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(54) **Title**: METHOD AND APPARATUS FOR FACILITATING HVAC DESIGN FOR A BUILDING

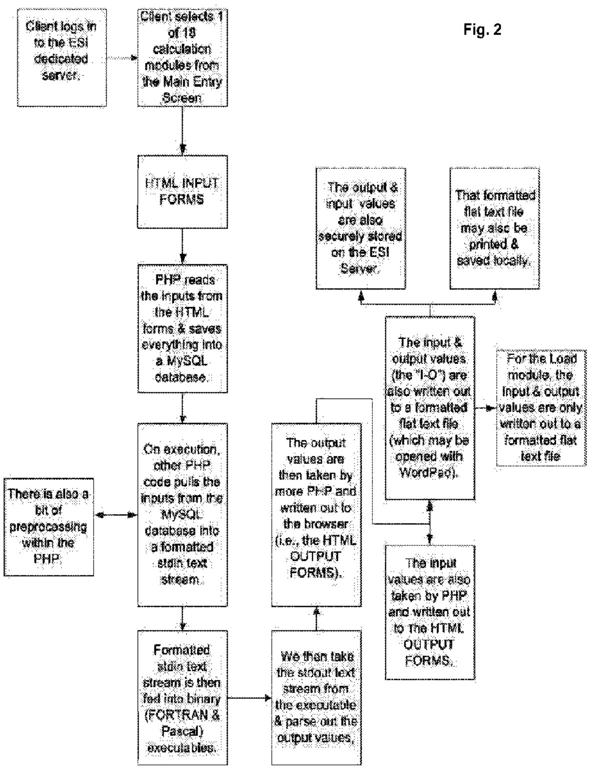

Fig. 2

(57) **Abstract**: A system which facilitates HVAC design for buildings or portions thereof is disclosed. The system comprises a server and one or more remotely situated terminals. The server, which can be a secure server, comprises software that facilitates calculation of HVAC design. A user can access one or more calculation modules in a session of use of a project. The user can provide alphanumeric information items in one or more data input fields. A calculation module can determine a variety of HVAC design output information items using the data added by the user. Both input and output information items can be securely recorded by the server in a record of a session for a project. Furthermore, multiple users can collaborate by accessing the system and contributing to the record of a project in separate sessions. A record of a session or project can be provided in a printable text file.

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METHOD AND APPARATUS FOR FACILITATING HVAC DESIGN FOR A BUILDING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Non-Provisional Patent Application Serial No. 12/110347 filed April 28, 2008, which is incorporated herein by reference in its entirety.

INTRODUCTION

[0002] HVAC building design can involve a large number of engineering considerations. Decisions made by an HVAC engineer can have profound effects on the utility, comfort, and energy efficiency of a building. However, calculations for determination of appropriate values for various parameters regarding HVAC building design can be difficult, tedious, and/or unknown to builders. As a result, buildings can often be built or remodeled without thorough consideration of HVAC requirements. As a result, a building can be, for example, wasteful of energy and/or uncomfortable to live or work in, and remediation can be difficult or expensive.

[0003] Currently available aids for calculating values for HVAC requirements involve “stand-alone” software, such as “Green Toolbox 5.0” (Carmel Software, San Rafael, CA); “CHVAC” (Elite Software Development, Inc., College Station, TX); HVAC Design Solutions (San Diego, CA); Trace™ 700 Load Design software (Trane®, Piscataway, NJ). However, these software packages are not comprised by a server or accessed over the Internet, do not provide a filing system for HVAC calculations and projects or for development of a user-initiated collaboration on HVAC calculations and projects over the Internet, using the World Wide Web.

SUMMARY

[0004] In view of a need for more efficient methods for HVAC design, the inventors have developed systems and methods for facilitating determination of HVAC (Heating, Cooling and Air Conditioning) design features for a building. In some aspects of the present teachings, a system comprises at least one terminal, and a server configured to a) provide a web-based user interface comprising a plurality of web pages, wherein one or more web pages are configured to receive as input information one or more descriptors, each

descriptor selected from a descriptor of a building, a descriptor of a portion of a building and a descriptor of a building environment; b) receive, from at least one user via at least one terminal operably connected to the server, at least one selection of a program comprising at least one web page configured to receive one or more input information items and at least one calculation module; and c) receive one or more input information items from the at least one user via the at least one terminal. In some configurations of these aspects, a system can be further configured to d) determine at least one HVAC building design specification using at least one HVAC building design executable program and at least one input information item of the one or more input information items. Furthermore, in some configurations, a system can be further configured to e) provide at least one HVAC building design specification as at least one output information item.

[0005] In some aspects of the present teachings, a web service is described for providing one or more HVAC design features for a building to one or more users. A web service of these aspects can include a server which comprises software for determining HVAC building specifications as described herein and which can be accessed by one or more users using the World Wide Web. A web service of these aspects can further include an IT staff that can maintain, repair and/or update all server hardware and/or software. In addition, in some configurations, a web service can provide a user access to an SSL secure server, which can be, for example, a RAID 1 SSL secure server. In some configurations, a web service can also provide at least one mirrored hard drive, which can be physically situated at a site remote from the server. In some configurations, a web service of the present teachings can reduce administrative overhead for a user or subscriber of a system.

[0006] In some aspects of the present teachings, methods are disclosed for providing one or more HVAC design features for a building to one or more users. In various configurations, these methods comprise: a) providing a web-based user interface comprising a plurality of web pages, wherein one or more web pages are configured to receive as input information one or more descriptors, each descriptor selected from a descriptor of a building, a descriptor of a portion of a building and a descriptor of a building environment; b) receiving, from at least one user accessing the web-based user interface at a terminal located remote from a server comprising software encoding the web-based user interface, at least one selection of a program comprising at least one web page configured to receive one or more input information items and at least one calculation module; c) receiving one or more input information items from the at least one user; d) determining at least one HVAC building design specification using at least one HVAC building design executable program and at least one input information item of the one or more input information items, and e) providing at least one HVAC building design specification as at least one output information item.

[0007] In some aspects of the present teachings, methods are disclosed for designing heating, ventilation and/or air conditioning for a building or a portion thereof. In various configurations, these methods comprise: accessing from a terminal a web-based user interface comprised by a server, wherein the user interface comprises a plurality of web pages configured to receive data for at least one selection of an HVAC design calculation module of a plurality of HVAC design calculation modules; submitting to the web-based user interface at least one selection of a plurality of selections of HVAC design calculation modules; submitting input data for a building design or a portion thereof; and receiving from the web-based user interface one or more calculated HVAC building parameters.

[0008] In various configurations of these aspects, at least one terminal can be operably connected to a server via the Internet. In addition, the server can be a secure server, such as a dedicated secure server.

[0009] In some other configurations, at least one web page can comprise a web-based user interface, which can be an interactive user interface. In addition, in certain configurations, a server can validate the one or more input information items, and/or check for errors in the one or more input information items. In some configurations, at least one web page can comprise one or more data input fields, and can further require entry of at least one password and/or require entry of at least one user identification for user access to a program or calculation module. Furthermore, a server can be configured to require and/or allow user access to a program or a calculation module on a subscription basis.

[0010] In some configurations, a web page of the present teachings can comprise a navigation bar (the "Navbar") which can appear at the top of a screen for a user using a computer as a terminal. A Navbar can comprise links, such as Main, Contact, Projects, Misc, and Logout, and can provide an "escape route" from a screen for a user, without saving anything entered or edited on the screen exited.

[0011] In some configurations, a web page of the present teachings can comprise a link to miscellaneous calculations. By selecting a miscellaneous calculation link (e.g., by mouse click), a user can leave a web page wherein a calculation is not complete, and explore further calculations which are not incorporated in the record of the session. Similarly, a web page of the present teachings can also comprise a link to the Main Entry Screen. Such a link facilitates a user returning to the main entry page.

[0012] In some configurations, a server can record a session of use of a building HVAC design project. In these configurations, after a user enters a user identification and a password, the server can record the web pages accessed, the data entries (such as, for example, alphanumeric data added to data input fields and/or selection of radio buttons) and/or the output information generated in a session. In some configurations, the server can generate and/or store a record of a session, comprising the web pages accessed, the data entries, and/or the output information generated. In addition, a record of a session can further comprise one or more of a user's identification, a title of a project, time of a session, and date of a session. In some configurations, a server can record a session in a manner in which the user, accessing the server from a terminal remote from the server, is prevented from erasing or altering the record of the session, either during the session, or subsequently. Furthermore, in some configurations a server can create a record of a project, which can comprise each record of the sessions recorded for the project. Accordingly, in a multi-user, collaborative project, a record of the project can include all the records of sessions recorded by each user.

[0013] In some configurations, one or more web pages can comprise one or more data input fields configured to receive at least one input information item for at least one calculation not comprised by the project. A server in these configurations can thus be configured not to record the data entries or output information in the record of a session.

[0014] In various configurations of the present teachings, a web-based user interface can be a graphical user interface, and a web page can comprise one or more data input fields, and/or output information on at least one terminal. Input information items can be displayed in the input data field(s). In addition, in some configurations, the server can generate a printable report comprising input information and/or output information comprised by a session. A printable report can comprise, in non-limiting example, information recorded and/or displayed using ASCII code. In some configurations, a printable report can be saved in electronic form by a user on the user's terminal, which can be situated remote from the server.

[0015] In various configurations, a calculation module of the present teachings can be any of a number of different calculation modules, such as, without limitation, a heating and cooling load calculation module, a psychrometric processes calculation module, a psychrometric properties calculation module, a psychrometric mixing process calculation module, a psychrometric cooling and dehumidifying process calculation module, a psychrometric sensible heating or cooling process calculation module, a psychrometric isothermal humidification process calculation module, a psychrometric evaporative cooling process calculation module, a psychrometric differences between two state points calculation module, a heating and cooling coil selection calculation module, a heating and cooling coil diagnostics calculation module, a cooling/dehumidifying coil selection calculation module, a cooling/dehumidifying coil diagnostics calculation module, a heating coil diagnostics calculation module, a heating coil selection calculation module, a steam properties calculation module, a hydronic pipe sizing calculation module, a steam expansion (Power) process calculation module, a steam processes calculation module, a fuel heat required to generate steam calculation module, a steam control valve sizing calculation module, a steam orifice size/capacity calculation module, a steam differences between two state points calculation module, and an expansion tank calculation module. When the module is a psychrometric process module, it can be, without limitation, a psychrometric mixing process calculation module, a psychrometric cooling and dehumidifying process calculation module, a psychrometric sensible heating or cooling process calculation module, a psychrometric isothermal humidification process calculation module, a psychrometric evaporative cooling process calculation module, and a psychrometric differences between two state points calculation module.

[0016] In some configurations, a calculation module can comprise a web page for steam processes, which can include, without limitation, one or more of expansion (power) process, fuel heat required to generate steam, control valve sizing, steam orifice size/capacity, and differences between two state points.

[0017] In some configurations, a calculation module can comprise an input/output summary, which can be comprised by a flat text file. A flat text file can, for example, be configured to be printable or printed as a WYSIWYG document by a user, who can be situated at a terminal located remote from the server.

[0018] In some configurations, a calculation module can retain the input information items even after a user ends a session prior to completion of data entry into the calculation module. In some configurations, a calculation module which retains input information when a user ends a session prior to completing data entry can be, for example, heating and cooling load calculation module.

[0019] In some configurations, a server of the present teachings can be used for determining HVAC specifications in collaborative projects. In these configurations, multiple users, such as, for example, multiple HVAC building engineers collaborating on a project, can each access the web pages for the project under his or her own personal identification and password. Any data or information item that is added or modified by a user can be recorded by the server, and attributed to the user who entered the changes. Collaborative users can be, for example, a plurality of users employed by a business entity such as an engineering firm. Hence, in some configurations, one user can continue a project of a different user.

[0020] In some configurations, a web page of the present teachings can also include educational guidance, such as educational guidance for HVAC design.

[0021] In some configurations, a calculation module can be configured to receive one or more psychrometric properties as input information items. In various configurations, an input information item can be, without limitation, a barometric pressure information item, or a properties information items such as, without limitation, a wet bulb temperature information item, a dew point temperature information item, a humidity ratio in grains/lb information item, a humidity ratio information item, a relative humidity information item, an enthalpy information item, and a specific volume information item.

[0022] In some calculation modules, a server can provide, as output information items, one or more properties information items not provided by a user. In addition, in some calculation modules, a web page can comprise at least one button configured to receive a calculation selection and/or a button configured to receive units selection from a user.

[0023] In some configurations, a web page can comprise a menu configured to receive a request from a user to initiate a new load calculation, continue a previously initiated load calculation, review a previously initiated load calculation, provide master load data, provide a printable input summary, and/or calculate loads. In various configurations, a load calculation can be selected from design conditions, thermal characteristics of building elements, and/or zones and spaces.

[0024] In various configurations, a server can comprise one or more calculation modules, such as, without limitation, an initiating load calculation module, a design conditions calculation module, a thermal characteristics of building input elements calculation module, a mixing process calculation module, a cooling and dehumidifying process calculation module, a sensible heating or cooling process calculation module, an isothermal humidification process calculation module, an evaporative cooling process calculation module, a differences between two state points calculation module, a heating and cooling coil selection calculation module, an expansion tank sizing calculation module, a heating and cooling coil diagnostics calculation module, a steam properties calculation module, a hydronic pipe sizing calculation module, a steam expansion processes calculation module, a fuel heat required to generate steam calculation module, a control valve sizing calculation module, or a steam orifice size/capacity calculation module.

[0025] In some configurations, a web page can comprise a master load data input field or can be configured to receive as an input information item, a new zone designation, and/or information items concerning individual space input. A web page of these configurations can also be configured to receive input information items concerning individual space input, such as exposed walls information items, exposed roofs information items, doors exposed to outside conditions information items, floors exposed to outside conditions information items, floors -- winter loss from slab perimeter information items, floor over unconditioned spaces information items, and partitions adjoining unconditioned spaces information items.

[0026] In some configurations, a web page can be configured to display an input summary, an output summary, or an input/output summary such as, without limitation, a heating and cooling load calculation summary. A summary of these configurations can be a printable summary. In some configurations, a summary can be viewed by a user operating a terminal, printed by a user operating a terminal, or saved by a user.

[0027] The present application includes the following aspects.

[0028] Aspect 1. A method of providing one or more HVAC design features for a building to one or more users, the method comprising:

a) providing a web-based user interface comprising a plurality of web pages, wherein one or more web pages are configured to receive as input information one or more descriptors, each descriptor selected from a descriptor of a building, a descriptor of a portion of a building and a descriptor of a building environment;

b) receiving, from at least one user accessing the web-based user interface at a terminal located remote from a server comprising software encoding the web-based user interface, at least one selection of a program comprising at least one web page configured to receive one or more input information items and at least one calculation module;

c) receiving one or more input information items from the at least one user;

d) determining at least one HVAC building design specification using at least one HVAC building design executable program and at least one input information item of the one or more input information items, and

e) providing at least one HVAC building design specification as at least one output information item.

[0029] Aspect 2. A method in accordance with aspect 1, wherein the server is a secure server.

[0030] Aspect 3. A method in accordance with aspect 1, wherein the at least one user accesses the web site over the Internet.

[0031] Aspect 4. A method in accordance with aspect 2, wherein at least one web page comprises an interactive user interface.

[0032] Aspect 5. A method in accordance with aspect 1, wherein the server performs input validation on the one or more input information items.

[0033] Aspect 6. A method in accordance with aspect 1, wherein the server performs error checking on the one or more input information items.

[0034] Aspect 7. A method in accordance with aspect 1, wherein at least one web page comprises one or more data input entry fields.

[0035] Aspect 8. A method in accordance with aspect 1, wherein access to the one or more web pages configured to receive the one or more descriptors requires entry of at least one password.

[0036] Aspect 9. A method in accordance with aspect 8, wherein a user initiates a session of use of a building HVAC design project upon accessing the web-based user interface and entering a user identification and at least one password.

[0037] Aspect 10. A method in accordance with aspect 8, wherein the user interface is accessed by the at least one user on a subscription basis.

[0038] Aspect 11. A method in accordance with aspect 9, further comprising generating or adding to a record of the project.

[0039] Aspect 12. A method in accordance with aspect 11, wherein the generating or adding to a record of the project comprises recording at each session, one or more of: the at least one user's identification, a title of the project, date of the session, the at least one selection of a web page, at least one input information item, and at least one output information item.

[0040] Aspect 13. A method in accordance with aspect 12, wherein after the determining of the at least one HVAC building design specification, at least one of a) the date of the session, b) the at least one input information item and c) the at least one output information item, cannot be erased or altered during a subsequent session of use by a user accessing the web-based user interface at a terminal located remote from the server.

[0041] Aspect 14. A method in accordance with aspect 13, wherein one or more web pages of the plurality of web pages comprises one or more data input fields configured to receive at least one input information item for at least one calculation not comprised by the project.

[0042] Aspect 15. A method in accordance with aspect 1, wherein one or more web pages of the plurality of web pages comprises one or more data input fields.

[0043] Aspect 16. A method in accordance with aspect 1, wherein the web-based user interface is a graphical user interface.

[0044] Aspect 17. A method in accordance with aspect 1, wherein the output information is displayed at the terminal.

[0045] Aspect 18. A method in accordance with aspect 15, wherein the one or more input information items are displayed on the one or more data input fields.

[0046] Aspect 19. A method in accordance with aspect 1, wherein the providing the at least one output information item comprises displaying the at least one output information item on a web page of the plurality of web pages.

[0047] Aspect 20. A method in accordance with aspect 1, wherein the providing the at least one output information item comprises providing a printable report.

[0048] Aspect 21. A method in accordance with aspect 20, wherein the printable report is configured to be saved by the at least one user.

[0049] Aspect 22. A method in accordance with aspect 1, wherein a calculation module is selected from the group consisting of a heating and cooling load calculation module, a psychrometric mixing process calculation module, a psychrometric cooling and dehumidifying process calculation module, a psychrometric sensible heating or cooling process calculation module, a psychrometric isothermal humidification process calculation module, a psychrometric evaporative cooling process calculation module, a psychrometric differences between two state points calculation module, a heating and cooling coil selection calculation module, a heating and cooling coil diagnostics calculation module, a steam properties calculation module, a hydronic pipe sizing calculation module, a steam expansion (Power) process calculation module, a fuel heat required to generate steam calculation module, a steam control valve sizing calculation module, a steam orifice size/capacity calculation modules, a steam differences between two state points calculation module and an expansion tank calculation module.

[0050] Aspect 23. A method in accordance with aspect 22, wherein the plurality of web pages further comprise a web page comprising at least one data entry field linking to calculation modules of psychrometric processes, wherein the psychrometric processes include one or more of mixing process, cooling and dehumidifying process, sensible heating or cooling process, isothermal humidification process, evaporative cooling process, and differences between two state points.

[0051] Aspect 24. A method in accordance with aspect 22, wherein the plurality of web pages further comprise a web page comprising a menu linking to calculation modules for steam processes, wherein the steam processes include one or more of expansion (power) process, fuel heat required to generate steam, control valve sizing, steam orifice size/capacity, and differences between two state points.

[0052] Aspect 25. A method in accordance with aspect 1, wherein a calculation module generates an input/output summary.

[0053] Aspect 26. A method in accordance with aspect 21, wherein the input/output summary is a flat text file.

[0054] Aspect 27. A method in accordance with aspect 26, wherein the flat text file is configured to be printed as a WYSIWYG document by the at least one user at a terminal located remote from the server.

[0055] Aspect 28. A method in accordance with aspect 11, wherein a calculation module retains the input information items prior to or after completion of data entry into the module by the at least one user.

[0056] Aspect 29. A method in accordance with aspect 22, wherein the module is the heating and cooling load calculation module.

[0057] Aspect 30. A method in accordance with aspect 1, wherein the at least one user comprises a plurality of collaborative users.

[0058] Aspect 31. A method in accordance with aspect 30, wherein the plurality of collaborative users consists of persons employed by a business entity employing the at least one user.

[0059] Aspect 32. A method in accordance with aspect 1, wherein at least one web page comprises educational guidance for HVAC design.

[0060] Aspect 33. A system for facilitating determination of one or more HVAC design features for a building, the system comprising:

a server configured to a) provide a web-based user interface comprising a plurality of web pages, wherein one or more web pages are configured to receive as input information one or more descriptors, each descriptor selected from a descriptor of a building, a descriptor of a portion of a building and a descriptor of a building environment; b) receive, from at least one user via at least one terminal operably connected to the server, at least one selection of a program comprising at least one web page configured to receive one or more input information items and at least one calculation module; and c) receive one or more input information items from the at least one user via the at least one terminal; and

the at least one terminal.

[0061] Aspect 34. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the server is further configured to d) determine at least one HVAC building design specification using at least one HVAC building design executable program and at least one input information item of the one or more input information items.

[0062] Aspect 35. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 34, wherein the server is further configured to e) provide at least one HVAC building design specification as at least one output information item.

[0063] Aspect 36. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the least one terminal is communicatively connected to the server via the Internet.

[0064] Aspect 37. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the server is a secure server.

[0065] Aspect 38. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 37, wherein the secure server is a dedicated secure server.

[0066] Aspect 39. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the server is further configured to require entry of at least one password for user access to the at least one selection of a program.

[0067] Aspect 40. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 39, wherein the server is further configured to require entry of at least one user identification for user access to the at least one selection of a program.

[0068] Aspect 41. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the server is further configured to allow user access to the at least one selection of a program on a subscription basis.

[0069] Aspect 42. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 39, wherein the server records a session of use of a building HVAC design project upon the at least one user entering a user identification and at least one password.

[0070] Aspect 43. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 42, wherein the server stores the record.

[0071] Aspect 44. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 42, wherein the record comprises one or more of: the at least one user's identification, a title of the project, date of the session, the at least one selection of at least one web page, at least one input information item, and at least one output information item.

[0072] Aspect 45. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 42, wherein the record cannot be erased or altered during a subsequent session of use by the at least one user from the at least one terminal operably connected to the server.

[0073] Aspect 46. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 42, wherein one or more web pages of the plurality of web pages comprises one or more data input fields configured to receive at least one input information item for at least one calculation not comprised by the project.

[0074] Aspect 47. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein at least one web page comprises a web-based interactive user interface.

[0075] Aspect 48. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the server validates the one or more input information items.

[0076] Aspect 49. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the server checks for errors on the one or more input information items.

[0077] Aspect 50. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein at least one web page comprises one or more data input entry fields.

[0078] Aspect 51. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein one or more web pages of the plurality of web pages comprises one or more data input fields.

[0079] Aspect 52. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the web-based user interface is a graphical user interface.

[0080] Aspect 53. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the at least one output information is displayed at the terminal.

[0081] Aspect 54. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 52, wherein the one or more input information items are displayed on the one or more data input fields.

[0082] Aspect 55. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the at least one output information is displayed on a web page of the plurality of web pages.

[0083] Aspect 56. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the at least one output information is comprised by a printable report.

[0084] Aspect 57. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 56, wherein the printable report is configured to be saved by the at least one user at a terminal located remote from the server.

[0085] Aspect 58. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein a calculation module is selected from the group consisting of a heating and cooling load calculation module, a psychrometric mixing process calculation module, a psychrometric cooling and dehumidifying process calculation module, a psychrometric sensible heating or cooling process calculation module, a psychrometric isothermal humidification process calculation module, a psychrometric evaporative cooling process calculation module, a psychrometric differences between two state points calculation module, a heating and cooling coil selection calculation module, a heating and cooling coil diagnostics calculation module, a steam properties calculation module, a hydronic pipe sizing calculation module, a steam expansion (Power) process calculation module, a fuel heat required to generate steam calculation module, a steam control valve sizing calculation module, a steam orifice size/capacity calculation modules, a steam differences between two state points calculation module and an expansion tank calculation module.

[0086] Aspect 59. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 58, wherein the psychrometric processes include one or more of mixing process, cooling and dehumidifying process, sensible heating or cooling process, isothermal humidification process, evaporative cooling process, and differences between two state points.

[0087] Aspect 60. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 59, wherein the plurality of web pages further comprise a web page comprising a menu linking to calculation modules for steam processes, wherein the steam processes include one or more of expansion (power) process, fuel heat required to generate steam, control valve sizing, steam orifice size/capacity, and differences between two state points.

[0088] Aspect 61. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein a calculation module comprises an input/output summary.

[0089] Aspect 62. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 61, wherein the input/output summary is a flat text file.

[0090] Aspect 63. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 61, wherein the flat text file is configured to be printed as a WYSIWYG document by the at least one user at a terminal located remote from the server.

[0091] Aspect 64. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 59, wherein a calculation module retains the input information items upon the at least one user ending a session prior to completion of data entry into the module.

[0092] Aspect 65. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 64, wherein the module is the heating and cooling load calculation module.

[0093] Aspect 66. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the at least one user comprises a plurality of collaborative users.

[0094] Aspect 67. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 66, wherein the plurality of collaborative users consists of persons employed by a business entity employing the at least one user.

[0095] Aspect 68. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the at least one web page further comprises educational guidance for HVAC design.

[0096] Aspect 69. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 33, wherein the calculation module is configured to receive one or more psychrometric properties input information items,

[0097] Aspect 70. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 69, wherein the calculation module is configured to receive one or more input information items, wherein an input information item is selected from an elevation information item, a barometric pressure information item, and properties information items selected from a dry bulb temperature information item, a wet bulb temperature information item, a dew point temperature information item, a humidity ratio in grains/lb information item, a humidity ratio in lb/lb information item, a relative humidity information item, an enthalpy information item, and a specific volume information item.

[0098] Aspect 71. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 70, wherein the calculation module is further configured to provide as output information items, the properties information items not provided by the at least one user.

[0099] Aspect 72. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 70, wherein the at least one web page further comprises at least one button configured to receive a calculation selection from the at least one user.

[00100] Aspect 73. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 70, wherein the web page is further configured to receive a units selection from the at least one user.

[00101] Aspect 74. A system for facilitating determination of one or more HVAC design features for a building in accordance with aspect 39, wherein at least one web page comprises a menu configured to receive a request from the at least one user to initiate a new load calculation, continue a previously initiated load calculation, review a previously initiated load calculation, provide master load data, provide a printable input summary, or calculate loads, wherein a load calculation is selected from the group consisting of design conditions, thermal characteristics of building elements, and zones and spaces.

[00102] Aspect 75. A method of designing heating, ventilation and/or air conditioning for a building or a portion thereof, the method comprising:

accessing from a terminal a web-based user interface comprised by a server, wherein the user interface comprises a plurality of web pages configured to receive data for at least one selection of an HVAC design calculation module of a plurality of HVAC design calculation modules;

submitting to the web-based user interface at least one selection of a plurality of selections of HVAC design calculation modules;

submitting input data for a building design or a portion thereof; and

receiving from the web-based user interface one or more calculated HVAC building parameters.

[00103] Aspect 76. A method in accordance with aspect 75, wherein the terminal is operatively connected to the server via the Internet.

[00104] Aspect 77. A method in accordance with aspect 75, wherein the server is a secure server.

[00105] Aspect 78. A method in accordance with aspect 77, wherein the secure server is a dedicated secure server.

[00106] Aspect 79. A method in accordance with aspect 75, wherein at least one web page comprises a web-based interactive user interface.

[00107] Aspect 80. A method in accordance with aspect 75, wherein at least one web page comprises a user-accessible input menu.

[00108] Aspect 81. A method in accordance with aspect 75, wherein the server validates the one or more input information items.

[00109] Aspect 82. A method in accordance with aspect 75, wherein the server checks for errors on the one or more input information items.

[00110] Aspect 83. A method in accordance with aspect 75, wherein at least one web page comprises one or more data input entry fields.

[00111] Aspect 84. A method in accordance with aspect 75, wherein the accessing from a terminal a web-based user interface comprises providing at least one password.

[00112] Aspect 85. A method in accordance with aspect 84, wherein the accessing from a terminal a web-based user interface further comprises providing at least one user identification.

[00113] Aspect 86. A method in accordance with aspect 75, wherein the server is configured to allow user access to the at least one selection of a program on a subscription basis.

[00114] Aspect 87. A method in accordance with aspect 84, further comprising initiating a session of use of a building HVAC design project.

[00115] Aspect 88. A method in accordance with aspect 87, wherein the server records data entered during the session of use.

[00116] Aspect 89. A method in accordance with aspect 87, wherein the server generates or adds to a record of a project, data entered during the session of use.

[00117] Aspect 90. A method in accordance with aspect 89, wherein the server records, in the record at each session, one or more of: the at least one user's identification, a title of the project, date of the session, the at least one selection of a web page, at least one input information item, and at least one output information item.

[00118] Aspect 91. A method in accordance with aspect 75, wherein one or more web pages of the plurality of web pages comprises one or more data input fields

[00119] Aspect 92. A method in accordance with aspect 75, wherein the output information is displayed by the terminal.

[00120] Aspect 93. A method in accordance with aspect 92, wherein the one or more input information items are displayed on the one or more data input fields.

[00121] Aspect 94. A method in accordance with aspect 75, wherein the at least one output information item is displayed on a web page of the plurality of web pages.

[00122] Aspect 95. A method in accordance with aspect 75, wherein the providing the at least one output information item comprises providing a printable report.

Aspect 96. A method in accordance with aspect 75, wherein the at least one user comprises a plurality of collaborative users.

[00123] Aspect 97. A method in accordance with aspect 75, wherein the plurality of collaborative users consists of persons employed by a business entity employing the at least one user.

[00124] Aspect 98. A method in accordance with aspect 75, wherein at least one web page comprises educational guidance for HVAC design.

Brief Description of the Drawings

[00125] FIG. 1 illustrates a system block diagram of a system of the present teachings.

[00126] FIG. 2 illustrates a flow diagram of a method of designing heating, ventilation and/or air conditioning for a building or a portion thereof.

[00127] FIG. 3 illustrates an exemplary web page comprising data input fields for initiating load calculations in a heating and cooling load calculation module.

[00128] FIG. 4 illustrates an exemplary web page comprising data input fields for design conditions in a heating and cooling load calculation module.

[00129] FIG. 5 illustrates an exemplary web page comprising data input fields for thermal characteristics of building elements in a heating and cooling load calculation module.

[00130] FIG. 6 illustrates an exemplary web page comprising data input fields for master load data in a heating and cooling load calculation module.

[00131] FIG. 7 illustrates an exemplary web page comprising a data input field for selection of spaces on a zones and spaces web page of a heating and cooling load calculation module.

[00132] FIG. 8 illustrates an exemplary web page comprising data input fields for individual space input (with exposures) in a heating and cooling load calculation module.

[00133] FIG. 9 illustrates a second exemplary web page comprising data input fields for individual space input (with exposures) in a heating and cooling load calculation module.

[00134] FIG. 10 illustrates a third exemplary web page comprising data input fields for individual space input (with exposures) in a heating and cooling load calculation module.

[00135] FIG. 11 illustrates a fourth exemplary web page comprising data input fields for individual space input (with exposures) in a heating and cooling load calculation module.

[00136] FIG. 12 illustrates a fifth exemplary web page comprising data input fields for individual space input (with exposures) in a heating and cooling load calculation module.

[00137] FIG. 13 illustrates a sixth exemplary web page comprising data input fields for individual space input (with exposures) in a heating and cooling load calculation module.

[00138] FIG. 14 illustrates an exemplary web page comprising data input fields for a psychrometric properties calculation module.

[00139] FIG. 15 illustrates an exemplary web page comprising calculated output for a psychrometric properties calculation module.

[00140] FIG. 16 illustrates an exemplary web page comprising a menu of processes for a psychrometric processes calculation module.

[00141] FIG. 17 illustrates an exemplary web page comprising data input fields for a mixing process psychrometric processes calculation module.

[00142] FIG. 18 illustrates an exemplary web page comprising calculated values based upon input data for a mixing process psychrometric processes calculation module (button "To Main Entry Screen" not shown).

[00143] FIG. 19 illustrates an exemplary web page comprising data input fields for a cooling and dehumidifying process psychrometric processes calculation module.

[00144] FIG. 20 illustrates an exemplary web page comprising calculated values based upon input data for a cooling and dehumidifying process psychrometric processes calculation module (button "To Main Entry Screen" not shown).

[00145] FIG. 21 illustrates an exemplary web page comprising data input fields for a sensible heating or cooling process psychrometric processes calculation module.

[00146] FIG. 22 illustrates an exemplary web page comprising calculated values based upon input data for a sensible heating or cooling process psychrometric processes calculation module. (Button "To Main Entry Screen" not shown).

[00147] FIG. 23 illustrates an exemplary web page comprising data input fields for an isothermal humidification process psychrometric processes calculation module.

FIG. 24 illustrates an exemplary web page comprising calculated values based upon input data for a for an isothermal humidification process psychrometric processes calculation module (button "To Main Entry Screen" not shown).

[00148] FIG. 25 illustrates an exemplary web page comprising data input fields for an evaporative cooling process psychrometric processes calculation module.

[00149] FIG. 26 illustrates an exemplary web page comprising calculated output values based upon input data for an evaporative cooling process psychrometric processes calculation module (button "To Main Entry Screen" not shown).

[00150] FIG. 27 illustrates an exemplary web page comprising data input fields for a difference between two state points psychrometric processes calculation module.

[00151] FIG. 28 illustrates an exemplary web page comprising calculated values based upon input data for a difference between two state points psychrometric processes calculation module (button "To Main Entry Screen" not shown).

[00152] FIG. 29 illustrates an exemplary web page comprising data input fields for a heating and cooling coil selection calculation module, in which the web page is configured for cooling input data.

[00153] FIG. 30 illustrates an exemplary web page comprising data input fields for liquid conditions for a cooling/dehumidifying coil selection calculation module.

[00154] FIG. 31 illustrates an exemplary web page comprising calculated values for a cooling/dehumidifying coil selection calculation module.

[00155] FIG. 32 illustrates an exemplary web page comprising data input fields for a refrigerant fluid in a heating and cooling coil diagnostics calculation module.

[00156] FIG. 33 illustrates an exemplary web page comprising data input fields for physical characteristics of coil in a cooling/dehumidifying coil diagnostics calculation module.

[00157] FIG. 34 illustrates an exemplary web page comprising input and output values for a cooling/dehumidifying coil diagnostics calculation module.

[00158] FIG. 35 illustrates an exemplary web page comprising data input fields for cooling/dehumidifying coil diagnostics calculation module, wherein the tube side includes water as liquid.

[00159] FIG. 36 illustrates an exemplary web page comprising data input fields for physical characteristics of coil, entering conditions and performance conditions on a heating coil diagnostics calculation module.

[00160] FIG. 37 illustrates an exemplary web page comprising input values for coil description, entering conditions and performance conditions, and calculated output values for air side and liquid side, in a heating coil diagnostics calculation module.

[00161] FIG. 38 illustrates an exemplary web page comprising data input fields for wherein the type of coil is heating and the fluid is steam, in a heating and cooling coil diagnostics calculation module.

[00162] FIG. 39 illustrates an exemplary web page comprising data input fields for physical characteristics of coil with a tube side stream, in a heating coil diagnostics calculation module.

[00163] FIG. 40 illustrates an exemplary web page comprising input data for coil description, entering conditions, and performance conditions, and calculated output regarding coil performance on air side, in a heating coil diagnostics calculation module.

[00164] FIG. 41 illustrates an exemplary web page comprising data input fields for water as liquid fluid, in a heating and cooling coil selection calculation module.

[00165] FIG. 42 illustrates an exemplary web page comprising data input fields for liquid conditions in a cooling/dehumidifying coil selection calculation module.

[00166] FIG. 43 illustrates an exemplary output page, which includes input and/or calculated values for input requirements and coil selection, for a liquid water tube side in a cooling/dehumidifying coil selection calculation module.

[00167] FIG. 44 illustrates an exemplary web page comprising selection of a cooling/dehumidifying coil in a heating and cooling coil selection calculation module.

[00168] FIG. 45 illustrates an exemplary web page comprising data input fields for air conditions and coil conditions in a cooling/dehumidifying coil selection calculation module.

[00169] FIG. 46 illustrates an exemplary web page comprising input requirements and coil selection data in a cooling/dehumidifying coil selection calculation module.

[00170] FIG. 47 illustrates an exemplary web page comprising data input fields, wherein the selection of type of coil is for heating and the fluid is liquid water, in a heating and cooling coil selection calculation module.

[00171] FIG. 48 illustrates an exemplary web page comprising data input fields for liquid conditions, air conditions and coil specifications in a heating coil selection calculation module wherein the tube side is liquid water.

[00172] FIG. 49 illustrates an exemplary web page comprising calculated input requirements and coil selection as output, in a heating coil selection calculation module.

[00173] FIG. 50 illustrates an exemplary web page comprising data input fields wherein the type of coil is heating and the fluid is steam, in a heating and cooling coil selection calculation module.

[00174] FIG. 51 illustrates an exemplary web page comprising data input fields for air conditions and coil specification, in a heating coil selection calculation module, wherein the tube side is steam.

[00175] FIG. 52 illustrates an exemplary web page comprising calculated output, including input requirements and coil selection, in a heating coil selection calculation module, wherein the tube side is steam.

[00176] FIG. 53 illustrates an exemplary web page comprising a selection of diaphragm or bladder as type of tank, selection of water as fluid in a data input field, and data input field for temperature and pressure at lower temperature and higher temperature, for an expansion tank sizing calculation module.

[00177] FIG. 54 illustrates an exemplary web page comprising calculated output wherein the type of tank is a diaphragm (bladder), the fluid is water, and wherein the user selects options for approximate calculation based on building size and chilled or hot/chilled system or heating water system, temperature and pressure at lower temperature and at higher temperature are disclosed, and actual total size (Volume) for tank or tanks is entered in a data input field, in an expansion tank sizing calculation module.

[00178] FIG. 55 illustrates an exemplary web page comprising output data including temperature and pressure at lower temperature and at higher temperature, tank volume, actual total size (volume) of tank or tanks, and actual pressure at higher temperature, in an expansion tank sizing calculation module.

[00179] FIG. 56 illustrates an exemplary web page comprising a menu of processes in a steam processes calculation module.

[00180] FIG. 57 illustrates an exemplary web page comprising data input fields for initial (throttle) conditions and outlet conditions, in a steam processes calculation module, wherein isentropic expansion is selected.

[00181] FIG. 58 illustrates an exemplary web page comprising calculated output for initial (throttle) conditions and outlet conditions, in a steam processes calculation module.

[00182] FIG. 59 illustrates an exemplary web page comprising data input fields for initial (throttle) conditions and outlet conditions, in a steam processes calculation module, wherein nonisentropic expansion is selected at an efficiency of 65%.

[00183] FIG. 60 illustrates an exemplary web page comprising calculated output for initial (throttle) conditions and outlet conditions, for a non-isentropic expansion (power) process, in a steam processes calculation module.

[00184] FIG. 61 illustrates an exemplary web page comprising data input fields for fuel heat required to generate steam, in a steam processes calculation module.

[00185] FIG. 62 illustrates an exemplary web page comprising calculated output for fuel heat required to generate steam, in a steam processes calculation module.

