside drybulb of any packaged central heat pump with a nominal cooling capacity greater than 65,000 Btu/hr. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-HSPF (none, 0.0 – 50.0, optional)
The heating seasonal performance factor (HSPF) of any packaged central heat pump with a nominal cooling capacity not greater than 65,000 Btu/hr. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-EER82 (none, 0.0 – 50.0, optional)
The energy efficiency ratio (EER) at 82F outside drybulb of any packaged terminal or room air conditioning unit. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-EER85EWT (none, 0.0 – 50.0, optional)
The energy efficiency ratio (EER) at 85F entering water temperature of any water cooled air conditioner. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-EER75EWT (none, 0.0 – 50.0, optional)
The energy efficiency ratio (EER) at 75F entering water temperature of any water cooled air conditioner. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-EER70EWT (none, 0.0 – 50.0, optional)
The energy efficiency ratio (EER) at 70F entering water temperature of any source heat pump. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-EER50EWT (none, 0.0 – 50.0, optional)
The energy efficiency ratio (EER) at 50F entering water temperature of any water source heat pump. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-COP70EWT (none, 0.0 – 50.0, optional)
The coefficient of performance (COP) at 70F entering water temperature of any water source heat pump. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-COP50EWT (none, 0.0 – 50.0, optional)
The coefficient of performance (COP) at 50F entering water temperature of any water source heat pump. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-FURN-CONFIG (0, integer symbol, -)
The configuration of the combustion furnace. This keyword is referenced by the rules processor only if HEAT-SOURCE equals FURNACE. Valid inputs for this keyword are dependent on the value input for TYPE and are given in the following table:

	Value	Furnace Configuration
TYPE = UHT, FPH	3	"Unit Heater"
TYPE = All Others	1	"Indoor Furnace"
	2	"Duct Furnace"
	4	"Integral to Packaged Unit"

C-AFUE (none, 0.0 – 1.0, optional)
The annualized fuel utilization efficiency (AFUE) for the central furnace with a nominal heating capacity less than 225,000 Btu/hr. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-THERM-EFF-MAX (none, 0.0 – 1.0, optional)
The thermal efficiency of the combustion furnace for any furnace not required to have a minimum AFUE. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-THERM-EFF-MIN (none, 0.0 – 1.0, optional)
The thermal efficiency of the combustion furnace for any furnace not required to have a minimum AFUE and which has a low fire rate. If this value is not entered by the user, the rules processor will assign a default value approximately equal to the minimum value allowed by the Standards.

C-USER-INPUT-HIR (none, 0.0 – 10.0 Btu/Btu, optional)
The heat input ratio (HIR), calculated by the user, that is the average of the HIRs for all combustion furnaces combined together to be simulated as one SYSTEM. The following types of furnaces may be combined together (and may only be combined as listed below):

- gas fired furnaces < 225,000 Btu/hr
- oil fired furnaces < 225,000 Btu/hr
- gas fired furnaces ≥ 225,000 Btu/hr
- oil fired furnaces ≥ 225,000 Btu/hr
- HIRs for individual furnaces shall be calculated as follows:
- < 225,000 Btu/hr, 75 ≤ AFUE ≤ 80:
- HIR = 1 / (0.1 * AFUE + .725)
- < 225,000 Btu/hr, 80 ≤ AFUE ≤ 100:
- HIR = 1 / (0.875 * AFUE + .105)
- All other furnaces:
- HIR = 1 / C-THERM-EFF-MAX

The value for C-USER-INPUT-HIR is:

$$C-USER-INPUT-HIR = \frac{\sum HIR * FurnaceOutput}{\sum FurnaceOutput}$$

C-SUPP-FAN-TYPE (0, integer symbol, -)
An integer representing the type of supply fan for the system. This keyword is only referenced by the rules processor if FAN-CONTROL equals FAN-EIR-FPLR or during the establishment of the budget supply fan control for any multi-zone system. Valid inputs for this keyword are given in the following table:

Value	Supply Fan Type	Description
0	"Constant Volume"	Constant Volume Fan
1	"FC Fan w/Dampers"	Forward Curved Fan with Discharge Dampers
2	"FC Fan w/ Vanes"	Forward Curved Fan with Inlet Vanes
3	"AF Fan w/ Vanes"	Air Foil Fan with Inlet Vanes
4	"Any Fan w/ VSD"	Any Fan with an Adjustable Speed Drive
5	"Custom Fan Curve"	Custom Fan Curve
6	"AF Fan w/ Dampers"	Air Foil Fan with Discharge Dampers
7	"Vane Axial Fan"	Vane Axial (Propeller) Fan with Variable Pitch Blades

C-SUP-FAN-QTY (1, 1 – 1,000,000, -)
The total number of fans for all of the systems combined to make up this SYSTEM command. The rules processor will use this value to calculate the average BHP per fan. This value is then used to determine the budget supply fan type.

C-SF-TOT-BHP (0, 0 – 10,000 hp, optional)
The total brake horsepower of all supply fan motors combined in to this SYSTEM. The rules processor will determine the average brake horsepower for budget conversion purposes by dividing S-SF-TOT-BHP

by C-NUM-OF-UNITS. If C-SF-TOT-BHP is zero the rules processor will determine the value from SUPPLY-STATIC and SUPPLY-EFF or SUPPLY-KW/FLOW.

C-SF-TOT-NOM-HP (0, 0 – 10,000 hp, optional)
The total nominal horsepower of all supply fan motors combined in to this SYSTEM. The rules processor will determine the average nominal horsepower for determining the budget motor efficiency by dividing S-SF-TOT-NOM-HP by C-NUM-OF-UNITS. If C-SF-TOT-NOM-HP is zero the rules process will determine the value from C-SF-TOT-BHP.

C-SF-MTR-TYPE (1, integer symbol, -)
The efficiency category of the supply fan motors. Valid inputs for this keyword are given in the following table:

Value	Motor Type	Description
0	"Standard Efficiency"	Older NEMA standard efficiency
1	"CEC Minimum Efficiency"	Minimum prescriptive motor efficiency from the Standards
2	"CEE Premium Efficiency"	The minimum efficiency allowed by the Consortium for Energy Efficiency's voluntary Premium Efficient Motor standard

C-SF-MTR-ENCL (1, integer symbol, -)
The type of motor enclosure for the supply fan motor. The rules processor uses this value, along with C-SF-MTR-TYPE, C-SF-MTR-SNC-SPD and C-SF-TOT-NOM-HP to determine default and budget motor efficiencies. Valid inputs for this keyword are given in the following table:

Value	Motor Enclosure Type
0	"Open"
1	"Closed"

C-SF-MTR-SNC-SPD (0, integer symbol, -)
The synchronous speed of the supply fan motor. The rules processor uses this value, along with C-SF-MTR-TYPE, C-SF-MTR-ENCL and C-SF-TOT-NOM-HP to determine default and budget motor efficiencies. Valid inputs for this keyword are given in the following table:

Value	Motor Synchronous Speed
0	"900 rpm"
1	"1200 rpm"
2	"1800 rpm"
3	"3600 rpm"

C-SF-MOTOR-EFF (none, 0.0 – 1.0, optional)
The nominal efficiency of the supply fan motor. If not input, the rules processor will determine C-SF-MOTOR-EFF according to the following procedure

1. calculating the average nominal horsepower for all systems by dividing C-SF-TOT-NOM-HP by C-NUM-OF-UNITS.

2. determining the motor efficiency using result of 1, above, C-SF-MTR-TYPE and C-SF-MTR-SNC-SPD.

C-SF-DRIVE-EFF (1, 0.0 – 1.0, -)
The efficiency of the system that connects the supply fan motor shaft to the supply fan shaft. Direct couplings have an efficiency of 1.0. Belt drives typically have an efficiency of 0.97.

C-SF-TOT-SP (0, 0.0 – 50.0 in h2o, -)
The total static pressure of the supply duct system.

C-SF-FILTRATION (0, integer flag, -)
Flag indicating if special filtration is included in the supply ducting system. A value of one indicates that special filtration exists in the supply ducting system.

C-SF-FILT-SP (0, 0.0 – 50.0 in. h2o, optional)
The total static pressure drop through any special filtration system in the supply duct system. When the sum of C-SF-FILT-SP and C-RF-FILT-SP is greater than 1 inH20 (See Section 144(c) of the Standards) the rules processor will adjust the overall fan power (both supply and return) by the following factor:

$$FAN\ ADJUSTMENT\ FACTOR = 1 - \frac{C-SF-FILT-SP + C-RF-FILT-SP}{C-SF-TOT-SP + C-RF-TOT-SP}$$

C-TOT-RET-FLOW (0, 0.0 – 9,999,999.0 cfm, optional)
The total return flow of all systems combined into this SYSTEM. This value is used by the rules processor to calculate the fan power index of the fan system. If not input, the rules process will determine its value from DOE-2.2 design run results.

C-RET-FAN-TYPE (0, integer symbol, -)
The type of return fan in the system. Refer to C-SUP-FAN-TYPE for valid values and other requirements.

C-RET-FAN-QTY (1, 1 – 1,000,000, -)
The total number of return fans for all of the systems combined to make up this SYSTEM command. The rules processor will use this value to calculate the average BHP per fan. This value is then used to determine the budget supply fan type.

C-RF-TOT-BHP (0, 0.0 – 10,000 hp, optional)
The total brake horsepower of all return fans combined into this SYSTEM. Refer to C-SF-TOT-BHP for valid inputs and other information.

C-RF-TOT-NOM-HP (0, 0 – 10,000 hp, -)
The total nominal horsepower of all return fan motors combined into this SYSTEM. Refer to C-SF-TOT-NOM-HP for more information.

C-RF-MTR-TYPE (0, integer symbol, -)
The type of the return fan motors. Refer to C-SF-MTR-TYPE for valid inputs and other requirements.

C-RF-MTR-ENCL (1, integer symbol, -)
The type of motor enclosure for the supply fan motor. The rules processor uses this value, along with C-RF-MTR-TYPE, C-RF-MTR-SNC-SPD and C-RF-TOT-NOM-HP to determine default and budget motor efficiencies. Valid inputs for this keyword are given in the following table:

Value	Motor Enclosure Type
0	"Open"
1	"Closed"

C-RF-MTR-SNC-SPD (0, integer symbol, -)
The synchronous speed of the return fan motors. Refer to C-SF-MTR-SNC-SPD for valid inputs and other requirements.

C-RF-MOTOR-EFF (none, 0.0 – 1.0, optional)
The nominal efficiency of the return fan motor. If not input, the rules processor will determine C-SF-MOTOR-EFF in the same manner as C-SF-MOTOR-EFF.

C-RF-DRIVE-EFF (1, 0.0 – 1.0, -)
The efficiency of the system that connects the return fan motor shaft to the return fan shaft. Direct couplings have an efficiency of 1.0. Belt drives typically have an efficiency of 0.97.

C-RF-TOT-SP (0, 0.0 – 50.0 in h2o, -)
The total static pressure of the return duct system.

C-RF-FILTRATION (0, integer flag, -)
Flag indicating if special filtration is included in the return ducting system. A value of one indicates that special filtration exists in the supply ducting system.

C-RF-FILT-SP (0, 0.0 – 50.0 in. h2o, -)
The total static pressure drop through any special filtration system in the return duct system. Refer to C-SF-FILT-SP for further information about how this keyword is used to adjust total fan power.

COMPLIANCE ANALYSIS KEYWORDS FOR DUAL-FAN, DUAL-DUCT SYSTEMS: The following 11 keywords are only referenced by the ruleset if TYPE = DDS and DDS-TYPE = DUAL-FAN.

C-HFAN-FAN-TYPE (0, integer symbol, -)
An integer representing the type of heating supply fan for the system. Refer to C-SUP-FAN-TYPE for valid values and other requirements.

C-HFAN-QTY (1, 1 – 1,000,000, -)
The total number of fans for all of the systems combined to make up this SYSTEM command. The rules processor will use this value to calculate the average BHP per fan. This value is then used to determine the budget supply fan type.

C-HFAN-TOT-BHP (0, 0 – 10,000 hp, optional)
The total brake horsepower of all heating supply fan motors combined in to this SYSTEM. The rules processor will determine the average brake horsepower for budget conversion purposes by dividing C-HFAN-TOT-BHP by C-HFAN-QTY. If C-HF-TOT-BHP is zero the rules processor will determine the value from HSUPPLY-STATIC and HSUPPLY-EFF or HSUPPLY-KW/FLOW.

C-HFAN-TOT-NM-HP (0, 0 – 10,000 hp, optional)
The total nominal horsepower of all heating supply fan motors combined in to this SYSTEM. The rules processor will determine the average nominal horsepower for determining the budget motor efficiency by dividing C-HFAN-TOT-NM-HP by C-HFAN-QTY. If C-HFAN-TOT-NM-HP is zero the rules process will determine the value from C-HFAN-TOT-BHP.

C-HFAN-MTR-TYPE (1, integer symbol, -)
The efficiency category of the heating supply fan motors. Valid inputs for this keyword are given in the following table:

Value	Motor Type	Description
0	"Standard Efficiency"	Older NEMA standard efficiency
1	"CEC Minimum Efficiency"	Minimum prescriptive motor efficiency from the Standards
2	"CEE Premium Efficiency"	The minimum efficiency allowed by the Consortium for Energy Efficiency's voluntary Premium Efficient Motor standard

C-HFAB-MTR-ENCL (1, integer symbol, -)
The type of motor enclosure for the heating supply fan motor. The rules processor uses this value, along with C-HFAN-MTR-TYPE, C-HFAN-MTR-SPD and C-HFAN-TOT-NM-HP to determine default and budget motor efficiencies. Valid inputs for this keyword are given in the following table:

Value	Motor Enclosure Type
0	"Open"
1	"Closed"

C-HFAN-MTR-SPD (0, integer symbol, -)
The synchronous speed of the heating supply fan motor. The rules processor uses this value, along with C-HFAN-MTR-TYPE, C-HFAN-MTR-ENCL and C-HFAN-TOT-NM-HP to determine default and budget motor efficiencies. Valid inputs for this keyword are given in the following table:

Value	Motor Synchronous Speed
0	"900 rpm"
1	"1200 rpm"
2	"1800 rpm"
3	"3600 rpm"

C-HFAN-MOTOR-EFF (none, 0.0 – 1.0, optional)
The nominal efficiency of the heating supply fan motor. If not input, the rules processor will determine C-HFAN-MOTOR-EFF according to the following procedure

3. calculating the average nominal horsepower for all systems by dividing C-HFAN-TOT-NM-HP by C-HFAN-QTY.

4. determining the motor efficiency using result of 1, above, C-HFAN-MTR-TYPE and C-HFAN-MTR-SPD.

C-HFAN-DRIVE-EFF (1, 0.0 – 1.0, -)
The efficiency of the system that connects the heating supply fan motor shaft to the supply fan shaft. Direct couplings have an efficiency of 1.0. Belt drives typically have an efficiency of 0.97.

C-HF-TOT-SP (0, 0.0 – 50.0 in h2o, -)
The total static pressure of the heating supply duct system.

C-HF-FILTRATION (0, integer flag, -)
Flag indicating if special filtration is included in the heating supply ducting system. A value of one indicates that special filtration exists in the heating supply ducting system.

C-HF-FILT-SP (0, 0.0 – 50.0 in. h2o, optional)
The total static pressure drop through any special filtration system in the heating supply duct system. When the sum of C-SF-FILT-SP, C-RF-FILT-SP, C-HF-FILT-SP is greater than 1 inH20 (See Section 144(c) of the Standards) the rules processor will adjust the overall fan power (both supply, heating supply and return) by the following factor:

$$Fan\ Adj\ Fact = 1 - \frac{\frac{C-SF-FILT-SP \times SUPPLY-FLOW + C-HF-FILT-SP \times HSUPPLY-FLOW}{SUPPLY-FLOW + HSUPPLY-FLOW} + C-RF-FILT-SP}{\frac{C-SF-TOT-SP \times SUPPLY-FLOW + C-HF-FILT-SP \times HSUPPLY-FLOW}{SUPPLY-FLOW + HSUPPLY-FLOW} + C-RF-TOT-SP}$$

C-TIME-CONTROL (0, integer symbol, -)
Integer representing the type of time control on the SYSTEM. Valid inputs are given in the following table:

Value	Time Control
0	"Programmable Switch"
1	"Occupancy Sensor"
2	"Manual Timer"

C-SETBK-CONTROL (none, integer symbol, optional)
Integer representing the type of setback control on the SYSTEM. Valid inputs are given in the following table:

Value	Setback Control
0	"None"
1	"Heating"
2	"Cooling"
3	"Heating and Cooling"

If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-NUM-ISO-ZONES (1, 1 – 100 (integer), -)
The number of isolation zones or areas served by this system. Refer to Section 122(g) of the Standards for more information.

C-HT-PUMP-TSTAT (none, integer flag, optional)
Flag indicating that a heat pump is equipped with a thermostat meeting the requirements of Section 112(b). The rules processor will automatically set this value to one (requisite thermostat is included) any time supplemental heat is included in the proposed building input file.

C-VENT-METHOD (0, integer symbol, -)
Integer representing the proposed method for verifying the outdoor air supply (ventilation) quantity. Valid inputs are given in the following table:

Value	Ventilation Method	Description
0	"Air Balance"	Air balance will be performed prior to occupancy
1	"OSA Certification"	Outside air flow rate will be measured and certified prior to occupancy
2	"OSA Meas. Equipment"	System is equipped with outside air measurement and display equipment
3	"Demand Ctrl. Ventilation"	System is equipped with a demand control ventilation system
4	"Natural Ventilation"	System does not have outside air – building has natural ventilation through openable windows.

If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-OSA-DMPR-CTRL (none, integer flag, optional)
Integer flag indicating if the SYSTEM has automatic control of the outside air damper(s). The standards require automatic shutoff of outside air supply for all systems except under one of four conditions (see Section 122(f) of the Standards). A value of one indicates that automatic controls are included. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-HTG-EQUIP-MFRG (none, text string – 96 characters max, optional)
The manufacturer of the heating equipment that is part of the system. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-HTG-EQUIP-MNUM (none, text string – 96 characters max, optional)
The model number of the heating equipment that is part of the system. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-CLG-EQUIP-MFRG (none, character string – 96 characters max, optional)
The manufacturer of the cooling equipment that is part of the system. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-CLG-EQUIP-MNUM (none, text string – 96 characters max, optional)
The model number of the cooling equipment that is part of this system. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-HTG-DUCT-LOCN (none, text string – 96 characters max, optional)
The location of the system's heating ducts (e.g. "within conditioned space"). If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-HTG-DUCT-RVAL (none, 0 – 100 h-ft2-degF/Btu, optional)
The R-value of the heating duct insulation. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-CLG-DUCT-LOCN (none, text string – 96 characters max, optional)
The location of the system's cooling ducts (e.g. "within conditioned space"). If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-CLG-DUCT-RVAL (none, 0 – 100 h-ft2-degF/Btu, optional)
The R-value of the cooling duct insulation. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-DUCT-TAPE-OK (0, integer flag, -)
Flag indicating if pressure sensitive "duct" tape is acceptable on the systems supply air ducts. Refer to Section 124 of the Standards for complete requirements for using pressure sensitive tape to seal ducts and plenums.

C-PIPE-TYPE (none, integer symbol, optional)
Integer representing the type of piping for the system. Valid inputs are given in the following table:

Value	Type of Piping
0	"- other cooling fluid -"
1	"Chilled Water"
2	"Refrigerant Return"
3	"Glycol"
4	"Brine"
10	"- other heating fluid -"
11	"Hot Water"
12	"Steam Supply"
13	"Steam Condensate Return"

If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-PIPE-INS-RVAL (none, 0 – 100 h-ft2-degF/Btu, optional)
The minimum R-value of any pipe insulation. If this value is not input by the user, then its value must be filled in by hand in Form MECH-2 of the compliance documentation.

C-DUCT-SEALING (0, integer flag, -)
Flag to indicate if ducts are sealed according to Chapter 7 of the ACM Manual. A value of one indicates that duct sealing credits are being utilized.

C-DUCT-LEAK-FRAC (none, 0 – 1.00, optional)
The amount of duct leakage for systems whose value for C-DUCT-SEALING equals one. C-DUCT-LEAK-FRAC must be set to one minus the actual amount of duct leakage from the entire duct system.

C-SUP-DUCT-RVAL (none, 0 – 100 h-ft2-degF/Btu, optional)
The R-value of the supply ducts. This value is used by the rules processor to determine energy efficiency credits when C-DUCT-SEALING equals one.

C-RET-DUCT-RVAL (none, 0 – 100 h-ft2-degF/Btu, optional)
The R-value of the return ducts. This value is used by the rules processor to determine energy efficiency credits when C-DUCT-SEALING equals one.

CIRCULATION-LOOP

The following compliance analysis keywords are available in the CIRCULATION-LOOP command:

C-TWR-PIPE-SIZE **C-DHW-TANK-VOL**
C-TANK-INS-RVAL **C-RES-DHW-TYPE**

C-TWR-PIPE-SIZE (none, 0 – 1000 in., optional)
The size of the condenser loop piping at the inlet to the heat rejection device. The rules processor uses this value to adjust condenser loop head pressure for the budget system and sets the budget head pressure higher as the inlet pipe size increases. If this value is not input by the user, the rules processor will automatically set it to a value where budget and proposed head pressures are equal (i.e. no credit is given).

C-TANK-INS-RVAL (none, 0 – 100 h-ft2-degF/Btu, optional)
The R-value of the insulation on the indirect fired water heater attached to a hot water circulation loop. If this value is not input by the user, the rules processor will automatically set it to R-11.

C-DHW-TANK-VOL (none, 0 – 1,000,000 gals, optional)
The storage capacity of the indirect fired water heater attached to a hot water circulation loop. If not input by the user, a volume of zero (instantaneous/heat exchanger) is assigned by the rules processor.

C-RES-DHW-TYPE (0, integer symbol, -)
Integer representing the type of residential water heating distribution system. The rules processor references this keyword only for buildings with high-rise residential occupancies. Valid inputs are given in the following table:

Value	Residential Water Heating System Type
0	"Standard"
1	"POU"
2	"HWR"
3	"Pipe Insulation"
4	"Parallel Piping"
5	"Recirc/NoControl"
6	"Recirc/Timer"
7	"Recirc/Temp"
8	"Recirc/Demand"
9	"Recirc/Time + Temp"
10	"Recirc/Demand + HWR"
11	"Recirc/Demand + Pipe Insulation"

PUMP

The following compliance analysis keywords are available in the PUMP command:

C-BHP **C-MOTOR-SPEED** **C-DRIVE-EFF**
C-NOM-HP **C-MOTOR-TYPE**

C-BHP (none, 0 – 10,000 hp, optional)
The brake horsepower needed to power the pump at design conditions. If not input by the user, the rules processor will assign this value according to results of the proposed design sizing simulation.

C-NOM-HP (none, 0 – 10,000 hp, optional)
The nominal, or nameplate, horsepower of the pump motor. If not input by the user, the rules processor will assign this value based on C-BHP.

C-MOTOR-SPEED (2, integer symbol, -)
The synchronous speed of the pump motor. Refer to C-SF-MTR-SNC-SPD for valid inputs.

C-MOTOR-TYPE (1, integer symbol, -)
The efficiency category for the pump motor. Refer to C-SF-MTR-TYPE for valid inputs and additional information.

C-DRIVE-EFF (1, 0.0 – 1.0, -)
The efficiency of the drive system connecting the pump motor shaft to the pump shaft. Direct couplings have an efficiency of 1.0 while belt drives typically have an efficiency of 0.97.

CHILLER

The following compliance analysis keywords are available in the CHILLER command:

C-TOTAL-CLG-CAP
C-NUM-OF-UNITS
C-TYPE
C-COP
C-IPLV
C-CONDENSER-TYPE

C-TOTAL-CLG-CAP (none, 0 – 9,999,999 Btuh, optional)
The total cooling capacity of all chillers combined in to the CHILLER command. Chillers may be combined together and simulated as a single CHILLER command if all of the combined chillers fall into one of the following groups:

- Water Cooled, Reciprocating
- Water Cooled, Screw $\geq$ 150 tons and < 300 tons
- Water Cooled, Screw $\geq$ 300 tons, ozone safe refrigerants
- Water Cooled, Screw $\geq$ 300 tons, non-ozone safe refrigerants
- Air Cooled With Condenser

- Air Cooled $\geq$ 150 and < 300 tons
- Air Cooled $\geq$ 300 tons
- If this value is not input by the user, the rules processor will determine the value from SIZE and sizing run results for the proposed building. The rules process calculates an average chiller capacity by dividing C-TOTAL-CLG-CAP by C-NUM-OF-UNITS and uses this value to determine the budget efficiencies for the chiller.