[00186] FIG. 63 illustrates an exemplary web page comprising data input fields for control or regulator valve sizing (Cv), in a steam processes calculation module.

[00187] FIG. 64 illustrates an exemplary web page comprising calculated output for control or regulator valve sizing (Cv), in a steam processes calculation module, wherein the steam flow rate is 1Aspect 00.00 lb/hr.

[00188] FIG. 65 illustrates an exemplary web page comprising data input fields for steam orifice size/capacity, in a steam processes calculation module, wherein the steam flow rate is 100.00 lb/hr.

[00189] FIG. 66 illustrates an exemplary web page comprising calculated output for steam orifice size/capacity, in a steam processes calculation module, wherein the steam flow rate is 100.00 lb/hr.

[00190] FIG. 67 illustrates an exemplary web page comprising data input fields for steam orifice size/capacity, in a steam processes calculation module, wherein the orifice diameter is 0.100 in.

[00191] FIG. 68 illustrates an exemplary web page comprising calculated output for steam orifice size/capacity, in a steam processes calculation module, wherein the orifice diameter is 0.100 in.

[00192] FIG. 69 illustrates an exemplary web page comprising data input fields for differences between two state points, in a steam processes calculation module.

[00193] FIG. 70 illustrates an exemplary web page comprising calculated output for differences between two state points, in a steam processes calculation module.

[00194] FIG. 71 illustrates an exemplary web page comprising data input fields for saturated properties, in a steam properties calculation module.

FIG. 72 illustrates an exemplary web page comprising data input fields for saturated properties, in a steam properties calculation module, wherein the saturated pressure is 500 psia.

FIG. 73 illustrates an exemplary web page comprising calculated output for properties of saturated liquid and saturated vapor, in a steam properties calculation module, wherein the saturated pressure is 500 psia.

[00195] FIG. 74 illustrates an exemplary web page comprising data input fields for saturated properties, in a steam properties calculation module, wherein the saturation temperature is 500°F.

[00196] FIG. 75 illustrates an exemplary web page comprising calculated output for properties of saturated liquid and saturated vapor, in a steam properties calculation module, wherein the saturation temperature is 500°F.

[00197] FIG. 76 illustrates an exemplary web page comprising data input fields for saturated properties, in a steam properties calculation module, wherein the saturated pressure is 500 psia, at a quality of 50%.

[00198] FIG. 77 illustrates an exemplary web page comprising calculated output for saturated properties, in a steam properties calculation module, wherein the saturated pressure is 500 psia, at a quality of 50%.

[00199] FIG. 78 illustrates an exemplary web page comprising data input fields for saturated properties, in a steam properties calculation module, wherein the temperature is 500°F, at a quality of 50%.

[00200] FIG. 79 illustrates an exemplary web page comprising calculated output for saturated properties, in a steam properties calculation module, wherein the temperature is 500°F, at a quality of 50%.

[00201] FIG. 80 illustrates an exemplary web page comprising data input fields for superheated or supercritical vapor or subcooled liquid properties, in a steam properties calculation module, wherein the wherein the pressure is 500 psia, and the temperature is 400°F.

FIG. 81 illustrates an exemplary web page comprising calculated output for superheated or supercritical vapor or subcooled liquid properties, in a steam properties calculation module, wherein the pressure is 500 psiaand the temperature is 400°F.

[00202] FIG. 82 illustrates an exemplary web page comprising data input fields for superheated or supercritical vapor or subcooled liquid properties, in a steam properties calculation module, wherein the pressure is 500 psia, and the temperature is 500°F.

[00203] FIG. 83 illustrates an exemplary web page comprising calculated output for superheated or supercritical vapor or subcooled liquid properties, in a steam properties calculation module, wherein the pressure is 500 psia, and the temperature is 500°F.

[00204] FIG. 84 illustrates an exemplary web page comprising data input fields for superheated or supercritical vapor or subcooled liquid properties, in a steam properties calculation module, wherein the pressure is 500 psia, and the temperature is 900°F.

[00205] FIG. 85 illustrates an exemplary web page comprising calculated output for superheated or supercritical vapor or subcooled liquid properties, in a steam properties calculation module, wherein the pressure is 500 psia, and the temperature is 900°F.

[00206] FIG. 86 illustrates an exemplary web page comprising data input fields for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module.

[00207] FIG. 87 illustrates an exemplary web page comprising data input fields for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, and the maximum velocity is 8 ft/sec. FIG. 88 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm.

[00208] FIG. 89 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm or 1.00 gpm.

[00209] FIG. 90 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm or 10.00 gpm.

[00210] FIG. 91 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm, 10.00 gpm or 100.00 gpm.

[00211] FIG. 92 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm, 10.00 gpm, 100.00 gpm or 1,000.00 gpm.

[00212] FIG. 93 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm, 10.00 gpm, 100.00 gpm, 1,000.00 gpm or 10,000.00 gpm.

[00213] FIG. 94 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm, 10.00 gpm, 100.00 gpm, 1,000.00 gpm, 10,000.00 gpm or 100,000.00 gpm.

[00214] FIG. 95 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm, 10.00 gpm, 100.00 gpm, 1,000.00 gpm, 10,000.00 gpm or 100,000.00 gpm, plus 138,000 comprised by a data input field for an additional entry.

[00215] FIG. 96 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm, 10.00 gpm, 100.00 gpm, 1,000.00 gpm, 10,000.00 gpm, 100,000.00 gpm, or 138,000.00 gpm, plus a data input field for an additional entry.

[00216] FIG. 97 illustrates an exemplary web page comprising calculated output for pipe material, pipe strength and fluid, in a hydronic pipe sizing calculation module, wherein the mean fluid temperature is 60°F, the design head loss is 4 ft/100 ft, the maximum velocity is 8 ft/sec, and the flow rate is 0.10 gpm, 1.00 gpm, 10.00 gpm, 100.00 gpm, 1,000.00 gpm, 10,000.00 gpm, 100,000.00 gpm, or 138,000.00 gpm.

[00217] FIG. 98 illustrates an exemplary Psychrometric Properties Input/Output summary.

[00218] FIG. 99 illustrates an exemplary Psychrometric Processes Input/Output summary.

[00219] FIG. 100 illustrates an exemplary Steam Properties Input/Output summary.

[00220] FIG. 101 illustrates an exemplary Hydronic Pipe Sizing Input/Output summary.

[00221] FIG. 102 illustrates an exemplary Heating and Cooling Loads Input/Output summary.

[00222] FIG. 103 illustrates an exemplary Expansion Tank Sizing Input/Output summary.

[00223] FIG. 104 illustrates an exemplary Heating and Cooling Coil Diagnostics Input/Output summary.

[00224] FIG. 105 illustrates an exemplary Heating and Cooling Coil Selection Input/Output summary.

[00225] FIG. 106 illustrates an exemplary Steam Processes Input/Output summary.

Detailed Description

[00226] The present inventors have developed methods and systems for facilitating design of HVAC specifications for a building or portion thereof. In some aspects of the present teachings, a system can comprise at least one terminal, and a server. With reference to FIG. 1, a server can be operably connected to one or more terminals. The connection can be through a network which can be, for example, the Internet, an intranet, a WAN or a LAN. The server and terminal(s) can be connected by wire, wirelessly, or a combination thereof. A “terminal,” as used herein, can be any sort of device for receiving data from and/or sending data to a server. The terminals in various configurations can communicate not only with the server, but with each other via the network. In some configurations, a system can comprise a plurality of terminals which can be situated remotely from one another (e.g., in two different cities); multiple users can thus contribute in a collaborative project. Without limitation, examples of a terminal include a desktop computer, a laptop computer, a portable desk assistant (PDA) device, and a wireless telephone. In various configurations, a server can be a secure server, such as a dedicated server.

[00227] In various configurations, a server can provide a web-based user interface comprising a plurality of web pages, wherein one or more web pages are configured to receive as input information one or more identifiers and/or descriptors, wherein each descriptor can be selected from a descriptor of a building, a descriptor of a portion of a building and a descriptor of a building environment. An identifier, as used herein, is any sort of information that can be used to identify a user, a calculation, a project or a session of use.

[00228] In some configurations, a server can record a session of use of a building HVAC design project. In these configurations, after a user enters a user identification and a password, the server can record the web pages accessed, the data entries (such as, for example, alphanumeric data added to data input fields and/or selection of radio buttons) and/or the output information generated in a session. In some configurations, the server can generate and/or store a record of a session, comprising the web pages accessed, the data entries, and/or the output information generated. A record of a session can further comprise one or more identifiers, which can include, for example, one or more of a user's identification, a title of a project, time of a session, and date of a session, a company name, a project name, a project file number, and/or a calculation label. In some configurations, a server can record a session in a manner in which the user, accessing the server from a terminal remote from the server, is prevented from erasing or altering the record of the session, either during the session, or subsequently. Furthermore, in some configurations a server can create a record of a project, which can comprise each record of the sessions recorded for the project. Accordingly, in a multi-user, collaborative project, a record of the project can include all the records of sessions recorded by each user, including, for example, dates when calculation modules were accessed and calculations were performed for a project. In a non-limiting example, a user can log in securely to a website providing access to a server of the present teachings, access a project and a calculation module, provide new values for one or more data fields, execute calculation by the calculation modules, and exit from the web site. The server automatically and securely records the new calculations, along with one or more identifiers which indicate the user who inputted the new values, as well as the date when the changes were made.

[00229] In some aspects, calculations related to a project can be automatically filed in a project file comprised by a server, for example in connection with an identifier, which can be, in non-limiting example, a company name, a project name, a project file number, a calculation label, an user's name, date of a user session and/or time of a user session. In some configurations, a calculation not related to a project can be automatically filed as a "Miscellaneous" calculation. Because a server can be a secure server, confidentiality of a project can be maintained. Furthermore,

[00230] A descriptor, as used herein, can be a numerical value of a physical property of a building or portion thereof, such as, for example, a space height of a room, a coil width of a heating coil, or an environmental property, such as, for example, the elevation of a building. In some configurations, a user can select a calculation module using methods known to skilled artisans, such as by selecting from a menu by a mouse click. A calculation module can comprise a web page, which, in some configurations, can comprise one or more input fields. A user accessing a web page via a terminal can enter alphanumerical data for descriptors and/or identifiers. Upon a user entering alphanumerical data in the input fields on a web page for a calculation module, the server can determine if the data items required for a calculation have been entered, and/or if the data items entered are compatible with the calculations to be performed by the calculation module, and/or if too many data items have been added. If the server determines an omission or error in the data added, the user can receive an error message, and the user can then modify the input data. For example, on a web page comprising a calculation module for heating and cooling diagnostics, if the user selects steam as a fluid, data input fields are presented for three descriptors: saturated steam temperature in °F, saturated steam pressure in psig, and saturated steam pressure in psia. The web page instructs the user to add a numerical value for only one descriptor. If a user adds values to more than one field, the user receives an error message; the user can then correct the values of the descriptors to comport with the requirements of the calculation module. If all required values added are compatible with the requirements for the calculation module, upon the user selecting "proceed," the server calculates output values for various HVAC parameters. In various configurations, the output values can be displayed on a web page and/or can be comprised by a computer file such as a text file, which can be viewed and/or saved by the user, e.g., by downloading onto a hard drive comprised by the user's terminal.

[00231] In some cases, a web page can provide a cumulative table, in which different values are iteratively provided to a data input field in a calculation module. A cumulative table can thus report both input values and calculated output values, thereby allowing a user to compare the effects of varying the value of an input item.

[00232] In some cases, an HVAC specification can be either an input information item or an output information item, and the value of the output information items can be calculated by a calculation module using the input information items. In a non-limiting example, a web page such as a Psychrometric Processes calculation module for mixing process (**FIG. 17**) includes data input fields for mixing ratio by percent of stream by mass. A user can enter a value for a percentage of either Stream 1 or Stream 2. For example, if a user enters a number between 0 and 100 in the data input field for Stream 1, a calculated value will appear in the data input field for Stream 2. If the user then overwrites the calculated value in the data input field for Stream 2, a calculated value will appear in the data input field for Stream 1, overwriting the value initially entered for in the data input field for Stream 1.

[00233] In addition, in some cases, a calculation module can limit the number of data input fields for which alphanumeric data is accepted. In non-limiting example, a web page such as a Psychrometric Processes calculation module for mixing process (**FIG. 17**) includes data input fields not only for mixing ratio by percent of stream by mass, but also for mixing ratio by volume flow rate. If a user attempts to enter numbers in the data input data field for volume flow rate for Stream 1 and for Stream 2, an error message is displayed stating that the user may enter only one volume flow rate. Furthermore, in another non-limiting example using the Psychrometric Processes calculation module for mixing process, if a user attempts to enter data into data input fields for both percent of stream by mass and volume flow rate, the calculation module will erase the first data entered.

[00234] In addition, in some cases, a calculation module will perform a calculation only when necessary data has been entered. In non-limiting example, a web page such as a Psychrometric Processes calculation module for mixing process (**FIG. 17**), the calculation module will not perform a calculation unless alphanumeric text is included in the data input field for Equipment Identifier, or numerical text is included in the data input fields for Mixed Air Flow Rate and Barometric Pressure.

[00235] In some cases, a web page of a system of the present teachings can comprise educational material. In non-limiting example, **FIG. 7** includes a statement that "Each constituent of a mixture of perfect gases behaves as though the other constituents were not present (at least as far as pressure is concerned). - Dalton's Law." In some configurations, such educational statements can be added or replaced on a web page by an entity such as a web master (but not a user) who has access privileges to modify the software as comprised by a server.

[00236] With reference to the flowchart set forth in **FIG. 2**, in various configurations of the present teachings, a user can log into a dedicated server by entering a user identification and a password (step **1**). The user can then select a calculation module from a Main Entry Screen (step **2**). On a web page for the selected calculation module, the user can then enter alphanumeric data into data input field(s) and/or can select one or more radio buttons in an HTML form (step **3**). The calculation module can then read inputs from the HTML form, and can save the data in a database (step **4**). In some configurations, PHP code can be used to read the inputs and the data can be saved in any database known to skilled artisans, such as a MySQL database. On execution, other code (which can also be PHP code) can pull inputs from the MySQL database into a formatted standard input (stdin) text stream (step **5**). Furthermore, the calculation module can, in some cases, perform additional preprocessing of the data (step **6**). The calculation module can then feed the formatted stdin text stream in binary executables, which can be, without limitation, programs written in computer languages such as FORTRAN and/or Pascal (step **7**). Stdout stream generated by the executable(s) can then be parsed out for output values (step **8**).Output values can then be taken by more code (which can be PHP code) and written out to a browser (e.g., to an HTML output form which can be displayed on a browser) (step **9**). In some configurations, input values can be taken by more code (which can be PHP code) and written out to a browser (e.g., to an HTML output form which can be displayed on a client such as a web browser) (step **10**). In some other configurations, input and output ("I-O") values can be written out to a formatted flat text file (step **11**). In some configurations, for the Load module, the I-O values can be separately written out to a formatted flat text file (step **12**). In other configurations, I-O values can be stored securely on a server (step **13**), and/or a formatted flat text file can be printed or saved locally by the user (step **14**). A non-limiting example of formatted text file is provided in table I.

[00237] In some aspects of the present teachings, a system can comprise a collaborative feature. This feature can allow individual users and/or firms to create an on-line virtual company comprising, for example, professionals and/or expert consultants from anywhere on the planet, without the use of any additional collaboration software. In some configurations, such collaborative groups may be formed at will, for example, on an "as needed" or an "on-the-fly" basis. In various configurations, a collaborator can be added or deleted as a member company wishes.

[00238] In some configurations, a system of the present teachings can comprise a Heating & Cooling Load Calculation calculation module. This calculation module can include an input web page for initiating load calculation (e.g., **FIG. 3**). This web page can comprise data input fields for alphanumeric data, such as fields for title, description, latitude, elevation, and weight/room construction.

[00239] In some configurations, a system of the present teachings can comprise a calculation module for Heating & Cooling Load Calculation which can include an input web page for Design Conditions (e.g., **FIG. 4**). This web page can comprise data input fields for alphanumeric data, such as fields for indoor conditions, including, for example, fields for space temperature for cooling, space relative humidity for cooling, space temperature for heating, and space relative humidity for heating. This web page can further comprise a data input field for heating outdoor conditions such as dry bulb temperature; cooling outdoor conditions for ventilation such as design dew point temperature and mean coincident dry bulb temperature; and cooling outdoor conditions for space load such as design dry bulb temperature, mean coincident wet bulb temperature, daily temperature range, and design cooling month. In addition, the page can further compris, for cooling outdoor conditions for space load, data input fields for each month, including cooling design dry bulb temperature, cooling design web bulb temperature, and cooling design range.

[00240] In some configurations, a system of the present teachings can comprise a calculation module for Heating & Cooling Load Calculation which can include an input web page for Thermal Characteristics of Building Elements (e.g., **FIG. 5**). This web page can comprise data input fields for alphanumeric data, such as data input fields for opaque wall types, such as designation, color, U-value, and construction weight; data input fields for window (fenestration) types, such as designation, U-value, glass shading coefficient, and interior shading coefficient; data input fields for roof types, such as designation, color, U-value, and construction weight; data input fields for exterior door types, such as designation, color, U-value, and construction weight; data input fields for exposed floor types, such as designation, U-value, and construction weight; and data input fields for exterior shading geometries, such as designation, window width, window height, overhang projection, overhang offset, left fin projection, left fin offset, right fin projection, and right fin offset.

[00241] In some configurations, a system of the present teachings can comprise a calculation module for Heating & Cooling Load Calculation which can include an input web page for Master Load Data (e.g., **FIG. 6**). This web page can comprise data input fields for alphanumeric data, such as data input fields for space height, lighting decimal fraction to return, and lighting density. The web page can further comprise data input fields for ventilation, CFM/person and CFM/ft^2; for infiltration, air changes/hour and CFM/ft^2; for load/person, sensible Btu/hr and latent Btu/hr; and for operating hours, start occupied and stop occupied.

[00242] In some configurations, a system of the present teachings can comprise a calculation module for Heating & Cooling Load Calculation which can include a summary web page for Zones and Spaces (e.g., **FIG. 7**). This web page can comprise a data input field for alphanumeric data, such as data input field for a new zone designation, and can also provide a summary of all spaces and zones entered for a calculation. From this web page, a load calculation can be executed by a user clicking a 'Calculate' button, or a user can return to an appropriate screen by clicking on a 'To Loads Menu' button.

[00243] In some configurations, a system of the present teachings can comprise a calculation module for Heating & Cooling Load Calculation which can include an input web page for Individual Space Input (With Exposures) (e.g., **FIG. 8**). This web page can comprise data input fields for alphanumeric data, such as data input fields for name of space, zone, number of additional identical spaces, space area, and ceiling height; for occupant load: occupancy (people), sensible load/person, latent load/person; for lighting: wattage and decimal fraction to return; for ventilation (cfm); for infiltration (cfm); for appliances: sensible (W), sensible (BTU/hr), latent (BTU/hr); and for infiltration (cfm). The web page can further comprise check boxes for excluding space from cooling loads and for excluding space from heating loads.

[00244] In some configurations, a system of the present teachings can comprise a calculation module for Heating & Cooling Load Calculation which can include an input web page for Individual Space Input (With Exposures) as shown in **FIG. 8**, and can further comprise data input fields for exposed walls, such as, for example, data input fields for wall designation, direction, net area, decimal fraction to return, as well data input fields for window designation, window area, and estimated shade. Furthermore, this web page can also include data input fields regarding exposed roofs, including roof designation, net area, decimal fraction to return, skylight designation, and skylight area; data input fields regarding doors exposed to outside conditions, including door designation, direction, door area, window area, and estimated shade; input fields regarding floors exposed to outside conditions, including floor designation and floor area; input fields regarding floors - winter loss from slab perimeter, including perimeter slab loss net perimeter length; input fields regarding floors over unconditioned spaces, including floor U-value, net floor area, cooling temperature of unconditioned spaces, and heating temperature of unconditioned spaces; input fields regarding partitions adjoining unconditioned spaces, including partition U-value, net partition area, cooling temperature of unconditioned space, and heating temperature of unconditioned space. Examples of such web pages are provided in **FIG. 9**, **FIG. 10**, **FIG. 11**, **FIG. 12** and **FIG. 13**.

[00245] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Properties which can include an input web page which can comprise data entry fields for calculation identifier, units, elevation, barometric pressure (which can be in psia or in Hg), and properties including dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume (e.g., **FIG. 14**).

[00246] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Properties which can include an output web page (e.g., **FIG. 15**) which can report data entered into an input web page such as a page illustrated in **FIG. 14**, and can also present inputted or calculated values for properties, such as dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, specific volume, and vapor pressure. In some configurations, such web pages can further specify whether the reported properties are within ASHRAE standard 55 comfort zone in summer or winter.

[00247] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include a web page comprising a Menu of Processes (e.g., **FIG. 16**), with radio buttons for a user to choose from Mixing Process, Cooling and Dehumidifying Process, Sensible Heating or Cooling Process, Isothermal Humidification Process, Evaporative Cooling Process, and/or Differences Between Two State Points.

[00248] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an input web page which can comprise data entry fields regarding Mixing Process (e.g., **FIG. 17**). These web pages can include data entry fields for equipment identifier, elevation, barometric pressure (in psia and in Hg), and mixed air flow rate. A web page of these configurations can further comprise data entry fields regarding mixing ratio, which can include, for percent of stream by mass, data entry fields for stream 1 and stream 2; for volume flow rate, data entry fields for stream 1 and stream 2, and for each of stream 1 and stream 2, data entry fields for dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume.

[00249] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an output web page regarding Mixing Process (e.g., **FIG. 18**), which comprises data entered into an input web page such as a page presented in **FIG. 17**, and can also present inputted or calculated values for properties for stream 1, stream 2 and mixed stream, such as dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, specific volume, vapor pressure and air flow rate. An output page of these configurations can further comprise a selection of Chain Output into another process.

[00250] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an input web page which can comprise data entry fields regarding Cooling and Dehumidifying Process (e.g., **FIG. 19**). These web pages can include data entry fields for equipment identifier, elevation, barometric pressure (in psia and in Hg), and initial air flow rate. A web page of these configurations can further comprise data entry fields regarding mixing ratio, which can include, for percent of stream by mass, data entry fields for stream 1 and stream 2; for volume flow rate, data entry fields for stream 1 and stream 2, and for each of stream 1 and stream 2, data entry fields for dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume.

[00251] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an output web page regarding Cooling and Dehumidifying Process (e.g., **FIG. 20**), which comprises data entered into an input web page such as a page presented in **FIG. 19**, and can also present inputted or calculated values for properties for initial state, final state, and difference for dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume, vapor pressure and/or air flow rate. A page of these configurations can further include energy requirements, such as energy requirement for cooling, including sensible, latent, and/or total energy requirements for cooling. An output page of these configurations can further comprise a selection of Chain Output into another process.

[00252] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an input web page which can comprise data entry fields regarding Sensible Heating or Cooling Process (e.g., **FIG. 21**). These web pages can include data entry fields for equipment identifier, units, elevation, barometric pressure (in psia and in Hg), and initial air flow rate. A web page of these configurations can further comprise data entry fields for initial and/or final state, regarding dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and/or specific volume.

[00253] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an output web page regarding Sensible Heating or Cooling Process (e.g., **FIG. 22**), which comprises data entered into an input web page such as a page represented in **FIG. 21**, and can also present inputted or calculated values for properties for initial state, final state, and difference for dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume, vapor pressure and/or air flow rate. A page of these configurations can further include energy requirements, such as energy requirement for heating, such as sensible energy requirements for heating. An output page of these configurations can further comprise a selection of Chain Output into another process.

[00254] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an input web page which can comprise data entry fields regarding Isothermal Humidification Process (e.g., **FIG. 23**). These web pages can include data entry fields for equipment identifier, units, elevation, barometric pressure (in psia and in Hg), and initial air flow rate. A web page of these configurations can further comprise data entry fields for initial and/or final state, regarding dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and/or specific volume.

[00255] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an output web page regarding Isothermal Humidification Process (e.g., **FIG. 24**), which comprises data entered into an input web page such as a page represented in **FIG. 23**, and can also present inputted or calculated values for properties for initial state, final state, and difference for dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume, vapor pressure and/or air flow rate. A page of these configurations can further include energy requirements, such as energy requirement for heating, such as sensible energy requirements for heating, including requirements for sensible heating, latent heating and total heating. An output page of these configurations can further comprise a selection of Chain Output into another process.

[00256] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an input web page which can comprise data entry fields regarding Evaporative Cooling Process (e.g., **FIG.**

25). These web pages can include data entry fields for equipment identifier, units, elevation, barometric pressure (in psia and in Hg), initial air flow rate, and adiabatic effectiveness. A web page of these configurations can further comprise data entry fields for initial state, regarding dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and/or specific volume.

[00257] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an output web page regarding Evaporative Cooling Process (e.g., **FIG. 26**), which can comprise data entered into an input web page such as a page represented in **FIG. 25**, and can also present inputted or calculated values for properties for initial state, final state, and difference for dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume, vapor pressure and/or air flow rate. An output page of these configurations can further comprise a selection of Chain Output into another process.

[00258] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an input web page which can comprise data entry fields regarding differences between two state points (e.g., **FIG. 27**). These web pages can include data entry fields for calculation identifier, units, elevation, and barometric pressure (in psia and in Hg). A web page of these configurations can further comprise data entry fields for each of two state points (State Point 1 and State Point 2), regarding dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and/or specific volume.

[00259] In some configurations, a system of the present teachings can comprise a calculation module for Psychrometric Processes which can include an output web page regarding differences between two state points (e.g., **FIG. 28**), which comprises data entered into an input web page such as a page represented in **FIG. 27**, and can also present inputted or calculated values for properties for initial state, final state, and difference for dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio (grains/lb), humidity ratio (lb/lb) relative humidity, enthalpy, and specific volume, and/or vapor. An output page of these configurations can further comprise a selection of Chain Output into another process.

[00260] In some configurations, a system of the present teachings can comprise a calculation module for Heating and Cooling Coil Diagnostics regarding Fluid. A web page for this calculation module (e.g., **FIG. 29**) can include data entry fields for equipment identifier, units, elevation, and barometric pressure (in psia and in Hg), and can further include buttons regarding type of coil (cooling/dehumidifying or heating). A web page of these configurations can further comprise buttons for fluid (either liquid or refrigerant). In some configurations, if liquid is selected for fluid, data entry fields appear for type of liquid (e.g., water), percent glycol, and freezing temperature.

[00261] In some configurations, a system of the present teachings can comprise a calculation module for Heating and Cooling Coil Diagnostics regarding Fluid. A web page for this calculation module (e.g., **FIG. 30**) can include data entry fields for equipment identifier, units, elevation, and barometric pressure (in psia and in Hg), and can further include buttons regarding type of coil (cooling/dehumidifying or heating). A web page of these configurations can further comprise buttons for fluid (either liquid or refrigerant). In some configurations, if Refrigerant is selected for fluid, a data entry field can appear for saturated suction temperature.

[00262] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Diagnostics, in which a web page for this calculation module wherein the tube side is liquid water (e.g., **FIG. 31**) can comprise data input fields regarding Physical Characteristics of Coil. These can include, for example, data input fields for coil height, coil width, rows, circuiting, fin type, fins per inch, and fin spacing. A web page of this module can further comprise data input fields regarding entering conditions, which can include, for example, data input fields for air flow rate actual (ACFM), entering air dry bulb temperature (EDB), entering air wet bulb temperature, (EWB), and/or entering liquid temperature (ELT). A web page of this module can further comprise data input fields regarding performance conditions, which can include, for example, data input fields for leaving dry air bulb temperature (LDB), leaving liquid temperature (LLT), and/or liquid flow rate (GPM).

[00263] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Diagnostics, in which an output web page for this calculation module for which the tube side liquid is water (e.g., **FIG. 32**) can comprise input data regarding coil description, entering conditions and performance conditions such as data entered on a web page exemplified in **FIG. 31**, and can further provide information for coil performance output, such as, for air side: one or more of air flow rate, coil face area, total heat transfer, sensible heat transfer, sensible heat ratio, entering face velocity, leaving dry bulb temperature, leaving wet bulb temperature, leaving dew point temperature, and/or air pressure drop; and for liquid side: one or more of liquid flow rate, liquid pressure drop, liquid volume of coil, leaving liquid temperature, liquid temperature rise, and liquid velocity.

[00264] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Diagnostics, in which a web page for this calculation module wherein the tube side is refrigerant, (e.g., **FIG. 33**) can comprise data input fields regarding Physical Characteristics of Coil. These can include, for example, data input fields for coil height, coil width, rows, circuiting, fin type, fins per inch, and fin spacing. A web page of this module can further comprise data input fields regarding entering conditions, which can include, for example, data input fields for air flow rate actual (ACFM), entering air dry bulb temperature (EDB), and/or entering air wet bulb temperature (EWB).

[00265] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Diagnostics, in which an output web page for this calculation module for tube side refrigerant (e.g., **FIG. 34**) can comprise input data regarding coil description, entering conditions and performance conditions such as data entered on a web page exemplified in **FIG. 33**, and can further provide information for coil performance output, such as, for air side: one or more of air flow rate, coil face area, total heat transfer, sensible heat transfer, sensible heat ratio, entering face velocity, leaving dry bulb temperature, leaving wet bulb temperature, leaving dew point temperature, and/or air pressure drop.

[00266] In some configurations, a system of the present teachings can comprise a calculation module for Heating and Cooling Coil Diagnostics including choice of Fluid. A web page for this calculation module (e.g., **FIG. 35**) can include data entry fields for equipment identifier, units, elevation, and barometric pressure (in psia and in Hg), and can further include buttons regarding type of coil (cooling/dehumidifying or heating). In some configurations, if 'heating' is selected for type of coil, a web page can further comprise buttons for fluid (either liquid or steam). If 'liquid' is selected for fluid, data entry fields can appear for type of liquid (e.g., water), percent glycol, and freezing temperature.

[00267] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Diagnostics, in which a web page for this calculation module wherein the tube side is liquid water (e.g., **FIG. 36**) can comprise data input fields regarding Physical Characteristics of Coil. These can include, for example, data input fields for coil height, coil width, rows, circuiting, fin type, fins per inch, and fin spacing. A web page of this module can further comprise data input fields regarding entering conditions, which can include, for example, data input fields for air flow rate actual (ACFM), entering air temperature (EAT), and/or entering liquid temperature (ELT). A web page of this module can further comprise data input fields regarding performance conditions, which can include, for example, data input fields for leaving air temperature (LAT), leaving liquid temperature (LLT), and/or liquid flow rate (GPM).

[00268] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Diagnostics, in which an output web page for this calculation module for which the tube side liquid is water (e.g., **FIG. 37**) can comprise input data regarding coil description, entering conditions and performance conditions such as data entered on a web page exemplified in **FIG. 36**, and can further provide information for coil performance output, such as, for air side: one or more of air flow rate standard (SCFM), coil face area, total heat transfer, entering face velocity, leaving dry bulb temperature, and/or air pressure drop; and for liquid side: one or more of liquid flow rate, liquid pressure drop, liquid volume of coil, leaving liquid temperature, liquid temperature drop, and liquid velocity.

[00269] In some configurations, a system of the present teachings can comprise a calculation module on Heating and Cooling Coil Diagnostics, in which a web page for this calculation module (e.g., **FIG. 38**) can comprise data buttons for type of coil (cooling/dehumidifying or heating), and data input fields for equipment identifier, elevation, and barometric pressure. A web page of these configurations can further comprise buttons for Fluid, either liquid or steam. If a user selects 'heating' for type of coil and 'steam' for fluid, the web page can comprise data input fields for saturated, saturated steam pressure in psig, and/or saturated steam pressure in psia.

[00270] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Diagnostics, in which a web page for this calculation module wherein the tube side is steam (e.g., **FIG. 39**) can comprise data input fields regarding Physical Characteristics of Coil. These can include, for example, data input fields for coil height, coil width, rows, fin type, fins per inch, and fin spacing. A web page of this module can further comprise data input fields regarding entering conditions, which can include, for example, data input fields for air flow rate actual (ACFM) and/or entering air temperature (EAT).

[00271] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Diagnostics, in which an output web page for this calculation module for which the tube side is steam (e.g., **FIG. 40**) can comprise input data regarding coil description, entering conditions and performance conditions such as data entered on a web page exemplified in **FIG. 39**, and can further provide information for coil performance output, such as, for air side: one or more of air flow rate standard (SCFM), coil face area, total heat transfer, entering face velocity, leaving dry bulb temperature, and/or air pressure drop.

[00272] In some configurations, a system of the present teachings can comprise a calculation module on Heating and Cooling Coil Selection, in which a web page for this calculation module (e.g., **FIG. 41**) can comprise data buttons for type of coil (cooling/dehumidifying or heating), and data input fields for equipment identifier, units, elevation, and barometric pressure. A web page of these configurations can further comprise buttons for Fluid, either liquid or refrigerant. If a user selects 'cooling' for type of coil and 'liquid' for fluid, the web page can comprise data input fields for liquid type (e.g., water), percent glycol and/or freezing temperature. In some configurations, a web page can further comprise buttons regarding piping connections, for which a user can select amongst same end, opposite end or either end.

[00273] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Selection, in which an output web page for this calculation module for which the tube side liquid is water (e.g., **FIG. 42**) can comprise input data regarding Liquid Conditions, Air Conditions and Coil Specifications. For Liquid Conditions, data input fields can be included for entering liquid temperature (ELT), leaving liquid temperature (LLT), liquid temperature rise (ΔT), flow rate (GPM), and/or maximum fluid head loss (ΔH). For Air Conditions, data input fields can be included for entering dry bulb temperature (EDB), entering wet bulb temperature (EWB), leaving dry bulb temperature (LDB), leaving wet bulb temperature (LWB), leaving dew point temperature (LDP), total heat transfer (BTUH), and/or maximum air pressure loss (PDA). For Coil Specifications, data input fields can be included for air flow rate actual (ACFM), maximum face velocity (FV), preliminary face area (FA), coil height (H), coil width (W), maximum fins per inch (FPI max), minimum fin spacing (FS min), and/or fin type.

[00274] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Selection, in which an output web page for this calculation module for which the tube side liquid is water (e.g., **FIG. 43**) can display information regarding Input Requirements and/or Coil Selection. For Input Requirements, the web page can display information such as entering liquid temperature (ELT), liquid temperature rise (ΔT), maximum fluid head loss (ΔH), entering dry bulb temperature (EDB), entering wet bulb temperature (EWB), leaving dry bulb temperature (LDB), maximum air pressure loss (PDA), air flow rate actual (ACFM), maximum face velocity (FV), coil height (H), maximum fins per inch (FPI max), minimum fin spacing (FS min), and/or fin type. For Coil Selection, the web page can display information such as coil height (H), tubes high (TH), coil width (W), air flow rate standard (SCFM), face area (FA), face velocity (FV), rows, fins per inch (FPI), circuiting, liquid volume of coil, leaving dry bulb (LDB), leaving wet bulb (LWB), leaving dew point (LDP), liquid head loss (LPD), liquid flow rate (GPM), leaving liquid temperature (LLT), liquid velocity (LV), air pressure drop (APD), total heat (TH), sensible heat (SH) and/or sensible heat ratio (SHR).

[00275] In some configurations, a system of the present teachings can comprise a calculation module for Heating and Cooling Coil Selection including choice of Fluid. A web page for this calculation module (e.g., **FIG. 44**) can include data entry fields for equipment identifier, units, elevation, and barometric pressure (in psia and in Hg), and can further include buttons regarding type of coil (cooling/dehumidifying or heating). In some configurations, if 'cooling/dehumidifying' is selected for type of coil, a web page can further comprise buttons for fluid (either liquid or refrigerant). If 'refrigerant' is selected for fluid, a data entry field can appear for suction temperature. In addition, a web page of these configurations can also comprise buttons regarding choices of piping connections, including same end, opposite end, or either end.

[00276] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Selection, in which an output web page for this calculation module for which the tube side liquid is refrigerant (e.g., **FIG. 45**) can comprise input data regarding Air Conditions and Coil Specifications. For Air Conditions, data input fields can be included for entering dry bulb temperature (EDB), entering wet bulb temperature (EWB), leaving dry bulb temperature (LDB), leaving wet bulb temperature (LWB), leaving dew point temperature (LDP), total heat transfer (BTUH), and/or maximum air pressure loss (PDA). For Coil Specifications, data input fields can be included for air flow rate actual (ACFM), maximum face velocity (FV), preliminary face area (FA), coil height (H), coil width (W), maximum fins per inch (FPI max), minimum fin spacing (FS min), and/or fin type.

[00277] In some configurations, a system of the present teachings can comprise a calculation module regarding Cooling/dehumidifying Coil Selection, in which an output web page for this calculation module for which the tube side liquid is refrigerant (e.g., **FIG. 46**) can display information regarding Input Requirements and/or Coil Selection. For Input Requirements, the web page can display information such as entering dry bulb temperature (EDB), entering wet bulb temperature (EWB), leaving dry bulb temperature (LDB), maximum air pressure loss (PDA), air flow rate actual (ACFM), maximum face velocity (FV), coil height (H), maximum fins per inch (FPI max), minimum fin spacing (FS min), and/or fin type. For Coil Selection, the web page can display information such as coil height (H), tubes high (TH), coil width (W), air flow rate standard (SCFM), face area (FA), face velocity (FV), rows, fins per inch (FPI), leaving dry bulb (LDB), leaving wet bulb (LWB), leaving dew point (LDP), air pressure drop (APD), total heat (TH),sensible heat (SH) and/or sensible heat ratio (SHR).

[00278] In some configurations, a system of the present teachings can comprise a calculation module for Heating and Cooling Coil Selection including choice of Fluid. A web page for this calculation module (e.g., **FIG. 47**) can include data entry fields for equipment identifier, units, elevation, and barometric pressure (in psia and in Hg), and can further include buttons regarding type of coil (cooling/dehumidifying or heating). In some configurations, if 'heating' is selected for type of coil, a web page can further comprise buttons for fluid (either liquid or steam). If 'liquid' is selected for fluid, data entry fields can appear for type of liquid (e.g., water), percent glycol, and freezing temperature. In addition, a web page of these configurations can also comprise buttons regarding choices of piping connections, including same end, opposite end, or either end.

[00279] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Selection, in which an output web page for this calculation module for which the tube side liquid is water (e.g., **FIG. 48**) can comprise input data regarding Liquid Conditions, Air Conditions and Coil Specifications. For Liquid Conditions, data input fields can be included for entering liquid temperature (ELT), leaving liquid temperature (LLT), liquid temperature rise (ΔT), flow rate (GPM), and/or maximum fluid head loss (ΔH). For Air Conditions, data input fields can be included for entering air temperature (EAT), leaving air temperature (LAT), total heat transfer (BTUH), and/or maximum air pressure loss (PDA). For Coil Specifications, data input fields can be included for air flow rate actual (ACFM), maximum face velocity (FV), preliminary face area (FA), coil height (H), coil width (W), maximum fins per inch (FPI max), minimum fin spacing (FS min), and/or fin type.

[00280] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Selection, in which an output web page for this calculation module for which the tube side liquid is water (e.g., **FIG. 49**) can display information regarding Input Requirements and/or Coil Selection. For Input Requirements, the web page can display information such as entering liquid temperature (ELT), leaving liquid temperature (LLT), maximum fluid head loss (ΔH), entering air temperature (EAT), leaving air temperature (LAT), maximum air pressure loss (PDA), air flow rate actual (ACFM), maximum face velocity (FV), coil height (H), maximum fins per inch (FPI max), minimum fin spacing (FS min), and fin type. For Coil Selection, the web page can display information such as coil height (H), tubes high (TH), coil width (W), air flow rate standard (SCFM), face area (FA), face velocity (FV), rows, fins per inch (FPI), circuiting, leaving air temperature (LAT), liquid head loss (LPD), liquid flow rate (GPM), leaving liquid temperature (LLT), liquid velocity (LV), air pressure drop (APD), total heat (TH), and/or liquid volume of coil.

[00281] In some configurations, a system of the present teachings can comprise a calculation module for Heating and Cooling Coil Selection including choice of Fluid. A web page for this calculation module (e.g., **FIG. 50**) can include data entry fields for equipment identifier, units, elevation, and barometric pressure (in psia and in Hg), and can further include buttons regarding type of coil (cooling/dehumidifying or heating). In some configurations, if ‘heating’ is selected for type of coil, a web page can further comprise buttons for fluid (either liquid or steam). If ‘steam’ is selected for fluid, data entry fields can appear for saturated steam temperature, saturated steam pressure in psig, and/or saturated steam pressure in psia. In addition, a web page of these configurations can also comprise buttons regarding choices of piping connections, including same end, opposite end, or either end.

[00282] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Selection, in which an intput web page for this calculation module for which the tube side liquid is steam (e.g., **FIG. 51**) can comprise data input fields regarding Air Conditions and Coil Specifications. For Air Conditions, data input fields can be included for entering air temperature (EAT), leaving air temperature (LAT), total heat transfer (BTUH), and/or maximum air pressure loss (PDA). For Coil Specifications, data input fields can be included for air flow rate actual (ACFM), maximum face velocity (FV), preliminary face area (FA), coil height (H), coil width (W), maximum fins per inch (FPI max), minimum fin spacing (FS min), and/or fin type.

[00283] In some configurations, a system of the present teachings can comprise a calculation module regarding Heating Coil Selection, in which an output web page for this calculation module for which the tube side liquid is refrigerant (e.g., **FIG. 52**) can display information regarding Input Requirements and/or Coil Selection. For Input Requirements, the web page can display information such as entering air temperature (EAT), leaving air temperature (LAT), maximum air pressure loss (PDA), air flow rate actual (ACFM), maximum face velocity (FV), coil height (H), maximum fins per inch (FPI max), minimum fin spacing (FS min), and/or fin type. For Coil Selection, the web page can display information such as coil height (H), tubes high (TH), coil width (W), air flow rate standard (SCFM), face area (FA), face velocity (FV), rows, fins per inch (FPI), leaving air temperature (LAT), air pressure drop (APD), and total heat (TH).

[00284] In some configurations, a system of the present teachings can comprise a calculation module regarding Expansion Tank Sizing. A web page for this calculation module (e.g., **FIG. 53**) can comprise data input fields for equipment identifier, units, fluid type, percent, freezing temperature. A web page of these configurations can further comprise buttons for selection of type of tank, including, e.g., diaphragm or bladder, closed, or open, and buttons for selection of piping material, such as copper or steel. A web page can further comprise buttons for selection of approximate calculation based on building size, chilled or hot/chilled system, heating water system, and/or precise calculation based on system water volume. Furthermore, a web page of these configurations can also include data entry fields for enter building area and/or system water volume, temperature at lower temperature, temperature at higher temperature, pressure at lower temperature, and pressure at higher temperature.

[00285] In some configurations, a system of the present teachings can comprise a calculation module regarding Expansion Tank Sizing. A web page for this calculation module (e.g., **FIG. 54** or **FIG. 55**) can be an output web page which can comprise selections and data entered into an input web page such as a page presented in **FIG. 53**, and/or calculated values, including, for example, type of tank (diaphragm (bladder), closed, or open); fluid type; percent; freezing temperature; selections such as of approximate calculation based on building site, chilled or hot/chilled system, and heating water system; building area, estimated water volume; piping material, temperature at lower temperature, temperature at higher temperature, pressure at lower temperature, and pressure at higher temperature. A web page of these configurations can also comprise a data input field for actual total size (Volume) of tank or tanks.

[00286] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include a web page comprising a Menu of Processes (e.g., **FIG. 56**), with radio buttons for a user to choose from Expansion (Power) Process, Fuel Heat Required to Generate Steam, Control Valve Sizing, Steam Orifice Size/Capacity and/or Differences Between Two State Points.

[00287] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Expansion (Power) Process (e.g., **FIG. 57**, which displays a selection of a button for an isentropic expansion, or **FIG. 59**, which displays a selection of a button a nonisentropic expansion). These web pages can include data entry fields for equipment identifier and units. A web page of these configurations can further comprise buttons and data entry fields regarding initial (throttle) conditions and outlet conditions. Initial (throttle) conditions can include buttons for selection of 'superheated' or 'saturated' conditions. If 'saturated' conditions is selected, data entry fields can include fields for pressure, temperature, and/or quality.

[00288] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include output pages which can display selections, data entries and calculations regarding Expansion Process (e.g., **FIG. 58**, which displays output from a selection of an isentropic expansion, or **FIG. 60,** which displays output from a selection of **a** non-isentropic expansion), including button selections and data entered into data input field in an input web page such as exemplified in **FIG. 57** or **FIG. 59**. These output web pages can display information such as Pressure (e.g., 500 psia), Quality (e.g., 100%), condensing temperature (e.g., 100°F), steam rate, which can be reported in units such as lb/kW-hr or lb/hp-hr, and steam properties. In some configurations, steam properties can be reported in a table. A table of these configurations can have header categories such as Property, Symbol, Units, Initial and Final. Examples of steam properties which can be included in a table can be properties such as condition, pressure, temperature, quality, density, specific volume, enthalpy, entropy, specific heat constant volume, specific heat constant pressure, internal energy, sonic velocity, thermal conductivity, viscosity, and/or Prandtl Number.

[00289] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Expansion (Power) Process (e.g., **FIG. 59**). These web pages can include data entry fields for equipment identifier and units. A web page of these configurations can further comprise buttons and data entry fields regarding initial (throttle) conditions and outlet conditions. Initial (throttle) conditions can include buttons for selection of ‘superheated’ or ‘saturated’ conditions. If ‘saturated’ conditions is selected, data entry fields can include fields for pressure, temperature, and/or quality. In addition, outlet conditions can include buttons for selection of ‘isentropic expansion’ or ‘nonisentropic expansion,’ and data input fields for efficiency.

[00290] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Fuel Heat Required to Generate Steam (e.g., **FIG. 61**). An input web page of these configurations can include data input fields for equipment identifier and units, and can also comprise data input fields for feedwater conditions, such as pressure and temperature; and input fields for steam conditions, including, for each of saturated and superheated conditions, data input fields for pressure and temperature. An input web page of these configurations can also include a data input field for combined efficiency.

[00291] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include output web pages which can provide inputted data and selections, and calculations regarding Fuel Heat Required to Generate Steam (e.g., **FIG. 62**). An output web page of these configurations can include, for example, feedwater conditions, such as pressure and temperature; steam conditions, such as, for example, pressure for saturated steam conditions; combined efficiency; and fuel heat required, which can be reported in standard units such as BTU/lb steam.

[00292] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Control or Regulator Valve Sizing (Cv) (e.g., **FIG. 63**). An input web page of these configurations can include data input fields for equipment identifier and units, and can also comprise data input fields for inlet conditions, such as for pressure and temperature for saturated inlet conditions, and pressure and temperature for superheated inlet conditions. An input web page of these configurations can also comprise a data input field for Outlet pressure.

[00293] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include output web pages which can provide inputted data and selections, and calculations regarding Control or Regulator Valve Sizing (Cv) (e.g., **FIG. 64**). Output web pages of these configurations can display information such as inlet conditions including selection of saturated or superheated, as well as pressure (e.g., 500 psia), and outlet pressure. In some configurations, an output web page can include steam properties, which can be reported in a table. A table of these configurations can have header categories such as Property, Symbol, Units, Inlet and Outlet. Examples of steam properties which can be included in a table can be properties such as condition, pressure, temperature, quality, density, specific volume, enthalpy, entropy, specific heat constant volume, specific heat constant pressure, internal energy, sonic velocity, thermal conductivity, viscosity, and/or Prandtl Number.

[00294] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Steam Orifice Size/Capacity (e.g., **FIG. 65** or **FIG. 67**). An input web page of these configurations can include data input fields for equipment identifier and units, and can also comprise data input fields for inlet conditions, such as for pressure and temperature for saturated inlet conditions, and pressure and temperature for superheated inlet conditions. An input web page of these configurations can also comprise a data input field for Outlet pressure, and data input fields for steam flow rate (for example, 100 lb/hr as illustrated in **FIG. 65**) and orifice diameter (for example, 0.100 in. as illustrated in **FIG. 67**).

[00295] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include output web pages which can provide inputted data and selections, and calculations regarding Steam Orifice Size/Capacity (e.g., **FIG. 66** and **FIG. 68**). Output web pages of these configurations can display information such as inlet conditions including selection of saturated or superheated, as well as pressure (e.g., 500 psia), and outlet conditions, such as outlet pressure and steam flow rate. An output web page can also include a calculated orifice diameter (e.g., as shown in **FIG. 66**) or a flow characteristic such as a calculated steam flow rate (e.g., as shown in **FIG. 68**) In some configurations, an output web page can include steam properties, which can be reported in a table. A table of these configurations can have header categories such as Property, Symbol, Units, Inlet and Outlet. Examples of steam properties which can be included in a table can be properties such as condition, pressure, temperature, quality, density, specific volume, enthalpy, entropy, specific heat constant volume, specific heat constant pressure, internal energy, sonic velocity, thermal conductivity, viscosity, and/or Prandtl Number.

[00296] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Differences between two state points (e.g., **FIG. 69**). An input web page of these configurations can include data input fields for equipment identifier and units, and can also comprise data input fields each of state point 1 and state point 2, including, for example, saturated conditions for pressure and quality, and temperature and quality, for each of state point 1 and state point 2. Furthermore, a button can provide selection for either state point 1 or state point 2 of superheated or supercritical vapor or subcooled liquid, and data input fields can further include fields for pressure and temperature regarding the selection.

[00297] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include output web pages which can comprise information regarding Differences between two state points (e.g., **FIG. 70**). An output web page of these configurations can include inputted information for equipment identifier and units, and can also comprise information for each of state point 1 and state point 2, including, for example, saturated conditions for pressure and quality for state point 1, and pressure and temperature for state point 2. In these configurations, steam properties can be reported in a table. A table of these configurations can have header categories such as Property, Symbol, Units, State Point 1 Properties, State Point 2 Properties, and Difference. Examples of steam properties which can be included in a table can be properties such as condition, pressure, temperature, quality, density, specific volume, enthalpy, entropy, specific heat constant volume, specific heat constant pressure, internal energy, sonic velocity, thermal conductivity, viscosity, and/or Prandtl Number.

[00298] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Saturated conditions (e.g., **FIG. 71**, **FIG. 72**, **FIG. 74**, **FIG. 76**, **FIG. 78**, **FIG. 80**, **FIG. 82**, and **FIG. 84**). A web page of these configurations can include buttons for selection of saturation pressure, saturation temperature, pressure, and temperature, and data input fields for saturation pressure, saturation temperature, pressure, pressure quality, temperature, and temperature quality. Furthermore, a web page can include a button for selection of superheated or supercritical vapor or subcooled liquid, as well as additional data input fields for pressure and temperature. In non-limiting examples, an input web page of these configurations can include a saturation pressure of 500 psia (e.g., **FIG. 72**), a saturation temperature of 500°F (e.g., **FIG. 74**), a pressure of 500 psia and a quality of 50% (e.g., **FIG. 76**), a temperature of 500°F and a quality of 50% (e.g., **FIG. 78**), or in a selection of superheated or supercritical vapor or subcooled liquid, a pressure of 500 psia and a temperature of 400°F (e.g., **FIG. 80**), a pressure of 500 psia and a temperature of 500°F (e.g., **FIG. 82**), or a pressure of 500 psia and a temperature of 900°F (e.g., **FIG. 84**).

[00299] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include output web pages which can provide inputted data and calculations regarding Saturated conditions (e.g., **FIG. 73**, **FIG. 75**, **FIG. 77**, **FIG. 79**, **FIG. 81**, **FIG. 83**, and **FIG. 85**). An output web page of these configurations can include, for example, inputted data such as exemplary data entered into fields in **FIG. 72**, **FIG. 74**, **FIG. 76**, **FIG. 78**, **FIG. 80**, **FIG. 82**, or **FIG. 84**, as well as properties of saturated liquid and saturated vapor. These properties can be provided in a table. A table of these configurations can have header categories such as Property, Symbol, Units, Liquid (f), Vapor(g) and Difference (fg). Examples of properties which can be included in a table can be properties such as pressure, temperature, quality, density, specific volume, enthalpy, entropy, specific heat constant volume, specific heat constant pressure, internal energy, sonic velocity, thermal conductivity, viscosity, and/or Prandtl Number.

[00300] In some configurations, a system of the present teachings can comprise a calculation module for Steam Processes which can include input web pages which can comprise data entry fields regarding Hydronic Pipe Sizing (e.g., **FIG. 86** or **FIG. 87**). An input web page of these configurations can include data input fields for equipment identifier and units, and can also comprise data input fields for pipe strength, fluid, percent concentration freezing temperature, mean fluid temperature, design head loss, maximum velocity, minimum pipe size and flow rate. An input web page of these configurations can also include buttons for pipe material (steel, copper, or PVC/CPVC). **FIG. 87** includes exemplary input data, including a mean fluid temperature of 60°F, a design head loss of 4 ft/100 ft, a maximum velocity of 8 ft/sec, a minimum pipe size of 0; and a flow rate (gpm) of 0.1, as well as a selection of steel as pipe material, standard pipe strength, and water as fluid.

[00301] In some configurations, a system of the present teachings can comprise a calculation module for Hydronic Pipe Sizing which can include output web pages which can provide inputted data and selections, as well as calculated Hydronic Pipe Sizing information. For example, **FIG. 88** reports a mean fluid temperature of 60°F, a design head loss of 4 ft/100 ft, a maximum velocity of 8 ft/sec, a minimum pipe size of 0; and a flow rate (gpm) of 0.1, as set forth in **FIG. 87**, it also reports a pipe size of 1/8 inch; a head loss of 1.35 ft/100 ft, a pressure drop of 0.58 psi/100 ft, and a velocity of 0.56.

[00302] **FIG. 89 - FIG. 97** each provide further examples of output web pages regarding hydronic pipe sizing, and further illustrate that the system allows a user to submit serially different input values and observe the output that results from the different input on a single web page. For example, **FIG. 97** includes 8 different flow rates inputted by a user, and the effects of changing the value of this variable on calculated values for pipe size, head loss, pressure drop and velocity.

EXAMPLES

[00303] The following examples are intended to illustrate various aspects and configurations of the present teachings and are not intended to be limiting of the scope any claim.

[00304] Guidance pertaining to materials and methods described in these examples can be found in standard texts such as ASHRAE publications on HVAC engineering (e.g., ASHRAE Handbook of Fundamentals 1972, ASIN: B000QA0RR0; ASHRAE Handbook of Fundamentals 2005 I-P Edition w/ CD; ISBN: 81050; ASHRAE HVAC Systems & Equipment Handbook 2004, IP Edition, ISBN:1-931862-47-8; ASHRAE HVAC Applications Handbook 2007 (IP), ISBN:1933742143; and Wirtz, R., ASHRAE Terminology of HVAC & R, ISBN-10: 1930044224, ISBN-13: 978-1930044227; ESCO Press, 2006, each of which is herein incorporated by reference in its entirety)

[00305] Example 1

[00306] This example illustrates the Psychrometric Properties calculation module and its use.

[00307] An ASHRAE Handbook of Fundamentals discloses an equation for the saturation vapor pressure for water as a function of temperature. Also provided are other equations with which, given a dry bulb temperature and a wet bulb temperature, it is possible to calculate humidity ratio, enthalpy, relative humidity, specific volume and density for moist air at a specific barometric pressure. Dew point temperature can be obtained by inverting the saturation pressure as a function of temperature equation to give saturation temperature as a function of vapor pressure. Because the saturation vapor pressure equation given is a polynomial with up to quartic terms, along with a reciprocal term and a natural logarithmic term, inversion becomes an iterative procedure, requiring care in execution to ensure convergence.

[00308] Similarly, finding all other properties given any two suitably independent properties usually requires an iterative approach. Specifically, properties of interest are dry bulb temperature, wet bulb temperature, dew point temperature, humidity ratio, relative humidity, enthalpy, specific volume (and its reciprocal, density) and vapor pressure. Wet bulb temperature and enthalpy are closely related and do not serve as two appropriate independent properties. Similarly, dew point temperature and humidity ratio are interdependent. Other than these, any two of the above properties can be used to calculate all the others.

[00309] Unfortunately, the appropriate ranges of the above properties are not always apparent. For instance, once a dry bulb temperature is selected, the wet bulb temperature cannot be greater than the dry bulb temperature, but also it cannot be lower than that which gives a zero humidity ratio. As an example, for a dry bulb temperature of 95 °F, the wet bulb temperature may not exceed 95°F, but it also may not be below 54.9 °F at 14.696 psia atmospheric pressure.

[00310] The Psychrometric Properties module calculates limits on the second variable, given the first, and notifies the user when he asks for properties when the second variable is out-of-range. Temperature limits of 200 °F and -80 °F are used.

Psychrometric Properties is a "look-up" program and, as such, it is not automatically filed. It may be accessed (like all other programs) via a Project File, or directly from the Main Entry Screen. The calculation will not be filed unless you enter a Calculation Identifier. If you do provide a Calculation Identifier, it will be filed (either in the appropriate Project File, or as a "Miscellaneous" calculation).

[00311] The only units available at this time are inch-pounds (IP).

[00312] The elevation shown is the default value from your "Member Preferences" screen. If you desire a different elevation, simply remove the default value from the elevation (or either of the pressure entry fields), and replace it with the value desired. (The next click of the mouse or "tab" key will change the other two entry fields).

[00313] To determine the properties at any state point (at the elevation shown), simply define the state point by entering any two properties in the entry fields. After entering two properties, click on "Calculate", and the remaining properties will appear on the output screen. The boxes in the lower right corner of the screen will indicate whether or not the state point is within the "Comfort Zone" (as defined in ASHRAE Standard 55 – 2004).

[00314] To view the properties in a printable format, click on "Printable I/O Summary", and the information from the screen will appear in a printable format (for paper filing or saving locally).

[00315] An exemplary Psychrometric Properties Input/Output summary is provided in FIG. 98.

Example 2

[00316] This Example illustrates the Psychrometric Processes calculation module and methods of use.

[00317] The Psychrometric Processes module uses the Psychrometric Property module previously described to provide properties needed for calculating processes. Processes specifically available in the Psychrometric Processes module are:

Mixing of Two Streams
Cooling with Dehumidification
Cooling or Heating without Dehumidification/Humidification (Sensible)
Isothermal Humidification
Evaporative Cooling

[00318] In addition, Differences Between Two State Points are available.

[00319] The Mixing of Two Streams process is the only one in which two separate input streams are used; all other processes have only one stream. In the Mixing process, a total resultant (combined) flow is specified in ACFM along with the flow of one of the component streams, either in percent by mass or by ACFM; the flow of the remaining input stream is calculated by the program. The output gives the properties of the composite stream. Since the process is adiabatic, there is no net heating or cooling associated with this process.

[00320] Cooling with Dehumidification calculates the net sensible, latent and total cooling associated with the change of state of the specified input flow from inlet to outlet conditions. The outlet ACFM is also calculated.

[00321] Sensible Cooling or Heating calculates the net sensible cooling or heating associated with the change of state of the specified input flow from inlet to outlet conditions. The outlet ACFM is also calculated.

[00322] Isothermal Humidification calculates the net latent heating associated with the change of state of the specified input flow from input to outlet conditions. The outlet ACFM is also calculated.

[00323] Evaporative Cooling calculates the final state associated with an adiabatic saturation process for a specified flow at given input conditions. The final state is determined by the adiabatic effectiveness of the evaporative cooling device. The outlet ACFM is also calculated.

[00324] The Difference Between Two State Points calculates the net change in all properties between input and output states.

[00325] Each of the above processes may be calculated as a stand-alone process; however, it is also possible to chain any or all of the above processes (except Difference Between Two State Points) in any order. By specifying the successive process after the completion of a prior one, outputs from the first become inputs to the second. A running total of sensible and latent cooling and heating energy is kept, along with the outlet states of all processes.

[00326] The Psychrometric Processes programs may be accessed via Miscellaneous Calculations, or a project file, or from the Main Entry Screen. Any program accessed through the Main Entry Screen will be filed as a “Miscellaneous” calculation.

[00327] A unique feature of five of these programs is that the analyst may use the outlet state point of one process as the inlet of another – in the same sequence that the air would move through a system from process to process. This procedure of moving through multiple “connected” processes is called “chaining” or “linking”. The following descriptions are of each individual process as a standalone, followed by a description of the chaining process.

[00328] The initial screen of Psychrometric Processes is a menu of the processes available. (If a particular process is selected via the Main Entry Screen, this screen will be bypassed). From this menu screen, the user will select a radio button to identify the process desired. Clicking on Proceed will bring up the screen for the desired process. As with all module screens, the other available footers will return you to the “Main Entry Screen” (or “Miscellaneous Calculations” / “Project Information” screen, as appropriate)…through which you entered Psychrometric Processes.

[00329] The Mixing Process

[00330] All Psychrometric Process calculations are filed:

1) Under the project through which they were accessed, or;
2) As a miscellaneous calculation.

[00331] Each calculation should be given a unique Equipment Identifier (a name and/or number…no punctuation or symbols). The program will not run without an identifier. The IP unit designation is the only one available at this time.

[00332] The elevation shown is the default value from your "Member Preferences" screen. If you desire a different elevation, simply remove the default value from the elevation (or either of the pressure entry fields), and replace it with the value desired. (The next click of the mouse or "tab" key will change the other two entry fields).

[00333] In the initial input field insert the volumetric air flow rate in actual cubic feet per minute (acfm). (Note: no commas when entering acfm…or when entering any numeric input).

[00334] The mixing ratio may be expressed in two ways (selected by the radio buttons at the left of the box on the screen:

1) As each stream's percentage of the whole (expressed as % by mass) or;

2) By actual volumetric flow rate of one stream in acfm.

[00335] Select the desired radio button then enter the appropriate value in the entry field.

[00336] Note: When selecting the mass ratio method, only one value is necessary and the other value will be the complement for the total of 100%. Likewise, when selecting volumetric flow rate, only one value need be entered, since the total flow after the mixing has already been entered; the program will calculate the second stream flow rate.

[00337] After entering the mix quantities, any two properties of each stream are entered. After entering these two properties for each stream click on Calculate , to see the output screen, showing all of the properties (plus those of the mixed stream).

[00338] The output stream may be input directly into a subsequent process, discussed below under “Chaining.”

[00339] The footer options are as follows:

Proceed is used only for linked processes (see below).

[00340] Printable I/O Summary will display an I/O Summary, which may be printed as a paper record, or saved locally.

[00341] If Recalculate is selected prior to Printable I/O Summary , it will return you to the previous input screen (with the same Equipment Identifier and elevations), and the results of the calculation will not be filed; only the new/recalculated calculation will be filed. If this ’new’ calculation is not completed, the permanent file will state, “no processes have been run yet.”

[00342] If Recalculate is selected after having clicked on Printable I/O Summary , it will return you to the Psychrometric Processes menu screen and the process just completed will be permanently and appropriately filed.

[00343] To Psychrometric Processes Menu , To Miscellaneous Calculations ,

To Project Information , and To Main Entry Screen footers will return you to each of these screens respectively and permanently file the calculation.

[00344] Cooling and Dehumidifying Process

[00345] Again, as in all other processes, the calculation should be given a unique Equipment Identifier. The (editable) elevation and barometric pressure fields will fill in with the default values from the Member Preferences screen.

[00346] Enter the air flow rate (in acfm) entering the process (no commas), and any two properties for the entering stream and the leaving steam. Then click Calculate.

[00347] The output screen displays the input properties in bold; the remainder of the properties for each statepoint; the absolute difference between each property of the entering statepoint; and the leaving state point (where relevant)…and the sensible, latent, and total heat removed in the process.

[00348] The footer options are as follows:

[00349] Proceed is used for chaining linked processes.

[00350] Printable I/O Summary will complete the calculation and display an "I/O Summary" which may be printed (or saved locally).

[00351] If Recalculate is selected prior to Printable I/O Summary , it will return you to the previous input screen (with the same Equipment Identifier and elevations), and the results of the calculation will not be filed; only the new/recalculated calculation will be filed.

[00352] If Recalculate is selected after having clicked on Printable I/O Summary , it will return you to the Psychrometric Processes menu screen and the process just completed will be permanently and appropriately filed.

[00353] To Psychrometric Processes Menu , To Miscellaneous Calculations , To Project Information , and To Main Entry Screen footers will return you to each of these screens respectively and permanently file the calculation.

[00354] Sensible Heating or Cooling Process

[00355] The Sensible Heating or Cooling Process, like other Psychrometric processes, requires a Equipment Identifier (for filing purposes). The elevation/barometric pressure default values may be modified. The initial actual airflow rate in acfm should be entered in numerals only (no commas – but decimal points are acceptable).

[00356] To define a process, enter any two properties at the initial statepoint. As the process is sensible only, the only property that may be used to define the final statepoint is the dry bulb temperature: so in the second column, simply enter the dry bulb temperature at the final state point, then click Calculate.

[00357] The output screen displays all of the properties at the initial state; the final state; the absolute difference between them (where relevant)…and the amount of sensible heating or cooling transferred in the process.

[00358] The footer options are as follows:

[00359] Proceed is used for chaining linked processes.

[00360] Printable I/O Summary will complete the calculation and display an "I/O Summary" which may be printed (or saved locally).

[00361] If Recalculate is selected prior to Printable I/O Summary , it will return you to the previous input screen (with the same Equipment Identifier and elevations), and the results of the calculation will not be filed; only the new/recalculated calculation will be filed.

[00362] If Recalculate is selected after having clicked on Printable I/O Summary , it will return you to the Psychrometric Processes menu screen and the process just completed will be permanently and appropriately filed.

[00363] To Psychrometric Processes Menu , To Miscellaneous Calculations , To Project Information , and To Main Entry Screen footers will return you to each of these screens respectively and permanently file the calculation.

[00364] Isothermal Humidification Process

[00365] After entering a Equipment Identifier and selecting the appropriate elevation, enter the initial air flow rate in actual cubic feet per minute (acfm)…in numerals only, no commas. Enter any two properties to define the initial statepoint. Since this is an isothermal process, the final dry bulb temperature will be equal to the initial. Any other final property will define the desired final statepoint.

[00366] The next step is to click Calculate. If you click To Miscellaneous Calculations , To Project Information , or To Main Entry Screen , an error signal will appear and ask if you want to abandon the calculation. If you confirm that you do, the data entered on the screen will not be filed.

[00367] To complete the calculation, click Calculate. The output screen will provide all of the properties, as well as the acfm at both the initial and final statepoints; the absolute difference between the properties (where appropriate); and the amount of latent heat added in BTU per hour.

[00368] The footer options are as follows:

[00369] Proceed is used for chaining linked processes.

[00370] Printable I/O Summary will complete the calculation and display an "I/O Summary" which may be printed (or saved locally).

[00371] If Recalculate is selected prior to Printable I/O Summary , it will return you to the previous input screen (with the same Equipment Identifier and elevations), and the results of the calculation will not be filed; only the new/recalculated calculation will be filed.

[00372] If Recalculate is selected after having clicked on Printable I/O Summary , it will return you to the Psychrometric Processes menu screen and the process just completed will be permanently and appropriately filed.

[00373] To Psychrometric Processes Menu , To Miscellaneous Calculations , To Project Information , and To Main Entry Screen footers will return you to each of these screens respectively and finalize / permanently file the calculation.

[00374] Evaporative Cooling Process

[00375] After entering a Equipment Identifier and selecting the appropriate elevation, enter the initial air flow rate in actual cubic feet per minute (acfm) in numerals only (no commas).

[00376] The entry field for the adiabatic effectiveness will display the default value at 100%. This required value may be edited. The adiabatic effectiveness is primarily a function of the evaporative device used to accomplish this process.

[00377] Next enter any two properties of the initial air stream entering the process and click Calculate. The output screen will provide all of the properties (as well as the acfm at both the initial and the final statepoints and the absolute difference between the properties, where appropriate).

[00378] The footer options are as follows:

[00379] Proceed is used for chaining linked processes.

[00380] Printable I/O Summary will complete the calculation and display an "I/O Summary" which may be printed (or saved locally).

[00381] If Recalculate is selected prior to Printable I/O Summary , it will return you to the previous input screen (with the same Equipment Identifier and elevations), and the results of the calculation will not be filed; only the new/recalculated calculation will be filed.

[00382] If Recalculate is selected after having clicked on Printable I/O Summary , it will return you to the Psychrometric Processes menu screen and the process just completed will be permanently and appropriately filed.

[00383] To Psychrometric Processes Menu , To Miscellaneous Calculations , To Project Information , and To Main Entry Screen footers will return you to each of these screens respectively and finalize / permanently file the calculation.

[00384] Differences Between Two State Points

[00385] This program is different from the other programs in the Psychrometric Processes in two ways. First, it is not a process but merely a quick reference to the difference between any relevant properties at the statepoints of interest. Secondly, it is handled as a look-up program and may be used without a Calculation Identifier. As with other "look-up" programs (i.e., Psychrometric Properties & Steam Properties), if no Calculation Identifier is entered, the program will run but will not be filed.

[00386] Enter a Calculation Identifier only if you wish the calculation to be filed. Change the elevation if you desire a value different than the default value. Then, simply enter any two properties for each of the statepoints desired.

[00387] Click Calculate , and the remainder of the properties at each statepoint will be displayed (as well as the absolute value of the difference between the two values of each of the properties).

[00388] When the calculation is completed footer options are:

[00389] The Printable I/O Summary will provide a summary to print for a paper reference.

[00390] To Psychrometric Processes Menu , To Miscellaneous Calculations , To Project Information , and To Main Entry Screen footers will return you to each of these screens respectively and finalize / permanently file the calculation.

[00391] Chaining Psychrometric Processes

[00392] The procedure for chaining psychrometric processes allows the analyst to study multiple processes that an air stream might realize in an air conditioning situation. A common series of processes may comprise:

- A Mixing Process between an outdoor air (ventilation air stream) and a return air stream. Then, the mixed air would enter…

- A Cooling And Dehumidifying Process as it passes through a chilled water or refrigerant cooling coil. Then, the cooled, dehumidified stream might enter…

- A reheat process (Sensible Heating and Cooling Process), where it would be reheated prior to being introduced into the space.

[00393] In applying this chaining procedure, the first process selected is the Mixing Process. Use of this program is as described above. The Mixing Process output screen includes the acfm; all of the characteristics of each of the two streams prior to the mixing; and all of the characteristics of the mixed stream.

[00394] On the output screen (immediately below the output characteristics) is the text "Chain output into the following process", followed by a pull down. Click on the pull down arrow to see all other psychrometric processes available for chaining. For the above example, select Cooling and Dehumidifying Process & click Proceed.

[00395] This will provide the input screen for that "chained in to" process, which will include the following (hard-wired) inputs:

- Equipment Identifier

- Units

- Elevation (and barometric pressure)

- Initial air flow rate in acfm

- All of the initial state point properties.

[00396] Enter two of the properties to describe the final state (that of the air leaving the Cooling and Dehumidifying Process) and click Calculate.

[00397] The output screen provides all of the properties at the Final Statepoint (and the absolute difference between the initial and final states; the initial and final volumetric air flow rates in acfm and the sensible, latent and total cooling requirement in BTU per hour).

[00398] To continue the chain (for the given example), select the next process (Sensible Heating or Cooling), and click Proceed. This will bring up the input screen for that process (which will include the same (hard-wired) inputs seen on the first "linked" screen, plus the output values from the Cooling and Dehumidifying Process). For the Sensible Heating and Cooling Process, the only input information required (when linking) is the final state point dry bulb temperature. After entering that value, click Calculate. The output screen will appear with the characteristics of the initial state point; the final state; the absolute difference between all relevant characteristics; the final state volumetric flow rate (in acfm); and the amount of heating required for the reheat (in BTU/hour).

[00399] IMPORTANT: We have just completed the last process of this chain (though we could have continued chaining processes). When chaining, the I/O summary may be viewed (by selecting Printable I/O Summary) before any chained calculation is finalized...in order to review your progress. A Psychrometric Processes calculation is terminated / finalized by clicking any of the other footer navigation bars (except, of course, "Recalculate"). Once finalized, the I/O summary may be viewed by selecting the Equipment Identifier in the Psychrometric Processes Calculation List (via the Miscellaneous Calculations or Project Information screens).

[00400] Once finalized, the chain may only be continued by starting over (perhaps with the aid of the I/O Summary), or by commencing a new series.

[00401] NOTE: In chaining, the computer keeps track of the cooling and heating requirements, and the Summary will include the Sensible, Latent and Total Heating Requirements and Cooling Requirements.

[00402] In addition to the Printable I/O Summary & Recalculate the other footer options are:

[00403] To Psychrometric Processes Menu , To Miscellaneous Calculations , To Project Information , and To Main Entry Screen …each will return you to these screens respectively and finalize / permanently file the calculation.

[00404] An exemplary Psychrometric Processes Input/Output summary is provided in FIG. 99.

[00405] Example 3

[00406] This Example illustrates the Steam Properties calculation module and methods of use.

[00407] The kernel of the Steam Properties module allows input of an appropriate two properties from the set of temperature, pressure, quality, enthalpy and entropy. State points may be in the subcooled, saturated, superheated or supercritical regions.

[00408] **Steam Properties** is a “look-up” program (similar to **Psychrometric Properties)** and as such, is only filed if a **Calculation Identifier** is provided. It may be accessed, per other programs, through a project file or from the **Main Entry Screen**. If you do provide a **Calculation Identifier**, an I-O summary will be saved either in the appropriate project file, or in **Miscellaneous Calculations**.

[00409] The only units available (at this time) are inch pounds (IP). All pressure terms are, in accordance with accepted steam table practice, expressed in pounds per square inch absolute (psia). No barometric pressure or elevation term is required.

[00410] The first set of entry fields is for **Saturated Steam**. The entry fields labeled **Saturated** provide for four input options. Option one, line one, has an entry field for **Saturation Pressure** in psia. Option two, line two, is for **saturation temperature** in °F.

[00411] To use either of these options, click on the appropriate radio button…and then enter either the desired Pressure or Temperature. Then click the “Calculate” button. An answer screen will appear with the project and member identifiers, and the saturation condition entered… plus a listing of the properties **Saturated Liquid** ($_f$), **Saturated Vapor** ($_g$) and the **Difference** ($_{fg}$) (for specific volume, enthalpy, entropy and internal energy).

[00412] Properties shown for both the saturated liquid and saturated vapor include:

Properties	Symbol	Units
Pressure	P	psia
Temperature	t	°F
Density	ρ	lb/Ft^3

Specific Volume	ν	Ft^3/lb
Enthalpy	h	Btu/lb
Entropy	s	Btu/lb °F
Specific Heat at Constant Volume	c_v	Btu/lb °F
Specific Heat at Constant Pressure	c_p	Btu/lb °F
Internal Energy	u	Btu/lb
Sonic Velocity	a	Ft/sec
Thermal Conductivity	k	Btu/HrFt °F
Viscosity	μ	lbm/ft.sec.
Prandtl Number	Pr	dimensionless

[00413] To view the properties in a printable format click the "Printable I/O Summary" button. This will provide a printable screen which contains the same information as the HTML output screen. Other footers include "New Steam Properties Calculation" (which will return you to the initial **Steam Properties** input screen, where you can look up another statepoint), "To Miscellaneous Calculations" **or** "To Project Information" (depending upon where you entered **Steam Properties** from), and the "To Main Entry Screen" button.

[00414] The third and fourth entry options under **Saturated** are for selecting a specific statepoint within the saturation dome. The third line requires **Saturated Pressure** in psia and quality in % (lbs. Steam/lb. Mixture x 100). Select the appropriate radio button, enter the appropriate property and quality, and click the "Calculate" button.

[00415] An answer screen will appear with the identifying headers, the property and quality which had been entered, and a list of the properties for the specific point within the saturation region. **Note**: Since this is a mix of saturated liquid and saturated vapor, only those properties which can be expressed as a mixture are presented. These include:

Property	Symbol	Units
Pressure	p	psia
Temperature	t	°F
Quality	x	% vapor
Density	ρ	lb/Ft^3
Specific Volume	ν	Ft^3/lb
Enthalpy	h	Btu/lb
Entropy	s	Btu/lb °F
Internal Energy	u	Btu/lb

[00416] The footers / navigation options are the same as those for the saturated liquid/vapor options above.

[00417] The other input option is for any steam condition other than saturated. This is identified on the input screen as **Superheated or Supercritical Vapor or Subcooled Liquid.** To select a statepoint for any of these conditions, select the radio button, then simply fill in the pressure and the temperature of the statepoint and click the “Calculate” button.

[00418] An answer screen will appear with identifying headers, and the pressure and temperature entered. At the top of the section with the values of the properties at that statepoint will be the “condition”…either **Subcooled Liquid, Superheated Vapor** or **Supercritical Vapor**. This screen displays these other properties at the selected statepoint:

Property	Symbol	Units

Pressure	P	psia
Temperature	t	°F
Density	ρ	lb/Ft^3
Specific Volume	ν	Ft^3/lb
Enthalpy	h	Btu/lb
Entropy	s	Btu/lb °F
Specific Heat at Constant Volume	c_v	Btu/lb °F
Specific Heat at Constant Pressure	c_p	Btu/lb °F
Internal Energy	u	Btu/lb
Sonic Velocity	a	Ft/sec
Thermal Conductivity	k	Btu/HrFt °F
Viscosity	ν	lbm/ft.sec.
Prandtl Number	Pr	dimensionless

[00419] The footers / navigation are the same as other output screens for Steam Properties.

[00420] An exemplary Steam Properties Input/Output summary is provided in FIG. 100.

Example 4

[00421] This Example illustrates the Hydronic Pipe Sizing calculation module and its use.