C-NUM-OF-UNITS (1, 0 – 1,000, -)
The number of chillers combined into this CHILLER command.

C-TYPE (0, integer symbol, -)
Integer representing the type of chiller. This keyword must not be confused with TYPE. The rules processor uses C-TYPE to determine the appropriate performance curves and minimum efficiencies for the chiller. The rules processor will automatically assign a value to TYPE (overriding any user input) based on C-TYPE. Valid inputs for this keyword are given in the following table:

Value	Chiller Type
1	"Reciprocating"
2	"Screw"
3	"Scroll"
4	"Centrifugal"
5	"Centrifugal w/ Heat Recovery"
6	"Single Effect Absorption"
7	"Double Effect Absorption"
8	"Gas Fired Absorption"

C-COP (none, 0.0 – 100.0, optional)
The coefficient of performance (COP) of the chiller. If C-NUM-OF-UNITS is greater than 1, C-COP shall be calculated as follows:

$$C-COP = \frac{\sum COP * Capacity}{\sum Capacity}$$

If C-COP is not input by the user, then the rules processor will assign a value which meets the minimum efficiency required by the Standards (See Section 112(a) of the Standards.

C-IPLV (none, 0.0 – 100.0 optional)
The integrated part load value (IPLV) of the chiller. If C-NUM-OF-UNITS greater than 1, C-IPLV shall be calculated as follows:

$$C-IPLV = \frac{\sum IPLV * Capacity}{\sum Capacity}$$

If C-IPLV is not input by the user, then the rules processor will assign a value which meets the minimum efficiency required by the Standards (See Section 112(a) of the Standards.

C-CONDENSER-TYPE (0, integer symbol, -)
The type of condenser for the CHILLER. This keyword must not be confused with CONDENSER-TYPE. If C-CONDENSER-TYPE is not input by the user, then the rules processor will automatically set its value based on CONDENSER-TYPE. If CONDENSER-TYPE and C-CONDENSER-TYPE are in conflict, then C-CONDENSER-TYPE will take precedence and the rules processor will automatically set

CONDENSER-TYPE (overriding any user input) based on C-CONDENSER-TYPE. Valid inputs for this keyword are given in the following table along with how they translate to CONDENSER-TYPE.

Value	Type of Condenser	Value of CONDENSER-TYPE
1	"Water Cooled"	WATER-COOLED
2	"Air Cooled w/Condenser"	AIR-COOLED
3	"Air Cooled w/out Condenser"	AIR-COOLED

BOILER

The following compliance analysis keywords are available in the BOILER command:

C-TOTAL-HTG-CAP **C-AFUE** **C-THERM-EFF-MAX** **C-NUM-OF-UNITS**

C-TOTAL-HTG-CAP (0, 0 – 9,999,999 Btuh, -)

The total capacity of all boilers combined in to the BOILER command. Boilers may be combined together and simulated as a single BOILER command if all of the combined boilers fall into one (and only one) of the following groups:

- Gas Fired, < 300,000 Btuh
- Gas Fired, ≥ 300,000 Btuh
- Oil Fired, < 225,000 Btuh
- Oil Fired, ≥ 225,000 Btuh and < 300,000 Btuh
- Oil Fired, ≥ 300,000 Btuh
- Residual Oil Fired, < 300,000 Btuh
- Residual Oil Fired, ≥ 300,000 Btuh
- If this value is not input by the user, the rules processor will determine the value from SIZE and sizing run results for the proposed building. The rules process calculates an average boiler capacity by dividing C-TOTAL-HTG-CAP by C-NUM-OF-UNITS and uses this value to determine the budget efficiencies for the boiler.

C-NUM-OF-UNITS (1, 0 – 1,000, -)

The total number of boilers combined into a BOILER command.

C-AFUE (none, 0.0 – 1.0, optional)

The annualized fuel utilization efficiency (AFUE) of the BOILER. The rules processor will reference this keyword only if AFUE is the applicable efficiency descriptor for the boiler (See Section 112(a) of the Standards). If C-AFUE is not input by the user, the rules processor will assign its value to minimally comply with the Standards. If C-NUM-OF-UNITS is greater than 1, C-AFUE shall be calculated as follows:

$$C-AFUE = \frac{\sum AFUE * Capacity}{\sum Capacity}$$

C-THERM-EFF-MAX (none, 0.0 – 1.0, optional)
The thermal or combustion efficiency (AFUE) of the BOILER. The rules processor will reference this keyword only if thermal or combustion efficiency is the applicable efficiency descriptor for the boiler (See Section 112(a) of the Standards). If C-THERM-EFF-MAX is not input by the user, the rules processor will assign its value to minimally comply with the Standards. If C-NUM-OF-UNITS is greater than 1, C-THERM-EFF-MAX shall be calculated as follows:

$$C-THERM-EFF-MAX = \frac{\sum Thermal\,Efficiency * Capacity}{\sum Capacity}$$

DW-HEATER

The following compliance analysis keywords are available in the DW-HEATER command:

C-TYPE
C-CATEGORY
C-RECOV-EFF
C-ENERGY-FACTOR
C-STBY-LOSS-FRAC
C-PILOT-BTUH
C-TANK-INT-RVAL
C-TANK-EXT-RVAL

C-TYPE (none, integer symbol, optional)
The type of water heater. This keyword must not be confused with TYPE. If C- TYPE is not input by the user, then the rules processor will automatically set its value based on TYPE. If TYPE and C- TYPE are in conflict, then C-TYPE will take precedence and the rules processor will automatically set TYPE (overriding any user input) based on CTYPE. Valid inputs for this keyword are given in the following table along with how they translate to TYPE.

Value	Type Water Heater	Value of TYPE
1	"Gas Fired"	GAS
2	"Oil Fired"	GAS
3	"Electric"	ELEC
4	"Heat Pump"	HEAT-PUMP

C-CATEGORY (none, integer symbol, optional)
The category of the water heater for determining the budget efficiency. This information is reported in the compliance forms. The compliance documentation author should review these forms and ensure that they match the construction documents for the proposed building. Valid inputs for this keyword are given in the following table:

Value	Water Heater Category
1	"DOE Covered Storage"
2	"DOE Covered Instantaneous"
3	"Other Direct Fired Storage"
4	"Other Instantaneous >= 10 gallons"
5	"Other Instantaneous < 10 gallons"
7	"DOE Covered Heat Pump"
8	"Other Heat Pump"

C-RECOV-EFF (none, 0.0 – 1.0, optional)
The recovery efficiency (or thermal efficiency) of the water heater. This keyword is referenced by the rules processor only if recovery efficiency is the applicable efficiency descriptor for the water heater (See

California Appliance Efficiency Regulations). If this keyword is not input by the user, the rules processor will assign its value to minimally comply with the Appliance Efficiency Regulations.

C-ENERGY-FACTOR (none, 0.0 – 1.0, optional)
The energy factor of the water heater. This keyword is referenced by the rules processor only if energy factor is the applicable efficiency descriptor for the water heater (See California Appliance Efficiency Regulations). If this keyword is not input by the user, the rules processor will assign its value to minimally comply with the Appliance Efficiency Regulations.

C-STBY-LOSS-FRAC (none, 0.0 – 100.0 %/hr, optional)
The energy factor of the water heater. This keyword is referenced by the rules processor only if the water heater must meet minimum requirements for standby loss (See California Appliance Efficiency Regulations). If this keyword is not input by the user, the rules processor will assign its value to minimally comply with the Appliance Efficiency Regulations.

C-PILOT-BTUH (0, 0.0 – 10,000.0 Btuh, -)
The energy consumption of an oil or gas pilot light. This value is only referenced when TYPE equals GAS.

C-TANK-INT-RVAL (0, 0.0 – 1,000.0 h-ft2-degF/Btu, -)
The R-value of insulation on the interior of the shell of the water heater. If not input by the user, the rules processor will assign its value to minimally comply with the Standards (See Section 123 of the Standards).

C-TANK-EXT-RVAL (0, 0.0 – 1,000.0 h-ft2-degF/Btu, -)
The R-value of insulation on the exterior of the shell of the water heater. If not input by the user, the rules processor will assign its value to minimally comply with the Standards (See Section 123 of the Standards).

Section

3

Compliance Rule Processor

Overview

The purpose of the DOE-2 compliance analysis system is to enable users of DOE-2.2, and any third party products based on DOE-2.2, to test input building descriptions for compliance with energy codes and standards. In order to test a building description for compliance with a code or standard, the user must have a compliance ruleset. Compliance rulesets contain all the building manipulation logic and simulation capabilities necessary to determine whether the building description satisfies the code/standard requirements. The following sections of this document will describe the format and structure of a compliance ruleset.

Compliance rulesets can be developed without modifying or recompiling any source code associated with DOE-2 or other products that rely on DOE-2 to perform building simulations. There are two compliance ruleset "formats", the raw format in which the ruleset is developed by a consultant or ruleset authority and a compiled format that is distributed to users for performing compliance analysis. A raw (uncompiled) compliance ruleset is made up of several Microsoft Access databases and Excel spreadsheet tables (exported into .CSV format). This collection of files is read by the compliance ruleset compiler (D2RulCmp.exe) and translated into a single, binary, encrypted ruleset file that is what gets distributed to end users and read at runtime by the compliance analysis module. The uncompiled ruleset files are maintained by consultants and/or ruleset authorities and cannot be read or utilized by a user's runtime compliance analysis system without first being compiled.

BACKGROUND

The DOE-2.2 compliance analysis system is based on several other modules developed over the last decade. The compliance ruleset structure and logic was originally developed for COMcheck-Plus, a DOE-2.1E based application. Two significant enhancements have been made to the COMcheck-Plus ruleset processing mechanism in creating the DOE-2.2 compliance analysis system. The first is the migration of the rules processing from operating on a simplified (compliance-only) database to operating directly on DOE-2.2 (BDL) inputs in memory at program runtime. The second most significant enhancement was the migration of the raw ruleset files from a collection of text files to a series of Microsoft Access databases and Excel spreadsheets. This new ruleset format enables ruleset developers to create compliance rulesets more quickly and efficiently and provides for better development tracking and documenting.

The development team utilized modules developed for PowerDOE and eQUEST in order to implement the compliance analysis system's ability to access and modify BDL data in memory at runtime. The ability to apply the compliance rules directly on the DOE-2 data structure in memory eliminates the need for additional building description databases and the source code used to translate building descriptions from those databases into BDL. By eliminating the additional databases and translators, we also eliminate the limitations and errors associated with managing and translating redundant building description databases.

COMPILING A RULESET

The ruleset compiler (D2RulCmp.exe) is a simple dialog-based application that enables consultants and ruleset authorities to search and compile raw (Access/Excel) ruleset files into compiled ruleset files that are then distributed to end users for use in their compliance analysis. Figure 1 provides a screen print of this basic dialog interface.

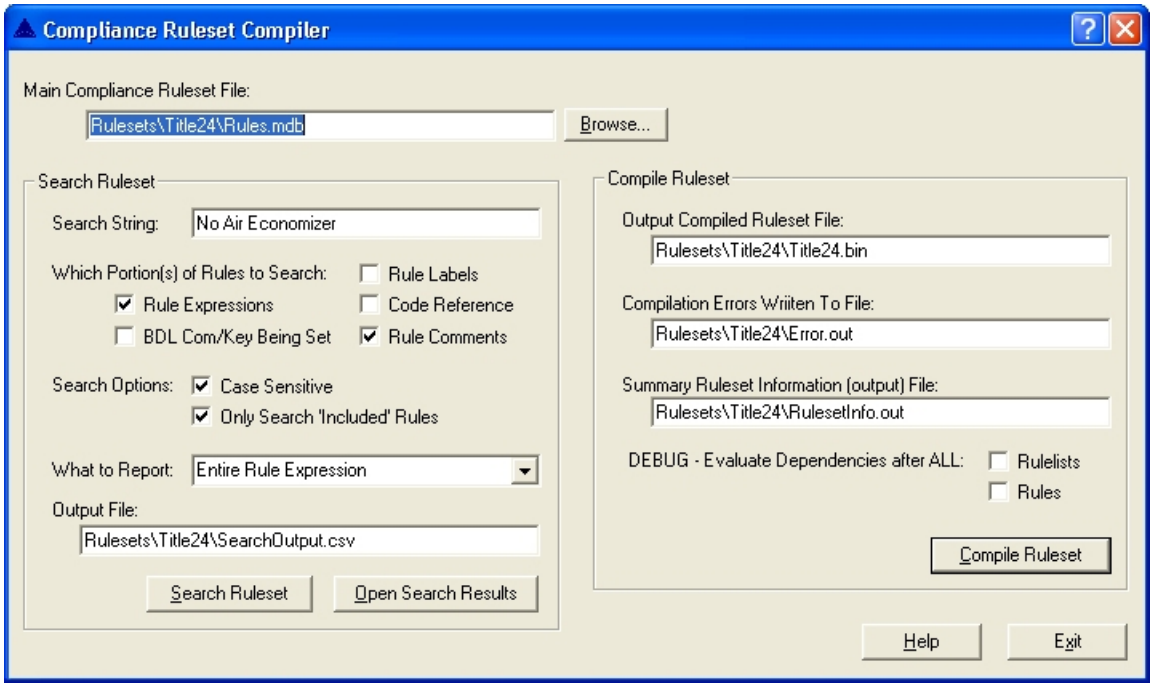


Figure 1: Compliance Ruleset Compiler Application Interface (D2RulCmp.exe)

To compile a ruleset, simply browse to or type in the name of the main compliance ruleset file and other inputs and press the Compile Ruleset button. The compilation process typically takes less than a minute and upon completion the user is informed whether or not the compilation was successful. In the event the compilation failed, one or more error messages will be written to the "Compilation Errors Written To File" file, identifying the raw (input) ruleset files and line numbers where the error(s) occurred.

COMPLIANCE ANALYSIS PROCESSING

The heart of the DOE-2 compliance analysis system is the function that manages the actual compliance analysis process. In order to describe this process, we must first understand a little bit about what a compliance ruleset is. The most fundamental information defined in each compliance ruleset is the rules themselves. The rules are organized into a series of rulelists. Each rulelist contains a series of rules and each rule is basically an expression that defines and/or sets a BDL variable (combination of BDL Command & Keyword) or performs some action, such as creating or deleting building components. The rules in each rulelist are evaluated in top down order. This top down evaluation order is contrary to the BDL expression evaluation mechanism that tracks all dependencies associated with each expression and re-evaluates any expression whenever one of its dependencies is modified. Each rulelist is designed to serve a specific purpose and is evaluated at a particular point in the compliance analysis process. The primary steps involved in this process include:

1. The ProposedInput rulelist contains all rules that are designed to assist the user in inputting their building description. These rules mainly include ruleset defaults that override DOE-2 defaults but not user-input values or ruleset prescribed values that override both DOE-2 defaults and user inputs. In an interactive environment, this rulelist can be evaluated each time the user enters a value. This enables the user to get continual feedback as to the ruleset defaults and prescribed values that result based on the inputs specified by the user.
2. The next step is to perform a pre-analysis check of the building description supplied by the user. The ProposedInput rulelist is evaluated first to ensure that it is evaluated at least once in the event the user just opened a project or the rules processor just read the input file. This pre-analysis check ensures that all values defined in BDL satisfy the range checks and other requirements defined in the compliance ruleset. In the event one or more inputs are missing or out of range, the user is informed of this via an error listing. They will need to rectify these errors before a successful compliance analysis can be completed.
3. Upon completion of the pre-analysis check, the PostProposedInput rulelist is evaluated. This rulelist is designed to convert the user's input building description into a building description that is classified by the compliance ruleset as the "Proposed" building. If performance of one or more HVAC sizing simulations is called for by the ruleset, then continue on to step 4, otherwise, skip directly top step 5.
4. An annual HVAC sizing run is performed and two more rulelists are evaluated. The StoreProposedDesignData rulelist is evaluated to store various inputs and/or simulation results that can be either referenced in output reports or by subsequent compliance rules. The ProposedHVACSizing rulelist is evaluated to set HVAC sizes based on user input and/or simulation results. The ProposedHVACSizing rulelist is also responsible for indicating whether the proposed building description can now move on to the annual simulation or if the HVAC sizing run must be performed again (in which case this step is repeated).
5. The ProposedFinal rulelist is evaluated to prepare the building description for the annual simulation. The final Proposed building annual simulation is performed followed by the evaluation of the StoreProposedFinalData rulelist (to store various inputs and/or simulation results). The final proposed building description is stored for later reference.
6. The BudgetConversion rulelist is evaluated to convert the Proposed building description into the Budget building. If performance of one or more HVAC sizing simulations is called for by the ruleset, then continue on to step 7, otherwise, skip directly top step 8.

7. An annual HVAC sizing run is performed and two more rulelists are evaluated. The StoreBudgetDesignData rulelist is evaluated to store various inputs and/or simulation results, followed by the BudgetHVACSizing rulelist that may modify the HVAC sizes or descriptions. The BudgetHVACSizing rulelist is also responsible for setting a flag indicating whether to repeat this sizing step or to continue on to the annual simulation.
8. The BudgetFinal rulelist is evaluated to prepare the building description for the annual simulation. Then the final Budget building annual simulation is performed followed by the evaluation of the StoreBudgetFinalData rulelist (to store various inputs and/or simulation results). The final budget building description is stored for later reference.
9. The FinalCompliance rulelist is evaluated to determine the final compliance analysis result. This final analysis result typically involves the comparison of final proposed and budget building simulation energy cost or usage results.
10. The user is notified of the success or failure of the compliance run. If one or more compliance messages (errors, warnings or other messages generated in the course of evaluating the rules) are available, then the user will be provided access to the listing of messages. The final compliance report is written to a PDF (Adobe's Portable Document Format) file in the event the building passes the compliance analysis.

Ruleset Structure

Each compliance ruleset consists of a collection of Microsoft Access databases and Excel spreadsheets. The formats of these files are designed to make creation and maintenance of each compliance ruleset as simple as possible for rule authority organizations. There are several different types of data required to describe a compliance ruleset, and each file defines a specific type of that data. This design helps to prevent any single ruleset file from becoming too large to manage and enables multiple ruleset developers to work on a single ruleset at once.

This focus of this section is to describe the format and contents of the Access database and Excel spreadsheet files that make up a raw (uncompiled) compliance ruleset. The compliance ruleset files that are referenced throughout this document make up the ruleset developed to test compliance with California's Title 24 Alternative Calculation Method (ACM) Approval Manual (1998). This is the first implementation of a compliance ruleset that utilizes the new Access database and Excel spreadsheet ruleset formats. This section will also touch on how the ruleset data is utilized by the compliance ruleset processor and how third party user interfaces to the DOE-2 compliance analysis system might also utilize this data.

MAIN RULESET DATABASE (RULES.MDB)

The main compliance ruleset database contains the most fundamental ruleset information, including references to all other files that together make up the entire ruleset. This database contains five separate tables as follows:

tblRulesetInfo

The tblRulesetInfo table contains only a single record and includes the following fields:

DBaseStructVer (Number) This field contains a ruleset database structure version number and is designed to enable future versions of the ruleset compiler and processor to maintain compatibility with rulesets developed for previous versions. If/when future rulesets identify the need for additional information to be stored in the ruleset, this version number will be increased and source code will be added to the ruleset compiler and processor to support the then current and all previous versions.

RulesetID (Text) This field contains a character string identifying the ruleset (i.e. "CEC Title 24, April 1998").

RulesetVersion (Text) This field contains a character string identifying the ruleset and its version (i.e. "CEC Title 24, April 1998 – Ver. 1.0"). Note the version indicated here is a version number designed to enable the ruleset authorities to track which version of the compiled ruleset binary was used by a DOE-2 compliance analysis system end user to perform their analysis. This field has NO relationship to the database structure version information tracked via the DBaseStructVer field.

CodeVerRulesetVar (Text) This field enables a single ruleset to provide compliance analysis for multiple versions of a single code or even multiple distinct codes. A separate table defined in the main ruleset database contains character strings describing the supported code versions and values associated with each code version. Rules within the compliance ruleset can reference this variable to influence the evaluation and application of the implemented code.

CodeVerBDLKeyword (Text) This field is identical to the above variable in purpose and use, the only difference being that the code version value is stored in the BDL keyword of the COMPLIANCE command identified by this text field.

DataTypeFile (Text) This field contains the name of the file which contains DataType information. The information contained in the DataType file is described later in this section.

SymbolsFile (Text) This field contains the name of the file which contains Symbols information. This information contained in the Symbols file is described later in this section.

RangesFile (Text) This field contains the name of the file which contains Ranges information. This information contained in the Ranges file is described later in this section.

ResetsFile (Text) This field contains the name of the file which contains Resets information. This information contained in the Resets file is described later in this section.

InputRulelistName (Number) This field contains the ID of the rulelist (defined in the tblRuleLists table described below) that is described as the "input" rulelist. The input rulelist is the rulelist that may be evaluated following each user input as the user goes through the process of entering their building description. The purpose of evaluating this rulelist following each input is so that the user can get immediate feedback as to the ruleset default or prescribed values of various building description inputs while they enter their buildings.

FileNewRulelistName (Text) This field contains the name of the rulelist that is to be evaluated each time the user of an application utilizing the compliance module creates a new building model.

FileOpenRulelistName (Text) This field contains the name of the rulelist that is to be evaluated each time the user of an application utilizing the compliance module opens an existing building model.

UnitsType (Number) This field contains the Value of the units type defined in the tblUnitTypes table for which this ruleset is based (English vs. Metric).

HasProposedDesign (Yes/No) A selection of No for this field will bypass step 4 of the primary compliance analysis steps describing in the preceding section, beginning with the performance of the proposed design sizing simulation and ending with the evaluation of the ProposedFinal rulelist (immediately prior to the final proposed simulation).

HasBudgetBuilding (Yes/No) A selection of No for this field will bypass steps 6 thru 8 of the primary compliance analysis steps describing in the preceding section, beginning with the conversion of the proposed design to budget design and ending with the retrieval of simulation results following the final budget design simulation (immediately prior to the evaluation of the FinalCompliance rulelist).

HasBudgetDesign (Yes/No) A selection of No for this field will bypass step 7 of the primary compliance analysis steps describing in the preceding section, beginning with the performance of the budget design sizing simulation and ending with the evaluation of the BudgetFinal rulelist (immediately prior to the final budget design simulation).

ProposedDesignRunName (Text) This text string is what gets used to identify the proposed design sizing simulation results and is appended onto the user input building design file name to store all DOE-2 input and output files associated with this simulation.

ProposedAnnualRunName (Text) This text string is what gets used to identify the final proposed design simulation results and is appended onto the user input building design file name to store all DOE-2 input and output files associated with this simulation.

BudgetDesignRunName (Text) This text string is what gets used to identify the budget design sizing simulation results and is appended onto the user input building design file name to store all DOE-2 input and output files associated with this simulation.

BudgetAnnualRunName (Text) This text string is what gets used to identify the final budget design simulation results and is appended onto the user input building design file name to store all DOE-2 input and output files associated with this simulation.