[00422] Typical pipe flow algorithms calculate pressure drop or head loss as a function of pipe specifications (material, internal diameter, roughness), fluid properties and flow velocity, using the Darcy-Weisbach equation: $\frac{\Delta p}{L} = \frac{f}{D}\rho\frac{V^2}{2}$. The friction factor is usually given by the Colebrook equation: $\frac{1}{\sqrt{f}} = 1.74 - 2\log\left(\frac{2\varepsilon}{D} + \frac{18.7}{Re\sqrt{f}}\right)$, an expression which expresses the friction factor as a function of relative roughness and Reynolds number; the expression is nonlinear and implicit in the friction factor (the friction factor appears on both the left and right sides of the equation). An iterative solution is used.

[00423] The Hydronic Pipe Sizing module has a kernel which will accept as input any two of head loss or pressure drop, volume flow, flow velocity and pipe internal diameter. Within the module, fluid properties are calculated for water at a specified mean temperature or for aqueous solutions of ethylene glycol or propylene glycol at a specified mean temperature and concentration from 0 to 60%.

[00424] When calculating hydronic pipe size, the user specifies a piping material (steel, copper or plastic), a strength grade (which specifies pipe wall thickness), design head loss (ft/100 ft), maximum flow velocity (ft/sec) and minimum pipe size and the desired volume flow; the module returns a pipe size selection within all criteria. Repeated volume flows may be input, and a pipe size is selected for each.

[00425] The Hydronic Pipe Sizing program may be accessed through the project files or the **Main Entry Screen.** If accessed directly through the **Main Entry Screen**, calculations will be filed under **Miscellaneous Calculations** (otherwise they will be filed under **Project Information**). It is necessary to provide an **Equipment Identifier**. The **Equipment Identifier** is helpful for future reference…especially if it relates to the physical location of the particular section of piping (concerning either the geometry of the building or the flow diagram; for example: “Chiller to AHU-1” or “Mains-AHU-1 to AHU-8” and so forth). Regarding **Units**, the only units available at this time are Inch Pounds (IP).

[00426] This program is not a network analysis or pump head calculation program. It is designed to assist the system designer in sizing the pipe only (in the least amount of time and with the most accurate information needed to conduct further system design activities).

[00427] The first block of input data required includes the **Pipe Material**, **Pipe Strength** (or wall thickness description) and the type of **Fluid.**

[00428] The **Pipe Material** is selected (by radio button) from three options: **Steel**; **Copper;** and **PVC** or **CPVC.** Selection of the **Pipe Material** prior to the **Pipe Strength** is necessary (as it will change the options available in the **Pipe Strength** draw-down field). If **Steel** pipe is selected, the strength options are **Standard**, **Extra Strong** and **Double Extra Strong (**as defined by the ASME Standard B31.9). For **Copper** pipe the strength options are **Type K, Type L** and **Type M** (as defined by ASME Standard B88). If **PVC** or **CPVC** are selected, the options are Schedule 40 and Schedule 80 (as defined by the Plastic Pipe Industry Standards).

[00429] The third section of this block is for **Fluid** type. The default fluid is **Water** (with N/A in the **Percent Concentration** field, and 32°F in the **Freezing Temperature** field). **Fluid** type has draw down selections of ethylene glycol and propylene glycol. When either of the glycol options are selected, the entry field for **Percent Concentration** will read 0%... and for the **Freezing Temperature** will read 32°F (both of these are editable and will fill in the proper value in the other; i.e., select the **Percent Concentration** and the **Freezing Temperature** will be indicated, or select the **Freezing Temperature** and **Percent Concentration** by weight will be indicated).

[00430] The next block includes four design options. The first field is for **Mean Fluid Temperature** (this is usually simply the sum of the design supply fluid temperature and the design return temperature divided by 2). The second field is for **Design Head Loss** (expressed in feet of fluid per 100 feet of pipe – a value of the designer's choice). The third field is for **Maximum Velocity** of the fluid in the pipe. If the **Maximum Velocity** is exceeded before the design head loss is reached, the maximum velocity will determine the pipe size. The last field is for **Minimum Pipe Size**. A draw-down field selects a minimum pipe size. Usually designers select a minimum pipe size for either structural purposes or to prevent fouling or blockage of very small pipes.

[00431] <u>**NOTE:**</u> For design conditions of the head loss, maximum velocity, and minimum pipe size refer to the appropriate chapter(s) in the ASHRAE Handbooks.

[00432] The next set of entry fields has one field beneath **Flow Rate, gpm.** Starting either at the source end of a piping branch (largest number) or a load end (smallest number) enter the flow rate for the first section of pipe and click **Add Entry.** The screen will be replaced by an answer screen which will include data for the **Flow Rate, gpm; Pipe Size, inches; Head Loss, ft/100 ft.; Pressure Drop, psi/100 ft**. and **Velocity, ft/sec**. Beneath that line another entry field for **Flow Rate, gpm** will be available. Fill in the flow rate in the next section of pipe, and after the flow rate in the initial section has entered (and the size, losses and velocity calculated), each subsequent section can be calculated by clicking **Add Entry**.

[00433] After entering the flow rates for each section (of this branch of the piping) and calculating the sizes, losses and velocities click the "Finalize Calculation" button. This will terminate this series of pipe size selections and provide the following footers:

[00434] The Printable I/O Summary" button which, of course provides a summary of all of the input and output information just calculated. (This can be printed for filing and/or for study and reference. A permanent copy of this printable I/O is automatically stored in either the project file or in the Miscellaneous Calculations, as appropriate). The "New Calculation" button will return you to a blank **Hydronic Pipe Sizing** input screen. The "To Project Information" button **<u>or</u>** the "To Miscellaneous Calculations" button…depending on where you entered the **Hydronic Pipe Sizing** program.

[00435] An exemplary Hydronic Pipe Sizing Input/Output summary is provided in FIG. 101.

[00436] Example 5

[00437] This Example illustrates the Heating and Cooling Loads calculation module and its use.

[00438] The Heating and Cooling Loads module is a general purpose loads program which considers solar loads, both on transparent surfaces and opaque surfaces, transmission through windows, walls, roofs, floors, etc., ventilation and infiltration loads, both sensible and latent, internal loads such as lights, appliances, people, etc., and partition and slab loads. A 24 hour occupancy schedule is used, either for a single cooling design month or for the 12 months of a year.

[00439] Solar loads calculations use ASHRAE equations for sun angles as a function of month and hour of the day. Shading from external projections (horizontal overhangs and vertical fins) is treated by two-dimensional calculations. Transmission loads are calculated using wall response factors subjected to hourly variations in exterior temperature (outside air temperature for conduction loads, sol-air temperature excess for solar loads through opaque surfaces). Within spaces, room loads comprise immediate loads (convection) and delayed (radiation); room response factors calculate instantaneous cooling loads as a function of instantaneous heat gains within the space.

[00440] Wall response factors express instantaneous heat gains through the surface as a function of an infinite series of past temperature differences across the wall. For 24 hour load calculations, each 24 hour period is regarded the same as every other 24 hour period, allowing the inside surface heat gain to be expressed as a function of only 24 past temperature differences. Mathematically, $|\mathbf{q}_t| = |\mathbf{Y}_{t,j}||\mathbf{T}_{o,j} - \mathbf{T}_i|$, where $|\mathbf{q}_t|$ is a 24 element vector (24 hourly instantaneous heat gains), $|\mathbf{Y}_{t,j}|$ is a 24 x 24 square matrix of the transfer function and $|\mathbf{T}_{o,j} - \mathbf{T}_i|$ is a 24 element vector of 24 hourly outside-to-inside temperature differences.

[00441] Separating the immediate (convection) component from the delayed (radiation) can be expressed in a similar manner; i.e., $|\mathbf{Q}_t| = |\mathbf{r}_{t,j}||\mathbf{q}_j|$, where $|\mathbf{Q}_t|$ is the instantaneous cooling load, $|\mathbf{r}_{t,j}|$ is a transfer function for room response and $|\mathbf{q}_j|$ is the instantaneous heat gain. If the room response is reasonably uniform from one space to another, the two matrix equations may be combined: $|\mathbf{Q}_t| = |\mathbf{r}_{t,j}||\mathbf{Y}_{t,j}||\mathbf{T}_{o,j} - \mathbf{T}_i|$ or $|\mathbf{Q}_t| = |\mathbf{R}_{t,j}||\mathbf{T}_{o,j} - \mathbf{T}_j|$ where the 24 x 24 matrix $|\mathbf{R}_{t,j}|$ is the product $|\mathbf{r}_{t,j}||\mathbf{Y}_{t,j}|$. Thus for each surface, the 24 hourly cooling loads are found as the product of the transfer matrix with the 24 hourly outside-to-inside temperature differences.

Solar and transmission loads through opaque surfaces are calculated separately: the transmission component is driven by the temperature difference between the outside air temperature and the room temperature. The solar loads are driven by the sol-air temperature excess, that is the difference between the sol-air temperature and the outside air temperature.

[00442] In the 1972 Handbook of Fundamentals, ASHRAE published tables of transfer functions for exterior walls, roofs and interior walls, partitions, floors and ceilings. These were presented for an equation of the form:

$\mathbf{q}_{e,\tau} = \mathbf{A}\left[\sum_{n=0}^{6}\mathbf{b}_n\left(\mathbf{t}_{n,\tau-n\Delta}\right)-\sum_{n=1}^{6}\mathbf{d}_n\left(\frac{\mathbf{q}_{e,\tau-n\Delta}}{\mathbf{A}}\right)-\mathbf{t}_{rc}\sum_{n=0}^{6}\mathbf{c}_n\right]$ where $\mathbf{q}_{e,\tau}$ is the heat gain to the room at the inner wall, $\mathbf{A}$ is the surface area, $\mathbf{t}_{e,\tau-n\Delta}$ is the exterior surface temperature of the wall, $\boldsymbol{\tau}$ is the time variable (usually hours), $\boldsymbol{\Delta}$ is the time interval (usually one hour), $\mathbf{n}$ is the summation index and $\mathbf{t}_{rc}$ is the constant room temperature. Constants $\mathbf{b}_n$, $\mathbf{c}_n$ and $\mathbf{d}_n$ are tabulated in Chapter 22 of the 1972 ASHRAE Handbook of Fundamentals. There is a different set of constants for each of 96 wall constructions, 36 roof constructions and 47 interior walls. Rearranging terms in the above equation: $\left|\frac{\mathbf{q}_e}{\mathbf{A}}\right|\left|\mathbf{d}\right| = \left|\mathbf{b}\right|\left|\mathbf{t}_e - \mathbf{t}_r\right|$, where $\left|\frac{\mathbf{q}_e}{\mathbf{A}}\right|$ is a 24 element vector of inside surface heat gains, $\left|\mathbf{t}_e - \mathbf{t}_r\right|$ is a 24 element vector of 24 outside-to-inside temperature differences and $\left|\mathbf{b}\right|$ and $\left|\mathbf{d}\right|$ are 24 x 24 matrices of $\mathbf{b}$ and $\mathbf{d}$ coefficients. Multiplying both sides of the equation by the inverse of the $\mathbf{d}$ matrix: $\left|\mathbf{d}\right|^{-1}\left|\frac{\mathbf{q}_e}{\mathbf{A}}\right|\left|\mathbf{d}\right| = \left|\mathbf{d}\right|^{-1}\left|\mathbf{b}\right|\left|\mathbf{t}_e - \mathbf{t}_r\right|$ and recognizing that multiplying a matrix by its inverse gives the identity matrix, the equation becomes $\left|\frac{\mathbf{q}_e}{\mathbf{A}}\right| = \left|\mathbf{d}\right|^{-1}\left|\mathbf{b}\right|\left|\mathbf{t}_e - \mathbf{t}_r\right|$. The $\left|\mathbf{d}\right|^{-1}\left|\mathbf{b}\right|$ product is the same as the $\left|\mathbf{r}_{tj}\right|$ two paragraphs back. Thus the tabulated b and d coefficients can be converted to wall response factor form and the wall response matrix can be pre-calculated after the appropriate wall is selected in the table. Further, as shown above, the room response factor can also be multiplied in, reducing calculating the 24 hour load profile from any wall to a matrix multiplication. The air-to-room temperature difference is calculated using a two-term sine wave fit of the outside air temperature (maximum = design air temperature, minimum = design air temperature minus daily temperature range). Extremes of the air temperatures are assumed to occur at 0600 hours (minimum) and 1500 hours (maximum).

[00443] To simplify the entering of information about the b and d factors, three typical walls have been selected from the table: #26, frame wall (light construction), #44, 8 inch concrete block (medium construction) and #33, 12 inch concrete wall (heavy construction) and the appropriate sets of b and d factors are written into the executable program. The user selects No Lag, Light, Medium or Heavy for the thermal mass characteristic of the wall being considered. The U factor for each wall implied by the b and d factors can be calculated as: $\mathbf{U} = \sum_{n=0}^{6}\mathbf{b}_n / \sum_{n=1}^{6}\mathbf{d}_n$. If the user desires a U value other than that for which the b and d pertain, the b factors may be scaled by the ratio $\mathbf{U_{new} / U_{old}}$. Roofs are treated in a similar manner.

[00444] Cooling load calculations are performed for 17 components of load and stored in three 2 x 17 x 24 x 12 matrices (cooling/heating, component, 24 hours per day, 12 months per year), with one matrix for the individual space being considered, one for a zone subtotal and one for a building total. Thus there is no practical limit to the number of zones or spaces being calculated. As each space is calculated, several subtotals of loads are calculated, and the time and value of the estimated space sensible peak are determined and displayed. The components are also added into zone and building totals. When a new space is in a new zone, the old zone totals are printed. After no more individual spaces are encountered, the last zone totals and the building totals are printed.

[00445] The Load Calculation program was designed and developed as a diagnostic and design load analysis program by a leading mechanical/electrical consulting engineering company (to provide precise load information taking into account the dynamics of transient heat transfer). The program utilizes the transfer function/ response factor method originally published by ASHRAE. Some of the useful features of this program are:

[00446] 1. An abbreviated quick-input building block load or single space load is available for preliminary calculations or diagnostics on a single space.

[00447] 2. In a multiple space calculation, such as a room-by-room calculation for a building, the printout shows the instantaneous design load for each zone and for the entire building (as well as the sum of the peaks). Which of these should be used to size the zone air-handling units (or other elements of the machinery) is the designer's choice (depending upon the system design).

[00448] 3. The space loads are calculated, reported, and integrated into the overall calculation separately from the ventilation loads, so that the designer can handle them separately in developing the system design.

[00449] 4. Because of changing solar dynamics and their effects on the cooling loads, the designer or analyst has the option of calculating the load for a single design day, or for a design cooling day for each of the twelve months (utilizing the current published ASHRAE weather data).

[00450] How to input the load data efficiently

Assembling the Input Data

[00451] The first step in performing a load calculation is to download a set of the input forms. Before proceeding, it is recommended that you go to the initial screen of the **Heating and Cooling Load** program, the **Loads Menu**, and click the "View/Print Input Forms" link.

[00452] A printable version of "Input Forms 1 through 6" will be displayed in Adobe PDF format.

[00453] These forms are numbered sequentially. They are to be used in the same sequence as the input screens. If the forms are used as described below, the task of performing a load calculation should require a minimum of time.

[00454] We recommend that you do not start inputting the data for a load calculation (on your computer screen) until you have filled in all of the relevant printed input forms. A brief description of each form and how it is used follows:

1. Initiating Load Calculation

[00455] The Project Title and Project Number should be the same as those in the project file. When you access the load calculation program through the **Project Information** screen (in turn accessed via the **Project File Contents** screen) the Project Title and Project Number, along with the date and the analyst (member) will be displayed.

[00456] The "Description" should be similar to that on the **Project Information** screen, except it generally includes a statement regarding the purpose of the specific calculation.

[00457] The Weight/Room Construction is quite important in the calculation, but is totally judgmental. Refer to the information in the ASHRAE Handbook of Fundamentals or the ASHRAE Publication *Fundamentals of Heating, Ventilating, and Air Conditioning* to assist with this judgment (if you are not familiar with this aspect).

2. Design Conditions

[00458] The form requires the indoor and outdoor design conditions.

[00459] For the **Indoor Conditions**, if the space is not going to be designed for winter humidification, place a Zero (0) in the space for "Space Relative Humidity for Heating." In the Cooling Outdoor Conditions "For Ventilation Only," use the "Dehumidification DP/MCDB" values from the 2005 ASHRAE Handbook of Fundamentals. This is used to calculate the ventilation load for cooling in warm climates.

[00460] The "**For Space Load Only**" selection allows you to select a single design day for a "Design Cooling Month" (as is usually done) or to select "For 12 Month Calculation" (in which case you assign a cooling design day for each month which will calculate the design load for each space considering both outdoor temperature effects and solar effects). The data for each month can be found in the electronic version of the 2005 ASHRAE Handbook of Fundamentals.

3. Thermal Characteristics of Building Elements (3 pages)

[00461] These forms accommodate numerous construction options for the various opaque and transparent materials that form the building envelope, or separation from other thermal environments (partitions, floors, etc.). The thermal characteristics (such as U value (1/R), glass shading coefficients, interior shading coefficient, etc.) may be found in the ASHRAE Handbook of Fundamentals; the ASHRAE publication "Principles of HVAC"; manufacturer's literature; or, in the case of opaque wall sections, can be calculated using fundamental heat transfer principles. (Once this data is entered into the Load program, it becomes a "pull down" selection where needed).

4. Master Load Data

[00462] Except for the "Operating Hours," this data provides default values for all of the individual space load calculations. However, any such defaults values will be editable (on the HTML input screens) in the event that the master data does not apply to any particular space. Load calculations assume that neither lighting, nor ventilation nor occupants are present (or "on") during a building's unoccupied cycle. The program also assumes that the buildings are pressurized with positive ventilation systems during occupied cycles, and that infiltration will only occur during non-occupied cycles. If this is not applicable to your building (and there is no positive controlled ventilation), the infiltration quantity should be entered in the "ventilation" box (but when utilizing the output values, the ventilation must be manually added to the space load).

[00463] The radiation components of all heat gains are time delayed. In addition to the normal delays between the time that solar and transmission gains become cooling loads, the Load program assumes that the internal heat sources commence at the "start occupied" time, and cease at the "stop occupied" time. Care should be taken to assure that the "Start Occupied" time and the "Stop Occupied" time do not coincide. For 24-hours per day operation, select the word "continuous" in the first column.

5. Zones and Spaces

[00464] At this point, the analyst or designer works with the building drawings, with all spaces either named or numbered. The first step is to list the zones and in some way describe them. For purposes of this load calculation, a zone is defined as all of the spaces served from a single air-handling unit. For example, if a single air-handling unit conditions a floor of a multi-story building, that floor would be considered a zone (even though there might be multiple exposures independently controlled).

[00465] The "Zones and Spaces" must be developed sequentially. This is so because when it comes to entering the spaces individually into the program, a space cannot be entered unless it is assigned to a zone that is already entered. So, on this page, list all of the zones that are planned for the building (describing them simply and understandably).

[00466] This "Zones and Spaces" page and the following page, "Zones and Spaces – Space Designations", may be printed or photocopied for as many zones and spaces as are necessary for the building.

[00467] The "Zones and Spaces – Space Designations" page is where the real "take-off" phase of the load calculation begins. It is the most time consuming task in calculating the load. It is suggested that it be done in two steps. Step 1 is "getting organized." This is accomplished by sitting at a comfortable "flat space" with the building plans and the load calculation input forms (available via the "View/Print Input Forms" link on the **Loads Menu screen)**. The next step (following the Zone Designations) is to go through the plans, listing each room or space on the appropriate form for the zone in which it will be assigned. Once each and every space in the building has been so assigned, you are ready to use the individual space input form.

6. Individual Space Input

[00468] The "Individual Space Input" form is two pages. A pair of these forms will be required for **each** room or space within the building. It is suggested that, with the "Space Designations" form in front of you, starting with the first zone, you fill out the "Individual Space Input" forms in the sequence in which they are listed on the "Zones and Spaces" form. Items that are shaded will be filled in as default items as you transfer the data to the computer screens. However, if there are more exacting values available, fill those in if more correct. (Example: if watts of lighting are more accurate by fixture count, the default value can be overridden to fill in this space on the input form). For wall designation, window designation, etc., you must use the same names as entered on Form 3 ("Thermal Characteristics of Building Elements"), since these will be pull downs as you enter them into the Load program, and are thus the only options available.

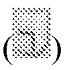
[00469] When an **Individual Space Input** form has been completed for each space, you are ready for the next step: Data Entry.

A. INPUTTING THE ASSEMBLED DATA

[00470] You are now ready to input the data from the input forms to the Load calculation program. There are several ways to access the Load program:

1. If it is a **new** load calculation for an **existing project** (that has already been set-up), (1) from the **Main Entry Screen** click on "Project File Contents"; (2) click in the "Project Title" desired and you will get the "Project Information" screen; (3) click on "Heating and Cooling Load Calculation" link and you will get the (Heating and Cooling Load Calculation) "Loads Menu" screen. On that screen, the input field labeled Calculation Identifier must be filled in. In this field you will typically state which load calculation this is (such as "preliminary," "block load", "room-by-room load," etc.).

   All other fields will be filled in by default but they may be changed. (Note: All of data for this screen is transferred directly from Form 1 "Initiating Load Calculation").

2. If it is a revision or "Update" to an earlier completed load calculation for an existing project, (1) from the **Main Entry Screen** click on "Project File Contents"; (2) click on the title of the project and you will get the "Project Information" screen; (3) click on the file cabinet icon () adjacent to the **"Heating and Cooling Load**

Calculation" link, and you will get a listing of all of the Load calculations for that project. You now have three options:

1. For a completed calculation, if you click on a Calculation Identifier (without an asterisk (*)), you will get a printable input/output summary of that calculation.
2. For a calculation has not been completed, the Calculation Identifier will have an asterisk (*). When you select a Calculation Identifier with an asterisk (*), you will be able to continue/edit (and complete) that calculation (from where you left off, via the HTML input screens).
3. If you click on Update, you will get the Loads Menu screen with links to each of the 7 input screens any of which may be revised or "updated." (Thereby allowing a revision or "clone" of an existing, completed calculation…. without the time-consuming reentry of data).

3. For a diagnostic analysis or a load calculation which is <u>not</u> identified with a project (i.e., a "Miscellaneous" calculation), you can access the Heating and Cooling Load Calculation program by clicking on the "Heating and Cooling Loads Calculation" link on either the **Main Entry Screen** menu or the **Miscellaneous Calculations** menu.
4. If it is a revision or "Update" of an earlier <u>completed</u> **miscellaneous** load calculation (or a continuation of a **miscellaneous** load calculation has <u>not been completed)</u>, steps are similar to those outlined above for a **project** calculation.

[00471] Once the input forms have been filled in and you've accessed the **Heating and Cooling Load Calculation – "Loads Menu"** screen, click on the **"Continue"** button/footer and enter the information sequentially from one screen to the next. The screens will lead you through the entry of data from the input forms to the screens. A few helpful hints:

Screen 1 **Initiating Load Calculations**

On a project that has been "set up" everything <u>except</u> the **Calculation Identifier,** the **Project Title,** and **Project Description** will be filled in by default. However, all default values are editable. <u>*The Calculation Identifier must be filled in before you can continue.*</u>

The remainder of the information on **Form 1 Initiating Load Calculation** is added. When the screen is completed, click on the button that says the "Continue to Design Conditions."

Screen 2 **Design Conditions**

This screen should be filled out directly from the information on the load input sheets.

Note: There are radio buttons to select between the "Design Cooling Month Only" and the "Twelve Month Calculation." Care must be taken when filling in all of the entry fields in the selected mode. (Note: The default selection is the design month only, and this must be moved to the "Twelve Month Cooling Calculation" option if that is your desire).
To continue click on:
The "Continue to Thermal Characteristics" button.

Screen 3 **Thermal Characteristics of Building Elements**

This screen shows one set of option blanks for each type of envelope closure (i.e., walls, roofs, etc.). Fill in the first type from the input form, and then click on the "Enter" button. Enter…this action will enter your choice and simultaneously provide another input line. You can enter as many types of, say, opaque walls as are needed. When complete there will be a blank line. Don't worry about this. Proceed to the next type of closure (such as, say, windows (fenestrations)).

Each Designation is a descriptive term of your choice; for example, exterior walls might be designated masonry, concrete, curtain wall, etc., for a typical wall construction used on this project.

Existing lines may be edited – make changes and click the "Update" button. Existing lines may also be deleted with the "Delete" button.

Enter information from the load forms for opaque walls, fenestrations, roofs, exterior doors, floors exposed to outside and exterior shading types. Floors over unconditioned spaces and partitions are fully specified on Form 6, Individual Space Input. If you do not have one of the closure types shown, just leave that line blank and proceed to the next type you do have.

After filling in each relevant line, click on the "Continue to Master Load Data" button.

Continue to Master Load Data.

Screen 4 **Master Load Data**

Enter the data from the input forms. The "Start Occupied Operation" and "Stop Occupied Operation" should not coincide. Note: For the "Operating Hours"…"Continuous" is the default value. If "Continuous" is selected, the load will calculate on a continuous schedule basis.

When screen 4 inputs are complete, click on
the Continue to Zone and Spaces Input Data button.

Screen 5 **Zones and Spaces**

Fill in the Zones from input Form 5. The spaces are not filled in on this screen. They will fill in automatically as you proceed to the **Individual Space Input** screen

Important*:* After typing in each "New Zone Designation", click on the "Enter" button and an entry field for another zone will appear. When you have no more zones to enter, leave the last entry field blank, and proceed by clicking the "To Individual Space Input" button.

If you are "**Updating**" (i.e., cloning) a completed calculation, and you want to add a space to a zone, go to this "Zones and Spaces" screen. It will list all of the zones and spaces previously entered. On the line that lists the zones, to the right are the words/ link "Add Space(s)" – click on this link and an "**Individual Space Input"** screen will appear with the zone filled in (in editable format). Then proceed as follows:

Screen 6 **Individual Space Input**

Some of the data will be already filled in on this screen. These are default values provided from earlier screens. However, all default values are editable (i.e., may be deleted and replaced), if this provides more appropriate data.

In the appropriate entry fields fill in the information from the input forms. The first four sections (above the "Update Space" footer) relate to the internal and ventilation loads. When the entry fields have all been filled in, click on the "Continue to Exposures for this Space" button
and the remainder of the screen will appear (please scroll down the screen). The remainder relates to transmission and solar load…that are a function of the thermal characteristics of the building materials, and the orientation and geometry of the space (this information was entered on Screen 3, "Thermal Characteristics of Building Elements).

In organizing the transfer of this information from the input forms to the screen, you should have the **Individual Space Input** forms arranged in the same sequence as the spaces are listed in **Form 5** – **Zones and Spaces (Space Designations)**.

[00472] After inputting the first four sections (above the "Update Space" footer), the "take-off" dimensional and orientation data for each element of building or space closure is input. Initially there is one input line for each envelope or closure surface. As each line is completed it is necessary to click on the "Enter" button. When this is done the entered data will be fixed (though editable) and a new line will appear. When no new data for this type surface is required, skip the blank line and proceed to the next surface. The surfaces or elements on the screen are Walls, Roofs, Exposed Doors, Exposed Floors, Slab Floors, Floors over Unconditioned Spaces, Partitions and so on. For each of these, if **"None"** is selected from the **Designation** dropdown**,** continue to the next element. If any category is irrelevant, simply move on to the next relevant category.

[00473] Also note, that after any element is "entered" a "Delete" & an "Update"▯button will appear, enabling the correction of an error (or the ability to delete/ update for any other purpose).

[00474] When all data for that space has been input, go to the next space by clicking the footer "Create New Space(s)."

[00475] When you have completed inputting **all** of the information for the spaces, click on the footer To Zones and Spaces -. This will return you to Screen 5 (the "Zones and Spaces" screen), which will list all of the Zones and all of the Spaces for the building.

Before calculating (via the "Calculate" button), you may wish to click the Show Input Summary▯button to review all of the input data (which you may print or save).

After verifying that all of the input data, including the zones and spaces, are correct…click on the "Calculate" button , and the next screen will display a summary of the calculation by showing:

Space Cooling Load	Tons
Ventilation Cooling Load	Tons
Total Cooling Load	Tons
Total Heating Load	MBH

[00476] For a complete I/O printout of the load analysis, click on the "Printable I/O Summary" button. The Load input data and output data in room-by-room, zone-by-zone, and total building bases will be displayed (and may be printed or saved locally). The calculation I/O may be subsequently reviewed (& easily "updated") via the Project (or Miscellaneous) "Heating & Cooling Calculations: Calculation List."

[00477] Once a Load Calculation is completed, it is saved and cannot be modified; however, by choosing the "Update" option for the completed run in the Heating & Cooling Load "Calculation List", the completed run may be easily modified and rerun; it will be filed as a new Load calculation.

[00478] An exemplary Heating and Cooling Loads Input/Output Summary is provided in FIG. 102.

[00479] Example 6

[00480] This Example illustrates the Heating and Cooling Coil (Selection & Diagnostics) calculation module and its use.

[00481] Calculation algorithms for finned cooling and heating coils are published as ARI Standard 410, Standard for Forced Circulation Air-Cooling and Air-Heating Coils, from the Air-Conditioning and Refrigeration Institute, an industry trade association. As part of this standard, procedures are established for specifying construction of air coils and for testing of completed assemblies. Manufacturers within the industry seek ARI certification that their coils have been tested and rated in conformance with the standard before coils are marketed.

[00482] The programs use algorithms from Standard 410, and thus should give answers very similar to those from coil manufacturers' ARI 410 programs.

[00483] The performance of heating coils is considerably simpler to calculate than that of cooling coils: heating of moist air is always a *sensible* process, in which the temperature of the air changes but the moisture content does not. On the other hand, cooling coils are usually employed to cool and to dehumidify moist air, a combination of *sensible* and *latent* cooling. The algorithms for combined sensible and latent cooling are more involved than for sensible heating or cooling.

[00484] The simplest type of calculation for either heating or cooling is one in which the flows of both fluids (inside the tubes and flowing over the outside of the tubes) are specified (entering and leaving temperatures, flow rates) and certain physical aspects of the coil are specified (tube-to-tube spacing, face area, circuiting). The calculation algorithms will yield the necessary depth of coil (length in the air-flow direction). Most calculations will not give a whole number of rows; since it is not physically possible to provide partial rows, the number of rows is rounded up to the next available value. In practice, the user rarely has exit conditions and liquid flow. The coil programs allow the user to specify known or desired quantities (e.g., liquid temperature change or leaving air dew point temperature) as input and provide several alternatives for output.

[00485] The coil programs are classified as either *Selection* or *Diagnostic*; for *Selection*, an exhaustive search of available configurations is made and the apparent best choice is identified, along with a list of alternative selections. For *Diagnostic*, the performance of a specified configuration is calculated. *Selection* is appropriate when the user is seeking a coil to provide a specified amount of heating or cooling and/or dehumidifying, subject to constraints such as pressure drops and flow velocities. *Diagnostic* is appropriate when the user wishes to know the performance capabilities of a specific coil configuration with specified flows.

[00486] For either the *Selection* program or the *Diagnostic* program, coil performance can be calculated for tube-side liquids (water, ethylene glycol, propylene glycol, the latter two with specified concentration or freezing temperature) or phase-change fluids (refrigerants for cooling, steam for heating). On the air side, elevation or barometric pressure can be specified. All calculations are performed for a specified actual air flow (acfm), specified entering air dry bulb and wet bulb temperatures and maximum allowable air pressure drop through the coil. On the tube side, all calculations are performed for specified entering fluid temperature (or saturation temperature for phase-change fluids).

[00487] For the *Selection* program, the user may select same end, opposite end or either end connections for the tube-side liquids. With same end connections, only even numbers of rows will be calculated; with opposite end connections, odd rows will be used. Either end allows any number of rows to be calculated (but limited to the range 2 to 12 for cooling, 1 to 12 for heating). On the tube side, leaving liquid temperature or liquid temperature change or flow rate (gpm) is specified, along with a maximum allowable liquid head loss. Given air flow rate and entering dry bulb and wet bulb temperatures, the desired performance on the air side is specified in terms of leaving dry bulb temperature, leaving wet bulb temperature or leaving dew point temperature or in terms of total heat transfer (BTUH). An upper limit for fin density (fins/inch) is set, as well as a specification of fin configuration (flat, mildly enhanced or severely enhanced). Calculations are performed for three circuitings (half, full and double). The selected coil will have the smallest number of rows and still make capacity, subject to pressure drop and liquid velocity limitations.

[00488] For the *Diagnostic* program, end connections are not specified because the number of rows used is specified. Similarly, there is no stated limit on either liquid or air pressure losses because the flow rate is specified. The circuiting, height and width and fins per inch or fin spacing are also to be specified by the user. Performance is based on specified leaving dry bulb air temperature, leaving liquid temperature or liquid flow rate (gpm).

[00489] Output for both *Selection* and *Diagnostic* cooling/dehumidifying programs includes leaving air and liquid conditions, total and sensible heat transfer and sensible heat ratio (shr), liquid flow rate (gpm), liquid velocity (fps), coil height, coil width, coil rows, coil face area, coil face velocity and coil volume. For heating programs, total heat transfer is entirely sensible heat transfer and the sensible heat ratio will always be one.

[00490] Because constructional details can change performance, the user should obtain certified calculations from the chosen manufacturer for the coil selected. By setting minimum criteria for coil parameters, the user will have better control of the choice of coil ultimately used.

[00491] Example 7

[00492] This Example illustrates the Expansion Tank Sizing calculation module and its use.

[00493] The Expansion Tank Sizing program uses equations given in Chapter 12 of the 2004 ASHRAE Systems Handbook; separate equations are given for open tanks, closed tanks with an air/water interface and diaphragm tanks.

[00494] The user may select a working fluid of water or ethylene glycol or propylene glycol, the latter two with specified concentration or freezing temperature. The volume of the system is an important input to the calculation, but at the earliest stages of design, the user may not have an accurate calculation of the volume. As an alternative to creating a preliminary design for the piping system and estimating its volume, the program contains a function which estimates the volume of the piping system as a function of the conditioned building floor area and whether the system is heating only or heating/cooling. The program output shows the estimate of volume made by the program. Once the piping system has been designed, the expansion tank size may be recalculated on the basis of the improved estimate of system volume.

[00495] The user specifies the material of the system (i.e., steel or copper), extremes of temperature the system will see (start-up temperature and operating temperature), the initial fill pressure and the final allowable pressure at the operating temperature. The program then calculates the required size of expansion tank. Because the calculated size will rarely coincide with a manufactured size, the user may then recalculate the final operating pressure based on the size of a catalogued tank.

[00496] **Expansion Tank Sizing** can be accessed either through the **Project File Contents** or through the **Menu of Programs** (on the **Main Entry Screen).** The first block of information displays the **Company Name**, **Project Title**, **Project Number**, **Date** and **Member** (or Engineer's Name)…along with entry fields for the (required) **Equipment Identifier** and **Units**. (At the present time, only inch-pound or IP units are available).

[00497] Following two instructional blocks is a block for **Elevation** (with editable default values from your **Member Preferences** screen**)**. As with other blocks for **Elevation,** all three fields can be changed by erasing the value in any one of them and entering a new value. If you change one value, the other two will change to comply with that new value.

[00498] On the next block, select the **Type of Tank** (by use of the radio buttons). The tank type selections are: 1) a **Diaphragm or Bladder** tank; 2) a **Closed** (or pressurized) tank; and 3) an **Open** or vented tank. The block to the right of **Type of Tank** is for the **Fluid** to be used in the system. The default value in the **Fluid** draw down is water (with the fields for **Percent** showing "NA" and for **Freezing** Temperature showing 32°F). The draw-down selections for **Fluid** are: **Water; Ethylene Glycol;** and **Propylene Glycol.** If either of the glycols is selected, the **Percent** field changes to 0%, and the **Freezing Temperature** remains at 32°F.

[00499] You now have two options. You can fill in the percent by weight of the glycol in the mixture (and the next click of the mouse will show the **freezing**

temperature), or you can enter the **freezing temperature** (and the next click of the mouse will show the **Percent** (by weight) to achieve that level of freeze protection).

[00500] There are two options in selecting the tank, either an **Approximate Calculation (**based on building size) or **Precise Calculation** (based on system water volume). Either one is selected by use of the radio buttons. The **Approximate Calculation** is usually used in preliminary system design (to allow the analyst to proceed with the layout of equipment rooms, locate the tank in the building, etc.). However, after the piping has been sized and other equipment selected, a final **Precise Calculation** should be performed to assure the proper size tank.

[00501] If the **Approximate Calculation** is selected, the type of system must be selected (for either a **Chilled** or **Hot/Chilled System** or a **Heating Water System)**. The entry field titled **Enter Building Area** must be filled in (in this field use whole numbers with no commas & no decimal points). NOTE: A sub-routine actually calculates a statistical volume of water for the selected system type for a building that size. This is an estimate only, and prior to final design, a recalculation should be run with the actual system volume!

[00502] If **Precise Calculation (**based on system water volume**)** is selected, the entry field **Enter System Water Volume** must be filled in (using whole numbers, with no commas & no decimal points).

[00503] The box to the lower left is the selection of the piping material in the system, either **steel** or **copper**. If plastic pipe is used the copper selection is recommended and it will simply result in the selection of a tank a little larger than actually required (erring on the safe side).

[00504] The boxes to the lower right are for the limits of the operating pressures at the expansion tank, and the system temperatures. Just above these boxes are helpful hints regarding the normal practice for selecting the design temperature limits. The pressures depend upon many system features such as both static and dynamic system hydraulics, relative elevation of tank, pump vs. tank location, relief value settings, materials, pressure limitations, etc.

[00505] After filling in the fields for the pressure and temperature limits, click the “Calculate” button and the output screen will appear (showing the input information, and, beneath the temperature and pressure design limits, will be the calculated required **Tank Volume**. Since actual tanks cannot be purchased in all sizes, there is an additional box at the bottom of the screen titled **Enter Actual Total Size (Volume) of Tank or Tanks**, with an accompanying entry field. If multiple tanks are used, they should be piped together (in parallel) with a single point of connection into the piping system. In this entry field enter the total volume of all such parallel tanks. (Normally you would select a total available or standard Tank volume greater than the calculated volume). Click the "Calculate" button. The resulting output screen will show the size of the tank selected, and the resulting **Actual Pressure at** the **higher temperature.**

[00506] If you elect to design or analyze a system with an open tank, the same procedure is used for filling in the data on the input screen. However, the output screen will not include system pressure values since they relate only to the elevation of the water level in the tank above the point of reading of the pressure.

[00507] After calculating a tank size, the footers for navigating to your next task include the "New Expansion Tank Sizing Calculation" (which will present you with a fully filled in and fully editable input screen…the only blank entry field is the "Equipment Identifier" field which *must* be entered. All other fields may be revised as you consider the next calculation). Other footers include "Printable I/O Summary"; "To Project Information" **or** the "To Miscellaneous Calculations" button (depending upon where you entered the **Expansion Tank Sizing** program), and the "To Main Entry Screen" button.

[00508] An exemplary Expansion Tank Sizing Input/Output summary is provided in FIG. 103.

[00509] Example 8

[00510] This Example illustrates the Heating and Cooling Coil Diagnostics calculation module and methods of its use.

[00511] These programs can be accessed through the project files or the **Main Entry Screen**. If accessed through the **Main Entry Screen,** they will be filed under **Miscellaneous**. Prior to entering any information, an **Equipment Identifier** must be provided. The only **units** available at this time are Inch-Pounds (IP).

[00512] The programs analyze the performance of an existing coil (for any purpose, including enhancing energy economics, increasing capacity, improving environmental comfort or air quality, etc.). They can also be used in designing new systems after selecting a coil for certain design conditions (i.e., to analyze the anticipated performance of that coil under various part load conditions).

Analyzing a Chilled Water or Water/Glycol Cooling Coil

[00513] Under **Type of Coil** are two selections, **Cooling/Dehumidifying** and **Heating.** The radio button will be in the default position for **Cooling/Dehumidifying**. The next field is **Elevation**, with the (editable) default value you filled in on the **Member Information** screen. The barometric pressure fields reflect the standard **Barometric Pressure** at the elevation selected. The **Barometric Pressure** may be entered either in psia or inches of mercury (the other values will re-calculate to show the conditions at the selected value).

[00514] If a **Cooling/Dehumidifying** coil is selected, the next line will have radio buttons for either a **Liquid** fluid in the tubes or **Refrigerant**. For a water or water/glycol coil, select **Liquid**. The pull-down adjacent to **Water** can be used to change the **Water** to **Ethylene Glycol** or **Propylene Glycol**. If **Water** is selected, the entry fields will read NA and 32°F. If either **Glycol** is selected, those entry fields will change to 0% and 32°F (both editable). Replace the “0” with the percentage by weight of the glycol mix and the freezing temperature will appear. If you know the freezing temperature you want, enter that prior to the percentage of the glycol mix and the percentage of the glycol required will appear.

[00515] Proceed to the bottom of the screen and click the “Proceed” button. A new screen will appear (with the fluid shown in an uneditable format). This screen has fields for the physical features of the coil; the entering fluid conditions; and the performance to be analyzed.

[00516] The first section is **Physical Characteristics of the Coil.** The coil height and width are the measured finned height and width between the frames of the coil…with the height in increments of 3 inches and the width in increments of 2 inches. The field for “Rows” has a pull down for any number of rows, even or odd, from 2 through 12. The field for “Circuiting” has a pull down for half circuit **(Half);** Full circuit **(Full);** or Double circuit **(Double)**. The Fin Type field has pull down selections for **Flat** (flat or non-enhanced fins), **Enhanced/Mild (**for mild or slightly enhanced fins), and **Enhanced/Severe** (for severely enhanced fins).

[00517] For the fin spacing, there are two interdependent fields (with a pull down for either "fins per inch" or spacing of fins, center to center, in "inches". When either of these is entered, the corresponding value will calculate.

[00518] Under **Entering Conditions**, all four fields must be entered (with whole numerals (no commas), and up to two decimal places. The information required is: **Airflow Rate Actual** (in actual cubic feet per minute (ACFM)); **Entering Air Dry Bulb Temperature** (EDB) in degrees F; **Entering Air Wet Bulb Temperature** (EWB) in degrees F; and **Entering Liquid Temperature** (ELT) in degrees F.

[00519] The next section, Performance Conditions, provides for **one** of three selections. They are **Leaving Air Dry Bulb Temperature** (LDB) in degrees F, **Leaving Liquid Temperature** (LLT) in degrees F, and **Liquid Flow Rate** (GPM) in gallons per minutes. (Only one of these fields is to be filled in). If two entries are attempted an error signal will appear when you attempt the sizing calculation,

[00520] After all fields have been filled, click on the "Calculate" button. An answer screen will show all input data, plus the following air side and water side performance conditions:

Air Side

Air Flow rate in Standard Cubic Feet Per Minute (scfm)
Coil Face Area in Square Feet
Total Heat Transfer in BTU/Hr
Sensible Heat Transfer in BTU/Hr
Sensible Heat Ratio
Entering Face Velocity, Ft/min.
Leaving Dry Bulb Temperature, °F
Leaving Wet Bulb Temperature, °F
Leaving Dewpoint Temperature, °F
Air Pressure Drop (wet-coil), inches w.c.

Liquid Side

Liquid Flow Rate, gpm
Liquid Pressure Drop, feet of fluid
Liquid Volume of Coil, gallons
Leaving Liquid Temperature, °F
Liquid Temperature Rise, °F
Liquid Velocity, ft/second

[00521] The footers include "Printable I/O Summary," and "New Calculation" (which will return you to the first input screen)…"To Project Information" or the "To Miscellaneous Calculations" (depending upon where you initiated from), and the "To Main Entry Screen".

Analyzing a Refrigerant (Direct Expansion) Coil

[00522] After entering the **Equipment Identifier,** and selecting the **Cooling/Dehumidifying** option (and the **Elevation)**, select the radio button for **Refrigerant** (under the **Fluid** heading). A new screen (under **Refrigerant)** will appear…for entering **Saturated Suction Temperature** (i.e., the saturation temperature for the specific refrigerant corresponding to the pressure at which the coil will operate).

[00523] To initiate the analysis, enter the **Saturated Suction Temperature**, and click the "Proceed" button. A new screen will appear with the **Equipment Identifier**, the **Refrigerant Suction Temperature** and the **Elevation**, plus a series of data entry fields under **Physical Characteristics of Coil** and **Entering Conditions**.

[00524] Under **Physical Characteristics of Coil** are entry fields for the **Coil Height** and the **Coil Width**. These dimensions are measured by distance between the frames. The height is in increments of 3 inches, and the width is (usually) in increments of 2 inches. The four pull downs are for number of **Rows** (2 through 12), **Fin Type** (Flat, Enhanced (mild) and enhanced (severe))…and the coupled fields of **Fins per Inch** and **Fin Spacing**.

[00525] Under Entering Conditions three features of the entering air to be conditioned are required…the Air Flow Rate Actual (ACFM) in ft^3 per minute, the Entering Air Dry Bulb Temperature (EDB) and the Entering Air Wet Bulb Temperature (EWB).

[00526] The CFM must be entered in whole numbers with no commas. The air temperatures can be entered with (up to) two decimal places. When all fields have been filled in, click the "Calculate" button.

[00527] An answer screen will show all the input data, plus the following information on the air side coil performance capabilities:

Air Flow Rate in Standard CFM (scfm)
Coil Face Area, square feet
Total Heat Transfer, BTU/Hour
Sensible Heat Transfer, BTU/Hour
Sensible Heat Ratio
Entering Face Velocity, Ft. per minute
Leaving Dry Bulb Temperature, °F
Leaving Wet Bulb Temperature, °F
Leaving Dewpoint Temperature, °F
Air Pressure Drop (inches w.c.)

[00528] The footers include "Printable I/O Summary," and "New Calculation" (which will return you to the first input screen). Either the "To Project Information" or the "To Miscellaneous Calculations" button will appear (depending upon where you initiated from), as well as the "To Main Entry Screen" button.

Analyzing a Hot Water or Glycol Heating Coil

[00529] After filling in the **Equipment Identifier,** select the radio button for **Heating (**in the box titled **Type of Coil)**. This will change the word **Refrigerant** to **Steam** in the **Fluid** box. When analyzing a heating water or glycol mix coil, the radio button should be selected for that option (default position). If the desired coil is a water coil, it will already appear in the entry field (default) under the word **Liquid** (the **Percent Glycol** field should read NA and the **Freezing Temperature** field should read 32°F).

[00530] If a water/glycol mix is used, the entry field under the word **Liquid** has a pull-down which provides for either **Ethylene Glycol** or **Propylene Glycol**. The glycol percent by weight of the mixture may be selected by entering the concentration value in the **Percent Glycol** field. When this is done, the freezing temperature will appear in the **Freezing Temperature** field. Optionally, the freezing temperature desired can be typed in that field, and a mouse click will provide the required concentration percent by weight for that level of protection.

[00531] Proceed to the bottom of the screen and click the "Proceed" button. A new screen will appear with the identifiers and the fluid. This screen has fields for the physical features of the coil, the entering fluid conditions available, and the performance to be analyzed.

[00532] The first section is **Physical Characteristics of the Coil.** The coil height and width are the measured finned height and width between frames of the coil (in inches)…normally in full numbers (no fractions or decimals) with the height in increments of 3 inches, and the width in increments of 2 inches. The field for "Rows" has a pull down for any number of rows, even or odd, from 1 through 12. The field for "circuiting" also has a pull down for half circuit **(Half),** Full circuit **(Full)** or Double circuit **(Double)**. The Fin Type field has pull down for **Flat** (for flat or non-enhanced fins), **Enhanced (Mild)** (for mild or slightly enhanced fins), and **Enhanced (Severe)** (for severely enhanced fins). The next field is for the fin spacing with pull down selection expressed in either "fins per inch" or spacing of fins center to center in "inches". When either is filled in, the corresponding value will appear.

[00533] Under **Entering Conditions**, all four entry fields must be filled in with whole numerals (no commas), and up to two decimal values. The information required is: the **Airflow Rate Actual** in actual cubic feet per minute (ACFM); the **Entering Air Temperature** (EAT) in degrees F; and the **Entering Liquid Temperature** (ELT) in degrees F.

[00534] The next section, **Performance Conditions,** provides three entry fields, only **<u>one</u>** of which is to be filled in. They are: **Leaving Air Dry Bulb Temperature**

(LAT) in degrees F; **Leaving Liquid Temperature** (LLT) in degrees F; and **Liquid Flow Rate** (GPM) in gallons per minutes. If two entries are attempted an error signal will appear.

[00535] After all appropriate entry fields have been filled, click the "Calculate" button. An answer screen will show all input data plus the following air side and water side performance conditions:

Air Side

Air Flow Rate in Standard CFM, scfm
Coil Face Area, Square Feet
Total Heat Transfer, BTU/Hour
Entering Face Velocity, feet/minute
Leaving Air Dry Bulb Temperature, °F
Air Pressure Drop, inches w.c.

Liquid Side

Liquid Flow Rate, gpm
Liquid Pressure Drop, feet of fluid
Liquid Volume of Coil, gallons
Leaving Liquid Temperature, °F
Liquid Temperature Drop, °F
Liquid Velocity, feet/second

[00536] Footers include "Printable I/O Summary," "New Calculation," and "To Project Information" **or** "To Miscellaneous Calculations" (depending upon where you initiated from)…and "To Main Entry Screen."

Analyzing a Steam Heating Coil

[00537] After entering the **Equipment Identifier**, in **Type of Coil** select the radio button for **Heating.** This will change **Refrigerant** to **Steam** in the **Fluid** box. Click on the radio button adjacent to **Steam.** The entry fields under **Liquid** will disappear and the new screen will contain three entry fields under **Steam**…with instructions to **Enter One of the**

Following. The three options are **Saturated Steam Temperature** in °F, **Saturated Steam Pressure** in psig and **Saturated Steam Pressure** in psia. The steam pressure in psig is the pressure in psia less the atmospheric pressure shown on the screen. To initiate the analysis fill in one of the descriptors for steam temperature **or** steam pressure and click the "Proceed" button. A new screen will appear with the **Equipment Identifier** and steam conditions displayed, and a series of entry fields under **Physical Characteristics of Coil** and **Entering Conditions.**

[00538] Under **Physical Characteristics of Coil** are entry fields for the **Coil Height** and the **Coil Width**. Similar to the liquid fluid coils, these dimensions are measured by distance between the frames. (The height in increments of 3 inches; the width in increments of 2 inches). The four pull down fields are for number of **Rows** (2 through 12), **Fin Type (Flat, Enhanced (mild)),** and **Enhanced (severe))…**and then the coupled fields of **Fins per Inch** and **Fin Spacing**.

[00539] Under **Entering Conditions** two features of the entering air to be heated are required. They are A**ir Flow Rate Actual (ACFM)** in cubic feet per minute, and the **Entering Air Temperature (EAT).** The CFM must be entered in whole numbers with no commas, and the air temperatures can be entered with up to two decimal places. When all entries have been filled in, click on the "Calculate" button.

[00540] This will display an answer screen showing all input data, including the steam conditions in temperature (°F) and both absolute (psia) and gauge (psig) pressure…plus information on the following air side coil performance capabilities:

Air Flow Rate Standard, CFM (scfm)
Coil Face Area, square feet
Total Heat Transfer, BTU/Hour
Entering Face Velocity, feet per minute

Leaving Dry Bulb Temperature, °F
Air Pressure Drop, inches w.c.

[00541] Footers include "Printable I/O Summary," "New Calculation," "To Project Information" or "To Miscellaneous Calculations" (depending upon where you initiated from) and "To Main Entry Screen."

[00542] An exemplary Heating and Cooling Coil Diagnostics Input/Output Summary is provided in FIG. 104.

[00543] Example 9

[00544] This Example illustrates the Heating and Cooling Coil Selection calculation module and methods of its use.

[00545] These programs can be accessed through the project files or directly through the **Main Entry Screen**. If accessed directly through the main entry screen they will be filed under miscellaneous. Also, for filing purposes, prior to inputting any coil information it is necessary to provide a **Calculation Identifier**. Regarding the **units** selection, the only units available at this time are Inch Pounds (IP).

Selecting a chilled water or water/glycol cooling coil

[00546] Under the heading "Type of Coil" there are two selections **Cooling/Dehumidifying** and **Heating.** The radio button will be in the default position for **Cooling Dehumidifying**. The next entry field is the **elevation**. The default value shown will be the elevation you had filled in on your member information form but it is editable. The barometric pressure fields will reflect standard **barometric pressure** at the elevation selected also, the **barometric pressure** can be entered either in psia or inches of mercury (and the other two values will re-calculate to show the conditions at the selected value).

[00547] If a cooling dehumidifying coil has been selected, the next line will have radio buttons with a selection for either a **liquid** fluid in the tubes or **refrigerant**. For a water or water/glycol coil select "liquid" (this is the radio button default position). The pull down arrow adjacent to the field in which the word "water" appears can be used to change the "water" to "Ethylene Glycol" or "Propylene Glycol". If water is selected the entry fields below will simply read NA and 32°F. If either glycol is selected those two fields will change to 0% and 32°F respectively (both editable). Replace the "0" with the percentage by weight of the glycol mix and with the next click of the mouse, the freezing temperature will appear. If you know the freezing temperature you want, simply enter that prior to the percentage of the glycol mix (and a 'tab' will show the percentage of the glycol required).

[00548] The next selection is the **Piping Connections** at the bottom of the screen. The default position is **Same End**, with the other options being **Opposite Ends** and **Either End**. The selection is usually dictated by the layout of the equipment room.

[00549] After selecting the desired piping connection, click the "Proceed" button at the bottom of the screen. A new screen will appear, with the identifiers and the fluid shown. This screen has fields for **Liquid Conditions, Air Conditions**, and **Coil Specifications** (dimensions, configuration, etc.).

[00550] The requirements for the liquid conditions are **Entering Liquid Temperature** (enter as a whole number or up to two decimal places). You then have one of three selections (**leaving liquid temperature, temperature rise**, or **flow rate)**. The last field under **Liquid Conditions** is for the **maximum fluid head loss,** which should be entered in Feet of Head.

[00551] For the air conditions you must enter both the **dry bulb temperature** and the **wet bulb temperature** for the entering conditions. For leaving conditions there are four options (the **dry bulb temperature**, the **wet bulb temperature**, the **dewpoint temperature** or the **total heat transfer** capacity). The last entry field under **air conditions** is the **maximum air pressure loss** (in inches of water).

[00552] The first entry field under "Coil Specifications" is for the **air flow rate** in ***actual*** cubic feet per minute (ACFM). This is entered in whole numbers…with no commas or periods. The next field provides a selection of either the maximum face velocity or the estimated face area.

[00553] **Caution!** In selecting a dehumidifying coil, if the face velocity is too high it could cause excessive water carryover resulting in water damage…or the growth of mold and mildew in the downstream sections of the system.

[00554] The coil dimensions are, of course, related to both the face area and the air velocity (dictated by the air handling unit size and location). Only one (usually the most critical) dimension of the coil is necessary, and the analyst need only enter one dimension, either the **coil height** or the **coil width** (tube length). The width should be in even numbers and the height in increments of 1 ½ inches.

[00555] Fin spacing may be expressed in either fins per inch or fin spacing in inches. For coils which will have dehumidifying loads, fin spacing closer than 1/8 inch (8 fins per inch) is not recommended since the draining condensate could bridge (i.e., fill the space between two fins. When this occurs, the air pressure will force droplets of water off the leaving face of the coil causing water carryover).

[00556] The last entry field, the fin type, is a pull down with three options: **Flat, Enhanced (Mild)** and **Enhanced (Severe)**. Severe enhancement is not recommended for a dehumidifying coil because of the high air side pressure drop, and its tendency to foul (and the extreme difficulty of removing accumulated dirt when it does become fouled). From the standpoint of maintenance and performance, flat fins are recommended for dehumidifying service.

[00557] After all the inputs have been entered, click the "Calculate" button. The output screen will appear with uneditable values, and the coil selection. The coil selection will be coil with the least rows that will best satisfy all of the parameters you entered. For an I/O summary, click the "Printable I/O Summary" button, which will provide the input requirements, and multiple coil selections that would satisfy those requirements. As with all I/O summaries, you may save a copy locally, and/or print a copy (for your paper file or a report).

[00558] The footers provide various options, including to go to the Main Entry Screen, or to perform another coil calculation. If the latter is selected, it will return you to the first "Heating and Cooling Coil" selection screen and you're ready to start on another coil selection.

<u>Selecting a Refrigerant (Direct Expansion) Coil</u>

[00559] After entering the **Calculation Identifier,** and selecting the **Cooling/Dehumidifying** option (and the elevation), click on the radio button for **Refrigerant**. The screen will change (with the water/glycol options disappearing) to a new entry screen (under **Refrigerant)** for entering suction temperature. This is the saturation temperature for the specific refrigerant corresponding to the pressure at which the coil will operate.

[00560] The **Piping Connections** for refrigerant coils can, like the water coils, be selected for **Same End, Opposite End** or **Either End** (but usually, for a refrigerant coil, the piping configuration is selected on the basis of serviceability).

[00561] After selecting the **Piping Connections** click on the "Proceed" button. A new screen will appear with a series of data entry fields under **Air Conditions** and **Coil Specifications.**

[00562] Like the liquid coils, the first block under **Air Conditions** requires the entering air conditions (in **Entering Dry Bulb Temperature** and **Entering Wet Bulb Temperature)**. Decimal points may be used (to 2 decimal places). Also, as with the liquid coils, only one of the four entry options for the coil leaving conditions should be provided (either **Leaving Dry Bulb Temperature, Leaving Wet Bulb Temperature, Leaving Dew Point Temperature** or **Total Heat Transfer).**

[00563] The last input information required under **Air Conditions** is the **Maximum Air Pressure Loss** (in inches of water).

[00564] The **Coil Specifications** include four input fields. The first field is for **Air Flow Rate Actual**, in *actual* CFM. Then *either* the **Maximum Face Velocity** or the **Preliminary Face Area.**

[00565] Again, as with water coils, a face velocity in excess of 500 Feet per minute is not recommended for dehumidifying coils.

[00566] Also, as with the water coil, either the **Coil Width** or **Coil Height** is entered in the appropriate entry field. This value is usually a function of the dimensional constraints of the air handling unit or the space in which it is to be located.

[00567] The fin selection requirements are similar to those for water coils. When the coil is functioning as a dehumidifying coil, no more than 8 fins per inch are recommended (and the fins should be either **Flat** or **Enhanced).**

[00568] When all of the entry fields have been input, click on the "Calculate" button to obtain the coil selection. The resulting screen, will show all the input values and all relevant output values relating to the coil selection.

[00569] The footer selections include “Printable I/O Summary,” “New Calculation” and “To Main Entry Screen.” Clicking “Printable I/O Summary” will generate a window showing the inputs and all coil selections that satisfy (or come close to satisfying) the input data…including the “selected” coil which satisfies the input requirements with the least costly coil. The summary may be saved locally or printed (for paper files or report illustrations). “To Miscellaneous Calculation” or “To Project File Contents” will lead you back to the File contents for the file in which the calculation has been filed.

The “New Calculation” button will send you to the opening screen for heating and cooling coil selection. The “To Main Entry Screen” button will, of course, return you to the Main Entry Screen.

Selecting a Hot Water or Glycol Heating Coil

[00570] After filling in the **Calculation Identifier**, in the box **Type of Coil** select the radio button for **Heating**. This will change the word **Refrigerant** to steam in the “FLUID” box. When selecting a heating water or glycol mix coil, the radio button should already be selected for that option. If the desired coil is a water coil it will appear in the entry field under the word **Liquid** (and the **Percent Glycol** field should read “NA”…and the **Freezing Temperature** should read 32°F). If a water/glycol mix is to be used, the entry field under the word **Liquid** has a drawdown which provides for a selection of either ethylene glycol or propylene glycol. The glycol percent by weight of the mixture can be selected by entering the concentration value in the **Percent Glycol** field. When this is done, the freezing temperature will appear in the **Freezing Temperature** field. Optionally, the freezing temperature desired can be typed in that field, and the click of the mouse will provide the required concentration present by weight (for that level of protection).

[00571] The next step is to select the appropriate radio button under “Piping Connections”. Again, for a water coil, the piping connection configuration usually depends upon the dimensional characteristics of the unit location and the servicing/maintenance requirements. To continue click the “Proceed” button.

[00572] The second screen will appear with the type Liquid, the freezing temperature and the elevation displayed in a non-editable form. As with cooling coils, there will be three main sections of the screen with appropriate entry fields under **LIQUID CONDITIONS, AIR CONDITIONS,** and **COIL SPECIFICATIONS.**

[00573] Under **LIQUID CONDITIONS** the first selection is **Entering Liquid Temperature**. The next selection requires one of the three options; the **Leaving Liquid Temperature**, or the **Liquid Temperature Drop,** or the **Flow Rate**. The third selection is for **Maximum Fluid Head Loss**.

[00574] In the AIR CONDITIONS section are Entering Air Temperature, Leaving Air Temperature (or the Total Heat Transfer in BTU per hour), and the Maximum Air Pressure Loss (in inches of water column).

[00575] **COIL SPECIFICATIONS** requires inputs for the **Air Flow Rate…**for *either* the maximum face velocity or preliminary face area (then *either* the coil height or the coil width, and finally the fin spacing). Since water carryover is not a problem with heating coils, the major concerns regarding the fin spacing is to assure that the coil can be cleaned (and to limit the air pressure drop for greater fan energy efficiency).

[00576] After selecting the fin spacing (via the **Maximum Fins per Inch,** or the Minimum Fin Spacing, and the **Fin Type)** click the "Calculate" button. The resulting screen will display all the input data and all the specifications for the coil selection.

[00577] For a printable I/O, click the "Printable I/O Summary" button. This summary displays all input values and several coil selections.

[00578] The other footer options include "New Calculation" (which returns you to the initial **Heating and Cooling Coil Selection** screen). Additional options are

"To Main Entry Screen"…or to the Miscellaneous or Project file (from which you entered this program).

Selecting a Steam Heating Coil

[00579] After entering the Equipment Identifier, for **Type of Coil** select the radio button for **Heating.** This will change the word **Refrigerant** to **Steam** in the **FLUID** box. Click on the radio button for **Steam.** The entry fields for **Liquid** will disappear, and the new screen will contain 3 entry fields under **Steam**…with instructions to **Enter One of the Following**. The options are **Saturated Steam Temperature**, **Saturated Steam Pressure** (in psig) and **Saturated Steam Pressure** (in psia). NOTE: The steam pressure in psig is the pressure in psia less the atmospheric pressure shown on the screen. After filling in one of the fields, select the appropriate piping connections and click **Proceed**.

[00580] This will bring up a screen with steam conditions and entry fields under **Air Conditions** and **Coil Specifications**. Fill in the **Entering Air Temperature,** then *either* the **Leaving Air Temperature** or **Total Heat Transfer,** and, finally, the **Maximum Air Pressure Loss.**

[00581] Under **Coil Specifications** enter the **Air Flow Rate Actual** in ACFM, either the **Maximum Face Velocity** or a **Preliminary Face Area**, either a **Coil Height** or **Coil Width** in inches, and select from the pull down entry fields either a **Maximum Fins Per Inch** or a **Minimum Fin Spacing.** The last entry is the **Fin Type** pulldown. As for the hot water heating coil, the primary concerns about fin spacing and type are those relating to cleanability and pressure loss.

[00582] With all entries complete, click the "Calculate" button. The resulting screen provides a summary of the inputs and the most appropriate coil selection.

[00583] The footers include "Printable I/O Summary," "New Calculation," and either "Miscellaneous Calculations" or "Project File Summary"…to return you to the file from which you initiated the calculation.

[00584] An exemplary Heating and Cooling Coil Selection Input/Output Summary is provided in FIG. 105.

[00585] Example 10

[00586] This example illustrates the Steam Processes calculation module and methods of use.

[00587] The **Steam Processes** programs may be accessed through a project file (**Project File Contents** screen) or from the **Main Entry Screen**. If accessed through the project file, the calculation will be identified for that project and will be filed in that project file. Any program accessed through the **Main Entry Screen** will, of course, be filed as a **Miscellaneous Calculation**. As **Steam Processes** calculations are not "look-up" programs (like **Psychrometric Properties** and **Steam Properties)**, they will be automatically and permanently filed.

[00588] When you select the **Steam Process** program, beneath the identification block (and a brief instructional block) will appear the **Menu of Processes**:

Expansion (power) Process

Fuel Heat Required to Generate Steam

Control Valve Sizing

Steam Orifice Size/Capacity

Difference Between two Statepoints

[00589] Select the program you want via the appropriate radio button and click the "Proceed" button.

Expansion (Power) Process

[00590] Within the identification block (with the **Company Name**, **Project Title**, **Project Number**, **Date** and **Member Name)**, is an entry field for the **Equipment Identifier** and a pull down field for **Units**. (In this version of the programs, only inch pound (IP) units are available). An **Equipment Identifier** is required as without an identifier your calculation cannot be filed.

[00591] Following the identification block (and an instructional section) are input sections for **Initial (Throttle) Conditions, Outlet Conditions**, and **Efficiency**.

[00592] For **Initial (Throttle) Conditions**, there are sections for **Superheated** condition and **Saturated** condition. (One or the other of these is selected by clicking on the appropriate radio button). If you have a **Superheated** inlet statepoint, click on that radio button, and fill in the entry fields for the absolute **Pressure** (in psia), and the **Temperature** (in °F). If the throttle or inlet statepoint is **Saturated** click in that radio button and fill in the field for *either* the **Pressure** or the **Temperature**, *and* for the **quality**. (Note: If you enter both a **Pressure** and a **Temperature** an error message will prevent you from continuing).

[00593] Steam turbine systems are designed to exhaust to either a condenser or a steam distribution system. Systems designed for condenser service exhaust to a design condensing temperature…whereas systems designed to exhaust into a steam distribution system (such as cogeneration plants) exhaust to a design pressure. For these reasons, in the **Outlet Conditions** box, enter *either* the exhaust pressure or the condensing temperature (of the exhaust condenser). If you enter both an exhaust pressure and a condensing temperature you will receive an error signal when attempting to calculate.

[00594] The last section of the input screen relates to the isentropic efficiency. If your analysis is to determine the turbine or engine steam rate under ideal (isentropic expansion) conditions, select the radio button for **Isentropic Expansion**. If it is to determine the steam rate under actual conditions, select **Nonisentropic Expansion (**and enter an appropriate efficiency in percent in the entry field provided). The efficiency is defined as the ideal steam rate (in pounds per horsepower hour) divided by the actual steam rate (in identical units). In addition to the affect of the efficiency upon the steam rate, it also will have a significant impact upon the statepoint of the exhaust steam.

[00595] After the input screen has been completed, click the "Calculate" button at the bottom of the screen. The output screen will present the **Initial (Throttle) Conditions**, and the **Outlet Conditions**…followed by the output, consisting of: 1) the steam rate in pounds of steam per kilowatt-hour and pounds of steam per horsepower hour; and 2) the statepoint of the inlet steam and exhaust steam as defined by 14 relevant properties.

[00596] Footer bars include "Printable I/O Summary," and "Recalculate" (which will present the input screen with all of the initial input values except the **Equipment Identifier**, which must be filled in to run a new calculation. All other entry fields are editable to allow you to change the input as needed).

[00597] Other footers bars include options to return "To Steam Processes Menu", "To Project File Contents" **or** "Miscellaneous Calculations" (depending upon from where you entered **Steam Processes)**, and "To Main Entry Screen."

Fuel Heat Required to Generate Steam

[00598] Again, the identification block requires an **Equipment Identifier** and the **Units** (which, at this time, are only inch pounds (IP)). Following an instructional block are the two blocks for input conditions, the first of which is **Feedwater Conditions**.

[00599] The feedwater **Pressure** (stated in psia) is usually equal to the boiler pressure plus the pressure drop across the feedwater control assembly. The feedwater temperature is usually the temperature leaving the feedwater reservoir or feedwater heater.

[00600] The **Steam Conditions** are the steam conditions (statepoint) leaving the boiler. There are two options, **Saturated** or **Superheated.** Selection is made with the appropriate radio button. If **Saturated** is selected, you must then enter either the saturation pressure *or* temperature. If **Superheated** is selected, you must enter both the temperature *and* the pressure.

[00601] The last block is for the **Combined Efficiency** of the boiler. **Combined Efficiency** is defined as the difference between the energy content of the steam leaving the boiler (or super heater nozzle) and the feedwater (expressed in BTU per hour divided by the HHV of the fuel input in equivalent units…expressed as a percent). In an analysis to determine size or capacity, the efficiency would normally be a power ratio at design capacity. To analyze a quantity used over time (annual, seasonal, etc.) the efficiency is usually calculated on a time integrated basis (and is usually considerably lower).

[00602] After providing the information required, click the "Calculate" button. An output screen will provide all of the input values, and the fuel heat required in **BTU per pound of steam.**

[00603] Footers include "Printable I/O Summary" and "Recalculate." "Recalculate" will return you to the input screen, with the input fields filled in as you had just calculated…and, after providing a new **Equipment Identifier**, any of the other values or radio button selections can be revised or edited. Other footers include "To Steam Processes Menu" (which returns you to the initial **Steam Processes** menu screen); "To Miscellaneous Calculations" or "To Project File Contents" (depending on from where you entered **Steam Processes)**; and "To Main Entry Screen."

Control Valve Sizing

[00604] The identification block requires an **Equipment Identifier** and the **Units** (which, at this time, are only inch pounds (IP)). Following the identification block is an entry field for the **Steam Flow Rate** (in pounds of steam per hour, which should be entered in numerals only (no comma), but decimal points are acceptable). The next two blocks are for **Inlet Conditions** and **Outlet Pressure**. The inlet conditions of **Saturated** and **Superheated** are selected by radio buttons. For **Saturated** enter either the **saturation pressure** or **temperature** (in the respective entry field); for **superheated,** enter both the **pressure** and **temperature**. In the **Outlet Pressure** block, only the outlet **Pressure** is required.

[00605] When all entries are complete click the "Calculate" button. The initial sections of the output screen provide all the input data and the outlet pressure. The outlet pressure will indicate the flow characteristics (either **Critical** or **Retarded)**, and the

Valve Constant Cv. The last section will reveal the "condition" of the steam at the valve inlet and outlet (either saturated or superheated), and will define the statepoint in terms of 14 properties as applicable.

[00606] Footers include "Printable I/O Summary" and "Recalculate." "Recalculate" will return you to the input screen, with the input fields filled in as you had just calculated…and, after providing a new **Equipment Identifier**, any of the other values or radio button selections can be revised or edited. Other footers include "To Steam Processes Menu" (which returns you to the initial **Steam Processes** menu screen); "To Miscellaneous Calculations" or "To Project File Contents" (depending on from where you entered **Steam Processes)**; and "To Main Entry Screen."

Steam Orifice Size/Capacity

[00607] The identification block requires an **Equipment Identifier** and the **Units** (which, at this time, are only inch pounds (IP)). Following the identification block are three blocks for input information.

[00608] The first block is for the steam **Inlet Conditions**. As with the other steam processes, the first step in the Inlet Conditions is to select either **saturated** or **superheated** (via the radio buttons). For **Saturated,** must enter either the **saturation pressure** or the **saturation temperature** – but not both. For **Superheated,** enter both the pressure and the temperature. If one of the two is omitted, an error signal will appear when you attempt to Calculate.

[00609] The next block is for the **Outlet Pressure** (which simply requires the downstream pressure).

[00610] In the third input block you can enter either the **Steam Flow Rate** or the **Orifice Diameter**. If the flow rate is entered the calculation program will tell you the required orifice diameter. If the **orifice diameter** is entered, calculation program will give you the **Steam Flow Rate.**

[00611] After filling in the required information click the "Calculate" button. The resulting output screen will present all of the input data, followed by either the steam flow rate or the orifice diameter…and will indicate the flow characteristics (either **Critical** or **Retarded)**, and the orifice diameter if steam flow rate were input or the steam flow rate had the orifice diameter been input.

[00612] The last block displays the "condition" of the steam at the orifice inlet and outlet (either saturated or superheated), and will define the statepoint in terms of 14 properties (as applicable).

[00613] Footers include "Printable I/O Summary" and "Recalculate". "Recalculate" will return you to the input screen, with the input fields filled in as you had just calculated…and, after providing a new **Equipment Identifier**, any of the other values or radio button selections can be revised or edited. Other footers include "To Steam Processes Menu" (which returns you to the initial **Steam Processes** menu screen); "To Miscellaneous Calculations" or "To Project File Contents" (depending on from where you entered **Steam Processes)**; and "To Main Entry Screen."

Differences Between Two Statepoints

[00614] This program is different from the other programs in **Steam Processes** in two ways. First, it is not a process but a quick reference to the difference between any relevant properties at the statepoints of interest. Secondly, as it is only a quick reference of the differences, it is handled as a look-up program and thus may be used without entering a **Calculation Identifier**. However, if no Calculation Identifier is entered, the calculation will not be filed.

[00615] To use, simply enter any two properties for each of the statepoints desired. <u>Note</u>: For a saturated condition of either statepoint, it is necessary to include the quality at any value between 0 and 100%.

[00616] Click the "Calculate" button and the remainder of the properties at each statepoint will be displayed…as well as the absolute value of the difference between the two values of the following properties: pressure, temperature, density, specific volume, enthalpy, entropy, and internal energy.

[00617] When the calculation is completed, footers include "Printable I/O Summary" and "Recalculate." "Recalculate" will return you to the input screen, with the input fields filled in as you had just calculated…and, after providing a new **Equipment Identifier**, any of the other values or radio button selections can be revised or edited. Other footers include "To Steam Processes Menu" (which returns you to the initial **Steam Processes** menu screen); The "To Miscellaneous Calculations" <u>or</u> "To Project File Contents" (depending on from where you entered **Steam Processes)**; and "To Main Entry Screen".

[00618] An exemplary Steam Processes Input/Output summary is provided in FIG. 106.

What is claimed is:

1. A method of providing one or more HVAC design features for a building to one or more users, the method comprising:

a) providing a web-based user interface comprising a plurality of web pages, wherein one or more web pages are configured to receive as input information one or more descriptors, each descriptor selected from a descriptor of a building, a descriptor of a portion of a building and a descriptor of a building environment;

b) receiving, from at least one user accessing the web-based user interface at a terminal located remote from a server comprising software encoding the web-based user interface, at least one selection of a program comprising at least one web page configured to receive one or more input information items and at least one calculation module;

c) receiving one or more input information items from the at least one user;

d) determining at least one HVAC building design specification using at least one HVAC building design executable program and at least one input information item of the one or more input information items, and

e) providing at least one HVAC building design specification as at least one output information item.

2. A method in accordance with claim 1, wherein the server is a secure server connected to the Internet.

3. A method in accordance with claim 1, wherein the at least one user accesses the web site over the Internet.

4. A method in accordance with claim 1, wherein the server performs input validation on the one or more input information items.

5. A method in accordance with claim 1, wherein the server provides software code that performs error checking on the one or more input information items.

6. A method in accordance with claim 1, wherein access to the one or more web pages configured to receive the one or more descriptors requires entry of at least one password.

7. A method in accordance with claim 6, wherein the user interface is accessed by the at least one user on a subscription basis.

8. A method in accordance with claim 6, further comprising generating or adding to a record of an HVAC design project for a building.

9. A method in accordance with claim 8, wherein the generating or adding to a record of the project comprises recording at each session, one or more of: the at least one user's identification, a title of the project, date of the session, the at least one selection of a web page, at least one input information item, and at least one output information item.

10. A method in accordance with claim 9, wherein after the determining of the at least one HVAC building design specification, at least one of a) the date of the session, b) the at least one input information item and c) the at least one output information item, cannot be erased or altered during a subsequent session of use by a user accessing the web-based user interface at a terminal located remote from the server.

11. A method in accordance with claim 10, wherein one or more web pages of the plurality of web pages comprises one or more data input fields configured to receive at least one input information item for at least one calculation not comprised by the project.

12. A method in accordance with claim 1, wherein the web-based user interface is a graphical user interface.

13. A method in accordance with claim 1, wherein the output information is displayed at the terminal.

14. A method in accordance with claim 1, wherein the providing the at least one output information item comprises providing a printable report.

15. A method in accordance with claim 14, wherein the printable report is configured to be saved by the at least one user.

16. A method in accordance with claim 1, wherein a calculation module is selected from the group consisting of a heating and cooling load calculation module, a psychrometric mixing process calculation module, a psychrometric cooling and dehumidifying process calculation module, a psychrometric sensible heating or cooling process calculation module, a psychrometric isothermal humidification process calculation module, a psychrometric evaporative cooling process calculation module, a psychrometric differences between two state points calculation module, a heating and cooling coil selection calculation module, a heating and cooling coil diagnostics calculation module, a steam properties calculation

module, a hydronic pipe sizing calculation module, a steam expansion (Power) process calculation module, a fuel heat required to generate steam calculation module, a steam control valve sizing calculation module, a steam orifice size/capacity calculation modules, a steam differences between two state points calculation module and an expansion tank calculation module.

17. A method in accordance with claim 16, wherein the plurality of web pages further comprise a web page comprising at least one data entry field linking to calculation modules of psychrometric processes, wherein the psychrometric processes include one or more of mixing process, cooling and dehumidifying process, sensible heating or cooling process, isothermal humidification process, evaporative cooling process, and differences between two state points.

18. A method in accordance with claim 16, wherein the plurality of web pages further comprise a web page comprising a menu linking to calculation modules for steam processes, wherein the steam processes include one or more of expansion (power) process, fuel heat required to generate steam, control valve sizing, steam orifice size/capacity, and differences between two state points.

19. A method in accordance with claim 1, wherein a calculation module generates an input/output summary.

20. A method in accordance with claim 15, wherein the input/output summary is a flat text file.

21. A method in accordance with claim 20, wherein the flat text file is configured to be printed as a WYSIWYG document by the at least one user at a terminal located remote from the server.

22. A method in accordance with claim 8, wherein a calculation module retains the input information items prior to or after completion of data entry into the module by the at least one user.