In order to facilitate maintenance, the CEC Title 24 version of the Rules.mdb file contains a form (frmRulesetInfo) to view or modify the record in this table, as shown below:

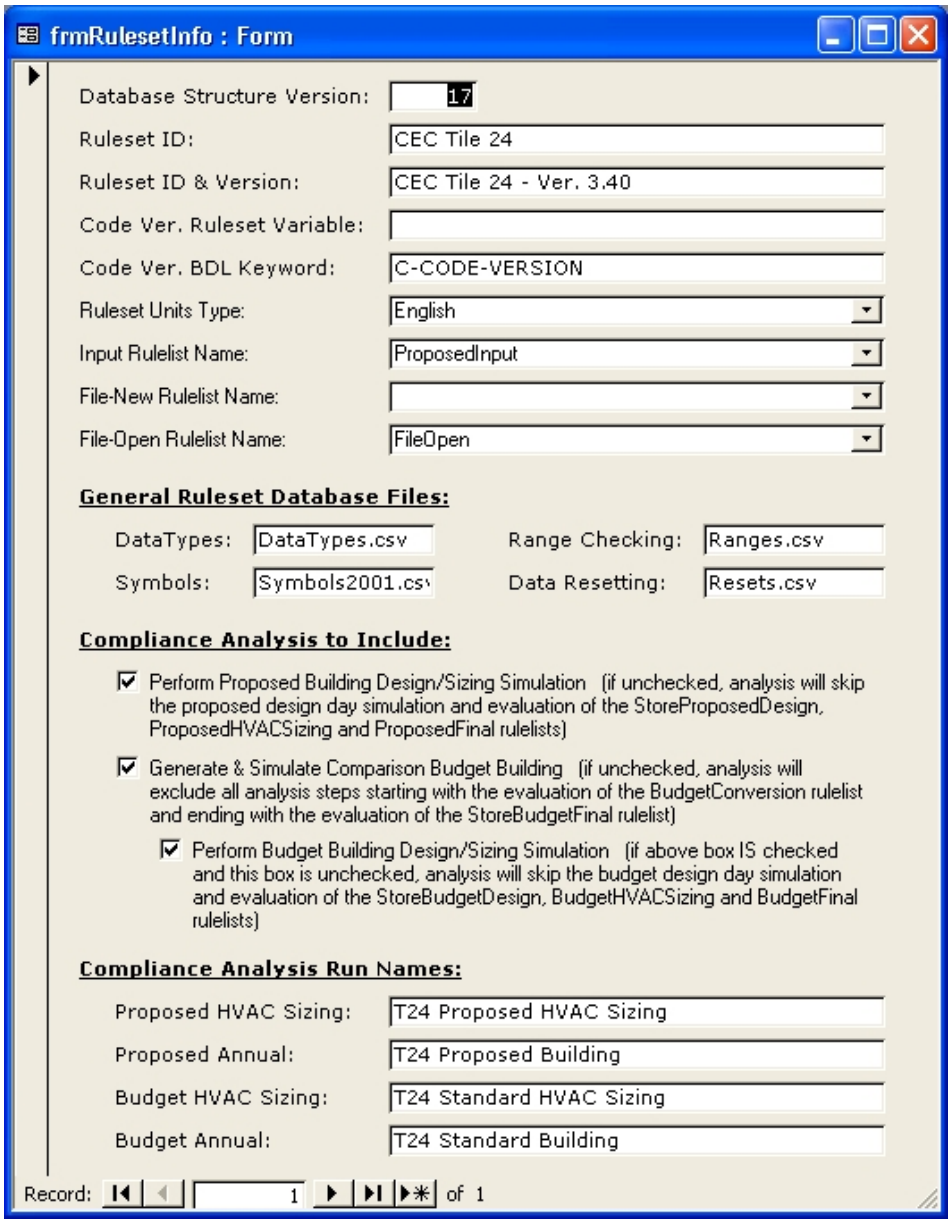


Figure 2: Form for Manipulating tblRulesetInfo Data (frmRulesetInfo)

tblRuleLists

The second table of the Rules.mdb database is the tblRuleLists table. Each record in this table identifies a unique rulelist. A rulelist is a collection of multiple rules, each of which contains an expression that manipulates the DOE-2 building description database (BDL) in memory during the compliance analysis processing. There are 12 pre-defined rulelists that must be contained in each compliance ruleset (which is why there must be at least 12 records contained in this table). Each of these 12 rulelists is evaluated at a specific time during the compliance analysis processing.

In order to minimize the overall number of rules contained in a ruleset, each ruleset may contain additional rulelists (beyond the 12 pre-defined ones) that can be referenced for evaluation by other rulelists. For example, let's say there are a group of 10 rules that manipulate wall construction settings and the ruleset needs to evaluate these rules during the course of evaluating three separate rulelists. The ruleset developer can move these rules into a separate rulelist and simply reference that new rulelist within the 3 other rulelists that require their evaluation. This results in a ruleset that contains only a single set (rulelist) of these 10 wall construction rules which results in a smaller overall number of rules and a more manageable ruleset maintenance workload.

The 12 required rulelist names and a brief description of each of their roles in the compliance analysis process is as follows:

1) **ProposedInput**: This rulelist is evaluated following each user input (only when the calling application interfaces directly with BDL in memory) and also as the first step of the compliance analysis processing. The rules contained in this rulelist are designed to install all values which are prescribed by the ruleset and also any default values which might be convenient for the user to view within the calling application's user interface.

2) **ReviewProposedInput**: This rulelist (if present in the ruleset) is evaluated following the ProposedInput rulelist to check certain aspects of the building design and report errors or exceptional conditions of the analysis. One of the final rules in this rulelist typically include a call to the function PromptToContinue() which causes the user to be prompted w/ a listing of all warnings and messages stored during the building design review process prior to continuing with the analysis.

3) **PostProposedInput**: This rulelist is evaluated immediately after the ReviewProposedInput rulelist during the compliance analysis processing. The purpose of this rulelist is to complete the translation of the user input building description into the proposed building design and to prepare for the performance of the proposed building HVAC sizing simulation.

   – Proposed building HVAC-sizing simulation performed here.

4) **StoreProposedDesign**: This rulelist is evaluated immediately after each proposed building HVAC sizing run to store building description inputs and/or simulation results for later reference by other rulelists and/or the compliance reporting module.

5) **ProposedHVACSizing**: This rulelist is evaluated after the sizing simulation and storage of simulation results to update proposed design system sizes and to determine whether or not additional sizing simulations need be run.

6) **ProposedFinal**: This rulelist is evaluated to prepare the proposed building for final (annual) simulation.

   – Proposed building final (annual) simulation performed here.

7) **StoreProposedFinal**: This rulelist is evaluated immediately after the final (annual) proposed building simulation to store building description inputs and/or simulation results for later reference by other rulelists and/or the compliance reporting module.

8) **BudgetConversion**: This rulelist is designed to convert the proposed building design into the budget building and to prepare for the budget building HVAC sizing simulation.

– Budget building HVAC-sizing simulation performed here.

9) **StoreBudgetDesign**: This rulelist is evaluated immediately after each budget building HVAC sizing run to store building description inputs and/or simulation results for later reference by other rulelists and/or the compliance reporting module.

10) **BudgetHVACSizing**: This rulelist is evaluated after the sizing simulation and storage of simulation results to update budget design system sizes and to determine whether or not additional sizing simulations need be run.

11) **BudgetFinal**: This rulelist is evaluated to prepare the budget building for final (annual) simulation.

– Budget building final (annual) simulation performed here.

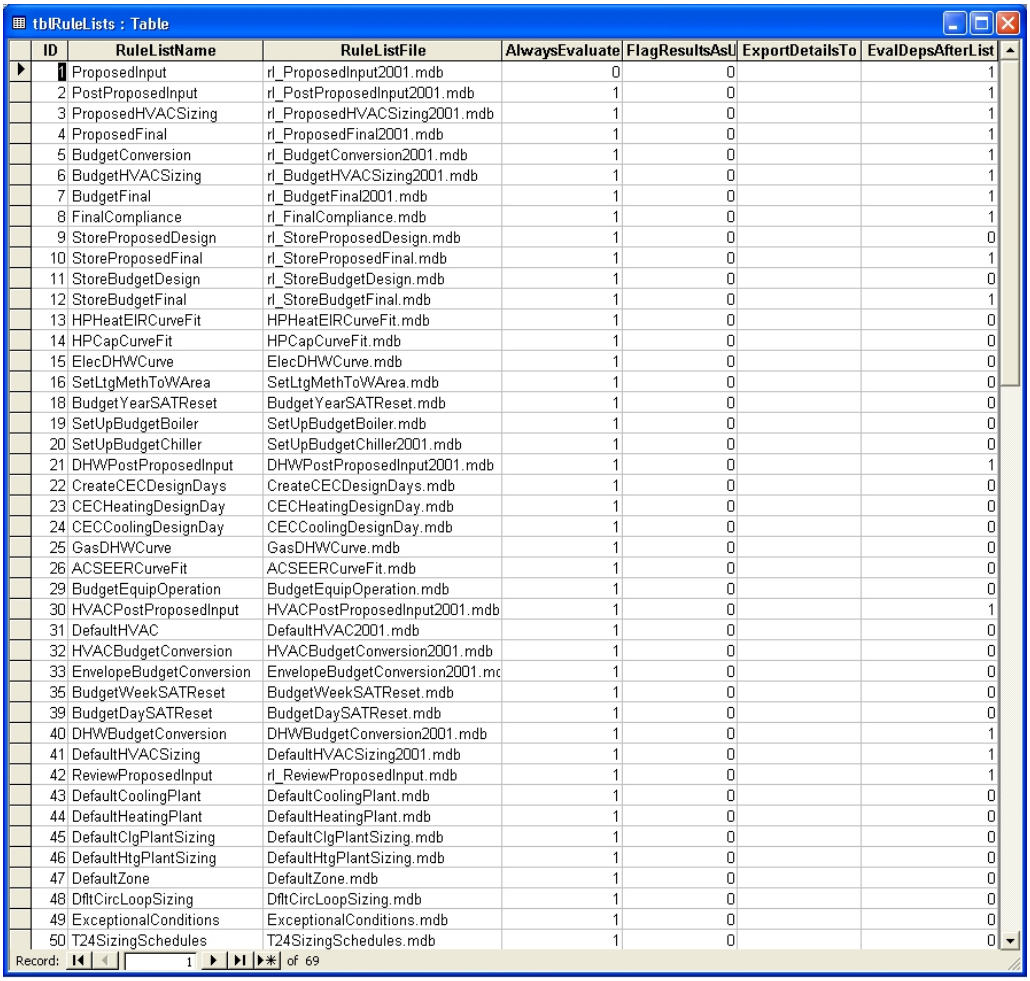
12) **StoreBudgetFinal**: This rulelist is evaluated immediately after the final (annual) budget building simulation to store building description inputs and/or simulation results for later reference by other rulelists and/or the compliance reporting module.

13) **FinalCompliance**: This rulelist is designed to calculate the final compliance analysis results, either pass/fail or some numeric rating, by comparing building description inputs and/or simulation results from the final proposed and budget building simulations.

Each record in this table contains the following fields:

ID	(AutoNumber) This field is essentially a record number identifier which is automatically assigned upon the creation of each new record of data. This field is not directly referenced by either the ruleset compilation or analysis source code.
RuleListName	(Text) This field contains the name of the rulelist defined in this record of the table.
RuleListFile	(Text) This field contains the Access database (.mdb) filename where the rulelist is defined. We have been using the convention "rl_RuleListName.mdb".
AlwaysEvaluate	(Number) This field is a flag value (0 or 1) indicating whether or not each rule in the corresponding rulelist is to be evaluated every time the rulelist is evaluated. A value of 1 causes each rule in the ruleset to be evaluated regardless of the status (user input vs. library data vs. DOE-2 default…) of the values in the building description that the rules are to set. A value of 0 in this field prevents the rules in the rulelist from overwriting user input or library values, unless the ruleset has classified those inputs as "prescribed" (refer to the discussion below about DataTypes for more information).
FlagResultsAsUserDefined	(Number) When this field is set to 1, it causes all rules within the referenced rulelist to post data to BDL as user-defined. When 0, the default, data posted to BDL from the evaluation of rules is classified as compliance ruleset defined.
ExportDetailsTo	(Text) This field is blank by default. When a text string such as " – Proposed Details.txt" is present in this field, a text file with detailed BDL building description data is exported to a file by the name "<user input path and file><ExportDetailsTo>". The resulting file documents the value and status (default, user-defined, library, etc.) of each and every BDL keyword for every component defined in the building description.
EvalDepsAfterList	(Number) Setting this field to 1 causes all BDL expression dependencies to be evaluated following the evaluation of the rulelist, while a value of 0 will carry over dependency evaluations until a later rule or rulelist calls for them to be performed. This value is one for most rulelists and 0 for a select few rulelists for which there are very few rules defined and no (or few relevant) dependencies likely to exist.

Figure 3 illustrates the contents of this table for the CEC Title 24 ruleset:



tblRuleLists : Table

ID	RuleListName	RuleListFile	AlwaysEvaluate	FlagResultsAsU	ExportDetailsTo	EvalDepsAfterList
1	ProposedInput	rl_ProposedInput2001.mdb	0	0		1
2	PostProposedInput	rl_PostProposedInput2001.mdb	1	0		1
3	ProposedHVACSizing	rl_ProposedHVACSizing2001.mdb	1	0		1
4	ProposedFinal	rl_ProposedFinal2001.mdb	1	0		1
5	BudgetConversion	rl_BudgetConversion2001.mdb	1	0		1
6	BudgetHVACSizing	rl_BudgetHVACSizing2001.mdb	1	0		1
7	BudgetFinal	rl_BudgetFinal2001.mdb	1	0		1
8	FinalCompliance	rl_FinalCompliance.mdb	1	0		1
9	StoreProposedDesign	rl_StoreProposedDesign.mdb	1	0		0
10	StoreProposedFinal	rl_StoreProposedFinal.mdb	1	0		1
11	StoreBudgetDesign	rl_StoreBudgetDesign.mdb	1	0		0
12	StoreBudgetFinal	rl_StoreBudgetFinal.mdb	1	0		1
13	HPHeatElRCurveFit	HPHeatElRCurveFit.mdb	1	0		0
14	HPCapCurveFit	HPCapCurveFit.mdb	1	0		0
15	ElecDHWCurve	ElecDHWCurve.mdb	1	0		0
16	SetLtgMethToWArea	SetLtgMethToWArea.mdb	1	0		0
18	BudgetYearSATReset	BudgetYearSATReset.mdb	1	0		0
19	SetUpBudgetBoiler	SetUpBudgetBoiler.mdb	1	0		0
20	SetUpBudgetChiller	SetUpBudgetChiller2001.mdb	1	0		0
21	DHWPostProposedInput	DHWPostProposedInput2001.mdb	1	0		1
22	CreateCECDesignDays	CreateCECDesignDays.mdb	1	0		0
23	CECHeatingDesignDay	CECHeatingDesignDay.mdb	1	0		0
24	CECCoolingDesignDay	CECCoolingDesignDay.mdb	1	0		0
25	GasDHWCurve	GasDHWCurve.mdb	1	0		0
26	ACSEERCurveFit	ACSEERCurveFit.mdb	1	0		0
29	BudgetEquipOperation	BudgetEquipOperation.mdb	1	0		0
30	HVACPostProposedInput	HVACPostProposedInput2001.mdb	1	0		1
31	DefaultHVAC	DefaultHVAC2001.mdb	1	0		0
32	HVACBudgetConversion	HVACBudgetConversion2001.mdb	1	0		0
33	EnvelopeBudgetConversion	EnvelopeBudgetConversion2001.mc	1	0		0
35	BudgetWeekSATReset	BudgetWeekSATReset.mdb	1	0		0
39	BudgetDaySATReset	BudgetDaySATReset.mdb	1	0		0
40	DHWBudgetConversion	DHWBudgetConversion2001.mdb	1	0		1
41	DefaultHVACSizing	DefaultHVACSizing2001.mdb	1	0		1
42	ReviewProposedInput	rl_ReviewProposedInput.mdb	1	0		1
43	DefaultCoolingPlant	DefaultCoolingPlant.mdb	1	0		0
44	DefaultHeatingPlant	DefaultHeatingPlant.mdb	1	0		0
45	DefaultClgPlantSizing	DefaultClgPlantSizing.mdb	1	0		0
46	DefaultHtgPlantSizing	DefaultHtgPlantSizing.mdb	1	0		0
47	DefaultZone	DefaultZone.mdb	1	0		0
48	DfltCircLoopSizing	DfltCircLoopSizing.mdb	1	0		0
49	ExceptionalConditions	ExceptionalConditions.mdb	1	0		0
50	T24SizingSchedules	T24SizingSchedules.mdb	1	0		0

Record: 1 of 69

Figure 3: tblRuleLists Data for CEC Title 24 Ruleset

tblLookupTables

The third table in the Rules.mdb database is the tblLookUpTables table. Look-up tables enable the ruleset to define tables of numbers where one or more independent values map to one or more dependent values. For example, the CEC Title 24 ruleset uses look-up tables to map a location ID to several site-specific values such as climate zone, longitude, latitude, weather file index, etc. The tblLookUpTables table contains any number of records, with each record defining a separate look-up table via the following fields:

ID — (AutoNumber) This field is a unique record identifier that is automatically assigned upon the creation of each new record of data. This field is not directly referenced by either the ruleset compilation or analysis source code.

TableName — (Text) This field contains the name of the table defined in each record. There cannot be more than one table by the same name and no table name can be the same as a reserved ruleset function name, such as Local(), Parent(), etc. (see the Rule Expression Syntax and Function Reference sections for a complete listing of illegal look-up table names).

TableFile — (Text) This field contains the name of the comma separated text (.csv) file that contains the table values. The .csv files are typically generated by exporting a worksheet from Excel using the File - Save As option and specifying the format as

"CSV (comma separated)". The contents and format of ruleset look-up tables is covered in more depth in the Look-up Tables section below.

NumIndep (Number) This field identifies the number of independent variables which are defined in the look-up table. The contents and format of ruleset look-up tables is covered in more depth in the following section of this document.

NumDep (Number) This field identifies the number of dependent variables which can be returned from the look-up table. The contents and format of ruleset look-up tables is covered in more depth in the following section of this document.

Figure 4 illustrates the contents of this table for the CEC Title 24 ruleset:

tblLookupTables : Table

ID	TableName	TableFile	NumIndep	NumDep
4	MotorEffTable	tbl_1998MotorEff.csv	3	3
2	OccupAssumpTable1998	tbl_1998OccupAssump.csv	1	8
12	ACEfficiency2001a	tbl_2001aACEffTable.csv	4	3
14	ChillerEfficiency2001a	tbl_2001aChillerEffTable.csv	4	2
16	FurnaceEfficiency2001a	tbl_2001aFurnaceEffTable.csv	5	3
18	HPEffTable2001a	tbl_2001aHPEffTable.csv	4	6
13	ACEfficiency2001b	tbl_2001bACEffTable.csv	4	3
15	ChillerEfficiency2001b	tbl_2001bChillerEffTable.csv	4	2
17	FurnaceEfficiency2001b	tbl_2001bFurnaceEffTable.csv	5	3
19	HPEffTable2001b	tbl_2001bHPEffTable.csv	4	6
21	DefaultUFactor2001	tbl_2001GlazingDefaults.csv	9	3
25	OccupAssumpTable2001	tbl_2001OccupAssump.csv	1	8
26	AB970BudgetGlazing	tbl_AB970BudgetGlazing.csv	6	2
9	ACEffTable	tbl_ACEffTable.csv	4	3
27	ACMLocationsTable	tbl_ACMLocations.csv	1	14
30	AppdxIOvhdUFactor	tbl_AppdxIOvhdUFactor.csv	7	1
29	AppdxIVertUFactor	tbl_AppdxIVertUFactor.csv	6	1
7	ChillerEfficiency	tbl_ChillerEffTable.csv	4	2
6	DesignDayTable	tbl_DesignDay.csv	1	12
8	FurnaceEfficiency	tbl_FurnaceEffTable.csv	5	3
10	HPEffTable	tbl_HPEffTable.csv	4	6
1	LocationTable	tbl_Locations.csv	1	10
31	PipeDimensions	tbl_PipeDimensions.csv	1	3
32	PipeInsParams	tbl_PipeInsParams.csv	1	4
5	SystemTypeTable	tbl_SystemType.csv	5	1
20	T24DefaultSHGC	tbl_T24DefaultSHGC.csv	4	1
28	T24DefaultUFactor	tbl_T24DefaultUFactor.csv	8	1
33	T24PipeIns	tbl_T24PipeIns.csv	2	2
(New Number)			1	1

Record: 1 of 28

Figure 4: tblLookupTables Data for CEC Title 24 Ruleset

tblLibraries

The fourth table in the Rules.mdb database is the tblLibraries table. This table identifies one or more .csv library files. Each library file contains descriptions of all building components that are defined within the context of the ruleset (energy code). For example, the occupancy and internal loads profiles specified in the CEC Title 24 ruleset are stored in the ruleset library files referenced by records of this table. The tblLibraries table contains any number of records, with each record defining a separate library file via the following fields:

ID (Number) This field is a unique record identifier that is automatically assigned upon the creation of each new record of data. This field is not directly referenced by either the ruleset compilation or analysis source code.

LibraryFile (Text) This field contains the name of the comma separated text (.csv) file that contains the library component descriptions. The .csv files are typically generated by exporting a worksheet from Excel using the File - Save As option and specifying the format as "CSV (comma separated)". The contents and format of ruleset library files is covered in more depth in the Component Libraries section below.

Figure 5 illustrates the contents of this table for the CEC Title 24 ruleset:

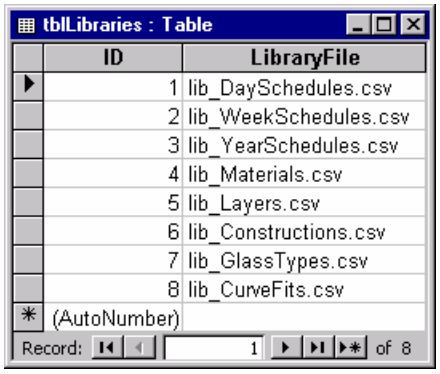


Figure 5: tblLibraries Data for CEC Title 24 Ruleset

tblUnitTypes

The fifth table in the Rules.mdb database is the tblUnitTypes table. This tables sole purpose is to define the Units Type entries selectable in tblRulesetInfo to identify the units system that the ruleset is written for. This table contains the only two entries compatible with BDL (English vs. Metric) and therefore should not vary across rulesets. Each tblUnitTypes record contains the following fields:

Value (Number) This field contains the numeric values that map into units type definitions in source code. These values should not be edited.

Label (Text) This field contains the label used in the selection list when defining the units system for the ruleset.

Figure 6 illustrates the contents of this table for ALL rulesets:

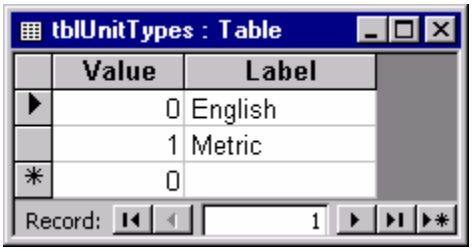


Figure 6: tblUnitTypes Data for ALL Compliance Rulesets

tblKeywordDefaulting

The sixth table in the Rules.mdb database is the tblKeywordDefaulting table. This table defines one or more .csv defaulting files. Each defaulting file contains flags representing how to default DOE-2 keywords. Each defaulting file may only include keywords and defaults for a single DOE-2 component. The tblKeywordDefaulting table contains any number of records, with each record defining a separate defaulting file via the following fields:

ID — (AutoNumber) This field is a unique record identifier that is automatically assigned upon the creation of each new record of data. This field is not directly referenced by either the ruleset compilation or analysis source code.

TableName — (Text) This field contains the name of the table defined in each record. There cannot be more than one table by the same name and no table name can be the same as a reserved ruleset function name, such as Local(), Parent(), etc. (see the Rule Expression Syntax and Function Reference sections for a complete listing of illegal look-up table names).

TableFile — (Text) This field contains the name of the comma separated text (.csv) file that contains the table values. The .csv files are typically generated by exporting a worksheet from Excel using the File - Save As option and specifying the format as "CSV (comma separated)". The contents and format of defaulting tables is covered in more depth in the Keyword Defaulting Tables section below.

NumColumns — (Number) This field identifies the number of columns which are defined in a defaulting file. The contents and format of defaulting tables is covered in more depth in the following section of this document.

Figure 7 illustrates the contents of this table for the CEC Title-24 ruleset:

tblKeywordDefaulting : Table

ID	TableName	TableFile	NumColumns
5	BoilerDefaulting	Defaulting_Boiler.csv	2
4	ChillerDefaulting	Defaulting_Chiller.csv	2
3	CircLoopDefaulting	Defaulting_CircLoop.csv	2
7	DWHeaterDefaulting	Defaulting_DWHeater.csv	2
6	HeatRejDefaulting	Defaulting_HeatRej.csv	2
2	SystemDefaulting	Defaulting_System.csv	2
1	ZoneDefaulting	Defaulting_Zone.csv	2
(New Number)			2

Record: 1 of 7

Figure 7: tblKeywordDefaulting Data for CEC Title-24 Ruleset

tblCodeVersions

The seventh table in the Rules.mdb database is the tblCodeVersions table. When present, this table identifies two or more unique code versions implemented within the ruleset. Implementing multiple codes or code versions into a single ruleset can help to minimize future ruleset maintenance effort, particularly when multiple codes are expected to evolve together. The tblCodeVersions table contains any number of records, with each record defining a unique code or code version via the following fields:

ID — (AutoNumber) This field is a unique record identifier that is automatically assigned upon the creation of each new record of data. This field is not directly referenced by either the ruleset compilation or analysis source code.

DisplayFlag — (Number) This field indicates whether or not the code version description contained in this record should be displayed to the user for selection within a user interface that links to the compliance module.

Value — (Number) This field provides a numeric indicator that enables the ruleset to identify which code or code version the user chose to perform analysis based on. This value corresponding to the code version selected by the user is posted into a ruleset variable or BDL keyword (depending on the CodeVerRulesetVar and CodeVerBDLKeyword fields of the main ruleset tblRulesetInfo table described

above) prior to the beginning of the compliance analysis and can be referenced throughout the analysis where the code versions may differ.

CodeVerLabel (Text) This field contains a character string used to identify the code version to be analyzed.

Figure 8 illustrates the contents of this table for the CEC Title-24 ruleset:

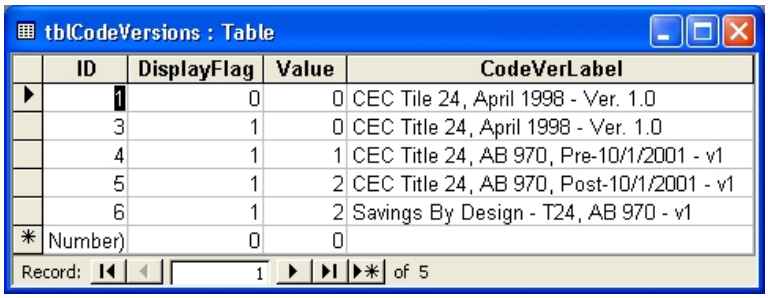


Figure 8: tblCodeVersions Data for CEC Title-24 Ruleset

RULELIST DATABASES

Each rulelist contained in a ruleset is defined in a separate Access database (.mdb) file. Each rulelist database contains a single table, called tblRules. Each record in this table represents a single rule of the rulelist and is described by the following fields of data:

RuleID (AutoNumber) This field is a unique record identifier that is automatically assigned upon the creation of each new record of data. This field is not directly referenced by either the ruleset compilation or analysis source code.

Order (Number) This number defines the order in which the rules in this rulelist are to be evaluated. Keep in mind that the evaluation of a rulelist involves the evaluation of each rule in sequence (based on the Order values).

RuleToSet (Text) This field contains the BDL Command/Keyword (or BDL Command/ruleset variable) that will be set by this rule. This field may reference data local to the specified command, or it may reference a keyword of a component that is assigned to this command. For example, a rule that is designed to alter the U-VALUE of CONSTRUCTION components, but only for those constructions that are assigned to UNDERGROUND-WALLs could be defined with a RuleToSet field consisting of something like this:

```
UNDERGROUND-WALL:CONSTRUCTION:U-VALUE
```

The RuleToSet field can also reference a ruleset variable. Ruleset variables are variables that are created at runtime during the rulelist evaluation. They must be associated with a specific building component and remain available for reference by other rules in this or other rulelists. Ruleset variables are also used to populate the fields of the compliance reports. For example, a rule that creates a ruleset variable for a ZONE based on the C-SCHEDULE-TYPE keyword of the SPACE that the ZONE references would have a RuleToSet field that looked something like this:

```
ZONE:rvScheduleType
```

(note that we generally name ruleset variables starting with a few lower case letters and containing a mixture of upper and lowercase letters.)

Expression (Memo) This field contains the expression that is evaluated to set the RuleToSet keyword/ruleset variable value. The format and options associated with rule expressions are described in the following section entitled "Rule Expression Syntax".

RuleLabel (Text) This field contains a brief character string used to identify this rule and its purpose/role in the rulelist. This string is output in compilation and evaluation error messages to identify the rule containing the error.

CodeRef (Text) This field is designed to enable the ruleset developer to reference section and/or page numbers out of the energy standard to which this rule applies.

Comments (Memo) This field is designed to enable ruleset developers to document the evolution of each rule and to help future developers understand why the rule was written the way it was.

IncludeRule (Yes/No) This field is designed to enable the ruleset developer to comment out certain rules, thereby excluding them from the compiled ruleset, without having to remove them entirely from the rulelist.

EvalAfter (Yes/No) This field indicates whether or not BDL expressions dependent on the value set by the rule should be re-evaluated following the evaluation of the rule. Flagging all rules as EvalAfter (yes) will cause the rulelist to evaluate significantly slower than if only those rules that really call for dependency re-evaluation to occur. All BDL expression dependencies are always evaluated following the evaluation of each compliance rulelist and also in the event that the list designed to track dependencies requiring re-evaluation nears its maximum capacity.

In order to facilitate the input of compliance rules, a form called frmRuleInput has been defined in each of the CEC Title 24 rulelist databases, as shown in Figure 9:

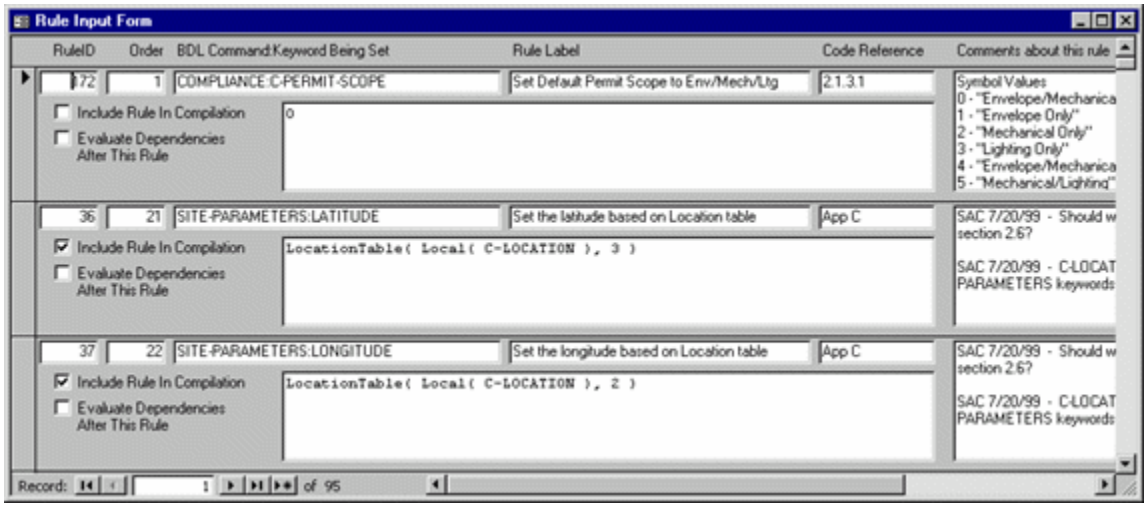


Figure 9: frmRuleInput form of a rulelist database file

LOOK-UP TABLES

Each compliance ruleset can reference one or more tables of data. The use of tables is often the most convenient way to integrate conditional data. These files can contain any number of both independent and dependent data arranged in columns. This format is consistent with tables of building description inputs provided in many compliance rule documents. All look-up tables for a ruleset are referenced in the tblLookUpTables table in the main compliance rules database (.mdb) file (as described above).

Throughout the compliance rule expressions, data contained in the look-up tables can be referenced by indicating the table name followed by parenthesis' containing look-up values for each independent variable in the table, followed by a 1-based index identifying the dependent variable to return from the table. The following is an example of a portion of a rule expression that performs a table look-up by selecting the

value from the third dependent column of data in the LocationTable in the record where the first (and only) independent value matches the numeric argument *LocCode*:

```
LocationTable( LocCode, 3 )
```

The number of arguments used for each table look-up equals the number of independent columns of data in that table plus one, where the final argument is the index of the dependent column to return the value from.

It is recommended that look-up tables contain comment lines in order to document the contents of the table. This is accomplished through the presence of semi-colon characters. All characters following a semi-colon on a line of text in the table will be ignored. Comments are routinely included at the top of tables, documenting the source of the data and what each column of the table corresponds to, as well as to the right of each line of data in the table, describing the independent and/or dependent values contained on that line.

During evaluation of a rule that contains a table look-up, the table is examined from the first (top) record to the last. Once the first mismatch occurs between a look-up argument and the corresponding independent table value, the following table record is checked. If the table look-up arguments do not match any single record of independent values in the table, no return value is provided and a warning is posted to the project's compliance log file. Values of -99 in the independent columns of the look-up table serve as wild card values, meaning that any function argument value will report a match in that column. If a table has a record of data where all independent values are equal to -99, then following records in that table will never get checked for return values since the record with the -99s will always report as matching the arguments.

In order to best facilitate the development and maintenance of look-up tables, each table is created as a separate worksheet within an Excel spreadsheet. Once all the data has been entered, it is then exported from Excel as a comma delimited (.csv) text file for compilation into the final binary encrypted ruleset file. Figure 10 provides an example of a look-up table worksheet in Excel:

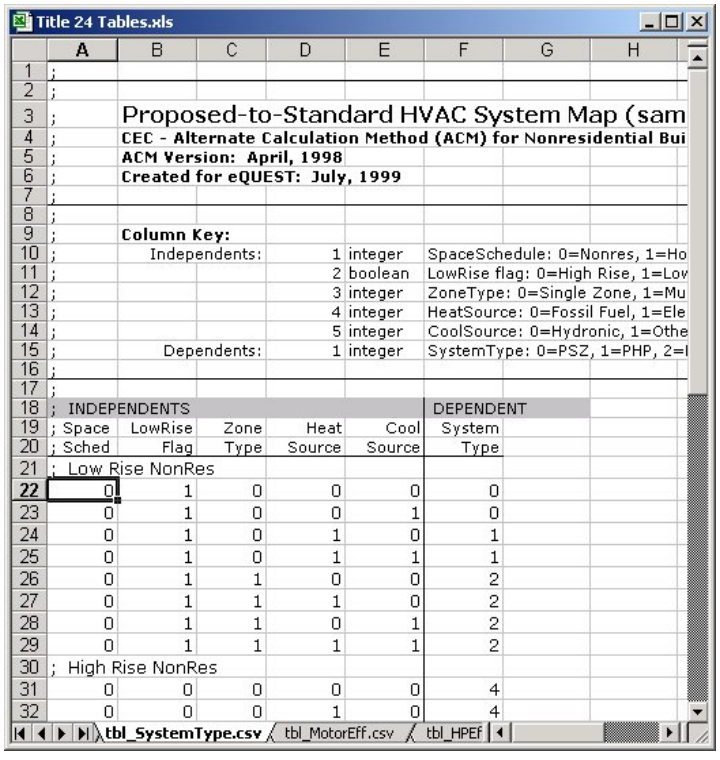


Figure 10: CEC Title 24 System Type Look-up Table Excerpt

COMPONENT LIBRARIES

Each compliance ruleset can include DOE-2 (BDL) building component descriptions that various rules within the ruleset can reference at any time throughout the compliance analysis processing. Only those library components selected for retrieval into the active building description are actually added to the building model and simulated during the compliance analysis. Like the ruleset's look-up tables, the library components are defined in Excel worksheets by component type (BDL command) and exported to comma delimited (.csv) text files for compilation into the final binary encrypted ruleset file.

What is contained in the first cell of each row in the worksheet determines what information is provided in that row (record) and in what columns to find that information. Rows beginning with a semicolon character are comment lines and will be ignored. The first row of actual data in each library worksheet should contain the number 0. This indicates that the following cell will contain the name of the component type (BDL command) that corresponds to all the component descriptions following it in the worksheet. Rows where the first cell contains the number 1 define the name of the library component and is followed by one or more records beginning with the number 2 that define the data that describes that component. For records beginning with 1, the component name should be provided in the second cell and for records beginning 2, the second cell is left blank, the third cell contains the BDL keyword, the fourth cell contains the array index (1-based) and the fifth and final cell contains the value. The value cell can contain either a number or character string. If the character string is assigning a pre-defined DOE-2 symbol (such as SYSTEM:TYPE = PSZ), then the character string need not be enclosed in quotes, but all other character values must be enclosed in quotes. The final record in the worksheet should begin with the value –1, indicating the end of the library component definitions for that sheet.

Figure 11 provides an example of the first few components defined in the CEC Title 24 ruleset's material library worksheet:

Title 24 Rulelibrary 00-10-02.xls

	A	B	C	D	E	F
9	;					
10	0	MATERIAL				
11	;			Array Index	Value	
12	;	Wood framed insulated walls - combined framing and insula				
13	1	"W.MAT.2X4.R11.16OC"				
14	2		THICKNESS	1	0.291667	
15	2		CONDUCTIVITY	1	0.035038	
16	2		DENSITY	1	6.950000	
17	2		SPECIFIC-HEAT	1	0.281079	
18	1	"W.MAT.2X4.R13.16OC"				
19	2		THICKNESS	1	0.291667	
20	2		CONDUCTIVITY	1	0.031571	
21	2		DENSITY	1	6.950000	
22	2		SPECIFIC-HEAT	1	0.281079	

lib_Materials.csv | lib_Layers.c

Figure 11: CEC Title 24 Construction Material Library Excerpt

DATATYPES TABLE

The DataTypes table enables the compliance ruleset to provide a compliance classification and several user-interface-oriented flag values for any and all DOE-2 (BDL) command/keyword pairs. Like with the look-up tables, the DataTypes table interprets semi-colon characters as the beginning of a comment and will ignore all data that follows it on that record. The following list provides a description of what data is entered in each column of this table:

1. This column of data contains a BDL command immediately followed by a colon and a keyword of that command.

2. This column contains a conditional statement. This feature is not yet implemented and therefore the second column of each entry must contain the string "None" (not in quotes though).

3. This column contains the compliance classification for the command/keyword pair provided in the first column. These classifications apply only to the proposed input building description and do not affect the translation of the proposed building into the energy/cost budget building. This column of the table must contain one of the following strings (and should not be enclosed in quotes):

   Compulsory Indicates this value MUST be defined via DOE-2 or user default or user input prior to performing the compliance analysis. If data tagged as Compulsory is not defined in the input building description, the compliance analysis will not pass the initial building check and abort.

   Required Indicates this value must be defined via DOE-2 or user default or user input prior to performing the compliance analysis only if the simulation option associated with this keyword is simulated. Data tagged as Required and left undefined will not prevent analysis from being performed.

   Optional Indicates this value may or may not be defined via default or user input. The compliance analysis is unaffected by this data being is left undefined.

   Default Indicates that the ProposedInput rulelist should contain a rule that defines a default value for this command/keyword pair that will override DOE-2 or user defaults (but user input will override this ruleset default).

   CriticalDef (not yet implemented) The ProposedInput rulelist contains a rule that defines a default value for this command/keyword pair that will override DOE-2 or user defaults. In the event the user overrides the ProposedInput rulelist default, the user must also provide an explanation of why this default value was overridden. Modifications to BDL enabling the storage and retrieval of comments assigned to specific command/keyword values must first be implemented before this feature can function.

   Prescribed Indicates that the ProposedInput and/or PostProposedInput rulelists contain rules to set this command/keyword pair and that value cannot be overridden by any other default or user input. User interfaces that are describing buildings solely for the purpose of compliance analysis should prevent their users from modifying data tagged as Prescribed.

   NotInput Similar to the Prescribed classification, in that rules will override any default or user inputs and users should be prevented from editing these data, with the addition that these values are often left undefined and are often designed to prevent the user from taking advantage of certain simulation options which the compliance ruleset disallows.

   Rules contained in the ProposedInput rulelist for command/keyword pairs classified as Compulsory, Required and Optional are considered ruleset defaults and override DOE-2 defaults but do not override user defaults. Rules in the ProposedInput rulelist that set Default and CriticalDef values on the other hand override both DOE-2 and user defaults.

4. This column of data are 0/1 flag values indicating whether or not the corresponding command/keyword is to be treated as a "primary variable". A primary variable is a variable that is considered a critical input by the ruleset. One or more other keywords for this command are likely dependent on its value. This flag does not affect the compliance analysis. It is however recommended that user interfaces that link to BDL memory reference these flags to determine what data should be collected describing a new building component being created by the user

prior to evaluating the ProposedInput rulelist. By collecting these values first, you enable the rules processing mechanism to set all other variables that are dependent on the primary variable(s) prior to displaying the dependent variables to the user.

5. This column of data do not affect the compliance processing but are provided for BDL user interfaces. These data are 0/1 flag values indicating whether or not the user should be able to edit the corresponding command/keyword.
6. This column of data are also 0/1 flag values and do not affect the compliance processing. These data are designed to enable user interfaces to prevent users from entering user-defined default values for the corresponding command/keyword pairs for which these flag values are 0.
7. This column of data are 0/1 flag values which, like the other flag values, do not affect the compliance processing but are there for the benefit of user interfaces. This flag value indicates whether a user interface should display or hide the corresponding command/keyword when the user is inputting their proposed building description. , or whether they are reviewing the final proposed or budget building descriptions generated by the compliance analysis processing.
8. This column of data are identical to the seventh column, only they are meant to indicate whether a user interface should display or hide the corresponding command/keyword when the user is reviewing the final proposed building description generated by the compliance analysis processing.
9. This column of data are identical to the seventh column, only they are meant to indicate whether a user interface should display or hide the corresponding command/keyword when the user is reviewing the final energy/cost budget building description generated by the compliance analysis processing.

The first entry in the DataTypes table should have the command/keyword field set to "DEFAULT" and all the following columns of data should contain default values for each element. All command/keyword pairs that are not specifically mentioned in the DataTypes table will be assigned these default properties.

The last record of data in the DataTypes table should contain the string "END-OF-TABLE" in the leftmost cell to inform the ruleset compiler to stop reading data from the file.

Figure 12 provides an example of the very first few records in the DataTypes table of the CEC Title 24 ruleset:

DataTypes.csv

	A	B	C	D	E	F	G	H	I
120	; 'DEFAULT' -or-			Prim	User	User	Display in modes:		
121	; BDL COMMAND:KEYWORD	Condition	DataType	Val	Edit	Dflt	Inp	Prop	Budg
122	;								
123	DEFAULT	None	Optional	0	1	1	1	1	1
124	;								
125	BOILER:C-AFUE	None	Optional	0	1	1	1	1	1
126	BOILER:C-NUM-OF-UNITS	None	Required	0	1	1	1	1	1
127	BOILER:C-THERM-EFF-MAX	None	Optional	0	1	1	1	1	1
128	BOILER:C-TOTAL-HTG-CAP	None	Required	0	1	1	1	1	1
129	BOILER:HW-LOOP	None	Required	0	1	1	1	1	1
130	BOILER:TYPE	None	Required	0	1	1	1	1	1
131	;								
132	CHILLER:C-NUM-OF-UNITS	None	Required	0	1	1	1	1	1
133	CHILLER:C-TOTAL-CLG-CAP	None	Required	0	1	1	1	1	1
134	CHILLER:C-TYPE	None	Required	0	1	1	1	1	1
135	CHILLER:CHW-LOOP	None	Optional	0	1	1	1	1	1
136	CHILLER:CONDENSER-TYPE	None	Required	0	1	1	1	1	1
137	CHILLER:CW-LOOP	None	Required	0	1	1	1	1	1

DataTypes

Figure 12: CEC Title 24 DataTypes Table Excerpt

SYMBOLS TABLE

There are certain inputs that are best handled by the user interface as a selection from a list of character strings. A good example of such an input would be HVAC system type. However, some such inputs need to have a different list of options (symbols) dependent on which compliance ruleset is loaded. For this reason, we have the Symbols table that enables the ruleset to define lists of symbols that are specific to that particular ruleset. The largest single list of symbols in the CEC Title 24 ruleset is the list of valid location selections, with over 600 entries.

Each symbol in the symbols table has associated with it a numeric value. Rules in the ruleset can default or set these symbolic values using either the character string or numeric representation of the symbol. However, since these symbol character strings are known only to the compliance ruleset and not to BDL, storage and retrieval of these values to/from BDL input files is always via the numeric representation. User interfaces that link to the DOE-2 compliance analysis system have access to both the character string and numeric versions of the symbols, so they can provide their users with much more user-friendly lists of options (vs. requiring the user to know what selections correspond to what values and to enter the correct numeric value).

Another feature of the ruleset symbols table is that it allows the available symbol options to be dependent on other data defined by the user. For example, providing a single long list of over 600 locations in California is hardly more friendly than requiring that the user enter the numeric value corresponding to their location. We therefore implemented a feature whereby the symbol lists were dynamic and can rely on the values of other inputs when determining what selections are valid within the current building description. For example, when collecting the building location from the user, we first ask the user to specify the county which allows us to narrow the list of possible locations to only those within the selected county.

Like with all ruleset tables, the symbols table is organized into columns of data, and interprets semi-colons as beginning comments, thereby ignoring all data that follows them on the same record. Like the ruleset library tables, the data contained in each record of the table are not interpreted in the same way. The leading numeric value in the record determines what data will follow on that record. The following list describes what valid values can be entered in the first cell of each row. This list is followed by additional listings of what is expected in the subsequent columns based on the value entered into the first cell.

0 Records beginning with the value 0 in the first cell (0-records) identifies the command/keyword pair which can be described by the symbols which follow this record (until reaching another record beginning with either 0 or –1). In the event multiple records beginning with 0 occur in immediate succession, then the symbol definitions that follow the last one apply to all the 0 records in that sequence.

1 1-records identify command/keyword pair(s) and numeric value(s) that define the condition under which the following symbol definitions may be applied to the command/keyword in the previous 0-record(s). Each symbol list may depend on up to two different command/keywords, which means that there can never be more than two consecutive records beginning with the value 1. When retrieving a currently active list of symbols for a command/keyword, that application must either provide the values assigned to all command/keywords that those symbols depend on, or have the compliance module access BDL data currently in memory to determine which list of symbols should be made available to the user.

2 2-records contain the numeric and character string representation of a single symbol which applies to the previous 0-record(s).

-1 End of file. This informs the ruleset compiler to stop reading data from this table.

Symbol Table Records beginning with 0

Column 2 The BDL command and keyword (separated by a colon) to which the following symbols will get applied.

Columns 3-6 Leave blank.

Symbol Table Records beginning with 1

Column 2 Leave blank.

Column 3 The BDL command and keyword (separated by a colon) whose value is referenced in order to determine whether or not the following symbols are valid for the command/keywords that are defined in the previous 0-records.

Column 4 The numeric value that the command/keyword in column 3 must equal in order for the following symbols to be valid inputs for the command/keywords that are defined in the previous 0-record(s). If a value in this column is equal -999, then it is treated like a wild card and any dependent command/keyword value will cause the following symbols to be made available.

Column 5 The numeric value corresponding to the default symbol for the following list of symbols.

Column 6 Leave blank.

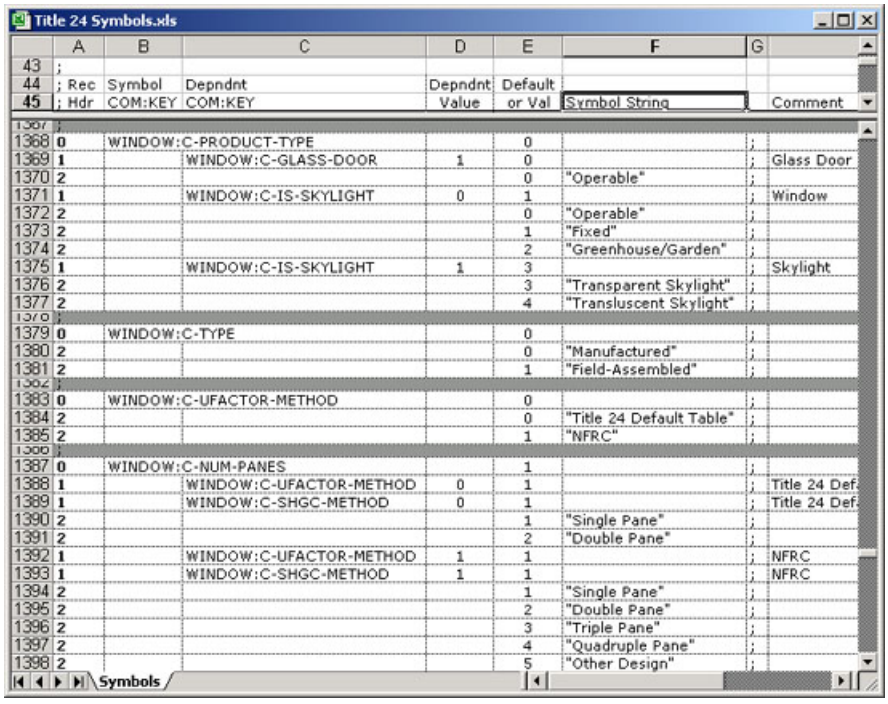
Symbol Table Records beginning with 2

Columns 2-4 Leave blank.