23. A method in accordance with claim 16, wherein the module is the heating and cooling load calculation module.

24. A method in accordance with claim 1, wherein the at least one user comprises a plurality of collaborative users.

25. A method in accordance with claim 1, wherein at least one web page comprises educational guidance for HVAC design.

26. A system for facilitating determination of one or more HVAC design features for a building, the system comprising:

a server configured to a) provide a web-based user interface comprising a plurality of web pages, wherein one or more web pages are configured to receive as input information one or more descriptors, each descriptor selected from a descriptor of a building, a descriptor of a portion of a building and a descriptor of a building environment; b) receive, from at least one user via at least one terminal operably connected over the Internet to the server, at least one selection of a program comprising at least one web page configured to receive one or more input information items and at least one calculation module; and c) receive one or more input information items from the at least one user via the at least one terminal; and

the at least one terminal.

27. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the server is further configured to d) determine at least one HVAC building design specification using at least one HVAC design executable program for a building and at least one input information item of the one or more input information items.

28. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 27, wherein the server is further configured to e) provide at least one HVAC building design specification as at least one output information item.

29. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the least one terminal is communicatively connected to the server via the Internet.

30. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the server is a secure server.

31. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the server is further configured to require entry of at least one password for user access to the at least one selection of a program.

32. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the server is further configured to allow user access to the at least one selection of a program on a subscription basis.

33. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 31, wherein the server records a session of use of a building HVAC design project upon the at least one user entering a user identification and at least one password.

34. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 33, wherein the server stores the record.

35. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 33, wherein the record cannot be erased or altered during a subsequent session of use by the at least one user from the at least one terminal operably connected to the server.

36. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 33, wherein one or more web pages of the plurality of web pages comprises one or more data input fields configured to receive at least one input information item for at least one calculation not comprised by the project.

37. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the server validates the one or more input information items.

38. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the server checks for errors on the one or more input information items.

39. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the at least one output information is displayed on a web page of the plurality of web pages.

40. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the at least one output information is comprised by a printable report.

41. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein a calculation module is selected from the group consisting of a heating and cooling load calculation module, a psychrometric mixing process calculation module, a psychrometric cooling and dehumidifying process calculation module, a psychrometric sensible heating or cooling process calculation module, a psychrometric isothermal humidification process calculation module, a psychrometric evaporative cooling process calculation module, a psychrometric differences between two state points calculation module, a heating and cooling coil selection calculation module, a heating and cooling coil diagnostics calculation module, a steam properties calculation module, a hydronic pipe sizing calculation module, a steam expansion (Power) process calculation module, a fuel heat required to generate steam calculation module, a steam control valve sizing calculation module, a steam orifice size/capacity calculation modules, a steam differences between two state points calculation module and an expansion tank calculation module.

42. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 41, wherein the psychrometric processes include one or more of mixing process, cooling and dehumidifying process, sensible heating or cooling process, isothermal humidification process, evaporative cooling process, and differences between two state points.

43. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 42, wherein the plurality of web pages further comprise a web page comprising a menu linking to calculation modules for steam processes, wherein the steam processes include one or more of expansion (power) process, fuel heat required to generate steam, control valve sizing, steam orifice size/capacity, and differences between two state points.

44. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein a calculation module comprises an input/output summary.

45. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 44, wherein the input/output summary is a flat text file.

46. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 41, wherein a calculation module retains the input

information items upon the at least one user ending a session prior to completion of data entry into the module.

47. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 46, wherein the module is the heating and cooling load calculation module.

48. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the at least one user comprises a plurality of collaborative users.

49. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 48, wherein the plurality of collaborative users consists of persons employed by a business entity employing the at least one user.

50. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the at least one web page further comprises educational guidance for HVAC design.

51. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 26, wherein the calculation module is configured to receive one or more psychrometric properties input information items,

52. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 51, wherein the calculation module is configured to receive one or more input information items, wherein an input information item is selected from an elevation information item, a barometric pressure information item, and properties information items selected from a dry bulb temperature information item, a wet bulb temperature information item, a dew point temperature information item, a humidity ratio in grains/lb information item, a humidity ratio in lb/lb information item, a relative humidity information item, an enthalpy information item, and a specific volume information item.

53. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 52, wherein the calculation module is further configured to provide as output information items, the properties information items not provided by the at least one user.

54. A system for facilitating determination of one or more HVAC design features for a building in accordance with claim 31, wherein at least one web page comprises a menu configured to receive a request from the at least one user to initiate a new load calculation, continue a previously initiated load calculation, review a previously initiated load calculation, provide master load data, provide a printable input summary, or calculate loads, wherein a load calculation is selected from the group consisting of design conditions, thermal characteristics of building elements, and zones and spaces.

55. A method of designing heating, ventilation and/or air conditioning for a building or a portion thereof, the method comprising:

accessing from a terminal a web-based user interface comprised by a server, wherein the user interface comprises a plurality of web pages configured to receive data for at least one selection of an HVAC design calculation module of a plurality of HVAC design calculation modules;

submitting to the web-based user interface at least one selection of a plurality of selections of HVAC design calculation modules;

submitting input data for a building design or a portion thereof; and

receiving from the web-based user interface one or more calculated HVAC building parameters.

56. A method in accordance with claim 55, wherein the terminal is operatively connected to the server via the Internet.

57. A method in accordance with claim 55, wherein the server is a secure server.

58. A method in accordance with claim 55, wherein at least one web page comprises a web-based interactive user interface.

59. A method in accordance with claim 55, wherein the server validates the one or more input information items.

60. A method in accordance with claim 55, wherein the server checks for errors on the one or more input information items.

61. A method in accordance with claim 55, wherein the accessing from a terminal a web-based user interface comprises providing at least one password.

62. A method in accordance with claim 61, wherein the accessing from a terminal a web-based user interface further comprises providing at least one user identification.

63. A method in accordance with claim 55, wherein the server is configured to allow user access to the at least one selection of a program on a subscription basis.

64. A method in accordance with claim 61, further comprising initiating a session of use of a building HVAC design project.

65. A method in accordance with claim 64, wherein the server records data entered during the session of use.

66. A method in accordance with claim 88, wherein the server generates or adds to a record of a project, data entered during the session of use.

67. A method in accordance with claim 66, wherein the server records, in the record at each session, one or more of: the at least one user's identification, a title of the project, date of the session, the at least one selection of a web page, at least one input information item, and at least one output information item.

68. A method in accordance with claim 55, wherein the providing the at least one output information item comprises providing a printable report.

69. A method in accordance with claim 55, wherein the at least one user comprises a plurality of collaborative users.

70. A web service comprising the system of claim 26, wherein the system comprises an SSL secure server.

71. A web service in accordance with claim 70, wherein an IT staff maintains all server hardware, all server software and a record of a building HVAC design project.

72. A web service in accordance with claim 70, further comprising at least one mirrored hard drive.

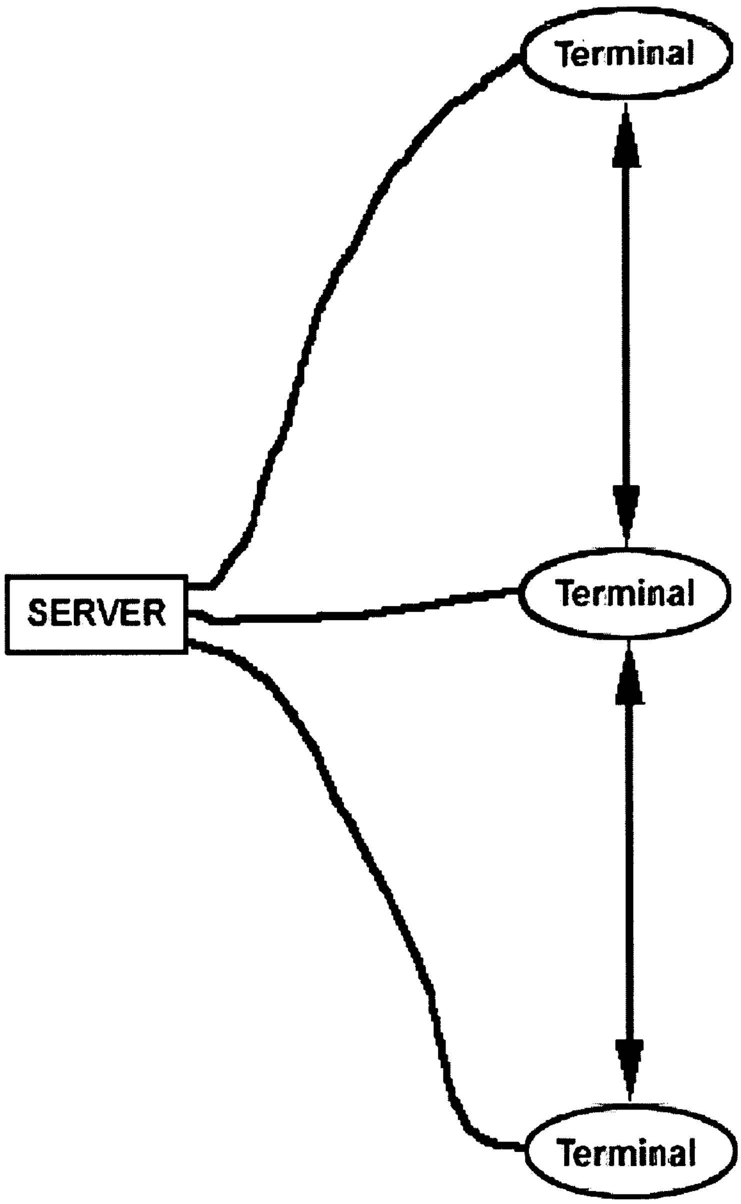


Fig. 1

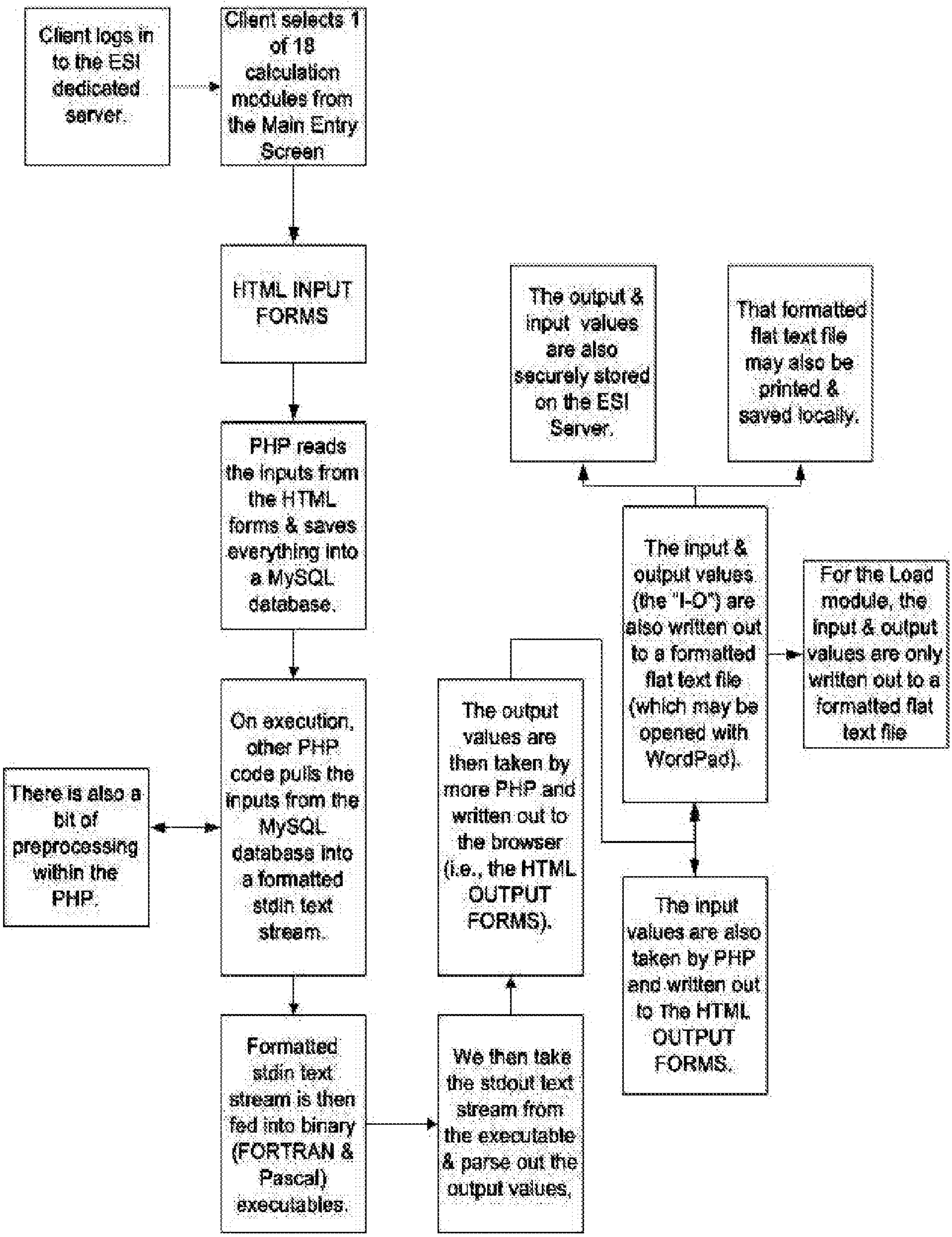

Client logs in to the ESI dedicated server.
Client selects 1 of 18 calculation modules from the Main Entry Screen
HTML INPUT FORMS
PHP reads the inputs from the HTML forms & saves everything into a MySQL database.
On execution, other PHP code pulls the inputs from the MySQL database into a formatted stdin text stream.
There is also a bit of preprocessing within the PHP.
Formatted stdin text stream is then fed into binary (FORTRAN & Pascal) executables.
We then take the stdout text stream from the executable & parse out the output values.
The output values are then taken by more PHP and written out to the browser (i.e., the HTML OUTPUT FORMS).
The input & output values (the "I-O") are also written out to a formatted flat text file (which may be opened with WordPad).
The input values are also taken by PHP and written out to The HTML OUTPUT FORMS.
For the Load module, the input & output values are only written out to a formatted flat text file
The output & input values are also securely stored on the ESI Server.
That formatted flat text file may also be printed & saved locally.

Fig. 2

Main	Contact	Projects	Misc	Logout

Engineering Software International

Heating & Cooling Load Calculation

Test Company

Project Title: (MISC) **Date:** October 17, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AlTest#2 **Units:** IP

Initiating Load Calculation

If you leave/quit a Load calculation prior to completion, while you may lose data on the screen you closed, we will save all data entered on prior screens, so you may continue/resume the calculation (via selection in the Heating & Cooling Load "Calculation List"). Upon completion of a Load calculation, you may "Update" (or clone) that calculation (also via selection in the Heating & Cooling Load "Calculation List").

Title:
Al\'s Test run

Description:
Before and after comparisons of executable code with 2 digit identification of wall type, etc.

38 North
Latitude Degrees

539
Elevation (ft)

Weight/Room Construction: Medium

Continue to Design Conditions ->

<-- To Loads Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 3

Engineering Software International

Heating & Cooling Load Calculation

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AlTest#2 **Units:** IP

Design Conditions

Indoor Conditions

Cooling		Heating	
75 (°F) Space Temperature For Cooling	50 (%) Space Relative Humidity for Cooling	70 (°F) Space Temperature for Heating	0 (%) Space Relative Humidity for Heating

Heating Outdoor Conditions

Dry Bulb Temperature 0 (°F)

Cooling Outdoor Conditions

For Ventilation	(Must Enter Both) ›	76 (°F) Design Dew Point	84 (°F) Mean Coincident Dry Bulb

For Space Load

- ◉ Design Cooling Month Only
  - 95 (°F) Design Dry Bulb
  - 78 (°F) Mean Coincident Wet Bulb
  - 19 (°F) Daily Range (Δt)
  - Jul ▾ Design Cooling Month
- ○ Twelve Month Calculation

For Twelve Month Calculation, fill in the following weather information for each month:

Month	Cooling Design Dry Bulb Temperature (°F)	Cooling Design Wet Bulb Temperature (°F)	Cooling Design Temperature Range (°F)
Jan			
Feb			
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			

Continue to Thermal Characteristics ->

Fig. 4

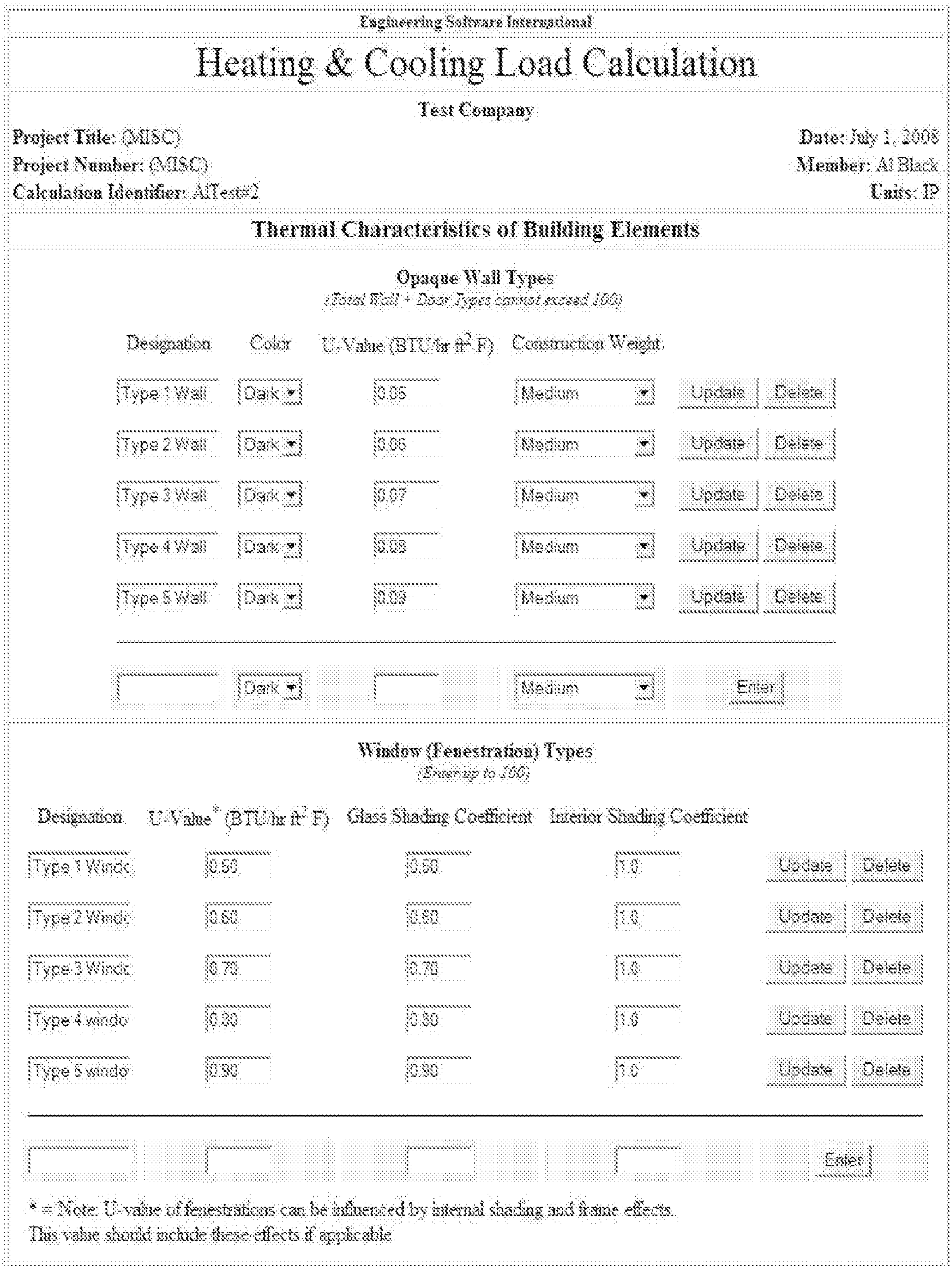

Engineering Software International
Heating & Cooling Load Calculation
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Calculation Identifier: AlTest#2
Units: IP
Thermal Characteristics of Building Elements
Opaque Wall Types
(Total Wall + Door Types cannot exceed 100)
Designation
Color
U-Value (BTU/hr ft2 F)
Construction Weight
Type 1 Wall
Dark
0.05
Medium
Update
Delete
Type 2 Wall
0.06
Type 3 Wall
0.07
Type 4 Wall
0.08
Type 5 Wall
0.09
Enter
Window (Fenestration) Types
(Enter up to 100)
Designation
U-Value* (BTU/hr ft2 F)
Glass Shading Coefficient
Interior Shading Coefficient
Type 1 Windc
0.50
1.0
Type 2 Windc
0.60
Type 3 Windc
0.70
Type 4 windo
0.80
Type 5 windo
0.90
* = Note: U-value of fenestrations can be influenced by internal shading and frame effects.
This value should include these effects if applicable

Fig. 5


Roof Types
(Total Roof + Floor Types cannot exceed 100)
Designation
Color
U-Value (BTU/hr ft² F)
Construction Weight
Type 1 Roof
Dark
0.05
Light
Update
Delete
Type 2 Roof
Dark
0.06
Light
Type 3 Roof
Dark
0.07
Light
Type 4 Roof
Dark
0.08
Light
Type 5 Roof
Dark
0.09
Light
Medium
Enter
Exterior Door Types
(Total Wall + Door Types cannot exceed 100)
Door Type 1
1.0
Door Type 2
1.1
Door Type 3
1.2
Door Type 4
1.3
Door Type 5
1.4
Medium
Exposed Floor Types
(Total Floor + Roof Types cannot exceed 100)
Exp Floor Typ
0.1
0.2
0.3
0.4
0.5
Medium

Exterior Shading Geometries (ESGs)
(Enter up to 100)

('Left' and 'Right' as viewed when looking at the wall from the outside.)

Designation	Window Width (ft)	Window Height (ft)	Overhang Projection (ft)	Overhang Offset (ft)	Left Fin Projection (ft)	Left Fin Offset (ft)	Right Fin Projection (ft)	Right Fin Offset (ft)	
ESG Type	1	1	1	0	0	0	0	0	Update Delete
ESG Type	1	1	0	0	1	0	0	0	Update Delete
ESG Type	1	1	0	0	0	0	1	0	Update Delete
ESG Type	1	1	2	0	0	0	0	0	Update Delete
ESG type 5	1	1	0	0	2	0	0	0	Update Delete
ESG Type	1	1	0	0	0	0	2	0	Update Delete
ESG Type	1	1	3	0	0	0	0	0	Update Delete
ESG Type	1	1	0	0	3	0	0	0	Update Delete
ESG type 9	1	1	0	0	0	0	3	0	Update Delete
									Enter

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating & Cooling Load Calculation

Test Company

Project Title: (MISC) **Date:** October 17, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AlTest#2 **Units:** IP

Master Load Data

15 Space Height (Floor to Structure) ft	0.5 Lighting Decimal Fraction to Return	1.2 Lighting Density W/ft^2	Occupied Only

Ventilation	15 CFM/Person	AND	0.1 CFM/ft^2	Occupied Only
Infiltration	1 Air Changes/Hour	OR	CFM/ft^2	Unoccupied Only
Load/Person	250 Sensible Btu/hr	AND	250 Latent Btu/hr	Occupied Only
Operating Hours	Start Occupied Continuous	Stop Occupied N/A		

Continue to Zones and Spaces Input Data ->

<-- To Loads Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 6

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating & Cooling Load Calculation

Test Company

Project Title: (MISC) **Date:** October 17, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AlTest#2 **Units:** IP

Zones & Spaces

Zones are groups of spaces on an air handling unit, hydronic piping controlled circuit, or other common elements deemed reasonable or necessary by the analyst.
Following is a summary of all spaces and zones entered for the calculation. After viewing, the load calculation can be executed by clicking the "Calculate" button below, or changes can be made by returning to the appropriate screen by clicking the "To Loads Menu" button below.

Summary of Spaces Entered
To view any space input screen click on a designation below:

New Zone Designation: [ ] Enter

ZONES	SPACES
#1 (Single Zone) - Remove	Add Space(s)
	#1 (Interior Space) - View/Edit - Remove
	#2 (Wall Space) - View/Edit - Remove
	#3 (Exposed Floor Space) - View/Edit - Remove
	#4 (Slab Loss Space) - View/Edit - Remove
	#5 (Space over Unconditioned) - View/Edit - Remove
	#6 (Space Adjoining) - View/Edit - Remove

Show Input Summary | Calculate | Show Executable Input

To Individual Space Input

<-- To Loads Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 7

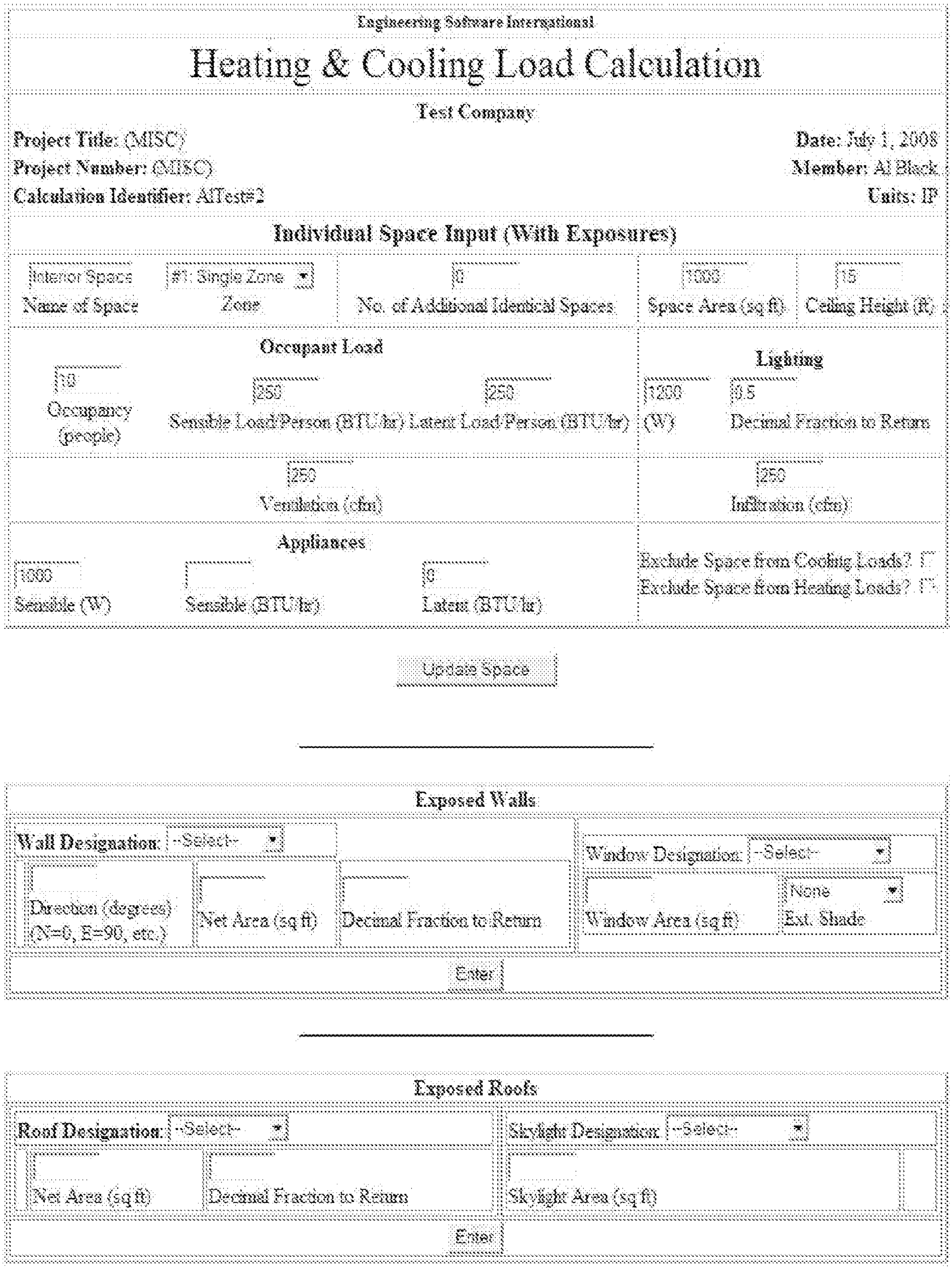

Engineering Software International
Heating & Cooling Load Calculation
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Calculation Identifier: AlTest#2
Units: IP
Individual Space Input (With Exposures)
Interior Space
Name of Space
#1: Single Zone
Zone
0
No. of Additional Identical Spaces
1000
Space Area (sq ft)
15
Ceiling Height (ft)
Occupant Load
10
Occupancy (people)
250
Sensible Load/Person (BTU/hr)
250
Latent Load/Person (BTU/hr)
Lighting
1200
(W)
0.5
Decimal Fraction to Return
250
Ventilation (cfm)
250
Infiltration (cfm)
Appliances
1000
Sensible (W)
Sensible (BTU/hr)
0
Latent (BTU/hr)
Exclude Space from Cooling Loads?
Exclude Space from Heating Loads?
Update Space
Exposed Walls
Wall Designation: --Select--
Direction (degrees) (N=0, E=90, etc.)
Net Area (sq ft)
Decimal Fraction to Return
Window Designation: --Select--
Window Area (sq ft)
None
Ext. Shade
Enter
Exposed Roofs
Roof Designation: --Select--
Net Area (sq ft)
Decimal Fraction to Return
Skylight Designation: --Select--
Skylight Area (sq ft)
Enter

Fig. 8

Doors Exposed To Outside Conditions

Door Designation None		Window Designation --Select--	
Direction (degrees) (N=0, E=90, etc.)	Door Area (sq ft)	Window Area (sq ft)	None Ext. Shade

Enter

Floors Exposed To Outside Conditions

Floor Designation None	Floor Area ft^2

Enter

Floors -- Winter Loss From Slab Perimeter

Perimeter Slab Loss F_p-Value Btu/hr-ft-°F	Net Perimeter Length ft

Enter

Floors Over Unconditioned Spaces

Floor U-Value Btu/hr-ft^2-°F	Net Floor Area ft^2	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F

Enter

Paritions Adjoining Unconditioned Spaces

Partition U-Value Btu/hr-ft^2-°F	Net Partition Area ft^2	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F

Enter

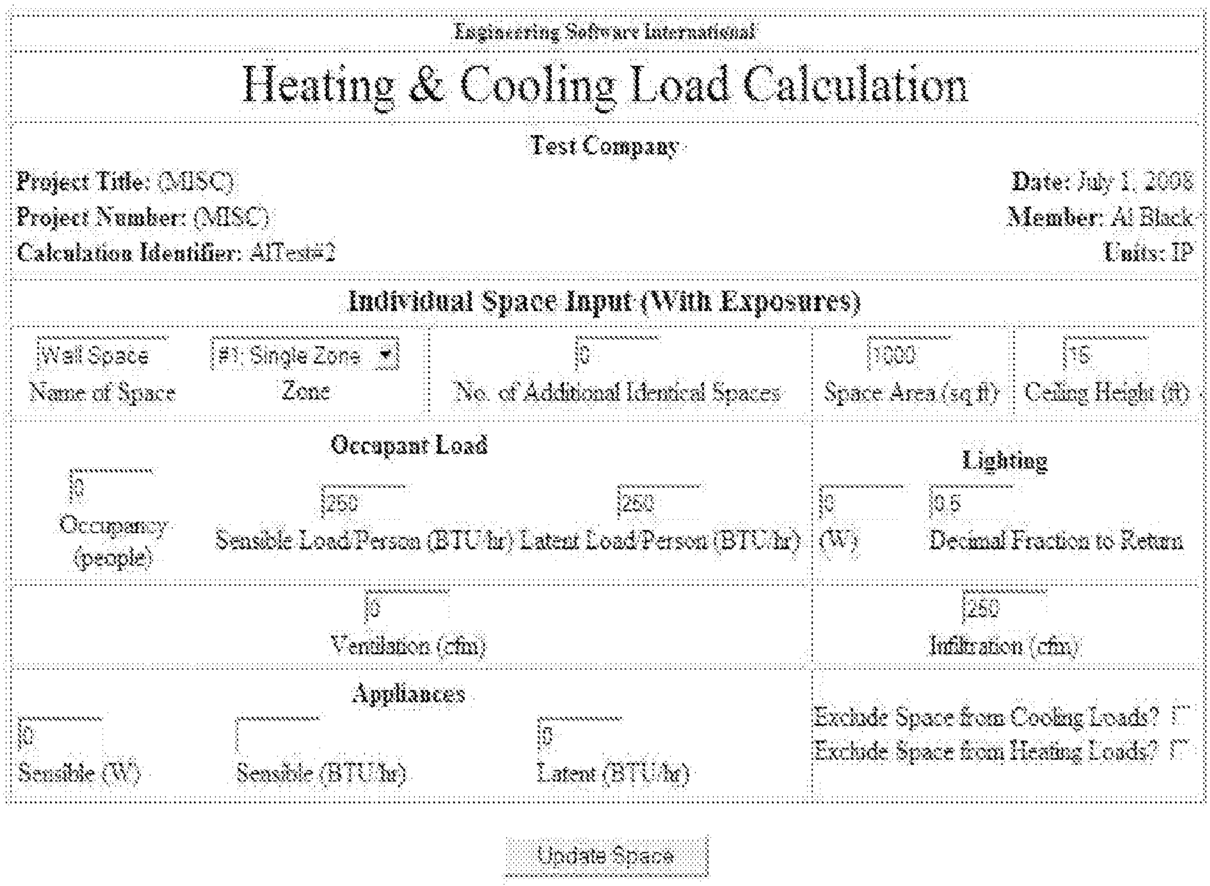
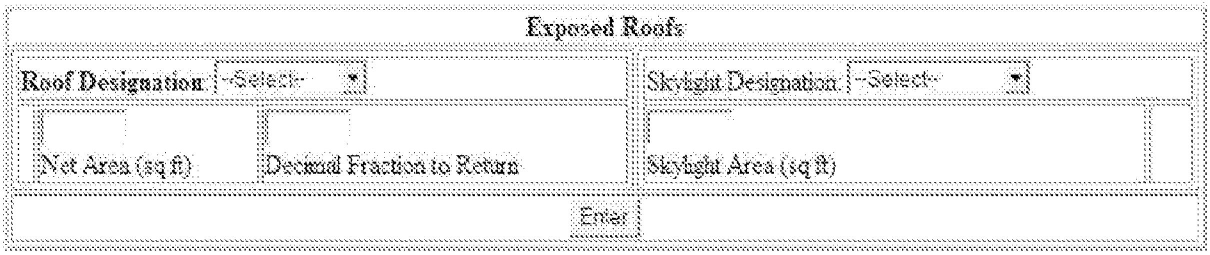
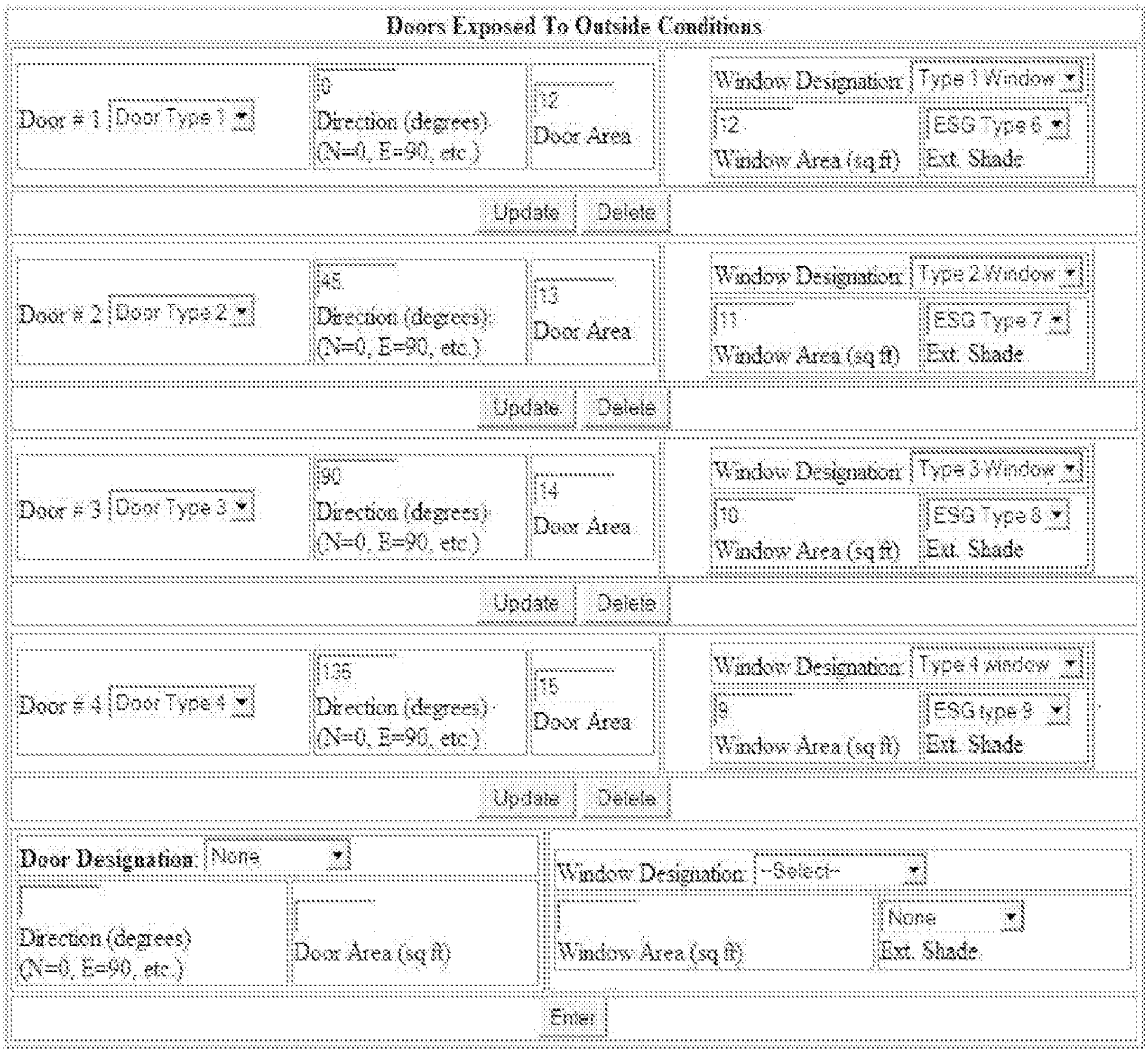
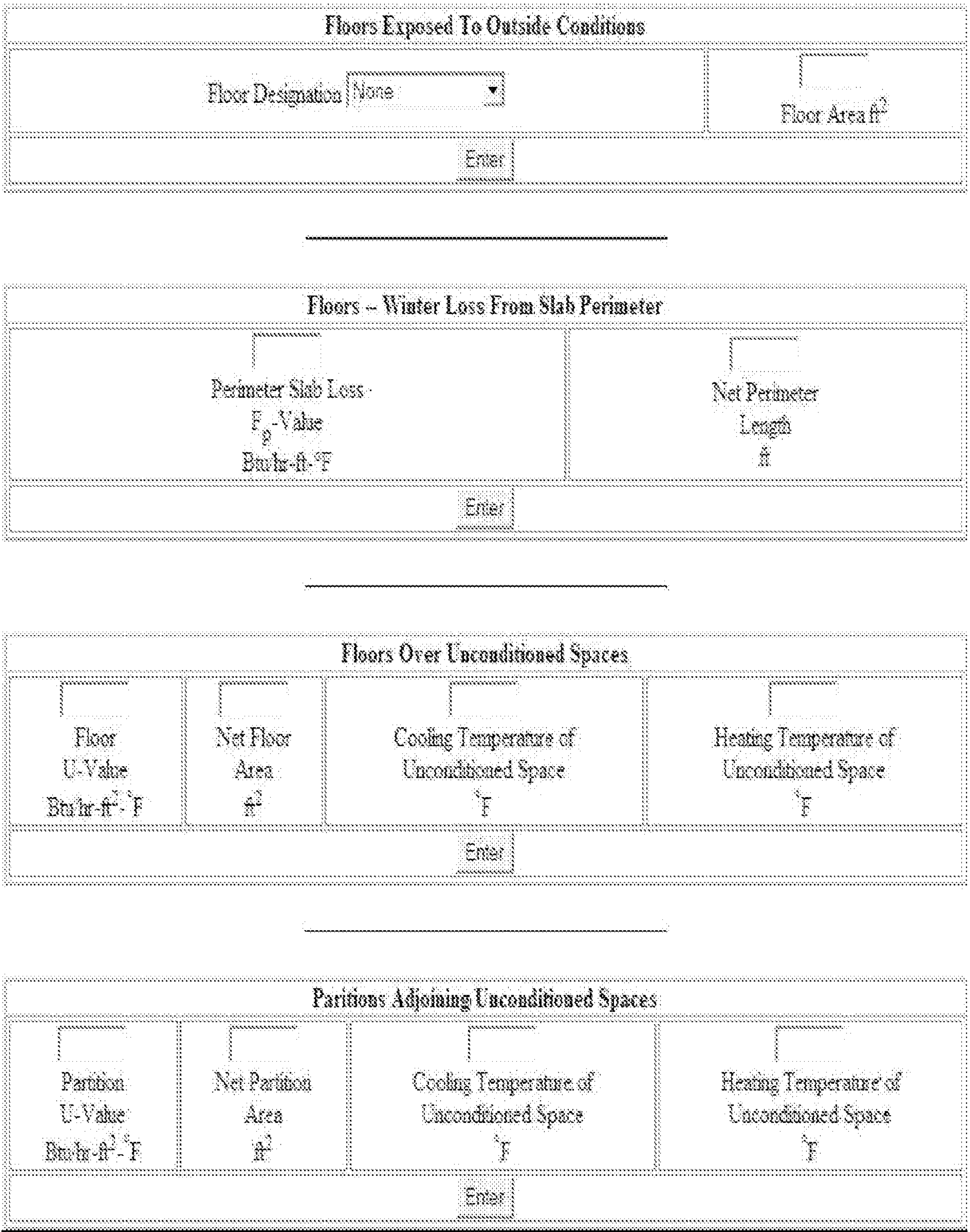