Column 5 The numeric value associated with the symbol defined on this record.

Column 6 The character string associated with the symbol defined on this record.

Figure 13 provides several example records of a symbols definition table:



Title 24 Symbols.xls

	A	B	C	D	E	F	G	
43	;							
44	; Rec	Symbol	Depndnt	Depndnt	Default			
45	; Hdr	COM:KEY	COM:KEY	Value	or Val	Symbol String		Comment
1368	0	WINDOW:C-PRODUCT-TYPE			0		;	
1369	1		WINDOW:C-GLASS-DOOR	1	0		;	Glass Door
1370	2				0	"Operable"	;	
1371	1		WINDOW:C-IS-SKYLIGHT	0	1		;	Window
1372	2				0	"Operable"	;	
1373	2				1	"Fixed"	;	
1374	2				2	"Greenhouse/Garden"	;	
1375	1		WINDOW:C-IS-SKYLIGHT	1	3		;	Skylight
1376	2				3	"Transparent Skylight"	;	
1377	2				4	"Transluscent Skylight"	;	
1379	0	WINDOW:C-TYPE			0		;	
1380	2				0	"Manufactured"	;	
1381	2				1	"Field-Assembled"	;	
1383	0	WINDOW:C-UFACTOR-METHOD			0		;	
1384	2				0	"Title 24 Default Table"	;	
1385	2				1	"NFRC"	;	
1387	0	WINDOW:C-NUM-PANES			1		;	
1388	1		WINDOW:C-UFACTOR-METHOD	0	1		;	Title 24 Def
1389	1		WINDOW:C-SHGC-METHOD	0	1		;	Title 24 Def
1390	2				1	"Single Pane"	;	
1391	2				2	"Double Pane"	;	
1392	1		WINDOW:C-UFACTOR-METHOD	1	1		;	NFRC
1393	1		WINDOW:C-SHGC-METHOD	1	1		;	NFRC
1394	2				1	"Single Pane"	;	
1395	2				2	"Double Pane"	;	
1396	2				3	"Triple Pane"	;	
1397	2				4	"Quadruple Pane"	;	
1398	2				5	"Other Design"	;	

Symbols

Figure 13: CEC Title 24 Symbol Definitions Table Excerpt

RANGE CHECKS TABLE

The range checks table enables a compliance ruleset to define its own user input range checking, above and beyond that which is present in DOE-2. The basic range checking mechanism's capabilities are to compare a command/keyword value to either a pre-defined or other command/keyword value and to classify each range check as either an Error, Warning or Message. Violations of range checks by any classification are output to project compliance log files, Errors and Warnings are also made available to the output compliance reporting mechanism and Errors will actually terminate the compliance analysis process.

In addition to these basic range checking capabilities, each range check can also define a condition that must evaluate to TRUE in order for the range check to be performed. For example, a range check can be implemented which checks that A <= B if and only if C > D.

Like the DataTypes and Symbols tables described above, this table is developed in the form of an Excel spreadsheet and then is exported into "CSV (Comma delimited)" format, which in turn is compiled by the compliance ruleset compiler. The Excel table (worksheet) that defines the range checks has 8 columns of data as described below.

Column 1 — The BDL command and keyword (separated by a colon) that the range check is to be performed on.

Column 2 — This field contains the operator associated with the range check. Valid operators include =, <, >, <=, >= and !=.

Column 3 — This field contains either a numeric value or a command and keyword (separated by a colon) that the data specified in column (A) is to be compared against.

<u>If the range check is to be performed regardless of any other building description inputs:</u>

Column 4 — Contains the string 'None' (with no quotes)

Columns 5-6 — Leave blank

<u>If the range check is to be performed regardless of any other building description inputs:</u>

Column 4 — The BDL command and keyword (separated by a colon) whose value will determine whether or not this range check is to be performed.

Column 5 — The operator (same options as column 2) to be performed on the Column 4 value that must evaluate to true in order for the range check to be performed.

Column 6 — Value -or- Command/Keyword to compare to column 4 (similar to column 3).

Column 7 — This field contains the classification of this range check and determines what actions are taken in the event the range check fails. Valid options include:

MESSAGE - The message in column 8 is written to the project's compliance log file.

WARNING - The message in column 8 is written to the project's compliance log file and is available to the compliance reporting mechanism for inclusion in the output compliance report(s).

ERROR - The message in column 8 is written to the project's compliance log file and is available to the compliance reporting mechanism for inclusion in the output compliance report(s) and the compliance analysis processing is terminated.

Column 8 — The message used to report the failure of the range check (enclosed in quotation marks).

The last record of data in the Range Checks table should contain the string "END-OF-TABLE" in the leftmost cell to inform the ruleset compiler to stop reading from the file.

Figure 14 provides some example records of a range checking definitions table:

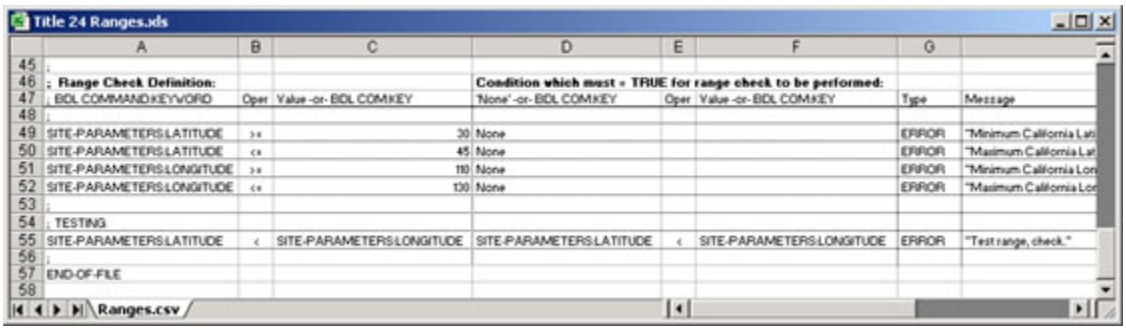


Figure 14: Sample Range Checking Definitions Table

RESETS TABLE

The resets table enables a compliance ruleset to reset certain command/keyword values in the event other command/keyword values are modified by the user. This data is only really useful to user interfaces that interact with BDL data in memory, since the user has no opportunity to modify BDL data when the compliance analysis is performed in batch mode via a BDL input file. When a command/keyword value is "reset" by this mechanism, it is as if user input was never provided, causing either a DOE-2, user or ruleset default to be installed. In the event no default of any type is available, the value is flagged as undefined.

Like the DataTypes, Symbols and Range Checks tables described above, this table is developed in the form of an Excel spreadsheet and then is exported into "CSV (Comma delimited)" format, which in turn is compiled by the compliance ruleset compiler. Like the Symbol table, the contents of each record in this table depends on the value entered in the first column of each record. The following list describes what valid values can be entered in the first cell of each row. This list is followed by additional listings of what is expected in the subsequent columns based on the value entered into the first cell.

0 Records beginning with the value 0 in the first cell (0-records) identifies the command/keyword pair which, when modified by the user at runtime, triggers one or more other command/keyword values to be re-initialized. In the event multiple records beginning with 0 occur in immediate succession, then the list of command/keyword values to be reset which follow the last one apply to all the 0 records in that sequence.

1 Records beginning with the value 1 in the first cell (1-records) identifies a command/keyword pair that gets reinitialized following the modification of the preceding 0-record command/keyword pair(s).

-1 End of file. This informs the ruleset compiler to stop reading data from this table.

Resets Table Records beginning with 0

Column 2 This field contains the command/keyword which, when modified by the user at runtime, causes the command/keyword pairs in the following 1-records to be re-initialized.

Column 3 Leave blank.

Resets Table Records beginning with 1

Column 2 Leave blank.

Column 3 This field contains the command/keyword that gets re-initialized upon the user's input of any of the preceding 0-record values.

Figure 15 provides some example records of a data reset definitions table:

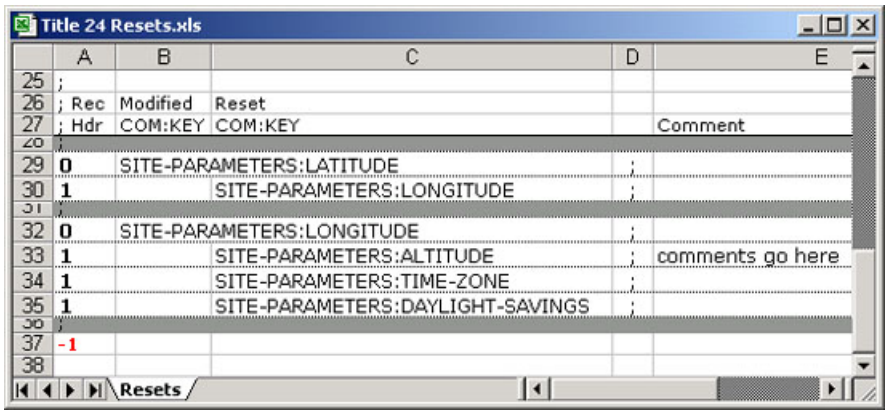


Figure 15: Sample Data Reset Definitions Table

KEYWORD DEFAULTING TABLE

The keyword defaulting tables enable a compliance ruleset to reset any keywords to their standard defaults specified in BDLDFT.DAT or BDLDFT.TXT. Invoking a default table from within the ruleset (See ApplyDefaultTable() function description) will cause properties listed in the table to be set to their standard defaults. A defaulting table is developed in the form of an Excel spreadsheet and then is exported into "CSV (Comma delimited)" format, which in turn is compiled by the compliance ruleset compiler. Each record in a defaulting table represents a keyword of a command. Keyword defaulting table CSV files can have varying numbers of columns (with a minimum of 4) in order to allow the ruleset developer to define separate sets of defaulting data to be applied to the building description at different points in the compliance analysis processing, for example defaulting performed on the proposed building versus budget building designs. Descriptions of the columns are provided below:

Column 1 The BDL command for which a keyword is to be defaulted.

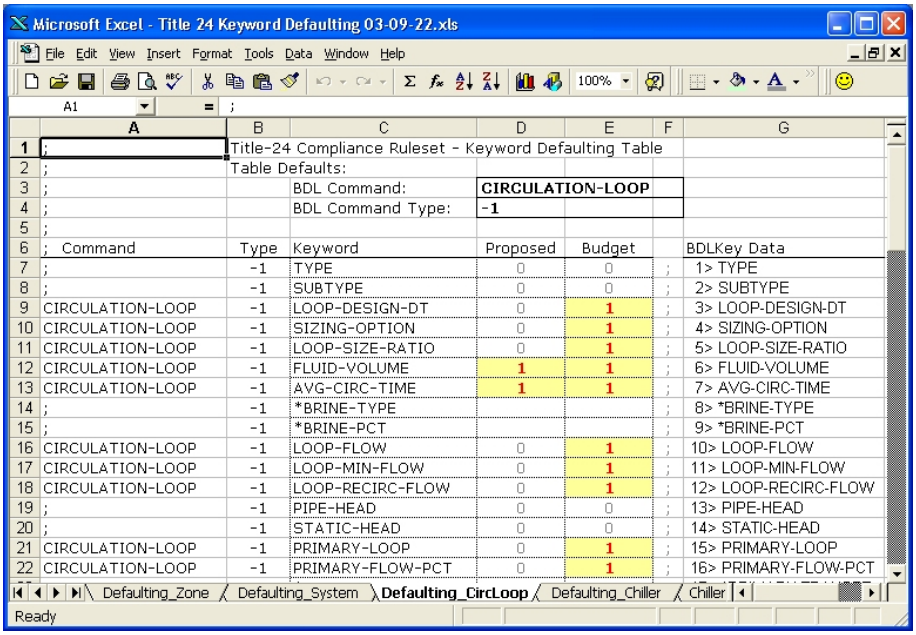
Column 2 This numeric value of the TYPE keyword for the BDL command. Some keywords have different meanings for similar BDL components with different values for TYPE. In these cases, it is necessary to specify the numeric value for TYPE. When specified, the defaulting actions specified in column four or greater will only be performed on keywords for commands of that numeric TYPE.

Column 3 The keyword to be defaulted.

Column 4 (and above) Keyword defaulting flag.

- 0 No defaulting performed
- 1 Keyword set to BDL default

Figure 16 provides some example records of a CEC Title-24 keyword defaulting table:



	A	B	C	D	E	F	G
1	;	Title-24 Compliance Ruleset - Keyword Defaulting Table					
2	;	Table Defaults:					
3	;		BDL Command:	CIRCULATION-LOOP			
4	;		BDL Command Type:	-1			
5	;						
6	; Command	Type	Keyword	Proposed	Budget		BDLKey Data
7	;	-1	TYPE	0	0	;	1> TYPE
8	;	-1	SUBTYPE	0	0	;	2> SUBTYPE
9	CIRCULATION-LOOP	-1	LOOP-DESIGN-DT	0	1	;	3> LOOP-DESIGN-DT
10	CIRCULATION-LOOP	-1	SIZING-OPTION	0	1	;	4> SIZING-OPTION
11	CIRCULATION-LOOP	-1	LOOP-SIZE-RATIO	0	1	;	5> LOOP-SIZE-RATIO
12	CIRCULATION-LOOP	-1	FLUID-VOLUME	1	1	;	6> FLUID-VOLUME
13	CIRCULATION-LOOP	-1	AVG-CIRC-TIME	1	1	;	7> AVG-CIRC-TIME
14	;	-1	*BRINE-TYPE			;	8> *BRINE-TYPE
15	;	-1	*BRINE-PCT			;	9> *BRINE-PCT
16	CIRCULATION-LOOP	-1	LOOP-FLOW	0	1	;	10> LOOP-FLOW
17	CIRCULATION-LOOP	-1	LOOP-MIN-FLOW	0	1	;	11> LOOP-MIN-FLOW
18	CIRCULATION-LOOP	-1	LOOP-RECIRC-FLOW	0	1	;	12> LOOP-RECIRC-FLOW
19	;	-1	PIPE-HEAD	0	0	;	13> PIPE-HEAD
20	;	-1	STATIC-HEAD	0	0	;	14> STATIC-HEAD
21	CIRCULATION-LOOP	-1	PRIMARY-LOOP	0	1	;	15> PRIMARY-LOOP
22	CIRCULATION-LOOP	-1	PRIMARY-FLOW-PCT	0	1	;	16> PRIMARY-FLOW-PCT

Figure 16: Sample Keyword Defaulting Table

Rule Expression Syntax

The most fundamental components of a compliance rule are the identification of what BDL command and keyword are to be set by the rule and the rule expression. Figure 17 provides an example of the most basic compliance rule expression.

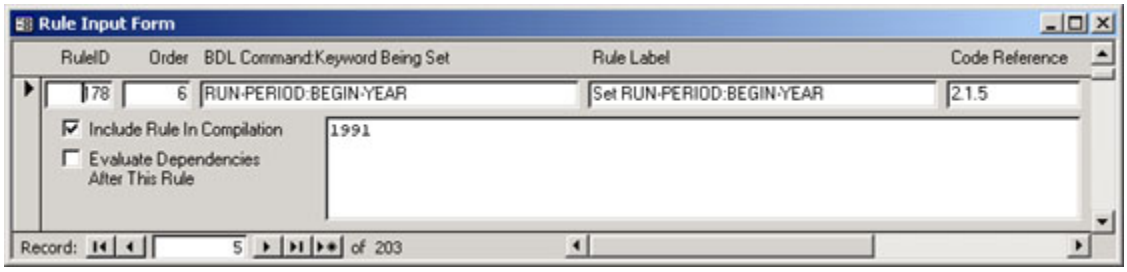


Figure 17: A Simple Compliance Rule

As mentioned in previous sections, each compliance rule is evaluated in the order defined for each list of rules (rulelist) contained in the ruleset. When each rule is evaluated, it is evaluated for each and every component contained in the building database of the type identified by the first part of the "BDL Command:Keyword Being Set" portion of the rule expression. When evaluated by the compliance rule processor, the rule provided in Figure 17 will set the `BEGIN-YEAR` keyword of every `RUN-PERIOD` component defined in the building description to the value 1991.

The reader should refer to the DOE-2 documentation and/or the BDLKey.out file for more information about the entire collection of commands and keywords that make up BDL to describe buildings.

This section will provide documentation on the command:keyword being set and expression field of a rule, including the entire set of function calls, statements and operators that can be included in rule expressions.

BDL COMMAND:KEYWORD BEING SET

The first part of this field identifies the primary building component type (BDL command), '`RUN-PERIOD`' for the example provided in Figure 17 above. The second part of this field identifies a variable (BDL keyword) that describes the type of building component identified in the first part ('`BEGIN-YEAR`' in the above example).

Most compliance rules have two-part command:keyword fields as described above, however these fields can contain additional parts that traverse one or more assigned building components. For example, a rule containing the command:keyword field '`EXTERIOR-WALL:CONSTRUCTION:C-USER-INP-ABS`' loops over every `EXTERIOR-WALL` in the building description and sets the `C-USER-INP-ABS` keyword of the `CONSTRUCTION` component that is assigned to the wall. All intermediate or referenced components in the command:keyword field must be identified using the keyword name associated with the command referenced to its immediate left. In the example above, it just so happens that `CONSTRUCTION` is both a command name as well as the name of an `EXTERIOR-WALL` keyword. If `CONSTRUCTION` components were assigned to `EXTERIOR-WALL`s via a keyword named `CONS`, then the above example should read '`EXTERIOR-WALL:CONS:C-USER-INP-ABS`'.

Array indices can also be included in command:keyword fields by including the 1-based array index enclosed in square brackets following any intermediate (component referencing) or final keyword. For example, the command:keyword field '`SPACE:PEOPLE-SCHEDULE[2]`' would cause the rule to set the 2nd element of the `PEOPLE-SCHEDULE` array for each `SPACE` component. Likewise, the

command:keyword field '`SPACE:LIGHTING-SYSTEM[1]:LAMP-TYPE`' would cause the rule to set the `LAMP-TYPE` keyword for the 1st element of the array of assigned `LIGHTING-SYSTEM`s for each `SPACE` in the building description.

The compliance rules processing mechanism is also capable of creating temporary (or ruleset) variables on the fly during the compliance processing to help simplify rule logic or for reporting purposes. In fact, all building input and simulation results that are reported in any compliance report must be defined as a ruleset variable. A command:keyword field can specify the creation or reset of a ruleset variable by specifying a non-BDL keyword as the far right component of the field, for example '`MATERIAL:rvHeatCapacity`'. It is important that the name contain one or more lower case letters, as the ruleset compiler assumes that any keyword containing all capitals must map to pre-defined BDL keywords and will cause compilation errors if not found. Once a ruleset variable has been created (via a rule where is appears in the command:keyword field) it can be referenced by any rule located later in the same rulelist or in any rulelist that is evaluated after the one in which it is defined.

RULE EXPRESSION STATEMENTS

Rule expression statements can contain a wide variety of elements, including constant numeric values or character strings, references to other BDL or ruleset variables, function calls and if..then and case (switch) statements. The preceding example (Figure 17) consists of a statement in the form of constant numeric value. Similarly, a statement consisting of a character string is simply the character string enclosed in quotation marks. These make up the simplest rule expression statements.

The following subsections will provide descriptions and examples of each non-constant type of statement that can be included in rule expressions.

Referencing Other BDL or Ruleset Variables

Compliance rule statements can reference data that describes the same component that is identified by the first portion of the command:keyword portion of the rule. These types of references are called local. Rule statements can also reference data that describe other components that are somehow related to the component identified as the local component. Any rule statement may also reference data that describe components classified as "Global".

The first and most important thing to understand when referencing other component's variables is what component is the local component. For a rule whose command:keyword field is '`RUN-PERIOD:BEGIN-YEAR`', the local component is the `RUN-PERIOD`. The local component is always identified as the leftmost (first) portion of the variable name. For a rule whose command:keyword field is '`EXTERIOR-WALL:CONSTRUCTION:C-USER-INP-ABS`', the local component is the exterior wall and NOT the construction that is assigned to the exterior wall.

Rule statements reference data describing building components via a set of functions. Which function you use to reference a component's variable depends on the relationship between the local component and the component whose variable you are referencing. The following bullets describe each type of component variable referencing available via the compliance rules processor.

- **Global References**: An expression may reference data that describes any building component classified as global (refer to Table 1 for a listing of those commands classified as global). The user is only able to define one of each of the global building components within each building description. Referencing global component variables is performed via the Global() function. The Global() function requires one argument, a command:keyword string that is not enclosed in quotes. The Global() function argument must include both and only these two parts (command and keyword or ruleset variable), with no subordinate or assigned component references. The following example rule sets each `WINDOW:HEIGHT` to the product of its current height and the ratio of the building's budget and proposed window/wall areas (previously calculated and stored as ruleset variables):

```
Local( HEIGHT ) *
( Global( COMPLIANCE:rvBudgetWWR   ) /
  Global( COMPLIANCE:rvProposedWWR ) )
```

- **References To All Components of a Specified Type**: An expression may generically reference the sum or maximum value of a particular keyword for all components of a specified type currently defined in the building description. This is performed via the SumAll() and MaxAll() functions, each of which require a single two-part command:keyword argument. The following example sets the building's `COMPLIANCE:rvBldgWinArea` to the sum of the window area for each floor defined in the building:

```
SumAll( FLOOR:rvTotWinArea )
```

- **Local References**: An expression may reference data that describes the same component as the one being altered by the expression. Referencing local keywords or ruleset variables is performed via the Local() function. The Local() function requires one argument, a one-part variable name (keyword or ruleset variable only). The Local() variable name argument need not (and must not) include a component type (BDL command), since this is already defined by the component type provided in the command:keyword field identifying what data is to be set by the result of the expression. For example, an expression defining the heat capacity of a construction material (`MATERIAL:rvHeatCapacity`) can reference various properties of that material as shown in the following sample expression:

```
Local( DENSITY ) * Local( SPECIFIC-HEAT ) *
Local( THICKNESS )
```

- **Assigned Component References**: An expression may reference data that describes a component that is assigned to the local component. For example, a `CONSTRUCTION` component can be attached to an `EXTERIOR-WALL` component via the exterior wall's `CONSTRUCTION` keyword. Therefore expressions that describe an `EXTERIOR-WALL` can reference data that describes the `CONSTRUCTION` assigned to that `EXTERIOR-WALL`. However, the reverse condition does not apply (i.e. expressions that describe a `CONSTRUCTION` can not reference data that describes an `EXTERIOR-WALL` that the `CONSTRUCTION` is assigned to). This local referencing functionality is also provided via the Local() function, which accepts either a single or multiple keyword argument. An example where data describing an assigned component is referenced within an expression is the rule that sets a `ZONE`'s schedule type (`ZONE:rvScheduleType`) to the same value that is entered for the `ZONE`'s assigned `SPACE`, as follows:

```
Local( SPACE:C-SCHEDULE-TYPE )
```

- **Parent References**: An expression may reference data that describes the component that serves as the parent of the local component (refer to Table 2 for a listing of valid BDL parent/child component relationships). For example, since every `EXTERIOR-WALL` has a parent `SPACE`, then expressions that define keywords or ruleset variables describing an `EXTERIOR-WALL` may reference data describes that `EXTERIOR-WALL`'s parent `SPACE`. Such references are performed via the Parent() function that requires a single keyword or ruleset variable argument. Additional functions are available for referencing data that describes a component's grandparent (Parent2()) and great-grandparent (Parent3()). For example, an `EXTERIOR-WALL`'s height (`EXTERIOR-WALL:HEIGHT`) can be set to the height of its parent `SPACE` by the rule:

```
Parent( SPACE:HEIGHT )
```

- **Parental Assigned Component References**: An expression may reference data that describes a component that is assigned to the parent of the local component. This is performed via the Parent() function, whose single argument has the same restrictions as defined for the Local() function. Similarly, the Parent2() and Parent3() functions can be used to reference data that describes a component assigned to the grandparent and great-grandparent of the local component.

- **Child Component References**: An expression may reference data that describes a child of the local component or any components assigned to the child component (refer to Table 2 for a listing of valid BDL parent/child component relationships). This is performed via the ChildRef() function, which requires two arguments. The first argument is a command:keyword or ruleset variable name (much like the Parent() function described above) that identifies both the child component type (command) and keyword or ruleset variable to reference. The second argument is a one-based integer index into the local component's list of children of the specified component type.
- **Child Component Variable Sums & Maximums**: An expression may reference the sum or maximum value of a keyword or ruleset variable across all children of the local component. This is performed via the SumChildren() and MaxChild() functions, each of which require a single command:keyword or ruleset variable name argument. The argument must have two parts, starting with the component type (BDL command) of the children whose data are to be referenced, followed by the keyword or ruleset variable name of the data to be summed/peaked for all children of the type specified by the first part. The following example uses the SumChildren() function to set each `EXTERIOR-WALL`'s window area ruleset variable (`EXTERIOR-WALL:rvWinArea`) to the sum of all attached window and glass door components' areas:

```
SumChildren( WINDOW:rvTotWinArea ) +
SumChildren( WINDOW:rvTotGlassDoorArea )
```

- **Reverse Reference Sums & Maximums**: An expression may reference the sum or maximum value of a particular keyword or ruleset variable for all components for which the local component is assigned via a keyword reference. This is performed via the SumRevRef() and MaxRevRef() functions, each of which require two separate arguments. The first command:keyword argument, starts with the component type of the component that assigns the local component and ends with the keyword used to assign the local component. The second command:keyword or ruleset variable argument identifies the data of the assigning component to sum or find the peak value of. These features are particularly useful when setting keyword inputs or ruleset variables for `CIRCULATION-LOOP`s based on data that describe `CHILLER`s or `BOILER`s assigned to the loop.
- **Assigning Compliance Library Components**: An expression may be used to assign a building component defined in the compliance ruleset's building component library. This is performed via the RuleLibrary() function, which accepts two arguments. The first argument identifies the type of component (BDL command) to retrieve from the ruleset's library. The second argument contains a character string consisting of the name of the library component to be retrieved (enclosed in quotes). For example, a `SPACE`'s occupancy schedule (`SPACE:PEOPLE-SCHEDULE[1]`) can be assigned to a schedule named "Non-Res-People" defined in the ruleset library with the expression:

```
RuleLibrary( SCHEDULE-PD, "Non-Res-People" )
```

Referencing Table Look-Up Values

All look-up tables defined in the ruleset can be referenced by compliance rule statements as if they were pre-defined rule processor functions (similar to those described above). In order to retrieve a value from a look-up table, the user must provide the look-up table name followed (in parentheses) by values for each independent variable and a one-based index of the dependent variable that they wish to retrieve. In the following example, the table OccupAssumpTable is defined as containing one independent variable and 8 dependent variables. Therefore, references to this table look-up must contain two arguments, the first specifying the independent value to be looked up and the second providing an index (1-8) to identify which dependent table value to return. This example sets the '`rvSubOccsPerSqFt[1]`' ruleset variable for each `SPACE` (`SPACE:rvSubOccsPerSqFt[1]`) to the 2nd dependent value stored in the OccupAssumpTable based on the value of the `SPACE:C-OCCUP-TYPE[1]` keyword:

```
OccupAssumpTable( Local( C-OCC-TYPE[1] ), 2 )
```

Executable Expression Statements

The compliance rules processor is compatible with two types of executable expression statements, including if...then...else and case (switch) statements. These statements reference other database values in order to create multiple branches for a single expression. The exact syntax for using these statements must be followed in order to ensure accurate evaluation.

- **if...then...else Statement**: The syntax associated with the if...then...else statement is quite simple. Each 'if' is directly followed by an expression (which evaluates to TRUE or FALSE) which is in turn followed by a 'then' and a statement which is evaluated only if the expression following the 'if' evaluates to TRUE. Every if statement must be followed by an 'else' statement (which is evaluated only if the expression following the 'if' evaluates to FALSE) and is concluded with an 'endif'. The expression following the 'if' and enclosed in parentheses can be a complex expression with multiple parts grouped by additional parentheses and combined together using And ('.AND.' or '&&') and Or ('.OR.' or '||') operators.
  A simple example of an if...then...else statement is the following rule that sets each `WINDOW`'s flag indicating whether or not it is a skylight (`WINDOW:C-IS-SKYLIGHT`) based on the tilt angle of it's parent `EXTERIOR-WALL` (`EXTERIOR-WALL:TILT`):

  ```
  if ( Parent( TILT ) <= 60 .AND. Parent( TILT ) >= -60 )
  then 1
  else 0
  endif
  ```

- If more than two branches are required, you can nest multiple if...then...else statements as illustrated in the following example. (note: indenting within expressions is not required and is included here simply to help the reader match up the if/then/else/endif of each statement).

  ```
  if ( Local( C-CONDITIONING ) == 0 .OR.
       Local( C-CONDITIONING ) = 1 )
  then "CONDITIONED"
  else if ( Local( C-CONDITIONING ) = 5 )
       then "PLENUM"
       else "UNCONDITIONED"
       endif
  endif
  ```

- **case (switch) Statement**: The case statement is very useful when you wish to create an expression with several branches based on a single variable being equal to several static values. Each case statement begins with the word 'switch' followed by an expression that is typically a reference to another building database variable. Following this expression is one or more case statements, each having the form 'case' followed by a constant numeric value, followed by a colon and a statement that is evaluated in the event the original expression is equal to the constant value of this case. The last case of the group is the default case and for this case the 'case' and following constant value is replaced by a single 'default'. At the end of the case statement is an 'endswitch'. Like if...then...else statements, case statements can be nested within each other. A simple example of a case statement is the following rule that assigns one of several `SCHEDULE`s defined in the ruleset library to each `SPACE:PEOPLE-SCHEDULE[1]` based on the value of the `SPACE:C-SCHEDULE-TYPE` keyword.

  ```
  switch ( Local ( C-SCHEDULE-TYPE ) )
     case  0:  RuleLibrary( SCHEDULE-PD, "Non-Res-People" )
     case  1:  RuleLibrary( SCHEDULE-PD, "Hotel-Fun-People" )
     default:  RuleLibrary( SCHEDULE-PD, "H-R-Res-People" )
  endswitch
  ```

Both if...then...else and case statements can be nested together into a single rule expression. This significantly more complex example sets each `WINDOW:GLASS-TYPE` keyword based on a variety of other building data, including attributes of the window itself, attributes of the window's parent wall (including type, facing direction and tilt), attributes of the window's grandparent space and the climate region the building is located in:

```
if ( Parent( C-DEMISING-WALL ) == 1 )
then UNCHANGED
else if ( ParentCompType() == 13 )
then UNCHANGED
else if ( ( Parent( DEG-FROM-NORTH ) < 45 .AND.
            Parent( DEG-FROM-NORTH ) > -45 ) .AND.
          ( ( Parent( TILT ) > 60 .AND.
              Parent( TILT ) < 120 ) .OR.
            ( Parent( TILT ) > -120 .AND.
              Parent( TILT ) < -60 ) ) )
then switch ( Global( SITE-PARAMETERS:rvClimateRegion ) )
          case  1: RuleLibrary( GLASS-TYPE, "T24.GT.1507" )
          case  2: RuleLibrary( GLASS-TYPE, "T24.GT.1503" )
          case  3: RuleLibrary( GLASS-TYPE, "T24.GT.1503" )
          case  4: RuleLibrary( GLASS-TYPE, "T24.GT.1507" )
          case  5: RuleLibrary( GLASS-TYPE, "T24.GT.1507" )
          default: RuleLibrary( GLASS-TYPE, "T24.GT.1507" )
          endswitch
else if ( Parent2( C-OCC-TYPE ) == 2 .AND.
        ( ( Parent( TILT ) > 60 .AND. Parent( TILT ) < 120 ) .OR.
          ( Parent( TILT ) > -120 .AND. Parent( TILT ) < -60 ) ) )
then switch ( Global( SITE-PARAMETERS:rvClimateRegion ) )
          case  1: RuleLibrary( GLASS-TYPE, "T24.GT.1507" )
          case  2: RuleLibrary( GLASS-TYPE, "T24.GT.1503" )
          case  3: RuleLibrary( GLASS-TYPE, "T24.GT.1504" )
          case  4: RuleLibrary( GLASS-TYPE, "T24.GT.1508" )
          case  5: RuleLibrary( GLASS-TYPE, "T24.GT.1508" )
          default: RuleLibrary( GLASS-TYPE, "T24.GT.1508" )
          endswitch
else if ( ( Parent( TILT ) > 60 .AND. Parent( TILT ) < 120 ) .OR.
          ( Parent( TILT ) > -120 .AND. Parent( TILT ) < -60 ) )
then switch ( Global( SITE-PARAMETERS:rvClimateRegion ) )
          case  1: RuleLibrary( GLASS-TYPE, "T24.GT.1507" )
          case  2: RuleLibrary( GLASS-TYPE, "T24.GT.1503" )
          case  3: RuleLibrary( GLASS-TYPE, "T24.GT.1504" )
          case  4: RuleLibrary( GLASS-TYPE, "T24.GT.1508" )
          case  5: RuleLibrary( GLASS-TYPE, "T24.GT.1508" )
          default: RuleLibrary( GLASS-TYPE, "T24.GT.1508" )
          endswitch
else if ( Local( C-PRODUCT-TYPE ) == 5 )
then switch ( Global( SITE-PARAMETERS:rvClimateRegion ) )
          case  1: RuleLibrary( GLASS-TYPE, "T24.GT.1506" )
          case  2: RuleLibrary( GLASS-TYPE, "T24.GT.1502" )
          case  3: RuleLibrary( GLASS-TYPE, "T24.GT.1502" )
          case  4: RuleLibrary( GLASS-TYPE, "T24.GT.1506" )
          case  5: RuleLibrary( GLASS-TYPE, "T24.GT.1506" )
          default: RuleLibrary( GLASS-TYPE, "T24.GT.1506" )
          endswitch
else switch ( Global( SITE-PARAMETERS:rvClimateRegion ) )
          case  1: RuleLibrary( GLASS-TYPE, "T24.GT.1505" )
          case  2: RuleLibrary( GLASS-TYPE, "T24.GT.1501" )
          case  3: RuleLibrary( GLASS-TYPE, "T24.GT.1501" )
          case  4: RuleLibrary( GLASS-TYPE, "T24.GT.1505" )
          case  5: RuleLibrary( GLASS-TYPE, "T24.GT.1505" )
          default: RuleLibrary( GLASS-TYPE, "T24.GT.1505" )
          endswitch
```

```
endif
endif
endif
endif
endif
endif
```

Special Reserved Expression Return Values

The following list documents special reserved words that can be specified as return values of rule expressions regardless of the type of BDL keyword or ruleset variable being set.

- The reserved word **DEFAULT** can be used to cause any BDL keyword to get reset to its default value.
- The reserved word **UNCHANGED** can be used to cause the result of the rule expression to be ignored, hence leaving any BDL keyword or ruleset variable unchanged.

The following rule expression provides an example of both the DEFAULT and UNCHANGED reserved words in use in a single expression that sets each `CIRCULATION-LOOP:LOOP-DESIGN-DT`:

```
if ( Local( SUBTYPE ) == 1 )
then if ( Local( TYPE ) == 4 )
     then 30
     else if ( Local( TYPE ) == 1 )
          then 12
          else UNCHANGED
          endif
     endif
else DEFAULT
endif
```

Expression Syntax and Functionality Tables

The following tables provide a summary of the expression syntax and functionality available within the compliance rule expressions. Special functions developed specifically for manipulating the DOE-2 building description database (BDL) are documented in the following section entitled "Function Reference".

Table 1: BDL Commands Classified As "Global"

BDL Command Classified As "Global"		
SITE-PARAMETERS	BUILD-PARAMETERS	MASTER-METERS
COMPLIANCE		

Table 2: BDL Parent/Child Component Relationships

Parent Component Types	Corresponding Child Component Types
FLOOR	SPACE
SPACE	EXTERIOR-WALL, ROOF, INTERIOR-WALL, UNDERGROUND-WALL, UNDERGROUND-FLOOR
EXTERIOR-WALL, ROOF, INTERIOR-WALL	WINDOW
EXTERIOR-WALL	DOOR
SYSTEM	ZONE

Table 3: BDL Data Status Flag Values and Descriptions

Value	Description / Meaning
0	Undefined
1	DOE-2 Default Value
2	DOE-2 Default Expression
3	Library Value
4	Library Expression
5	User Input Value
6	User Input Expression
7	User-Defined Default Value
8	User-Defined Default Expression
9	Linked Component Value
10	Linked Component Expression
11	Compliance Ruleset Installed Value
12	Compliance Ruleset Installed Expression
13	Compliance Ruleset Library Value
14	Compliance Ruleset Library Expression
15	Compliance Ruleset Default Symbol

Table 4: Arithmetic and Logical Expression Operators

Arithmetic:	*	Multiplication
	/	Division
	+	Addition
	-	Subtraction (or Unary Minus)
	**	Exponential
Logical:	|| or .OR.	Or
	&& or .AND.	And
	! or .NOT.	Not
	== or .EQ.	Equal
	!= or .NE.	Not equal
	> or .GT.	Greater than
	< or .LT.	Less than
	>= or .GE.	Greater than or equal to
	<= or .LE.	Less than or equal to

Table 5: Standard Expression Functions

Abs(x)	Absolute value
Max(x1, x2)	Maximum
Min(x1, x2)	Minimum
Mod(x1, x2)	Remainder of (int) x1 divided by (int) x2
Int(x)	Rounds x to nearest integer
Ftoa(x)	Converts a floating point number to a character string
Log(x)	Natural logarithm
Log10(x)	Base-10 logarithm
Exp(x)	Exponential (e raised to the power x)
Pow(x1, x2)	Power (x1 raised to the power x2)
Sqrt(x)	Square root
Sin(x)	Sine (angle expressed in radians)
ASin(x)	Arcsine (result in radians)
Cos(x)	Cosine (angle expressed in radians)
ACos(x)	Arccosine (result in radians)
Tan(x)	Tangent (angle expressed in radians)
ATan(x)	Arctangent (result in radians)

Note: All function names are case insensitive.

Format Specification Fields

Several of the expression functions allow for the formatting of character string and numeric data into messages and strings output to files, user prompts or message boxes. These functions include Format(), MessageBox(), PostUserPrompt(), PostMessage(), PostWarning(), PostError() and ExceptionalCondition().

Format specifications always begin with a percent sign (**%**). When the string/message argument of the above listed functions includes a single format specification, it converts the value of the first argument following the string/message and outputs it accordingly. A second format specification causes the second argument to be converted and output, and so on. A maximum of 18 format specifications and subsequent arguments can be included in a single function call and if there are more arguments than there are format specifications, the extra arguments are ignored.

Format specifications are written as "**%**[*flags*][*width*][**.***precision*]*type*", where the portions enclosed in square brackets are optional. The following table describes supported options for each component of the format specification fields.

Table 6: Format Specification Fields

flags: Optional character(s) that control justification of output and printing of signs, blanks and decimal points. More than one flag can appear in a single format specification.

-	Left align the result within the given field *width* (default is right aligned).
+	Prefix the output value with a sign (+ or –) (default is only show sign if value is negative).
0	If *width* is prefixed with 0, zeros are added until the minimum *width* is reached. If 0 and – appear, the 0 is ignored.
' ' (blank space)	Prefix the output value with a blank if the output value is positive; the blank is ignored if both the ' ' and + flags appear

width: Optional number that specifies the minimum number of characters output. This value can only serve to increase the width of an output string and will not truncate the value.

precision: Optional number that specifies the maximum number of characters printed for all or part of the output field.

for *type* = e, E or f	Specifies the number of digits after the decimal point.
for *type* = g or G	Specifies the maximum number of significant digits to output.
for *type* = s or S	Specifies the maximum number of characters to be output.

type: Required character that determines whether the associated *argument* is interpreted as a string or a number.

e	Signed value having the form [–]*d.dddd* **e** [*sign*]*ddd* where *d* is a single digit, *dddd* is one or more digits, *ddd* is exactly three digits, and *sign* is + or –.
E	Identical to the **e** format (above) except that **E** (as opposed to **e**) precedes the exponent.
f	Signed value having the form [–]*dddd.dddd*, where *dddd* is one or more digits. The number of digits before the decimal point depends on the magnitude of the number, and the number of digits after the decimal point depends on the requested precision.
g	Signed value printed in **f** or **e** format, whichever is more compact for the given value and precision. The **e** format is used only when the exponent of the value is less than –4 or greater than or equal to the precision argument. Trailing zeros are truncated, and the decimal point appears only if one or more digits follow it.
G	Identical to the **g** format (above) except that **E** (as opposed to **e**) precedes the exponent (when appropriate).
s	Character string of length not to exceed *precision*.

Function Reference

The section documents all rule expression functions that are specifically designed to retrieve and/or manipulate the DOE-2 building database (BDL) (plus a few others to provide additional compliance processing-related functions).

BDL Function Notes

BDL Command / Keyword / user-defined component names (u-names) case sensitivity and punctuation

BDL commands and keywords used in expressions are case sensitive. Commands and keywords must be entered in all caps and should not be enclosed in quotation marks, and u-names must be entered exactly as they were defined and should always be enclosed in quotation marks.

Ruleset Variables

Ruleset variables have no pre-defined type, the way BDL keywords do. Instead, they take on the type, either numeric or string, of the return value of the expression that sets them.

Reserved "Action" Keyword

Certain rules are designed to perform an action on the building description such as evaluating a reference rulelist or creating/deleting building components, as opposed to setting data to a keyword or ruleset variable as most rules do. Such rules should specify the command over which the action is performed followed by the keyword Action (i.e. `COMPLIANCE:Action`) in the field identifying the "BDL Command:Keyword Being Set". In most cases, the action is performed only once for the entire building, in which case the selection of the `COMPLIANCE` command is most appropriate as there will always be only one of them defined per building description and that one must be present in order to perform the compliance analysis. Other actions may be designed to be performed on each individual component of a specific type, in which case the command preceding the Action keyword should be the one for which the actions are to be performed on.

Keyword and Ruleset Variable function arguments

All function arguments that can reference either a valid BDL keyword or ruleset variable of a command will be written as "`KEY-or-RV`" whereas arguments that must be a valid BDL keyword will be written as "`KEYWORD`".

Function arguments listed *in italics*

All function arguments listed in italics in the following documentation are in fact optional, meaning they may or may not be specified when calling the function.

Array indexes

Individual array indexes can be included in function arguments accessing BDL keyword values of type numeric or symbolic if and only if that keyword's the value array length >1 (i.e. an array of numbers or symbols). The array index argument is a one-based index into the array of values and should always be enclosed in square brackets following the keyword (i.e. [i]). When an array index does not follow a keyword argument that is defined by an array of values, the function will retrieve the first value in the array of values that define the keyword. The definition of the array index arguments should be in the form of a numeric constant and not the result of an expression.

Symbolic return values

Functions such as Local(), Parent() and others, when returning the current setting for symbolic defined BDL keywords, returns the currently selected symbol's value and NOT its symbol table index. The value associated with any pre-defined symbol can be found in the final column of data in the listing of available symbols immediately following the definition of the keyword in the BDLKey.out file.

REFERENCING GLOBAL DATA

Global()

Returns the specified keyword or ruleset value for a BDL component classified as global (refer to Table 1 for a listing of BDL commands classified as global).

Abbreviated Function Name: **#G()**

Syntax **Global(COMMAND:KEY-or-RV*[i]*)**

The COMMAND portion of the argument must be a BDL command that is classified as global.

Example(s)

```
Global( COMPLIANCE:C-NUM-OF-STORIES )
```

SumAll()

Returns the sum across all building components for the specified BDL keyword or ruleset variable.

Abbreviated Function Name: **#SA()**

Syntax **SumAll(COMMAND:*KEYWORD[i]*:KEY-or-RV*[i]*)**

The intermediate portion of the function argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

```
SumAll( FLOOR:C-DISPLAY-PERIM )
```

MaxAll()

Returns the maximum value across all building components for the specified BDL keyword or ruleset variable.

Abbreviated Function Name: **#MA()**

Syntax **MaxAll(COMMAND:*KEYWORD[i]*:KEY-or-RV*[i]*)**

The intermediate portion of the function argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

REFERENCING LOCAL DATA

Local()

Returns the specified keyword or ruleset value for the local component (the local component being the component on which the rule is being evaluated which also corresponds to the command listed in the leftmost portion of the rule's "BDL Command:Keyword Being Set" field).

Abbreviated Function Name: **#L()**

Syntax **Local(** *KEYWORD[i]:***KEY-or-RV***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

When setting `SITE-PARAMETERS:LATITUDE` keyword via a LocationTable look-up where the independent variable is the value of the `SITE-PARAMETER:C-LOCATION` keyword:

```
LocationTable( Local( C-LOCATION ), 3 )
```

When setting the `ZONE:rvScheduleType` ruleset variable to be equal to the `C-SCHEDULE-TYPE` keyword of the `SPACE` assigned to this `ZONE` via the `ZONE:SPACE` keyword:

```
Local( SPACE:C-SCHEDULE-TYPE )
```

LocalCompAssigned()

Returns the value 1 if the keyword specified in the function argument assigns a valid building component, otherwise the value 0 is returned.

Abbreviated Function Name: **#LCA()**

Syntax **LocalCompAssigned(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables cannot directly reference BDL components.

Example(s)

The following rule expression excerpt is from a rule that sets the `SYSTEM:HW-LOOP` keyword. This portion of the rule expression checks to see if the system's `HEAT-SOURCE` is set to `HOT-WATER` (symbol value = -1) and then that there is no hot water loop assigned via the `HW-LOOP` keyword:

```
if ( Local( HEAT-SOURCE ) == -1 .AND.
     LocalCompAssigned( HW-LOOP ) == 0 )
then ...
```

LocalIsDefault()

If the keyword specified in the function argument is set to its DOE-2 default then the value 1 is returned, if the keyword is set to its user-defined default then the value returned is 2, otherwise the value 0 is returned.

Abbreviated Function Name: **#LID()**

Syntax **LocalIsDefault(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables have no DOE-2 or user-defined defaulting mechanism.

Example(s)

The following rule expression sets the SYSTEM:MIN-SUPPLY-T keyword to the value 55 in the event it is currently set to a default value, 60 if it is currently set higher than 60, 50 if it is currently set lower than 50, and otherwise leaves the value unchanged:

```
if ( LocalIsDefault( MIN-SUPPLY-T ) )
then 55
else if ( Local( MIN-SUPPLY-T ) > 60 )
then 60
else if ( Local( MIN-SUPPLY-T ) < 50 )
then 50
else UNCHANGED
endif
endif
endif
```

LocalIsValid()

Returns the value 0 if the keyword specified in the function argument is undefined or is set to one of four reserved DOE-2 values that stand for "Required", "Unused", "No Default" and "Unfilled". Otherwise a value greater than 0 is returned indicating the status of the BDL keyword value (refer to Table 3 for a listing of data status values).

Abbreviated Function Name: **#LIV()**

Syntax **LocalIsValid(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since this function operates only on BDL data.

Example(s)

LocalSymbolIndex()

Returns the BDL symbol index of the referenced keyword. Symbolic keyword data in BDL takes two forms, a Symbol Value which is typically in the range of 1-N for predefined symbolic keywords and a component index for user-defined symbolic values, and a Symbol Table Index which is an index into a table that uniquely identifies all predefined and user-defined symbols. Retrieving symbol data via the Local() function returns a symbol index for user-defined components and returns a symbol value for predefined symbolic selections. The LocalSymbolIndex() is specifically geared toward accessing the symbol table index of any (but typically predefined) symbolic keyword data.