Engineering Software International
Heating & Cooling Load Calculation
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Calculation Identifier: AlTest#2
Units: IP
Individual Space Input (With Exposures)
Wall Space
Name of Space
#1: Single Zone
Zone
0
No. of Additional Identical Spaces
1000
Space Area (sq ft)
15
Ceiling Height (ft)
Occupant Load
0
Occupancy (people)
250
Sensible Load/Person (BTU/hr)
250
Latent Load/Person (BTU/hr)
Lighting
0
(W)
0.5
Decimal Fraction to Return
0
Ventilation (cfm)
250
Infiltration (cfm)
Appliances
0
Sensible (W)
Sensible (BTU/hr)
0
Latent (BTU/hr)
Exclude Space from Cooling Loads?
Exclude Space from Heating Loads?
Update Space

Fig. 9


Exposed Walls
Wall #: 1 Type 1 Wall
0 Direction (degrees) (N=0, E=90, etc.)
230 Net Area (sq ft)
0.3 Decimal Fraction to Return
Window Designation: Type 1 Window
220 Window Area (sq ft)
ESG Type 1 Ext. Shade
Update Delete
Wall #: 2 Type 2 Wall
45 Direction (degrees) (N=0, E=90, etc.)
240 Net Area (sq ft)
0.3 Decimal Fraction to Return
Window Designation: Type 2 Window
210 Window Area (sq ft)
ESG Type 2 Ext. Shade
Update Delete
Wall #: 3 Type 3 Wall
90 Direction (degrees) (N=0, E=90, etc.)
250 Net Area (sq ft)
0.3 Decimal Fraction to Return
Window Designation: Type 3 Window
200 Window Area (sq ft)
ESG Type 3 Ext. Shade
Update Delete
Wall #: 4 Type 4 Wall
135 Direction (degrees) (N=0, E=90, etc.)
260 Net Area (sq ft)
0.3 Decimal Fraction to Return
Window Designation: Type 4 window
190 Window Area (sq ft)
ESG Type 4 Ext. Shade
Update Delete
Wall #: 5 Type 5 Wall
180 Direction (degrees) (N=0, E=90, etc.)
270 Net Area (sq ft)
0.3 Decimal Fraction to Return
Window Designation: Type 5 window
180 Window Area (sq ft)
ESG type 5 Ext. Shade
Update Delete
Wall #: 6 Type 1 Wall
225 Direction (degrees) (N=0, E=90, etc.)
280 Net Area (sq ft)
0.3 Decimal Fraction to Return
Window Designation: Type 2 Window
170 Window Area (sq ft)
ESG Type 6 Ext. Shade
Update Delete
Wall Designation: --Select--
Direction (degrees) (N=0, E=90, etc.)
Net Area (sq ft)
Decimal Fraction to Return
Window Designation: --Select--
Window Area (sq ft)
None Ext. Shade
Enter


Exposed Roofs
Roof Designation: --Select--
Skylight Designation: --Select--
Net Area (sq ft)
Decimal Fraction to Return
Skylight Area (sq ft)
Enter


Doors Exposed To Outside Conditions
Door # 1 Door Type 1
0
Direction (degrees) (N=0, E=90, etc.)
12
Door Area
Window Designation: Type 1 Window
12
Window Area (sq ft)
ESG Type 6
Ext. Shade
Update
Delete
Door # 2 Door Type 2
45
Direction (degrees) (N=0, E=90, etc.)
13
Door Area
Window Designation: Type 2 Window
11
Window Area (sq ft)
ESG Type 7
Ext. Shade
Update
Delete
Door # 3 Door Type 3
90
Direction (degrees) (N=0, E=90, etc.)
14
Door Area
Window Designation: Type 3 Window
10
Window Area (sq ft)
ESG Type 8
Ext. Shade
Update
Delete
Door # 4 Door Type 4
135
Direction (degrees) (N=0, E=90, etc.)
15
Door Area
Window Designation: Type 4 window
9
Window Area (sq ft)
ESG type 9
Ext. Shade
Update
Delete
Door Designation: None
Direction (degrees) (N=0, E=90, etc.)
Door Area (sq ft)
Window Designation: --Select--
Window Area (sq ft)
None
Ext. Shade
Enter


Floors Exposed To Outside Conditions
Floor Designation
None
Floor Area ft2
Enter
Floors – Winter Loss From Slab Perimeter
Perimeter Slab Loss
Fp-Value
Btu/hr-ft-°F
Net Perimeter
Length
ft
Enter
Floors Over Unconditioned Spaces
Floor
U-Value
Btu/hr-ft2-°F
Net Floor
Area
ft2
Cooling Temperature of
Unconditioned Space
°F
Heating Temperature of
Unconditioned Space
°F
Enter
Paritions Adjoining Unconditioned Spaces
Partition
U-Value
Btu/hr-ft2-°F
Net Partition
Area
ft2
Cooling Temperature of
Unconditioned Space
°F
Heating Temperature of
Unconditioned Space
°F
Enter

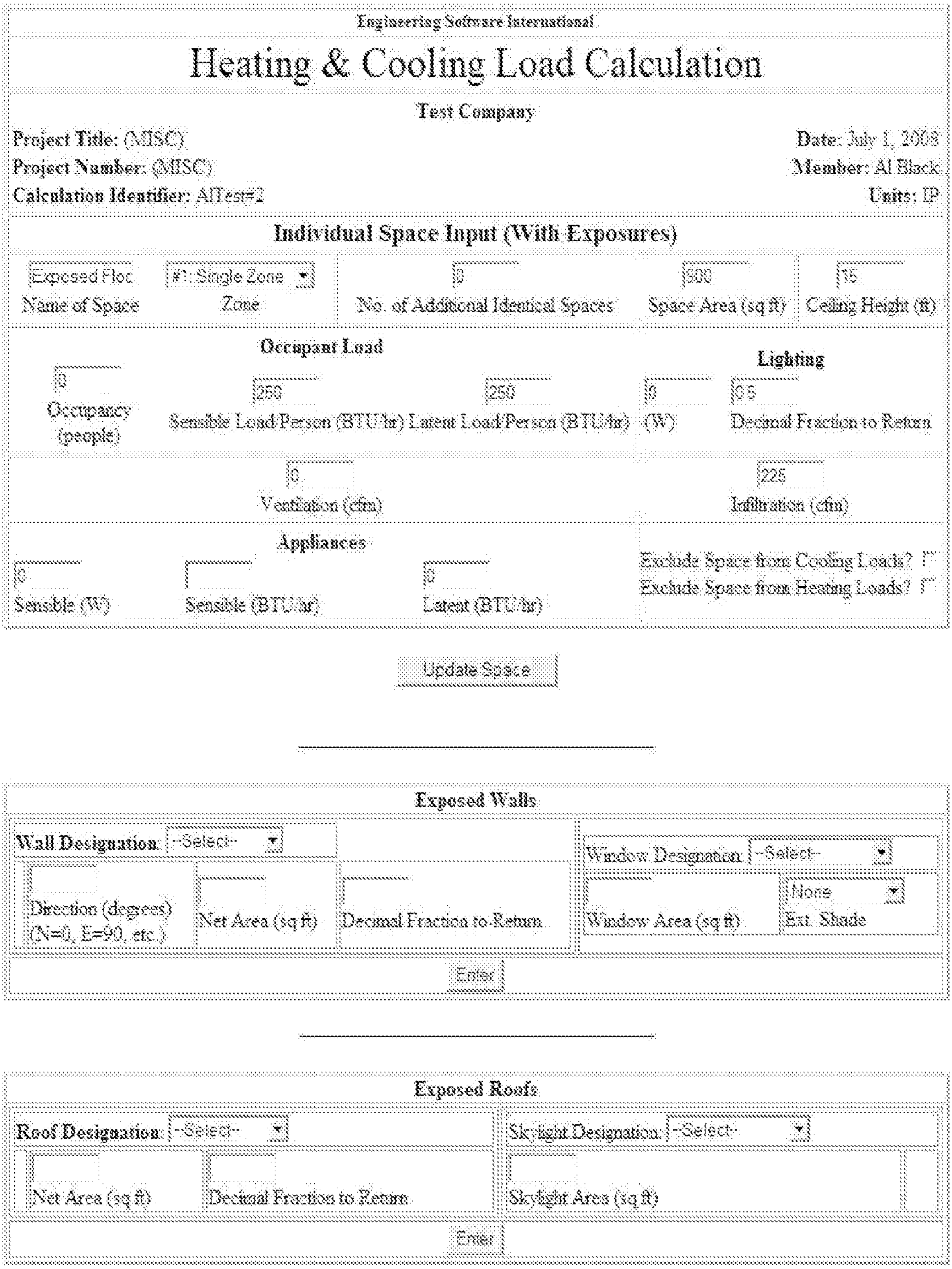

Engineering Software International
Heating & Cooling Load Calculation
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Calculation Identifier: AlTest#2
Units: IP
Individual Space Input (With Exposures)
Exposed Floc
#1: Single Zone
0
900
15
Name of Space
Zone
No. of Additional Identical Spaces
Space Area (sq ft)
Ceiling Height (ft)
Occupant Load
Lighting
0
250
250
0
0.5
Occupancy (people)
Sensible Load/Person (BTU/hr)
Latent Load/Person (BTU/hr)
(W)
Decimal Fraction to Return
0
225
Ventilation (cfm)
Infiltration (cfm)
Appliances
0
0
Sensible (W)
Sensible (BTU/hr)
Latent (BTU/hr)
Exclude Space from Cooling Loads?
Exclude Space from Heating Loads?
Update Space
Exposed Walls
Wall Designation: --Select--
Window Designation: --Select--
Direction (degrees) (N=0, E=90, etc.)
Net Area (sq ft)
Decimal Fraction to Return
Window Area (sq ft)
None
Ext. Shade
Enter
Exposed Roofs
Roof Designation: --Select--
Skylight Designation: --Select--
Net Area (sq ft)
Decimal Fraction to Return
Skylight Area (sq ft)
Enter

Fig. 10

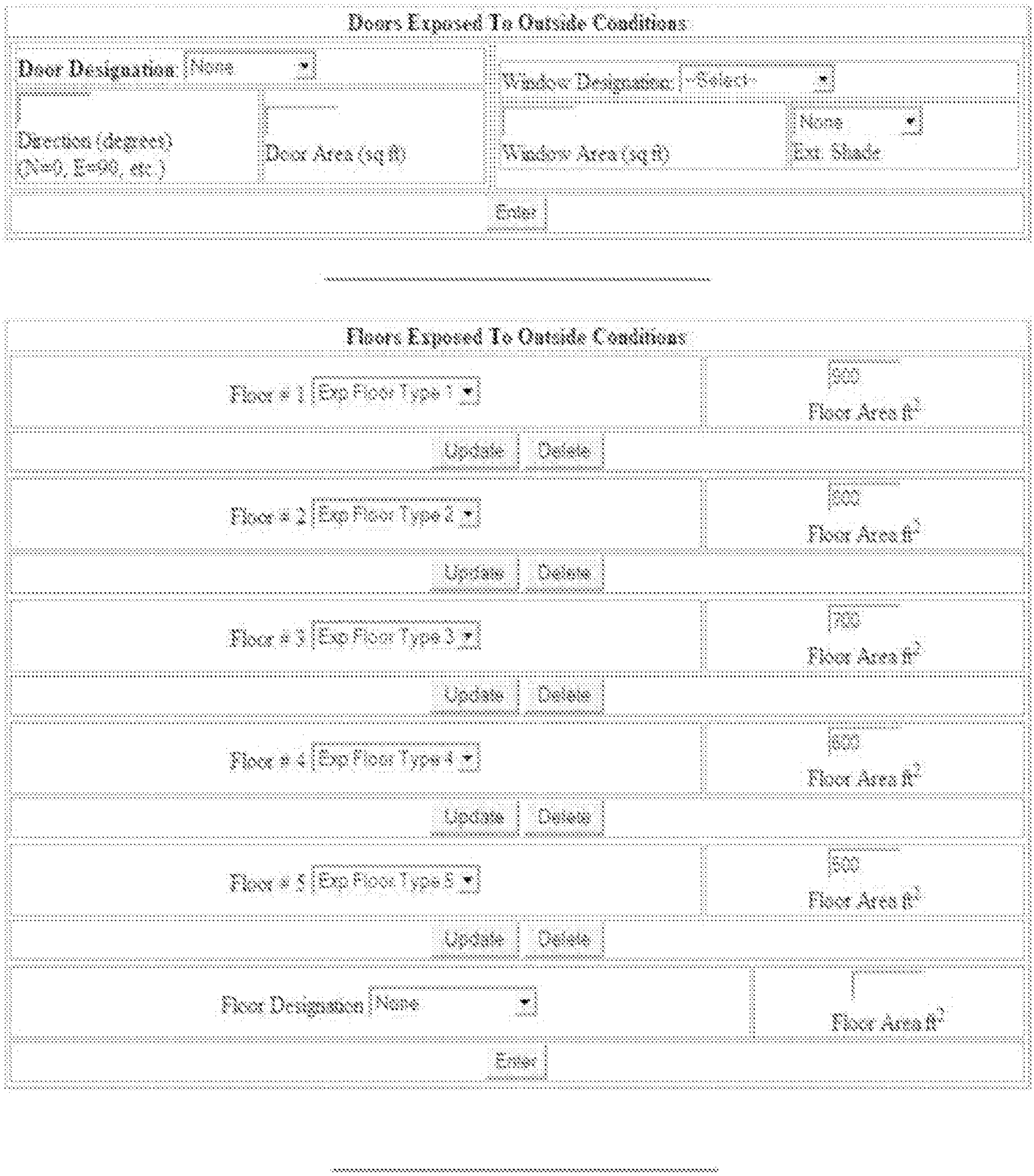

Doors Exposed To Outside Conditions
Door Designation: None
Direction (degrees) (N=0, E=90, etc.)
Door Area (sq ft)
Window Designation: --Select--
Window Area (sq ft)
None
Ext. Shade
Enter
Floors Exposed To Outside Conditions
Floor # 1 Exp Floor Type 1
900
Floor Area ft2
Update
Delete
Floor # 2 Exp Floor Type 2
800
Floor Area ft2
Update
Delete
Floor # 3 Exp Floor Type 3
700
Floor Area ft2
Update
Delete
Floor # 4 Exp Floor Type 4
600
Floor Area ft2
Update
Delete
Floor # 5 Exp Floor Type 5
500
Floor Area ft2
Update
Delete
Floor Designation None
Floor Area ft2
Enter

Fig. 10b

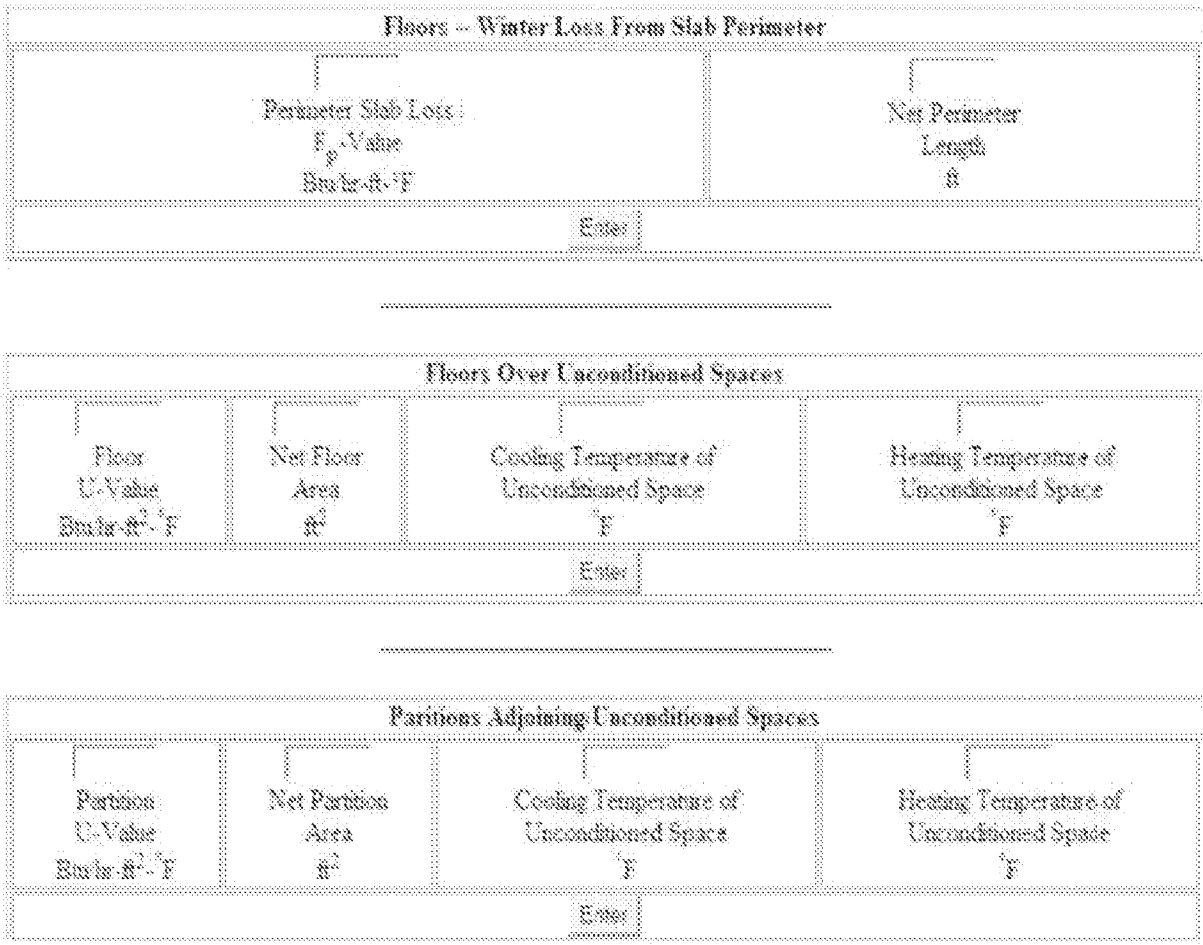

Floors – Winter Loss From Slab Perimeter
Perimeter Slab Loss
F_p-Value
Btu/hr-ft-°F
Net Perimeter
Length
ft
Enter
Floors Over Unconditioned Spaces
Floor
U-Value
Btu/hr-ft²-°F
Net Floor
Area
ft²
Cooling Temperature of
Unconditioned Space
°F
Heating Temperature of
Unconditioned Space
°F
Enter
Paritions Adjoining Unconditioned Spaces
Partition
U-Value
Btu/hr-ft²-°F
Net Partition
Area
ft²
Cooling Temperature of
Unconditioned Space
°F
Heating Temperature of
Unconditioned Space
°F
Enter

Fig. 10c

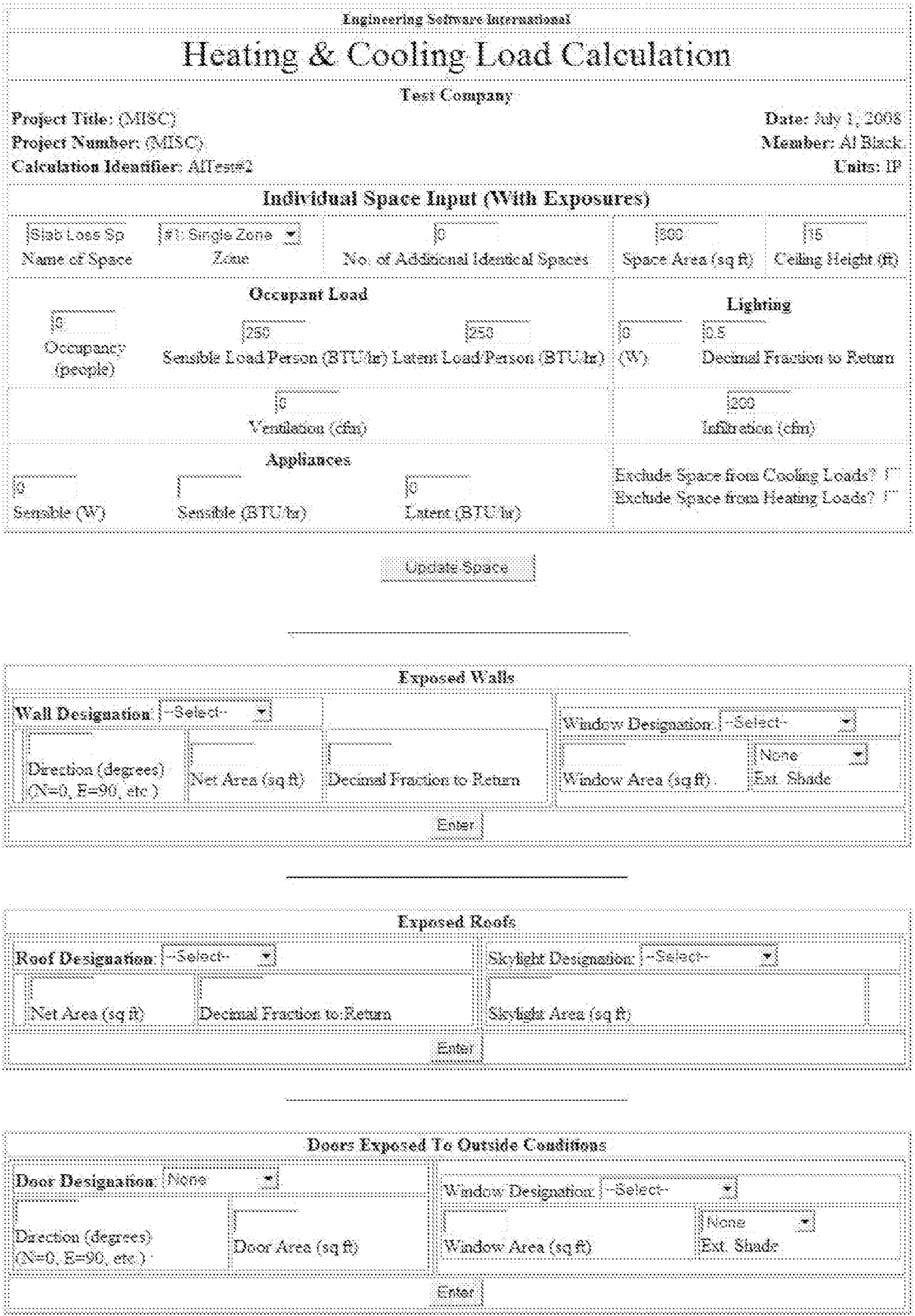

Engineering Software International
Heating & Cooling Load Calculation
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Calculation Identifier: AlTest#2
Units: IP
Individual Space Input (With Exposures)
Slab Loss Sp
Name of Space
#1: Single Zone
Zone
0
No. of Additional Identical Spaces
800
Space Area (sq ft)
15
Ceiling Height (ft)
Occupant Load
0
Occupancy (people)
250
Sensible Load/Person (BTU/hr)
250
Latent Load/Person (BTU/hr)
Lighting
0
(W)
0.5
Decimal Fraction to Return
0
Ventilation (cfm)
200
Infiltration (cfm)
Appliances
0
Sensible (W)
Sensible (BTU/hr)
0
Latent (BTU/hr)
Exclude Space from Cooling Loads?
Exclude Space from Heating Loads?
Update Space
Exposed Walls
Wall Designation --Select--
Direction (degrees) (N=0, E=90, etc.)
Net Area (sq ft)
Decimal Fraction to Return
Window Designation --Select--
Window Area (sq ft)
None
Ext. Shade
Enter
Exposed Roofs
Roof Designation --Select--
Net Area (sq ft)
Decimal Fraction to Return
Skylight Designation --Select--
Skylight Area (sq ft)
Enter
Doors Exposed To Outside Conditions
Door Designation None
Direction (degrees) (N=0, E=90, etc.)
Door Area (sq ft)
Window Designation --Select--
Window Area (sq ft)
None
Ext. Shade
Enter

Fig. 11

Floors Exposed To Outside Conditions	
Floor Designation None	Floor Area ft^2
Enter	

Floors -- Winter Loss From Slab Perimeter	
1 Perimeter Slab Loss F_p-Value Btu/hr-ft-°F	100 Net Perimeter Length ft
Update Delete	
2 Perimeter Slab Loss F_p-Value Btu/hr-ft-°F	90 Net Perimeter Length ft
Update Delete	
3 Perimeter Slab Loss F_p-Value Btu/hr-ft-°F	80 Net Perimeter Length ft
Update Delete	
4 Perimeter Slab Loss F_p-Value Btu/hr-ft-°F	70 Net Perimeter Length ft
Update Delete	
5 Perimeter Slab Loss F_p-Value Btu/hr-ft-°F	60 Net Perimeter Length ft
Update Delete	
Perimeter Slab Loss F_p-Value Btu/hr-ft-°F	Net Perimeter Length ft
Enter	

Floors Over Unconditioned Spaces			
Floor U-Value Btu/hr-ft²-°F	Net Floor Area ft²	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F
Enter			

Paritions Adjoining Unconditioned Spaces			
Partition U-Value Btu/hr-ft²-°F	Net Partition Area ft²	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F
Enter			

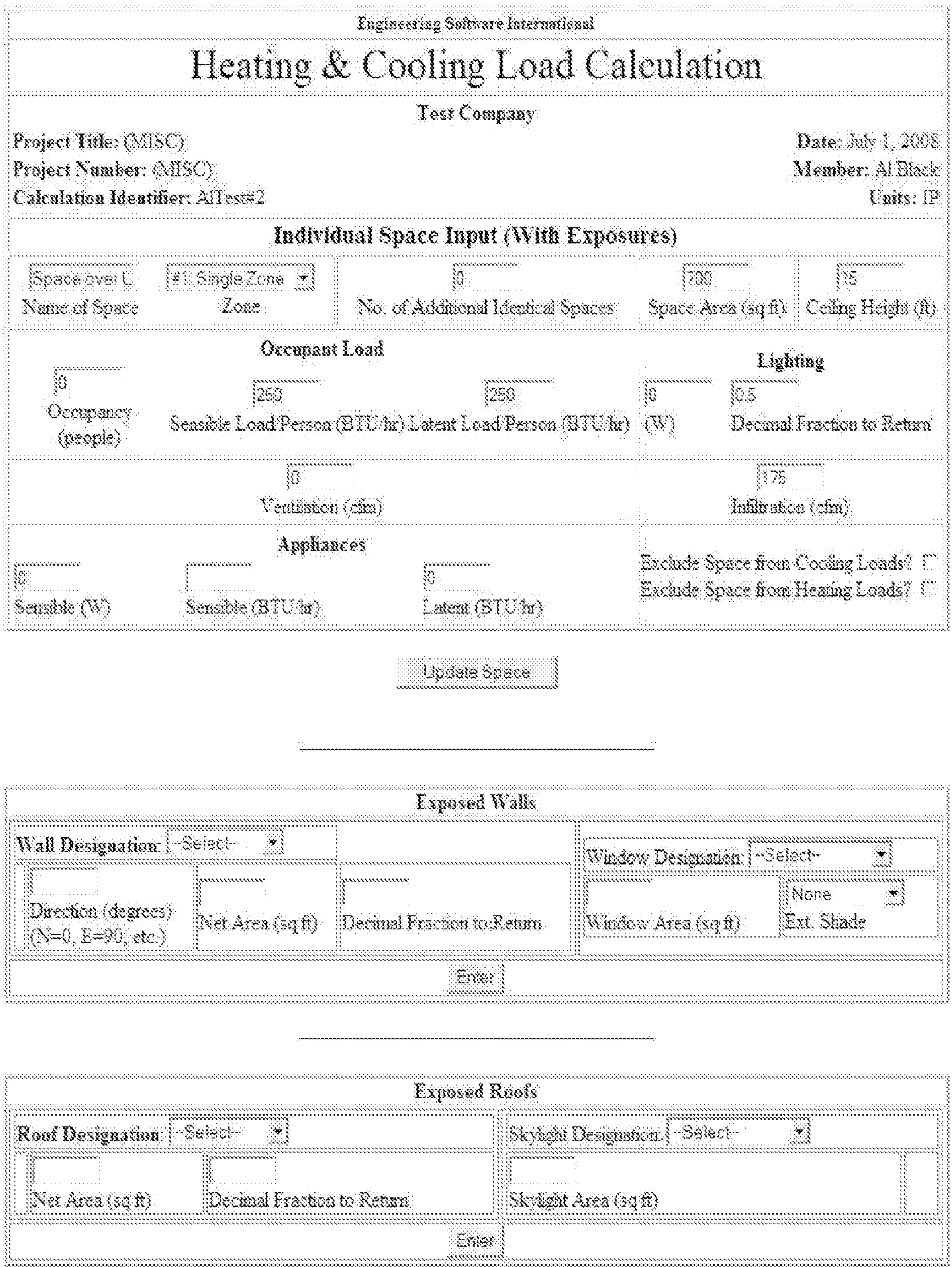

Engineering Software International
Heating & Cooling Load Calculation
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Calculation Identifier: AlTest#2
Units: IP
Individual Space Input (With Exposures)
Space over U
Name of Space
#1: Single Zone
Zone
0
No. of Additional Identical Spaces
700
Space Area (sq ft)
15
Ceiling Height (ft)
Occupant Load
0
Occupancy (people)
250
Sensible Load/Person (BTU/hr)
250
Latent Load/Person (BTU/hr)
Lighting
0
(W)
0.5
Decimal Fraction to Return
0
Ventilation (cfm)
175
Infiltration (cfm)
Appliances
0
Sensible (W)
Sensible (BTU/hr)
0
Latent (BTU/hr)
Exclude Space from Cooling Loads?
Exclude Space from Heating Loads?
Update Space
Exposed Walls
Wall Designation: --Select--
Direction (degrees) (N=0, E=90, etc.)
Net Area (sq ft)
Decimal Fraction to Return
Window Designation: --Select--
Window Area (sq ft)
None
Ext. Shade
Enter
Exposed Roofs
Roof Designation: --Select--
Net Area (sq ft)
Decimal Fraction to Return
Skylight Designation: --Select--
Skylight Area (sq ft)
Enter

Fig. 12

Doors Exposed To Outside Conditions

Door Designation: None

Direction (degrees)
(N=0, E=90, etc.)