Abbreviated Function Name: **#LSI()**

Syntax **LocalSymbolIndex(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variable symbolic selections are not contained in the BDL symbol table.

Example(s)

The following rule expression returns the symbol table index for the predefined symbol selection which the TYPE keyword is set to:

```
LocalSymbolIndex( TYPE )
```

LocalRulesetSymbol()

Returns the symbol represented by a DOE-2 compliance analysis BDL keyword. Compliance analysis keywords begin with the characters "C-". Compliance analysis keywords of integer type may be used as symbolic keywords by a compliance ruleset. The symbols (or text strings) that individual values represent are defined in the symbols table (see discussion of symbols table above).

Abbreviated Function Name: **#LRS()**

Syntax **LocalRulesetSymbol(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables have no ruleset-defined symbolic representations.

Example(s)

The following rule expression returns a character string corresponding to the numeric value that the compliance analysis keyword C-FURN-CONFIG is set to:

```
LocalRulesetSymbol( C-FURN-CONFIG )
```

LocalReservedValue()

Returns a value of 0 if the keyword is set to a valid selection or number, otherwise it returns the DOE-2 reserved value. DOE-2 reserved values include -99,999 (required), -88,888 (unused), -77,777 (no default) and -66,666 (unfilled).

Abbreviated Function Name: **#LRV()**

Syntax **LocalReservedValue(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables have no DOE-2 or user-defined defaulting mechanism.

Example(s)

The following rule expression uses LocalReservedValue() to see if the system keyword, DUCT-DELTA-T, is characterized by DOE-2 as "unused" (DOE-2 reserved value of –88888). If not, the expression returns a value of 3. Otherwise, no return value is processed.

```
if ( LocalReservedValue( DUCT-DELTA-T ) == -88888 )
then UNCHANGED
```

```
else 3
endif
```

SymbolIsValid()

Returns 1 if the specified keyword value is consistent w/ a valid ruleset-defined symbol entry. If no corresponding symbol entry exists, then the return value is 0. There is one required argument - a local keyword (followed by array index in square brackets when appropriate).

Abbreviated Function Name: **#SIV()**

Syntax **SymbolIsValid(KEYWORD*[i]*)**

The keyword must be local to the command from which this function is called. Note that the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables cannot represent ruleset-defined symbol entries.

Example(s)

The following rule expression uses SymbolIsValid() to see if the GLASS-TYPE keyword, C-PRODUCT-TYPE is a valid ruleset symbol. If not, the expression returns a value of 3. Otherwise, no return value is processed.

```
if ( SymbolIsValid( C-PRODUCT-TYPE ) == 1 )
then UNCHANGED
else 3
endif
```

REFERENCING PARENT DATA

Parent()

Returns the specified keyword or ruleset value for the parent of the local component (the local component being the component on which the rule is being evaluated which also corresponds to the command listed in the leftmost portion of the rule's "BDL Command:Keyword Being Set" field). Refer to Table 2 for information on DOE-2's parent/child component relationships.

Abbreviated Function Name: **#P()**

Syntax **Parent(** *KEYWORD[i]*:**KEY-or-RV***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

The following rule expression sets the `WINDOW:C-IS-SKYLIGHT` keyword based on the `TILT` of the window's parent wall:

```
if ( Parent( TILT ) <= 60 .AND. Parent( TILT ) >= -60 )
then 1
else 0
endif
```

Parent2()

Returns the specified keyword or ruleset value for the grand parent of the local component (the local component being the component on which the rule is being evaluated which also corresponds to the command listed in the leftmost portion of the rule's "BDL Command:Keyword Being Set" field). Refer to Table 2 for information on DOE-2's parent/child component relationships.

Abbreviated Function Name: **#P2()**

Syntax **Parent2(** *KEYWORD[i]:***KEY-or-RV***[i]* **)**
The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

Parent3()

Returns the specified keyword or ruleset value for the great grand parent of the local component (the local component being the component on which the rule is being evaluated which also corresponds to the command listed in the leftmost portion of the rule's "BDL Command:Keyword Being Set" field). Refer to Table 2 for information on DOE-2's parent/child component relationships.

Abbreviated Function Name: **#P3()**

Syntax **Parent3(** *KEYWORD[i]:***KEY-or-RV***[i]* **)**
The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

ParentCompType()

Returns the 1-based BDL command table index of the local component's parent component, or 0 if the local component has no parent.

Abbreviated Function Name: **#PCT()**

Syntax **ParentCompType( )**
This function does not accept any arguments.

Example(s)

The following rule expression excerpt is from a rule that sets the `WINDOW:GLASS-TYPE` keyword. This portion of the rule expression checks to see if the window's parent command index equals 13 (`INTERIOR-WALL`) in which case it leaves the existing `GLASS-TYPE` unchanged:

```
if ( Parent( C-DEMISING-WALL ) == 1 )
then UNCHANGED
else if ( ParentCompType() == 13 )
then UNCHANGED
else ...
```

ParentCompAssigned()

Returns the value 1 if the keyword specified in the function argument for the parent of the local component assigns a valid building component, otherwise the value 0 is returned.

Abbreviated Function Name: **#PCA()**

Syntax **ParentCompAssigned(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables cannot directly reference BDL components.

Example(s)

ParentIsDefault()

If the keyword specified in the function argument for the parent of the local component is set to its DOE-2 default then the value 1 is returned, if the keyword is set to its user-defined default then the value returned is 2, otherwise the value 0 is returned.

Abbreviated Function Name: **#PID()**

Syntax **ParentIsDefault(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables have no DOE-2 or user-defined defaulting mechanism.

Example(s)

ParentIsValid()

Returns the value 0 if the keyword specified in the function argument for the parent of the local component is undefined or is set to one of four reserved DOE-2 values that stand for "Required", "Unused", "No Default" and "Unfilled". Otherwise a value greater than 0 is returned indicating the status of the BDL keyword value (refer to Table 3 for a listing of data status values).

Abbreviated Function Name: **#PIV()**

Syntax **ParentIsValid(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since this function operates only on BDL data.

Example(s)

ParentSymbolIndex()

Returns the BDL symbol index of the referenced keyword. Symbolic keyword data in BDL takes two forms, a Symbol Value which is typically in the range of 1-N for predefined symbolic keywords and a component index for user-defined symbolic values, and a Symbol Table Index which is an index into a table that uniquely identifies all predefined and user-defined symbols. Retrieving symbol data via the Local() function returns a symbol index for user-defined components and returns a symbol value for predefined symbolic selections. The LocalSymbolIndex() is specifically geared toward accessing the symbol table index of any (but typically predefined) symbolic keyword data.

Abbreviated Function Name: **#PSI()**

Syntax **ParentSymbolIndex(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variable symbolic selections are not contained in the BDL symbol table.

Example(s)

The following rule expression returns the symbol table index for the predefined symbol selection which the parent component's TYPE keyword is set to:

```
ParentSymbolIndex( TYPE )
```

ParentRulesetSymbol()

Returns the symbol represented by a DOE-2 compliance analysis BDL keyword. Compliance analysis keywords begin with the characters "C-". Compliance analysis keywords of integer type may be used as symbolic keywords by a compliance ruleset. The symbols (or text strings) that individual values represent are defined in the symbols table (see discussion of symbols table above).

Abbreviated Function Name: **#PRS()**

Syntax **ParentRulesetSymbol(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables have no ruleset-defined symbolic representations.

Example(s)

The following rule expression returns a character string corresponding to the value for the compliance analysis keyword C-FURN-CONFIG of the parent component:

```
ParentRulesetSymbol( C-FURN-CONFIG )
```

ParentReservedValue()

Returns a value of 0 if the parent component keyword is set to a valid selection or number, otherwise it returns the DOE-2 reserved value. DOE-2 reserved values include -99,999 (required), -88,888 (unused), -77,777 (no default) and -66,666 (unfilled).

Abbreviated Function Name: **#PRV()**

Syntax **ParentReservedValue(** *KEYWORD[i]:***KEYWORD***[i]* **)**

The leading portion of the function argument represents one or more component indirections that can be specified via component assignment keywords. Note that the required ending portion of the argument must be a valid BDL keyword and not a ruleset variable, since ruleset variables have no DOE-2 or user-defined defaulting mechanism.

Example(s)

REFERENCING CHILD DATA

ChildRef()

Returns the specified keyword or ruleset value for a selected child component of the local component (the local component being the component on which the rule is being evaluated which also corresponds to the command listed in the leftmost portion of the rule's "BDL Command:Keyword Being Set" field). Refer to Table 2 for information on DOE-2's parent/child component relationships.

Abbreviated Function Name: **#CR()**

Syntax **ChildRef(COMMAND:***KEYWORD[i]:***KEY-or-RV***[i]*, **n)**

Where the second argument (n) is a constant, 1-based numeric index of the child component of the type indicated by the COMMAND portion of the first argument. The middle portion of the first function argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

The following function call might be included in a rule defining a SPACE keyword or ruleset variable to retrieve data describing the first child EXTERIOR-WALL assigned to the SPACE:

```
ChildRef( EXTERIOR-WALL:KEYWORD, 1 )
```

SumChildren()

Returns the sum of the specified BDL keyword or ruleset variable across all children of a specified component type (BDL command) for the local component.

Abbreviated Function Name: **#SC()**

Syntax **SumChildren(COMMAND:***KEYWORD[i]:***KEY-or-RV***[i]** **)**

The COMMAND portion of the argument identifies the type of child component to sum across. The middle portion of the argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

The following rule expression sets each `EXTERIOR-WALL:rvDoorArea` ruleset variable to the sum of the `rvTotDoorArea` ruleset variables for each of the `EXTERIOR-WALL`'s child `DOOR` components:

```
SumChildren( DOOR:rvTotDoorArea )
```

MaxChild()

Returns the maximum value of the specified BDL keyword or ruleset variable across all children of a specified component type (BDL command) for the local component.

Abbreviated Function Name: **#MC()**

Syntax **MaxChild(COMMAND:***KEYWORD[i]*:**KEY-or-RV***[i]* **)**

The COMMAND portion of the argument identifies the type of child component to retrieve the maximum value for. The middle portion of the argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

The following rule expression sets each `SYSTEM:rvScheduleType` ruleset variable to the maximum `rvTotDoorArea` ruleset variable for each of the `SYSTEM`'s child `ZONE` components:

```
MaxChild( ZONE:rvScheduleType )
```

MinChild()

Returns the minimum value of the specified BDL keyword or ruleset variable across all children of a specified component type (BDL command) for the local component.

Abbreviated Function Name: **#MNC()**

Syntax **MinChild(COMMAND:***KEYWORD[i]*:**KEY-or-RV***[i]* **)**

The COMMAND portion of the argument identifies the type of child component to retrieve the minimum value for. The middle portion of the argument represents one or more component indirections that can be specified via component assignment keywords.

Example(s)

The following rule expression stores the lowest value for the minimum flow ratio (rvMinFlowRatio) among all of a SYSTEM's child ZONEs:

```
MinChild( ZONE:rvMinFlowRatio )
```

ChildCount()

Returns the number of components of the specified type (BDL command) that are assigned as children of the local component.

Abbreviated Function Name: **#CC()**

Syntax **ChildCount(COMMAND)**
The function argument identifies what BDL command to return the number of children.

Example(s)

COMPONENT CREATION AND ASSIGNMENT

CreateComp()

The purpose of this function is to create a new BDL component. This function call can be nested within an 'if' or 'case' statement so that the component is only created under certain conditions. The keyword being set by the result of this function call must be either the reserved "Action" keyword or a BDL keyword that calls for the assignment of the component being created.

Abbreviated Function Name: **#CCO()**

Syntax **CreateComp(COMMAND,** *"CommandType",* **"NamePrefix", "Rulelist",** *RulelistEvalOption, AssignKeyword* **)**

Where:	**COMMAND**	Identifies the BDL command of the component to be created.
	"CommandType"	A required argument only when creating components whose first keyword is TYPE (commonly referred to as "type commands"). For type commands this argument is the pre-defined BDL symbol string that the TYPE keyword of the new component should get set to. This argument must **NOT** be specified when creating non-type command components.
	"NamePrefix"	A prefix to the name of the component being created. The ruleset processor will start with this name and then add a numeric index to ensure that the new component's name is unique.
	"Rulelist"	The name of the compliance rulelist to be evaluated immediately following the creation of the new component. The string "None" should be used here in the event no rulelist is to be evaluated following the new component's creation.
	RulelistEvalOption	An optional argument that defaults to a value of 1. A value of 1 here causes the rulelist specified in the previous argument to be evaluated only on the newly created component (handy for cases where the rulelist is designed to setup a new component but might corrupt existing components of the same command). A value of 0 causes the rulelist to be evaluated for all building components (as is the case with all standard rulelist evaluations).
	AssignKeyword	An optional argument that enables a connection to be established between the local and newly created components via the assignment of the local component to the `AssignKeyword` of the newly created component. For example, this argument enables a rule where the local component is a `CIRCULATION-LOOP` to create a `CHILLER` and have that `CHILLER` assigned to the local `CIRCULATION-LOOP` via the `CHILLER:CHW-LOOP` keyword.

Example(s)

The following CreateComp() function call creates a new SCHEDULE component whose TYPE keyword is set to the BDL symbol RESET-TEMP. The new component's name will begin "BudgClRes " and immediately following its creation the BudgetYearSATReset rulelist will be evaluated exclusively on the newly created schedule component.

```
CreateComp( SCHEDULE, "RESET-TEMP", "BudgClRes ",
            "BudgetYearSATReset" )
```

The following CreateComp() function call creates a new DESIGN-DAY component whose name will begin "Cooling " and immediately following its creation the CECCoolingDesignDay rulelist will be evaluated exclusively on the newly created design day component.

```
CreateComp( DESIGN-DAY, "Cooling ", "CECCoolingDesignDay" )
```

The following CreateComp() function call creates a new CHILLER component whose TYPE = ELEC-HERM-CENT and whose name will begin "Budget_Chiller". Immediately following its creation, the new chiller will assign the local component (a CIRCULATION-LOOP) to itself via its own CHW-LOOP keyword and then the SetUpBudgetChiller rulelist will be evaluated exclusively on the newly created chiller component. Note that the local component for the rule which includes this call to CreateComp() MUST be a CIRCULATION-LOOP, otherwise the assignment of the local component to the chiller via the CHILLER:CHW-LOOP keyword will fail. Note also that since the final (optional) AssignKeyword argument is specified, the previous (also optional) RulelistEvalOption argument must also be specified.

```
CreateComp( CHILLER, "ELEC-HERM-CENT", "Budget_Chiller",
            "SetUpBudgetChiller", 1, CHW-LOOP )
```

CreateChildren()

The purpose of this function is to create one or more new BDL components that are assigned as children to the local component. This function call can be nested within an 'if' or 'case' statement so that the components are only created under certain conditions. The keyword being set by the result of this function call must be the reserved "Action" keyword.

Abbreviated Function Name: **#CCH()**

Syntax **CreateChildren(COMMAND,** *"CommandType",* **num, "NamePrefix", "Rulelist",** *RulelistEvalOption* **)**

Where:	**COMMAND**	Identifies the BDL command of the new child component(s) to be created.
	"CommandType"	A required argument only when creating components whose first keyword is TYPE (commonly referred to as "type commands"). For type commands this argument is the pre-defined BDL symbol string that the TYPE keyword of the new component(s) should get set to. This argument must **NOT** be specified when creating non-type command components.

num	An integer constant (>= 1) denoting the number of child components to be created.
"NamePrefix"	A prefix to the name of the component(s) being created. The ruleset processor will start with this name and then add a numeric index to ensure that each new component's name is unique.
"Rulelist"	The name of the compliance rulelist to be evaluated immediately following the creation of the new component. The string "None" should be used here in the event no rulelist is to be evaluated following the new component's creation.
RulelistEvalOption	An optional argument that defaults to a value of 1. A value of 1 here causes the rulelist specified in the previous argument to be evaluated only on the newly created child component(s) (handy for cases where the rulelist is designed to setup newly created components but might corrupt existing components of the same command). A value of 0 causes the rulelist to be evaluated for all building components (as is the case with all standard rulelist evaluations).

Example(s)

AssignComp()

Searches for and assigns a component that meets certain criteria (has specific keyword values). If none are found, a new component meeting the criteria specified an option may be specified to cause the creation and assignment of a new component that does meet the criteria. The local component's keyword that is set to the return value of this function must be compatible with the assignment of a component of the type specified for assignment or creation.

Abbreviated Function Name: **#AC()**

Syntax **AssignComp(COMMAND,** *"CommandType",* **CreateFlag, "NamePrefix", "Rulelist", RulelistEvalOption,** *Keyword1, KeyValOrStr1, … Keyword10, KeyValOrStr10* **)**

Where:		
	COMMAND	Identifies the BDL command of the component to be assigned (and possibly created).
	"CommandType"	A required argument only when assigning/creating components whose first keyword is TYPE (commonly referred to as "type commands"). For type commands this argument is the pre-defined BDL symbol string that the TYPE keyword of the new component should get set to. This argument must **NOT** be specified when creating non-type command components.
	CreateFlag	The numeric value 0 if no component should be created in the event one matching the assignment criteria is not found. A value of 1 indicates that a component should be created in the event one matching the assignment criteria is not found.
	"NamePrefix"	A prefix to the name of the component that will be created in the event an existing one matching the assignment criteria is not found

and the CreateFlag argument is set to 1. The ruleset processor will start with this name and then add a numeric index to ensure that the newly created component's name is unique.

"Rulelist" The name of the compliance rulelist to be evaluated immediately following the creation or assignment of the component. The string "None" should be used here in the event no rulelist is to be evaluated following the creation or assignment of the component.

RulelistEvalOption A numeric constant value between 0 and 5. 0-1 if the rulelist is to be evaluated only in the event a component is created, 2-3 if the rulelist is to be evaluated only in the event a component is NOT created and 4-5 if the rulelist is to be evaluated regardless of whether or not a component is created.
0, 2 or 4 if the rulelist is to be evaluated for all building components. 1, 3 or 5 if the rulelist is to be evaluated only on the component found/created.

Keyword1-10 and KeyValOrStr1-10 Optional arguments that define the criteria for a component to be found or created and assigned. The Keyword1-10 arguments must be valid keywords of the command specified in the first argument (and not enclosed in quotes). The KeyOrVal1-10 arguments are made up of either numeric values or symbolic character strings enclosed in quotes. The KeyOrVal1-10 arguments must be entered as constant numeric values or character strings and cannot be the result of an expression. These optional arguments must be defined in pairs.

Example(s)

The following rule expression checks for a condition where a SYSTEM's HEAT-SOURCE is set to HOT-WATER but no CIRCULATION-LOOP is assigned via SYSTEM:HW-LOOP. For each SYSTEM that exhibits these properties, a CIRCULATION-LOOP of type HW and SUBTYPE=PRIMARY is searched for or created and then assigned to the SYSTEM:HW-LOOP.

```
if ( Local( HEAT-SOURCE ) == -1 .AND.
     LocalCompAssigned( HW-LOOP ) == 0 )
then AssignComp( CIRCULATION-LOOP, "HW", 1, "BudgHWLp ",
                 "none", 0, SUBTYPE, "PRIMARY" )
else UNCHANGED
endif
```

AssignGlassType()

Searches for and assigns a GLASS-TYPE component whose GLASS-CONDUCT, SHADING-COEF and VIS-TRANS are equal to those specified in the function's arguments. Like the AssignComp() function, if none are found, a new component is created with the specified keyword values. The local component's keyword that is set to the return value of this function must be compatible with the assignment of a GLASS-TYPE. The reason for this function being defined as opposed to simply using the AssignComp() function is that it was necessary that the GLASS-CONDUCT, SHADING-COEF and VIS-TRANS arguments be the result of expressions (in this case table look-ups) and therefore AssignComp() could not be used since it has optional arguments and functions with one or more optional arguments cannot have expressionized arguments.

Abbreviated Function Name: **#AGT()**

Syntax **AssignGlassType(GlassCond, ShadingCoef, VisTrans, "NamePrefix")**

Where:		
	GlassCond	The numeric `GLASS-CONDUCT` value.
	ShadingCoef	The numeric `SHADING-COEF` value.
	VisTrans	The numeric `VIS-TRANS` value.
	"NamePrefix"	A prefix to the name of the `GLASS-TYPE` component that will be created in the event an existing one matching the `GLASS-CONDUCT`, `SHADING-COEF` and `VIS-TRANS` of arguments 1-3 is not found. The ruleset processor will start with this name and then add a numeric index to ensure that the newly created component's name is unique.

Example(s)

The following rule expression sets the `WINDOW:GLASS-TYPE` keyword for each `WINDOW` by searching for an existing `GLASS-TYPE` component whose `GLASS-CONDUCT`, `SHADING-COEF` and `VIS-TRANS` keywords are equal to the `WINDOW`'s `rvGlassConduct, rvShadingCoef` and `rvVisTrans` ruleset variables. If one is not found, then one is created using the name prefix "PropGT ".

```
AssignGlassType( Local( rvGlassConduct ), Local(rvShadingCoef),
                 Local(rvVisTrans), "PropGT " )
```

RevRefSymbolIndex()

This function searches for components that assign the local component to themselves via the keyword specified as the first argument and returns the symbol table index of the desired one.

Abbreviated Function Name: **#RRSI()**

Syntax **RevRefSymbolIndex(COMMAND:KEYWORD*[i]*, num)**

The first argument identifies the component type (command) and keyword that might reference the local component (the component for which the rule is being evaluated). The second argument is a 1-based index of the component that references the local component of which the symbol table index should be returned.

Example(s)

The following rule expression returns the symbol table index of the second `CHILLER` found to reference the local `CIRCULATION-LOOP` via its `CHW-LOOP` keyword. Note that the local component type in this case must be a `CIRCULATION-LOOP` since that is the only component type that can be assigned via a `CHILLER:CHW-LOOP` keyword.

```
RevRefSymbolIndex( CHILLER:CHW-LOOP, 2 )
```

SumRevRef()

This function searches for components that assign the local component to themselves via the keyword specified as the first argument and returns the sum across all such components of the keyword or ruleset variable specified as the second argument.

Abbreviated Function Name: **#SR()**

Syntax **SumRevRef(COMMAND:KEYWORD*[i]*, COMMAND:KEY-or-RV*[i]*)**

The first argument identifies the component type (command) and keyword that might reference the local component (the component for which the rule is being evaluated). The second argument identifies the keyword value or ruleset variable to be summed for all components found to reference the local component via the first argument's keyword.

Example(s)

The following rule expression returns the sum of `CHILLER:drvEvapFlowGPM` ruleset variables for all `CHILLER`s that reference the local `CIRCULATION-LOOP` via their `CHW-LOOP` keyword. Note that the local component type in this case must be a `CIRCULATION-LOOP` since that is the only component type that can be assigned via a `CHILLER:CHW-LOOP` keyword.

```
SumRevRef( CHILLER:CHW-LOOP, CHILLER:drvEvapFlowGPM )
```

SumRevRefArray()

This function searches for components that assign the local component to themselves via the multi-element keyword (or array) specified as the first argument and returns the sum across all elements of all such components of the keyword or ruleset variable specified as the second argument.

Abbreviated Function Name: **#SRA()**

Syntax **SumRevRefArray(COMMAND:KEYWORD*[i]*, COMMAND:KEY-or-RV*[i]*)**

The first argument identifies the component type (command) and keyword that might reference the local component (the component for which the rule is being evaluated). The second argument identifies the keyword value or ruleset variable to be summed for all components found to reference the local component via the first argument's keyword.

Example(s)

The following rule expression returns the sum of `COMPLIANCE-DHW:rvTotDHWLoad[1]` ruleset variables for all `COMPLIANCE-DHW components` that reference the local `CIRCULATION-LOOP` via their `C-LOOPS[]` array keyword. Note that the local component type in this case must be a `COMPLIANCE-DHW` component ince that is the only component type that can be assigned via a `CHILLER:C-LOOPS` array keyword.

```
SumRevRefArray( COMPLIANCE-DHW:C-LOOPS,
                COMPLIANCE-DHW:rvTotDHWLoad[1] )
```

MaxRevRef()

This function searches for components that assign the local component to themselves via the keyword specified as the first argument and returns the maximum value across all such components of the keyword or ruleset variable specified as the second argument.

Abbreviated Function Name: **#MR()**

Syntax **MaxRevRef(COMMAND:KEYWORD*[i]*, COMMAND:KEY-or-RV*[i]*)**

The first argument identifies the component type (command) and keyword that might reference the local component (the component for which the rule is being evaluated). The second argument identifies the

keyword value or ruleset variable for which the maximum is desired across all components found to reference the local component via the first argument's keyword.

Example(s)

COMPONENT DELETION

DeleteAllComps()

Deletes all building components of the specified type (command) and returns the number of components successfully deleted.

Abbreviated Function Name: **#DAC()**

Syntax **DeleteAllComps(COMMAND, "Rulelist")**

Where:	**COMMAND**	Identifies the BDL command for which all components should be deleted.
	"Rulelist"	The name of the compliance rulelist to be evaluated immediately following the deletion of all components. The string "None" should be used here in the event no rulelist is to be evaluated following the creation or assignment of the component.

Since this function is likely one that should only be evaluated once, and since the return value is probably not something that the ruleset need track, the rule that references this function should most likely be defined for `COMPLIANCE:Action`.

Example(s)

The following rule expression deletes all components of type `DESIGN-DAY` and then evaluates the CreateCECDesignDays rulelist.

```
DeleteAllComps( DESIGN-DAY, "CreateCECDesignDays" )
```

DeleteComp()

Deletes the building component that is current assigned to the command and keyword for which this rule is evaluated.

Abbreviated Function Name: **#DCO()**

Syntax **DeleteComp("Rulelist")**

Where:	**"Rulelist"**	The name of the compliance rulelist to be evaluated immediately following the component deletion. The string "None" should be used here in the event no rulelist is to be evaluated following the creation or assignment of the component.

Example(s)

DeleteChildren()

Deletes all building components of the specified type (command) that are children of the local component and returns the number of components successfully deleted.

Abbreviated Function Name: **#DCH()**

Syntax **DeleteChildren(COMMAND, "Rulelist",** *RulelistEvalOption* **)**

Where:		
	COMMAND	Identifies the BDL command for which all components should be deleted.
	"Rulelist"	The name of the compliance rulelist to be evaluated immediately following the deletion of all components. The string "None" should be used here in the event no rulelist is to be evaluated.
	RulelistEvalOption	An optional argument that defaults to a value of 0. A value of 1 here causes the rulelist specified in the previous argument to be evaluated only on the local component (for which the children were deleted). A value of 0 causes the rulelist to be evaluated for all building components (as is the case with all standard rulelist evaluations).

Example(s)

MISCELLANEOUS BDL/DOE-2 FUNCTIONS

RuleLibrary()

Assigns a building component that is defined in the ruleset library to the command:keyword for which the result is posted. An existing, unchanged and identical to the library component is first searched for within the existing building description to ensure that the same component is not retrieve multiple times. If the library component is not found in the current building description, it is imported from the ruleset library into the building description.

Abbreviated Function Name: **#RL()**

Syntax **RuleLibrary(COMMAND, "Component Name")**

Where:		
	COMMAND	Identifies the BDL command for which the library component is to be assigned/imported.
	"Component Name"	The name of the library component to be retrieved.

Example(s)

The following rule expression imports the `SCHEDULE-PD` component named "Non-Res-People" from the ruleset library (if it hasn't already been imported) and assigns it to the command:keyword for which the rule is evaluated.

```
RuleLibrary( SCHEDULE-PD, "Non-Res-People" )
```

EvalRulelist()

Evaluates the specified rulelist on either the entire building or only the local component, depending on the presence (and value) of the second argument.

Abbreviated Function Name: **#ER()**

Syntax **EvalRulelist("Rulelist",** *RulelistEvalOption* **)**

Where:	**"Rulelist"**	The name of the compliance rulelist to be evaluated. The string "None" should be used here in the event no rulelist is to be evaluated.
	RulelistEvalOption	An optional argument that defaults to a value of 0. A value of 1 here causes the rulelist specified in the previous argument to be evaluated only on the local component (for which the rule is being evaluated). A value of 0 causes the rulelist to be evaluated for all building components (as is the case with all standard rulelist evaluations).

Example(s)

```
EvalRulelist( "SetLtgMethToWArea" )
```

RemoveUserDefaults()

At various points in the compliance analysis processing, BDL keywords are set or restored to their default values either directly or indirectly through the evaluation of rules contained in the ruleset. The DOE-2 default values are recognized as valid and reasonable data used in simulating building energy use, but if the user had created user-defined default values, then those user default values (and not the DOE-2 defaults) would get populated to BDL whenever defaults were called for.

This function was developed to remove all user-defined BDL default values in order to ensure the use of the DOE-2 defaults. All data classified as user-defined defaults at the time this function is evaluated will retain the same values but be re-classified as direct user inputs. The return value of this function is the total number of user-defined keyword defaults that are replaced by DOE-2 default data.

Abbreviated Function Name: **#RUD()**

Syntax **RemoveUserDefaults()**

There are no arguments to this function, but one very important item to note in terms of its use. If the COMMAND portion of the COMMAND:KEY-or-RV being set by the rule calling this function is the BDL COMPLIANCE command, then this function will remove ALL user-defined defaults across all commands and keywords. However, if the COMMAND portion of the COMMAND:KEY-or-RV being set is any other BDL command, then this function is performed only on the component on which the rule is being evaluated.

Example(s)

The following rule (when defined to set any COMPLIANCE command value) reclassifies all user-defined default BDL keyword data as user inputs, replaces all user-defined defaults with DOE-2 defaults and returns the total number of keywords where user-defined defaults were replaced by DOE-2 defaults:

```
RemoveUserDefaults()
```

ApplyDefaultTable()

Returns the number of BDL keyword data (values or expressions) in the building description that were previously classified as library, user or user-default and re-defaulted.

Abbreviated Function Name: **#ADT()**

Syntax **ApplyDefaultTable("DefaultTableName", ColumnIndex)**

The "DefaultTableName" argument must match a default table defined in the tblKeywordDefaulting of the main ruleset database (Rules.mdb), described above. The ColumnIndex is a 1-based numeric value indicating which column of default data (1-N) contained in the referenced table is to be applied to the component for which this function is being evaluated.

Example(s)

The following rule (where the BDL COMMAND:KEYWORD being set is `SYSTEM:Action`) re-defaults all keywords identified in the first column of default flags of the "SystemDefaulting" table and returns the total number of re-defaulted values:

```
ApplyDefaultTable( "SystemDefaulting", 1 )
```

SymbolName()

Returns the name of a symbol defined in the building description. Symbols include both building component names as well as the strings used to identify symbolic BDL inputs.

Abbreviated Function Name: **#SN()**

Syntax **SymbolName(SymIdxOrVal,** *SymType, D2SymbolName* **)**

Where:	**SymIdxOrVal**	The symbol table index for building components or symbol value for pre-defined symbolic BDL inputs to retrieve the name of.
	SymType	The type of symbol to return the name of (this can be found in the BDLKey.out file, immediately following the Length value for any keyword which utilizes the symbols of interest). This is required for pre-defined symbolic BDL inputs but not when retrieving component names.
	D2SymbolName	An optional argument that defaults to a value of 0. A value of 1 here causes the symbol name returned (for symbolic BDL inputs) to be equivalent to the symbols defined directly within the BDL database (BDLKey), meaning all capital letters, no spaces and limited to 16 characters in most cases. A value of 0 (the default) causes the return of the string used in the program's user interface that represents the raw BDL string but is typically more descriptive and better formatted. This argument has no affect on the symbol names returned that correspond to building component names.

Example(s)

The following rule returns the name of the `CONSTRUCTION` component assigned to a wall:

```
SymbolName( Local( CONSTRUCTION ) )
```

The following rule returns the user interface string used to represent the symbol assigned to the `WIN-SHADE-TYPE` keyword of a `WINDOW`:

```
SymbolName( Local( WIN-SHADE-TYPE ), 1125 )
```

ComponentName()

Returns the name of the component identified by the symbol table index supplied as its only argument.

Abbreviated Function Name: **#CN()**

Syntax **ComponentName(SymbolTableIndex)**

The SymbolTableIndex argument consists of the BDL symbol table index corresponding to the component for which the name is to be retrieved.

Example(s)

The following rule creates a new chiller component and returns the name of the newly created component (noting that the return value of CreateComp() is in fact the symbol table index of the created component):

```
ComponentName(  CreateComp(  CHILLER, "ELEC-HERM-REC",
                             "Budget_Chiller",
                             "SetUpBudgetChiller", 1, CHW-LOOP ) )
```

SimulationResult()

Retrieves a value from the binary, non-hourly, DOE-2 output from a simulation.

Abbreviated Function Name: **#SRes()**

Syntax **SimulationResult(ResultID**, *"KeyString", DefaultValue* **)**

The ResultID argument corresponds to the Entry IDs defined in the NHRList.txt file that can be found in the DOE-2 subdirectory of the compliance analysis or compiler application. The optional "KeyString" argument is used to retrieve data from a specific row of output reports, such as a month. The optional DefaultValue argument can be either a numeric or character string and is what the function will return if the specified result is not found. If no third argument is specified, this function will return a numeric value of 0 when the result is not found.

Example(s)

The following rule returns the lighting power density for the local SPACE from the LV-B report:

```
SimulationResult( 1102005 )
```

FlagResultForRetrieval()

Flags a result for later retrieval (via RetrieveFlaggedResults()) from the binary, non-hourly, DOE-2 output from a simulation. This function in combination with RetrieveFlaggedResults() provides a more efficient mechanism for retrieving many results from a single simulation result file (which retrieves all flagged results at once) as opposed to the SimulationResult() function which retrieves results one at a time.

Abbreviated Function Name: **#FRFR()**

Syntax **FlagResultForRetrieval(ResultID**, *"KeyString", DefaultValue* **)**

The ResultID argument corresponds to the Entry IDs defined in the NHRList.txt file that can be found in the DOE-2 subdirectory of the compliance analysis or compiler application. The optional "KeyString"

argument is used to retrieve data from a specific row of output reports, such as a month. The optional DefaultValue argument can be either a numeric or character string and is what the function will return if the specified result is not found.

Example(s)

The following rule flags the lighting power density for the local SPACE for later retrieval (initiated by a call to RetrieveFlaggedResults()):

```
FlagResultForRetrieval( 1102005 )
```

RetrieveFlaggedResults()

Retrieves all results flagged by previous rules (via FlagResultForRetrieval()) for retrieval from the binary, non-hourly, DOE-2 output from a simulation. Return values >= 0 indicate the number of results successfully retrieve, while negative return values denote error codes. This function in combination with FlagResultForRetrieval() provides a more efficient mechanism for retrieving many results from a single simulation result file (which retrieves all flagged results at once) as opposed to the SimulationResult() function which retrieves results one at a time.

Abbreviated Function Name: **#RFR()**

Syntax RetrieveFlaggedResults()

No function arguments.

Example(s)

The following rule retrieves all results previously flagged for retrieval via the FlagResultForRetrieval() function:

```
RetrieveFlaggedResults()
```

PolygonArea()

Returns the area of a POLYGON component defined in the building description.

Abbreviated Function Name: **#PA()**

Syntax PolygonArea(PolygonSymIdx)

The PolygonSymIdx argument is the symbol table index of a POLYGON component.

Example(s)

The following rule returns the area of an EXTERIOR-WALL whose shape is defined by the polygon assigned via its POLYGON keyword:

```
PolygonArea( Local( POLYGON ) )
```

DefaultDaylighting()

The purpose of this function is to calculate the top and side-daylightable area(s) for a space and position one or two daylighting controls based on one of a variety of methodologies. If no daylightable space is found and daylighting is turned on, then this function will turn daylighting off. SPACE command keywords set by this function include LIGHT-REF-POINT1/2, ZONE-FRACTION1/2 and VIEW-

AZIMUTH -or- C-LIGHT-REF-PNT1/2, C-ZONE-FRACTION1/2 and C-VIEW-AZIMUTH, depending on the value of the SetSimulationKeywords argument.

The COMMAND portion of the BDL COMMAND:KEYWORD being set for any rule including this function must

Abbreviated Function Name: **#DD()**

Syntax **DefaultDaylighting(AreaAndPositioningMethod,** *SetSimulationKeywords* **)**

The AreaAndPositioningMethod argument is a numeric value identifying which methodology is to be used to calculate the daylightable area and position the daylighting control(s). The only methodology currently implemented is that defined in the CEC Title-24 ACM and standard documents and is identified by the value 1. The optional SetSimulationKeywords argument is a 0/1 boolean that determines whether the daylighting keyword updates are to be made to the simulation keywords (those that are referenced during the building simulation) or to a separate copy of daylighting keywords which can then later be copied into the simulation keywords. By default, the non-simulation daylighting keywords are the ones modified by this function (meaning the default SetSimulationKeywords argument value is 0).

Example(s)

The following rule calculates daylightable area(s) and control position(s) for the space on which this rule is being evaluated and sets various BDL keyword values to be consistent with the results of those calculations:

```
DefaultDaylighting( 1 )
```

CleanupPlant()

The purpose of this function is to delete all HVAC central plant equipment that is not currently configured to affect the simulation of the building's energy use. This is necessary in many cases to avoid simulation errors resulting from plant equipment having no load or required component assignments. The value returned by this function is equal to the number of building components deleted during the plant cleanup processing.

Abbreviated Function Name: **#CP()**

Syntax **CleanupPlant(** *LoopTypesAndOrSupplierCommands1-N* **)**

If no function arguments are specified, then all loop types and loop supplier commands will be processed and "cleaned up". If only certain loop types are to be cleaned up, then specify them as their BDL numeric symbol values plus 1,000. If only certain loop supplier commands are to be cleaned up, then specify them as their 1-based BDL command index.

Example(s)

The following rule deletes all circulation loops and related equipment that are not currently configured to affect the building's simulation:

```
CleanupPlant()
```

DumpBDL()

Returns a value of 0 after writing all BDL keyword status and value information for the building component corresponding to the command:keyword being set by the rule to the compliance analysis log file.

Abbreviated Function Name: **#DBDL()**

Syntax **DumpBDL()**

Example(s)

FlagKeyword()

Posts a message, defined by the function arguments, to the compliance analysis log (.cal) file created during the compliance analysis. This may be called by via component name and ruleset variable in which case the message is stored to a ruleset variable. It may also be called via a component name and the "Action" reserved value in which case the message is only posted to the .cal file but not stored.

Abbreviated Function Name: **#FK()**

Syntax **FlagKeyword(KEYWORD,** flag, keyword description, message, default **)**

Where:	**KEYWORD**	The local keyword for which the FlagKeyword function is called. This keyword must be local to the command (i.e.; LocalRef() may not be used.)
	flag	A flag indicating why the keyword is required. A flag value of 1 means the keyword is required for proper ruleset function. A flag value of 2 means the keyword is required for permit submittal.
	keyword description	A more verbose description of the keyword being flagged.
	message	A more detailed message to be displayed in the required keyword dialog
	default	A default for the flagged keyword. This may be a single numeric value or a default expression, written using the format() ruleset function. A value of –999

Example(s)

The following rule expression flags the SYSTEM keyword as required for permit submittal with no default.

```
if ( LocalIsValid( SUPPLY-FLOW ) )
then UNCHANGED
else FlagKeyword( SUPPLY-FLOW, 2, "Supply Air Flow Rate", "Design
   supply fan flow rate required for permit submittal", -999 )
endif
```

DisableBDLMessages()

Returns a value of 0 after disabling the BDL message processing mechanism, which echoes error messages encountered during BDL keyword defaulting to the compliance analysis log file. All calls to this function should be followed not long after by a call to EnableBDLMessages(). Proper use of these two functions can serve to prevent BDL error messages from appearing in the compliance analysis log file resulting from rules that may individually cause BDL errors that automatically get resolved by subsequent rules.

Abbreviated Function Name: **#DBM()**

Syntax **DisableBDLMessages()**
No function arguments.

Example(s)

EnableBDLMessages()

Returns a value of 0 after enabling the BDL message processing mechanism, which echoes error messages encountered during BDL keyword defaulting to the compliance analysis log file. All calls to this function should be preceded by a call to DisableBDLMessages(). Proper use of these two functions can serve to prevent BDL error messages from appearing in the compliance analysis log file resulting from rules that may individually cause BDL errors that automatically get resolved by subsequent rules.

Abbreviated Function Name: **#EBM()**

Syntax **EnableBDLMessages()**
No function arguments.

Example(s)

MISCELLANEOUS NON-BDL FUNCTIONS

CurrentTime()

Returns the date and time at which the rule is evaluated in the form of a long integer value equivalent to the number of seconds that have elapsed since midnight, January 1, 1970 coordinated universal time.

Abbreviated Function Name: **#CT()**

Syntax **CurrentTime( )**
This function accepts no arguments.

Example(s)

CurrentTimeString()

Returns a character string representation of the date and time at which the rule is evaluated.

Abbreviated Function Name: **#CTS()**

Syntax **CurrentTimeString("FormatString")**
The FormatString argument is equivalent to the format argument of the ANSI-compatible strftime() function (refer to any ANSI-C programming documentation for additional information).

Example(s)

The following rule returns the date and time that the rule is evaluated in the form "10-Oct-2000 @ 04:12:46 PM":

```
CurrentTimeString( "%d-%b-%Y @ %I:%M:%S %p" )
```

Date()

Returns a long integer value equivalent to the number of seconds that have elapsed between midnight, January 1, 1970 coordinated universal time and the day identified by the function arguments.

Abbreviated Function Name: **#D()**

Syntax **Date(year, month, day)**

Where:		
	year	The four digit year (i.e. 2000).
	month	An integer value between 1 and 12.
	day	An integer value between 1 and number of days in the month identified in the previous argument.

Example(s)

PostMessage()

Posts a message, defined by the function arguments, to the compliance analysis log (.cal) file created during the compliance analysis. This may be called by via component name and ruleset variable in which case the message is stored to a ruleset variable. It may also be called via a component name and the "Action" reserved value in which case the message is only posted to the .cal file but not stored.

Abbreviated Function Name: **#PM()**

Syntax **PostMessage(<message w/ format specs>,** *var1, var2, … varN* **)**

Where:		
	message	The message to be posted to the compliance analysis log file, including format specification fields that enable the reporting of string or numeric data referenced by optional arguments var1-N. Refer to the preceding Table 6 describing compatible format specification fields for more information.
	var1-N	Data to be formatted into the preceding message for output to the compliance analysis log file.

Example(s)

PostWarning()

Posts a warning message, defined by the function arguments, to the compliance analysis log (.cal) file created during the compliance analysis. This may be called by via component name and ruleset variable in which case the message is stored to a ruleset variable. It may also be called via a component name and the "Action" reserved value in which case the message is only posted to the .cal file but not stored. In the .cal file, warning messages are preceded by the text "*** warning ***".

Abbreviated Function Name: **#PW()**

Syntax **PostWarning(<warning message w/ format specs>, *var1, … varN*)**

Where:

warning	The warning message to be posted to the compliance analysis log file, including format specification fields that enable the reporting of string or numeric data referenced by optional arguments var1-N. Refer to the preceding Table 6 describing compatible format specification fields for more information.
var1-N	Data to be formatted into the preceding warning message for output to the compliance analysis log file.

Example(s)

The following rule expression posts a warning that lighting control credits will be ignored.

```
if ( Local( rvLtgCtrlErrorCode2 ) ==1 )
then PostWarning( "Space '%s': Total lighting control credits (Sum
   of C-LTG-CNTRL-CRED[1-10]) exceeds the total installed non-task
   lighting power for the space. Lighting control credits will be
   ignored for this space.", Local( Name ) )
else -999
endif
```

PostError()

Terminates compliance analysis and posts an error message, defined by the function arguments, to the compliance analysis log (.cal) file created during the compliance analysis. This may be called by via component name and ruleset variable in which case the message is stored to a ruleset variable. It may also be called via a component name and the "Action" reserved value in which case the message is only posted to the .cal file but not stored. In the .cal file, warning messages are preceded by the text "*** error ***".

Abbreviated Function Name: **#PE()**

Syntax **PostError(<error message w/ format specs>, *var1, var2, … varN*)**

Where:

error msg	The error message to be posted to the compliance analysis log file, including format specification fields that enable the reporting of string or numeric data referenced by optional arguments var1-N. Refer to the preceding Table 6 describing compatible format specification fields for more information.
var1-N	Data to be formatted into the preceding error message for output to the compliance analysis log file.

Example(s)

The following rule expression terminates compliance analysis and posts an error if sunspaces exist.

```
if ( Local( rvSunspace ) > 0 )
then PostError( "Project contains at least one sunspace. Remove
   sunspaces before performing compliance analysis." )
else -999
endif
```

PostUserPrompt()

Stores a message, defined by the function arguments, that can be presented to the user, after creation, via the PromtToContinue() function. This function must be called via component name and ruleset variable so that the message is stored and available for the PromptToContinue() function.

Abbreviated Function Name: **#PUP()**

Syntax **PostUserPrompt(< message w/ format specs>,** *var1, var2, … varN* **)**

Where:

message	The user prompt to be posted to the compliance analysis log file, including format specification fields that enable the reporting of string or numeric data referenced by optional arguments var1-N. Refer to the preceding Table 6 describing compatible format specification fields for more information.
var1-N	Data to be formatted into the preceding user prompt for output to the compliance analysis log file.

Example(s)

The following rule expression stores a prompt message that "lighting only" analysis is not allowed.

```
if ( Local( rvBadAnalysisFlag ) )
then PostUserPrompt( "'Lighting Compliance Only' has been selected
   for this project which is not allowed by Title 24. The analysis
   may continue but the building will be shown to not comply." )
else -999
endif
```

PromptToContinue()

This function causes a dialog box to be presented containing whatever user prompts were previously stored via the PostUserPrompt() function and pauses the processing until the user confirms whether or not to continue to perform the compliance analysis. If no user prompts are currently stored, no dialog is presented and the processing immediately continues on to the next rule.

Abbreviated Function Name: **#PTC()**

Syntax **PromptToContiue()**

Example(s)

The following rule expression pauses the compliance analysis processing pending confirmation from the user to continue.

```
PromptToContinue()
```

ExceptionalCondition()

Stores a message, defined by the function arguments, that can be written to compliance analysis output forms. This function must be called via component name and ruleset variable so that the message is stored and available for inclusion in compliance analysis output forms.

Abbreviated Function Name: **#EC()**

Syntax **ExceptionalCondition(< message w/ format specs>, *var1, … varN*)**

Where: **message** The exceptional condition message to be posted to the compliance analysis report, including format specification fields that enable the reporting of string or numeric data referenced by optional arguments var1-N. Refer to the preceding Table 6 describing compatible format specification fields for more information.

var1-N Data to be formatted into the preceding exceptional condition message for output to the compliance analysis report.

Example(s)

The following rule expression stores the name(s) of water source heat pump systems.

```
if ( Local( TYPE ) == 15 )
then ExceptionalCondition( "Hycronic Heat Pump System: Name =
                           '%s'", Local( Name ) )
else -999
endif
```

FormatFloat()

This function provides customized formatting of floating point values, including commas (based on location settings stored in the Windows operating system) and a specified decimal precision. The return value is a character string containing the formatted number.

Abbreviated Function Name: **#FMTF()**

Syntax **FormatFloat(Value, DecimalPrecision)**

Where: **Value** The value to be formatted into a string.

DecimalPrecision An integer value specifying the decimal precision for the formatted number.

Example(s)

Format()

Returns a character string based on the one or more function arguments described below.

Abbreviated Function Name: **#FMT()**

Syntax **Format(< string w/ format specs>, *var1, var2, … varN*)**

Where: **string** The character string to be returned from this function call, including format specification fields that enable the reporting of string or numeric data referenced by optional arguments var1-N. Refer to the preceding Table 6 describing compatible format specification fields for more information.

var1-N Data to be formatted into the preceding character string.

Example(s)

MessageBox()

This function ..

Abbreviated Function Name: **#MB()**

Syntax **MessageBox(< message w/ format specs>, *var1, var2, … varN*)**

Where:

message	The message to be displayed in the message box, including format specification fields that enable the reporting of string or numeric data referenced by optional arguments var1-N. Refer to the preceding Table 6 describing compatible format specification fields for more information.
var1-N	Data to be formatted into the preceding message.

Example(s)