Door Area (sq ft)

Window Designation: --Select--

Window Area (sq ft)

None
Ext. Shade

Enter

Floors Exposed To Outside Conditions

Floor Designation None

Floor Area ft^2

Enter

Floors -- Winter Loss From Slab Perimeter

Perimeter Slab Loss
F_p-Value
Btu/hr-ft-°F

Net Perimeter
Length
ft

Enter

Floors Over Unconditioned Spaces			
0.1 Floor U-Value Btu/hr-ft^2-°F	100 Net Floor Area ft^2	85 Cooling Temperature of Unconditioned Space °F	60 Heating Temperature of Unconditioned Space °F
Update Delete			
0.2 Floor U-Value Btu/hr-ft^2-°F	50 Net Floor Area ft^2	86 Cooling Temperature of Unconditioned Space °F	59 Heating Temperature of Unconditioned Space °F
Update Delete			
0.3 Floor U-Value Btu/hr-ft^2-°F	33 Net Floor Area ft^2	87 Cooling Temperature of Unconditioned Space °F	58 Heating Temperature of Unconditioned Space °F
Update Delete			
0.4 Floor U-Value Btu/hr-ft^2-°F	25 Net Floor Area ft^2	88 Cooling Temperature of Unconditioned Space °F	57 Heating Temperature of Unconditioned Space °F
Update Delete			
0.5 Floor U-Value Btu/hr-ft^2-°F	20 Net Floor Area ft^2	89 Cooling Temperature of Unconditioned Space °F	56 Heating Temperature of Unconditioned Space °F
Update Delete			
0.6 Floor U-Value Btu/hr-ft^2-°F	17 Net Floor Area ft^2	90 Cooling Temperature of Unconditioned Space °F	55 Heating Temperature of Unconditioned Space °F
Update Delete			
0.7 Floor U-Value Btu/hr-ft^2-°F	14 Net Floor Area ft^2	91 Cooling Temperature of Unconditioned Space °F	54 Heating Temperature of Unconditioned Space °F
Update Delete			

0.8 Floor U-Value Btu/hr-ft^2-°F	12 Net Floor Area ft^2	92 Cooling Temperature of Unconditioned Space °F	53 Heating Temperature of Unconditioned Space °F
Update Delete			
0.9 Floor U-Value Btu/hr-ft^2-°F	11 Net Floor Area ft^2	93 Cooling Temperature of Unconditioned Space °F	52 Heating Temperature of Unconditioned Space °F
Update Delete			
1.0 Floor U-Value Btu/hr-ft^2-°F	10 Net Floor Area ft^2	94 Cooling Temperature of Unconditioned Space °F	51 Heating Temperature of Unconditioned Space °F
Update Delete			
Floor U-Value Btu/hr-ft^2-°F	Net Floor Area ft^2	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F
Enter			

Paritions Adjoining Unconditioned Spaces			
Partition U-Value Btu/hr-ft^2-°F	Net Partition Area ft^2	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F
Enter			

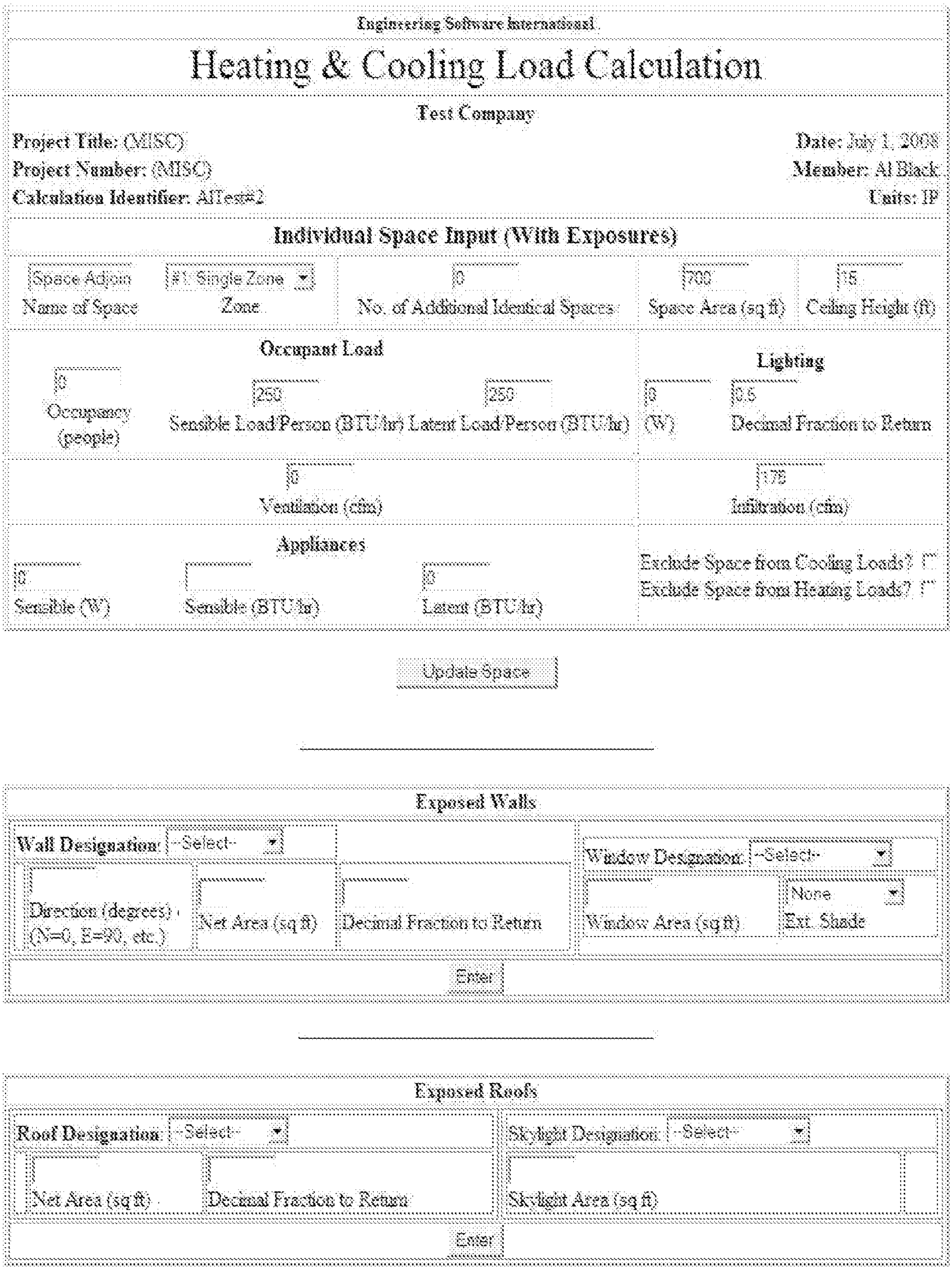
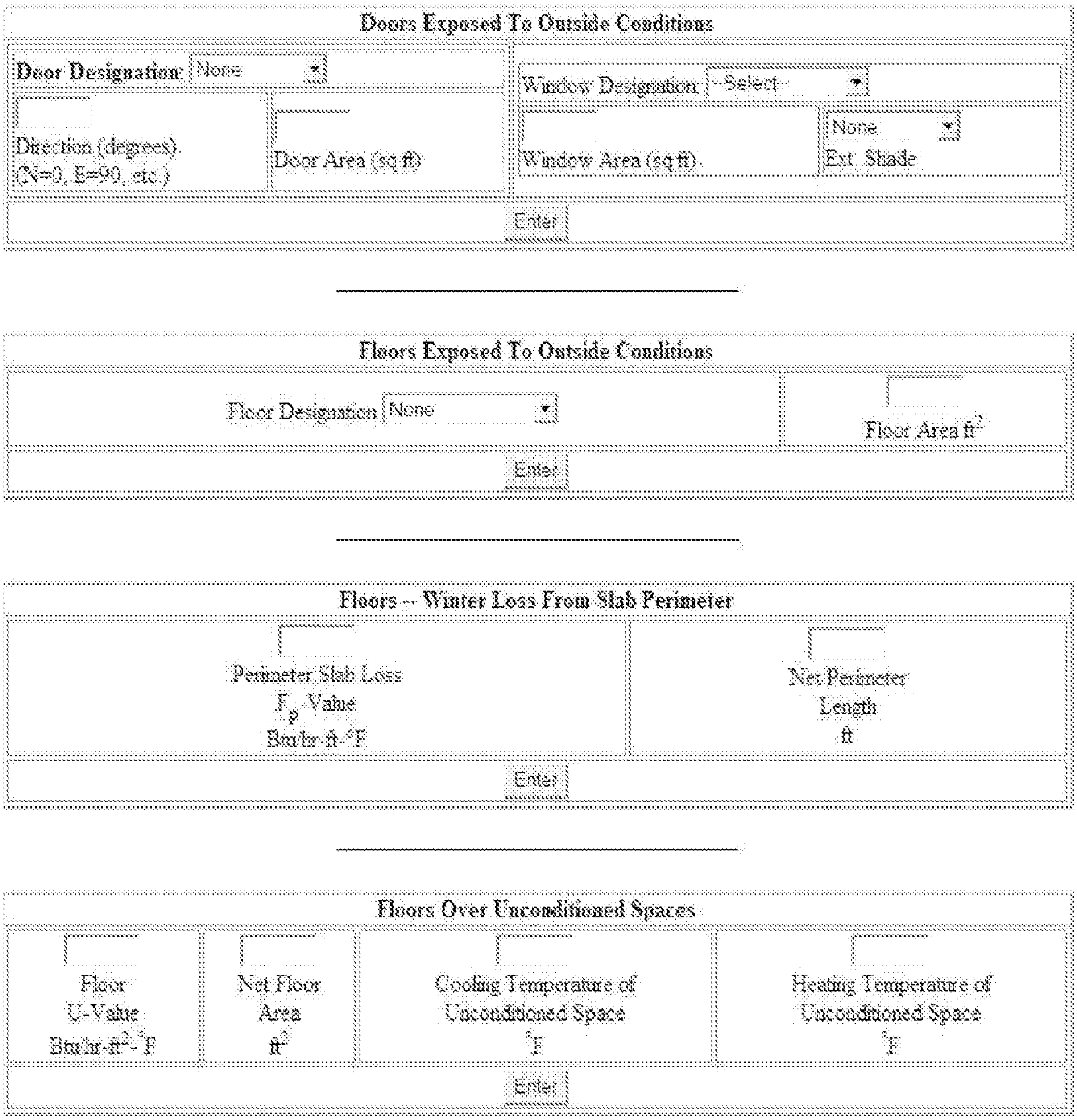

Engineering Software International
Heating & Cooling Load Calculation
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Calculation Identifier: AlTest#2
Units: IP
Individual Space Input (With Exposures)
Space Adjoin
Name of Space
#1: Single Zone
Zone
0
No. of Additional Identical Spaces
700
Space Area (sq ft)
15
Ceiling Height (ft)
Occupant Load
0
Occupancy (people)
250
Sensible Load/Person (BTU/hr)
250
Latent Load/Person (BTU/hr)
Lighting
0
(W)
0.5
Decimal Fraction to Return
0
Ventilation (cfm)
178
Infiltration (cfm)
Appliances
0
Sensible (W)
Sensible (BTU/hr)
0
Latent (BTU/hr)
Exclude Space from Cooling Loads?
Exclude Space from Heating Loads?
Update Space
Exposed Walls
Wall Designation: --Select--
Direction (degrees) (N=0, E=90, etc.)
Net Area (sq ft)
Decimal Fraction to Return
Window Designation: --Select--
Window Area (sq ft)
None
Ext. Shade
Enter
Exposed Roofs
Roof Designation: --Select--
Net Area (sq ft)
Decimal Fraction to Return
Skylight Designation: --Select--
Skylight Area (sq ft)
Enter

Fig. 13


Doors Exposed To Outside Conditions
Door Designation: None
Direction (degrees) (N=0, E=90, etc.)
Door Area (sq ft)
Window Designation: --Select--
Window Area (sq ft)
None
Ext. Shade
Enter
Floors Exposed To Outside Conditions
Floor Designation None
Floor Area ft2
Enter
Floors -- Winter Loss From Slab Perimeter
Perimeter Slab Loss
Fp-Value
Btu/hr-ft-°F
Net Perimeter
Length
ft
Enter
Floors Over Unconditioned Spaces
Floor
U-Value
Btu/hr-ft2-°F
Net Floor
Area
ft2
Cooling Temperature of
Unconditioned Space
°F
Heating Temperature of
Unconditioned Space
°F
Enter

Paritions Adjoining Unconditioned Spaces

Partition U-Value Btu/hr-ft²-°F	Net Partition Area ft²	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F	
0.1	100	95	60	Update / Delete
0.2	50	96	59	Update / Delete
0.3	33	97	58	Update / Delete
0.4	25	98	57	Update / Delete
0.5	20	99	56	Update / Delete
0.6	17	90	55	Update / Delete
0.7	14	91	54	Update / Delete

0.8 Partition U-Value Btu/hr-ft^2-°F	12 Net Partition Area ft^2	92 Cooling Temperature of Unconditioned Space °F	53 Heating Temperature of Unconditioned Space °F
Update Delete			
0.9 Partition U-Value Btu/hr-ft^2-°F	11 Net Partition Area ft^2	93 Cooling Temperature of Unconditioned Space °F	52 Heating Temperature of Unconditioned Space °F
Update Delete			
1.0 Partition U-Value Btu/hr-ft^2-°F	10 Net Partition Area ft^2	94 Cooling Temperature of Unconditioned Space °F	51 Heating Temperature of Unconditioned Space °F
Update Delete			
Partition U-Value Btu/hr-ft^2-°F	Net Partition Area ft^2	Cooling Temperature of Unconditioned Space °F	Heating Temperature of Unconditioned Space °F
Enter			

Main	Contact	Projects	Misc	Logout

Engineering Software International

Psychrometric Properties

Test Company

Project Title: (MISC) **Date:** October 17, 2007

Project Number: (MISC) **Member:** Al Black

Calculation Identifier: TestPsyc **Units:** IP

Each constituent of a mixture of perfect gases behaves as though the other constituents were not present (at least as far as pressure is concerned). - Dalton's Law

ELEVATION		BAROMETRIC PRESSURE
539 ft		14.412 psia 29.34 in Hg

PROPERTIES - ENTER TWO ONLY

Dry Bulb Temperature	tdb	95	°F
Wet Bulb Temperature	twb	78	°F
Dew Point Temperature	tdp		°F
Humidity Ratio	w		grains/lb
Humidity Ratio	w		lb/lb
Relative Humidity	rh		%
Enthalpy	h		BTU/lb
Specific Volume	v		ft^3/lb

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 14

Engineering Software International

Psychrometric Properties

Test Company

Project Title: (MISC) **Date:** July 2, 2008
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: TestPsyc **Units:** IP

Each constituent of a mixture of perfect gases behaves as though the other constituents were not present (at least as far as pressure is concerned). - Dalton's Law

ELEVATION		BAROMETRIC PRESSURE
539 ft		14.412 psia 29.34 in Hg

PROPERTIES

Dry Bulb Temperature	tdb	95	°F
Wet Bulb Temperature	twb	78	°F
Dew Point Temperature	tdp	71.92	°F
Humidity Ratio	w	120.37	grains/lb
Humidity Ratio	w	0.017196	lb/lb
Relative Humidity	rh	47.50	%
Enthalpy	h	41.77	BTU/lb
Specific Volume	v	14.65	ft^3/lb
Vapor Pressure	p_w	0.3877	psia

Printable I/O Summary

New Calculation

Within ASHRAE Standard 55 Comfort Zone? Summer NO Winter NO

Fig. 15

Main | Contact | Projects | Misc | Logout

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** October 17, 2007
Project Number: (MISC) **Member:** Al Black

Psychrometric processes can be analyzed individually (as a stand alone single process), or as a sequential series of individual processes. To perform a single stand-alone process, select the process from the menu below, and click the "Proceed" button. To analyze a series of processes, select the first process in the series from the menu and click the "Proceed" button.

NOTE: When you're done chaining processes, click the 'To Psychrometric Processes Menu' button to finalize the chaining process. (NOTE: Clicking 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also finalize the chain).

Menu of Processes

- ◉ 1. Mixing Process
- ○ 2. Cooling and Dehumidifying Process
- ○ 3. Sensible Heating or Cooling Process
- ○ 4. Isothermal Humidification Process
- ○ 5. Evaporative Cooling Process
- ○ 6. Differences Between Two State Points

Proceed

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 16

Main | Contact | Projects | Misc | Logout

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** October 17, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest **Units:** IP

MIXING PROCESS

Elevation	Barometric Pressure
539 ft	14.412 psia 29.34 in Hg

Mixed Air Flow Rate 10000 acfm

Mixing Ratio

Use either percent of stream or volume flow rate for stream. Fill in either Stream 1 or Stream 2.

◉ Percent of Stream by Mass	Stream 1 20 %	Stream 2 80 %
○ Volume Flow Rate	Stream 1 acfm	Stream 2 acfm

		Stream 1 (enter two only)		Stream 2 (enter two only)	
Dry Bulb Temperature	tdb	95	°F	75	°F
Wet Bulb Temperature	twb	78	°F		°F
Dew Point Temperature	tdp		°F		°F
Humidity Ratio	w		gr/lb		gr/lb
Humidity Ratio	w		lb/lb		lb/lb
Relative Humidity	rh		%	50	%
Enthalpy	h		BTU/lb		BTU/lb
Specific Volume	v		ft^3/lb		ft^3/lb

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 17

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest **Units:** IP

MIXING PROCESS

Elevation	Barometric Pressure
539 ft	14.412 psia 29.34 in Hg

Mixed Air Flow Rate: 10000 acfm

Mixing Ratio

Use either percent of stream or volume flow rate for stream. Fill in either Stream 1 or Stream 2.

◉ Percent of Stream by Mass Stream 1: **20%** Stream 2: **80%**

○ Volume Flow Rate

		Stream 1	Stream 2	Mixed Stream
Dry Bulb Temperature	tdb	**95.00 °F**	75.00 °F	79.02 °F
Wet Bulb Temperature	twb	**78.00 °F**	62.46 °F	66.02 °F
Dew Point Temperature	tdp	71.92 °F	55.12 °F	59.26 °F
Humidity Ratio	w	120.37 gr/lb	65.95 gr/lb	76.76 gr/lb
Humidity Ratio	w	0.017196 lb/lb	0.009421 lb/lb	0.010966 lb/lb
Relative Humidity	rh	47.50 %	**50.00 %**	50.82 %
Enthalpy	h	41.77 BTU/lb	28.31 BTU/lb	30.99 BTU/lb
Specific Volume	v	14.65 ft^3/lb	13.95 ft^3/lb	14.09 ft^3/lb
Vapor Pressure	p_g	0.3877 psia	0.2150 psia	0.2497 psia
Air Flow Rate	ACFM	2067 acfm	7933 acfm	10000 acfm

Chain Output into the Following Process [Select from Menu ▾]

[Proceed]

Fig. 18

Main | Contact | Projects | Misc | Logout

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** October 17, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest2 **Units:** IP

COOLING AND DEHUMIDIFYING PROCESS

Elevation	Barometric Pressure
539 ft	14.412 psia 29.34 in Hg

Initial Air Flow Rate 10000 acfm

		Initial State (enter two only)		Final State (enter two only)	
Dry Bulb Temperature	tdb	80	°F	55	°F
Wet Bulb Temperature	twb	67	°F	54.5	°F
Dew Point Temperature	tdp		°F		°F
Humidity Ratio	w		gr/lb		gr/lb
Humidity Ratio	w		lb/lb		lb/lb
Relative Humidity	rh		%		%
Enthalpy	h		BTU/lb		BTU/lb
Specific Volume	v		ft^3/lb		ft^3/lb

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 19

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest2 **Units:** IP

COOLING AND DEHUMIDIFYING PROCESS

Elevation	**Barometric Pressure**
539 ft	14.412 psia 29.34 in Hg

Initial Air Flow Rate **10000** acfm

		Initial State	**Final State**	**|Difference|**
Dry Bulb Temperature	tdb	**80.00** °F	**55.00** °F	25.00 °F
Wet Bulb Temperature	twb	**67.00** °F	**54.50** °F	12.50 °F
Dew Point Temperature	tdp	60.47 °F	54.16 °F	6.31 °F
Humidity Ratio	w	80.20 gr/lb	63.65 gr/lb	16.55 gr/lb
Humidity Ratio	w	0.011457 lb/lb	0.009093 lb/lb	0.002364 lb/lb
Relative Humidity	rh	51.38 %	96.99 %	45.61 %
Enthalpy	h	31.76 BTU/lb	23.07 BTU/lb	8.69 BTU/lb
Specific Volume	v	14.13 ft^3/lb	13.42 ft^3/lb	0.70 ft^3/lb
Vapor Pressure	p_w	0.2607 psia	0.2077 psia	0.0530 psia
Air Flow Rate	ACFM	10000 acfm	9501 acfm	499 acfm

Energy Requirement		**Cooling**
	Sensible	258977 BTU/hr
	Latent	110082 BTU/hr
	Total	369060 BTU/hr

Chain Output into the Following Process [Select from Menu]
[Proceed]

Fig. 20

Main | Contact | Projects | Misc | Logout

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** October 17, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest3 **Units:** IP

SENSIBLE HEATING OR COOLING PROCESS

Elevation	Barometric Pressure
539 ft	14.412 psia 29.34 in Hg

Initial Air Flow Rate 10000 acfm

		Initial State (enter two only)	Final State (enter dry bulb)
Dry Bulb Temperature	tdb	55 °F	65 °F
Wet Bulb Temperature	twb	54.5 °F	
Dew Point Temperature	tdp	°F	
Humidity Ratio	w	gr/lb	
Humidity Ratio	w	lb/lb	
Relative Humidity	rh	%	
Enthalpy	h	BTU/lb	
Specific Volume	v	ft^3/lb	

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 21

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest3 **Units:** IP

SENSIBLE HEATING OR COOLING PROCESS

Elevation	**Barometric Pressure**
539 ft	14.412 psia 29.34 in Hg

Initial Air Flow Rate **10000** acfm

		Initial State	**Final State**	**|Difference|**
Dry Bulb Temperature	tdb	**55.00 °F**	**65.00 °F**	10.00 °F
Wet Bulb Temperature	twb	**54.50 °F**	58.37 °F	3.87 °F
Dew Point Temperature	tdp	54.16 °F	54.16 °F	0.00 °F
Humidity Ratio	w	63.65 gr/lb	63.65 gr/lb	0.00 gr/lb
Humidity Ratio	w	0.009093 lb/lb	0.009093 lb/lb	0.000000 lb/lb
Relative Humidity	rh	96.99 %	67.92 %	29.07 %
Enthalpy	h	23.07 BTU/lb	25.51 BTU/lb	2.44 BTU/lb
Specific Volume	v	13.42 ft^3/lb	13.68 ft^3/lb	0.26 ft^3/lb
Vapor Pressure	p_w	0.2077 psia	0.2077 psia	0.0000 psia
Air Flow Rate	ACFM	10000 acfm	10194 acfm	194 acfm

Energy Requirement **Heating**

Sensible 109030 BTU/hr

Chain Output into the Following Process [Select from Menu]

[Proceed]

Fig. 22

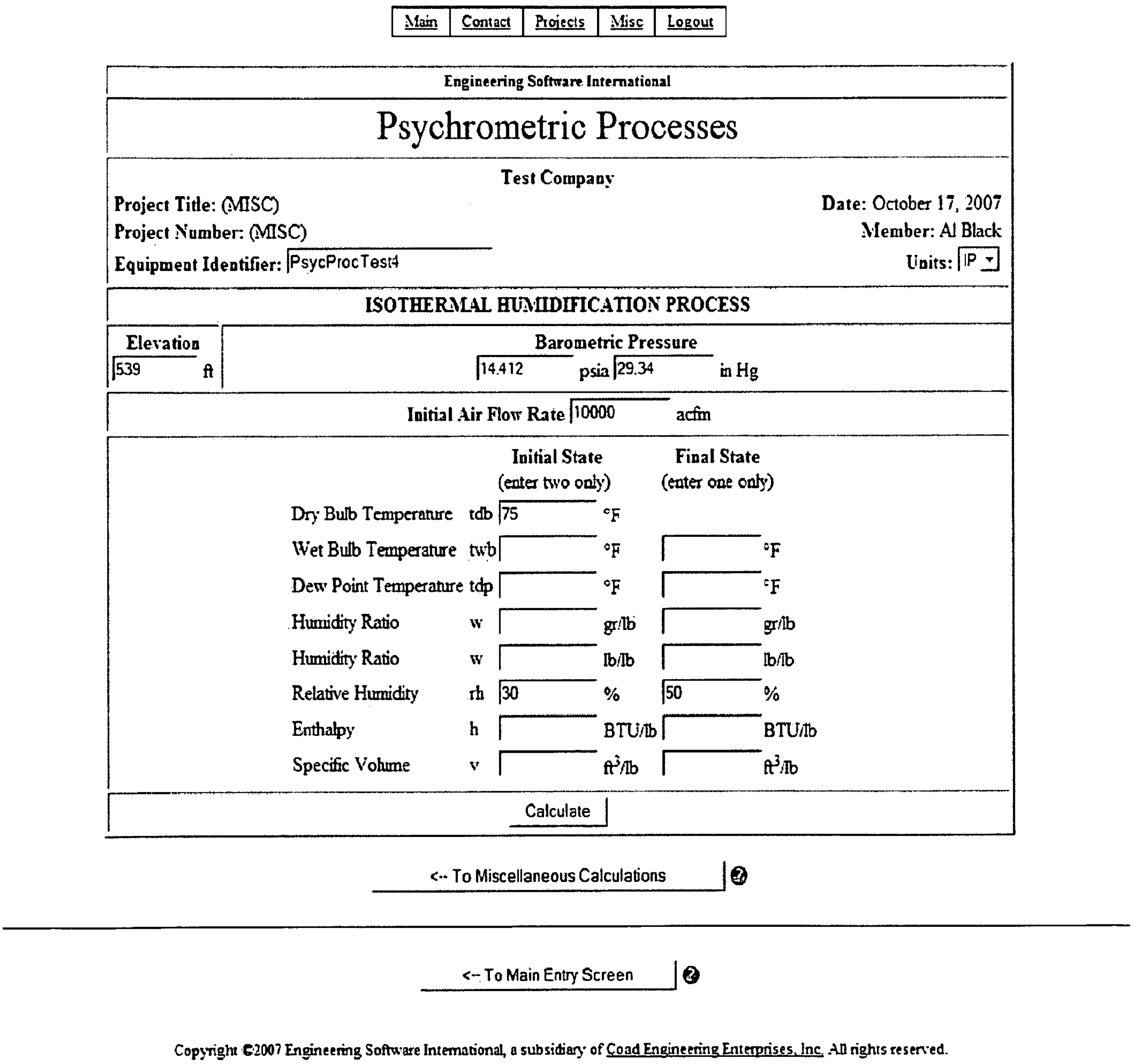

Main
Contact
Projects
Misc
Logout
Engineering Software International
Psychrometric Processes
Test Company
Project Title: (MISC)
Date: October 17, 2007
Project Number: (MISC)
Member: Al Black
Equipment Identifier: PsycProcTest4
Units: IP
ISOTHERMAL HUMIDIFICATION PROCESS
Elevation
539 ft
Barometric Pressure
14.412 psia 29.34 in Hg
Initial Air Flow Rate 10000 acfm
Initial State (enter two only)
Final State (enter one only)
Dry Bulb Temperature tdb 75 °F
Wet Bulb Temperature twb °F °F
Dew Point Temperature tdp °F °F
Humidity Ratio w gr/lb gr/lb
Humidity Ratio w lb/lb lb/lb
Relative Humidity rh 30 % 50 %
Enthalpy h BTU/lb BTU/lb
Specific Volume v ft3/lb ft3/lb
Calculate
<-- To Miscellaneous Calculations
<-- To Main Entry Screen
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Fig. 23

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest4 **Units:** IP

ISOTHERMAL HUMIDIFICATION PROCESS

Elevation	**Barometric Pressure**
539 ft	14.412 psia 29.34 in Hg

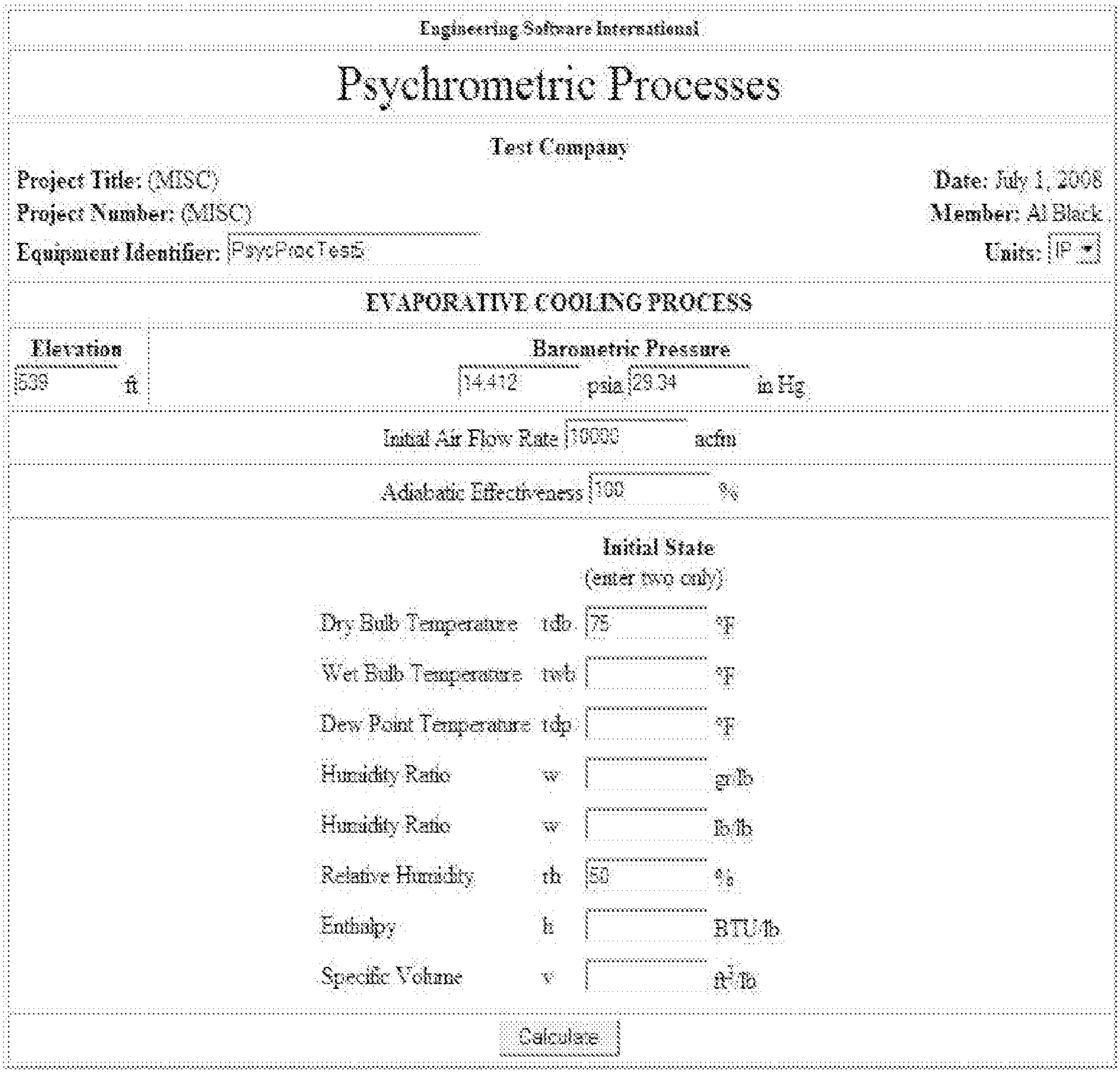
Initial Air Flow Rate **10000** acfm

		Initial State	**Final State**	**|Difference|**
Dry Bulb Temperature	tdb	**75.00 °F**	75.00 °F	0.00 °F
Wet Bulb Temperature	twb	56.38 °F	62.46 °F	6.08 °F
Dew Point Temperature	tdp	41.50 °F	55.12 °F	13.62 °F
Humidity Ratio	w	39.33 gr/lb	65.95 gr/lb	26.62 gr/lb
Humidity Ratio	w	0.005619 lb/lb	0.009421 lb/lb	0.003802 lb/lb
Relative Humidity	rh	**30.00 %**	**50.00 %**	20.00 %
Enthalpy	h	24.15 BTU/lb	28.31 BTU/lb	4.16 BTU/lb
Specific Volume	v	13.87 ft^3/lb	13.95 ft^3/lb	0.08 ft^3/lb
Vapor Pressure	p_w	0.1290 psia	0.2150 psia	0.0860 psia
Air Flow Rate	ACFM	10000 acfm	10061 acfm	61 acfm

Energy Requirement	**Heating**
Sensible	0 BTU/hr
Latent	180032 BTU/hr
Total	180032 BTU/hr

Chain Output into the Following Process [Select from Menu]
[Proceed]

Fig. 24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Psychrometric Processes
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Equipment Identifier: PsycProcTest5
Units: IP
EVAPORATIVE COOLING PROCESS
Elevation
539 ft
Barometric Pressure
14.412 psia 29.34 in Hg
Initial Air Flow Rate 10000 acfm
Adiabatic Effectiveness 100 %
Initial State
(enter two only)
Dry Bulb Temperature tdb 75 °F
Wet Bulb Temperature twb °F
Dew Point Temperature tdp °F
Humidity Ratio w gr/lb
Humidity Ratio w lb/lb
Relative Humidity rh 50 %
Enthalpy h BTU/lb
Specific Volume v ft³/lb
Calculate

Fig. 25

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: PsycProcTest5 **Units:** IP

EVAPORATIVE COOLING PROCESS

Elevation	**Barometric Pressure**
539 ft	14.412 psia 29.34 in Hg

Initial Air Flow Rate **10000** acfm

Adiabatic Effectiveness **100%**

		Initial State	**Final State**	**|Difference|**
Dry Bulb Temperature	tdb	**75.00** °F	62.46 °F	12.54 °F
Wet Bulb Temperature	twb	62.46 °F	62.46 °F	0.00 °F
Dew Point Temperature	tdp	55.12 °F	62.46 °F	7.34 °F
Humidity Ratio	w	65.95 gr/lb	86.18 gr/lb	20.23 gr/lb
Humidity Ratio	w	0.009421 lb/lb	0.012311 lb/lb	0.002890 lb/lb
Relative Humidity	rh	**50.00** %	100.00 %	50.00 %
Enthalpy	h	28.31 BTU/lb	28.40 BTU/lb	0.09 BTU/lb
Specific Volume	v	13.95 ft^3/lb	13.69 ft^3/lb	0.26 ft^3/lb
Vapor Pressure	p_H	0.2150 psia	0.2797 psia	0.0647 psia
Air Flow Rate	ACFM	10000 acfm	9810 acfm	190 acfm

Chain Output into the Following Process [Select from Menu ▾]
[Proceed]

Fig. 26

Main | Contact | Projects | Misc | Logout

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) Date: October 17, 2007
Project Number: (MISC) Member: Al Black
Calculation Identifier: PsycProc6 Units: IP

DIFFERENCES BETWEEN TWO STATE POINTS

Elevation	Barometric Pressure
539 ft	14.412 psia 29.34 in Hg

		State Point 1 (enter two only)		State Point 2 (enter two only)	
Dry Bulb Temperature	tdb	95	°F	55	°F
Wet Bulb Temperature	twb	78	°F	54.5	°F
Dew Point Temperature	tdp		°F		°F
Humidity Ratio	w		gr/lb		gr/lb
Humidity Ratio	w		lb/lb		lb/lb
Relative Humidity	rh		%		%
Enthalpy	h		BTU/lb		BTU/lb
Specific Volume	v		ft³/lb		ft³/lb

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 27

Engineering Software International

Psychrometric Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: PsycProc6 **Units:** IP

DIFFERENCES BETWEEN TWO STATE POINTS

Elevation	Barometric Pressure
539 ft	14.412 psia 29.34 in Hg

		State Point 1	State Point 2	|Difference|
Dry Bulb Temperature	tdb	95.00 °F	55.00 °F	40.00 °F
Wet Bulb Temperature	twb	78.00 °F	54.50 °F	23.50 °F
Dew Point Temperature	tdp	71.92 °F	54.16 °F	17.75 °F
Humidity Ratio	w	120.37 gr/lb	63.65 gr/lb	56.72 gr/lb
Humidity Ratio	w	0.017196 lb/lb	0.009093 lb/lb	0.008103 lb/lb
Relative Humidity	rh	47.50 %	96.99 %	49.49 %
Enthalpy	h	41.77 BTU/lb	23.07 BTU/lb	18.70 BTU/lb
Specific Volume	v	14.65 ft^3/lb	13.42 ft^3/lb	1.23 ft^3/lb
Vapor Pressure	p_w	0.3877 psia	0.2077 psia	0.1800 psia

Fig. 28

Main	Contact	Projects	Misc	Logout

Engineering Software International

Heating and Cooling Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: **Units:** IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil	Elevation	Barometric Pressure
◉ Cooling/Dehumidifying ○ Heating	539 ft	14.412 psia 29.34 in Hg

FLUID

◉ Liquid	○ Refrigerant

Water

Percent Glycol
NA %

Freezing Temperature
32 °F

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Proceed

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 29

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating and Cooling Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: **Units:** IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil	Elevation	Barometric Pressure
◉ Cooling/Dehumidifying ○ Heating	539 ft	14.412 psia 29.34 in Hg

FLUID

○ Liquid	◉ Refrigerant
	Saturated Suction Temperature °F

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Proceed

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 30

Main	Contact	Projects	Misc	Logout

Engineering Software International

Cooling/Dehumidifying Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Liquid: Water
Freezing Temp: 32 °F
Elevation: 539 ft

Physical Characteristics of Coil

Enter all of the following.

Coil Height, H:	[ ] in	Fin Type:	Flat
Coil Width, W:	[ ] in	Fins per Inch (FPI):	8
Rows:	2	Fin Spacing:	0.125 in
Circuiting:	Half		

Entering Conditions

Enter all of the following.

Air Flow Rate Actual, ACFM	[ ]	ft^3/min
Entering Air Dry Bulb Temperature, EDB	[ ]	°F
Entering Air Wet Bulb Temperature, EWB	[ ]	°F
Entering Liquid Temperature, ELT	[ ]	°F

Performance Conditions

Enter one of the following.

Leaving Air Dry Bulb Temperature, LDB	[ ]	°F
Leaving Liquid Temperature, LLT	[ ]	°F
Liquid Flow Rate, GPM	[ ]	gal/min

If this coil cannot provide the leaving conditions required with the fluid provided, the calculation will indicate the best it can do with the conditions given. The analyst may then "recalculate" and, exercising engineering judgment, change the input as required to achieve the desired performance. NOTE: It may be helpful to "recalculate" via accessing (and perhaps printing) the calculation's "Printable I/O Summary" (available via the footer of that same name) and then running the calculation anew via selecting the "New Calculation" footer.

Calculate

<-- To Coil Diagnostics Main Screen

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 31

Main	Contact	Projects	Misc	Logout

Engineering Software International

Cooling/Dehumidifying Coil Diagnostics

Test Company

Project Title: (MISC)	**Date:** November 29, 2007
Project Number: (MISC)	**Member:** Al Black
Equipment Identifier: AAA	**Units:** IP

Tube Side: Liquid: Water
Freezing Temp: 32 °F
Elevation: 539 ft

Coil Description, Input

Coil Height: 48 in	Tubes High: 32
Coil Width: 60 in	Fin Type: Flat
Rows: 8	Fins per Inch: 8
Circuiting: Full	Fin Spacing: 0.125 in

Entering Conditions, Input

Air Flow Rate: 10000 acfm	Entering Liquid Temp: 45 °F
Entering Air Dry Bulb Temp: 95 °F	
Entering Air Wet Bulb Temp: 78 °F	

Performance Conditions

Leaving Air Dry Bulb Temperature, LDB: 55 °F

Coil Performance, Output

Air Side

Air Flow Rate: 9,256 scfm	Entering Face Velocity: 463 ft/min
Coil Face Area: 20.00 ft^2	Leaving Dry Bulb Temp: 55.00 °F
Total Heat Transfer: 766,768 BTU/hr	Leaving Wet Bulb Temp: 54.96 °F
Sensible Heat Transfer: 404,843 BTU/hr	Leaving Dew Point Temp: 54.93 °F
Sensible Heat Ratio: 0.53	Air Pressure Drop: 0.5 in w.c.

Liquid Side

Liquid Flow Rate: 155.1 gpm	Leaving Liquid Temperature: 54.84 °F
Liquid Pressure Drop: 14.9 ft	Liquid Temperature Rise: 9.84 °F
Liquid Volume of Coil: 19.90 gal	Liquid Velocity: 5.6 ft/sec

Printable I/O Summary

New Calculation

<-- To Miscellaneous Calculations

Fig. 32

Main	Contact	Projects	Misc	Logout

Engineering Software International

Cooling/Dehumidifying Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Refrigerant
Saturated Suction Temp: 40 °F
Elevation: 539 ft

Physical Characteristics of Coil

Enter all of the following.

Coil Height, H:	[ ] in	Fin Type:	Flat
Coil Width, W:	[ ] in	Fins per Inch (FPI):	8
Rows:	2	Fin Spacing:	0.125 in

Entering Conditions

Enter all of the following.

Air Flow Rate Actual, ACFM	[ ]	ft^3/min
Entering Air Dry Bulb Temperature, EDB	[ ]	°F
Entering Air Wet Bulb Temperature, EWB	[ ]	°F

If this coil cannot provide the leaving conditions required with the fluid provided, the calculation will indicate the best it can do with the conditions given. The analyst may then "recalculate" and, exercising engineering judgment, change the input as required to achieve the desired performance. NOTE: It man be helpful to "recalculate" via accessing (and perhaps printing) the calculation's "Printable I/O Summary" (available via the footer of that same name) and then running the calculation anew via selecting the "New Calculation" footer.

Calculate

<-- To Coil Diagnostics Main Screen

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 33

Main | Contact | Projects | Misc | Logout

Engineering Software International

Cooling/Dehumidifying Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** November 29, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Refrigerant
Saturated Suction Temp: 40 °F
Elevation: 539 ft

Coil Description, Input

Coil Height: 48 in Tubes High: 32
Coil Width: 60 in Fin Type: Flat
Rows: 8 Fins per Inch: 8
Fin Spacing: 0.125 in

Entering Conditions, Input

Air Flow Rate: 10000 acfm Saturated Suction Temp: 40 °F
Entering Air Dry Bulb Temp: 95 °F
Entering Air Wet Bulb Temp: 78 °F

Performance Conditions

Coil Performance, Output

Air Side

Air Flow Rate: 9,256 scfm Entering Face Velocity: 463 ft/min
Coil Face Area: 20.00 ft^2 Leaving Dry Bulb Temp: 55.30 °F
Total Heat Transfer: 758,959 BTU/hr Leaving Wet Bulb Temp: 55.26 °F
Sensible Heat Transfer: 401,784 BTU/hr Leaving Dew Point Temp: 55.23 °F
Sensible Heat Ratio: 0.53 Air Pressure Drop: 0.5 in w.c.

Printable I/O Summary

New Calculation

<-- To Miscellaneous Calculations

Fig. 34

Main	Contact	Projects	Misc	Logout

Engineering Software International

Heating and Cooling Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** AJ Black
Equipment Identifier: **Units:** IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil	Elevation	Barometric Pressure
Cooling/Dehumidifying ◉ Heating	539 ft	14.412 psia 29.34 in Hg

FLUID

◉ **Liquid** ○ **Steam**

Water

Percent Glycol
NA %

Freezing Temperature
32 °F

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Proceed

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 35

Main	Contact	Projects	Misc	Logout

Engineering Software International

Heating Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Liquid: Water
Freezing Temp: 32 °F
Elevation: 539 ft

Physical Characteristics of Coil

Enter all of the following.

Coil Height, H:	[ ] in	Fin Type:	Flat
Coil Width, W:	[ ] in	Fins per Inch (FPI):	6 fins
Rows:	1	Fin Spacing:	0.167 in
Circuiting:	Half		

Entering Conditions

Enter all of the following.

Air Flow Rate Actual, ACFM	[ ] ft^3/min
Entering Air Temperature, EAT	[ ] °F
Entering Liquid Temperature, ELT	[ ] °F

Performance Conditions

Enter one of the following.

Leaving Air Temperature, LAT	[ ] °F
Leaving Liquid Temperature, LLT	[ ] °F
Liquid Flow Rate, GPM	[ ] gal/min

If this coil cannot provide the leaving conditions required with the fluid provided, the calculation will indicate the best it can do with the conditions given. The analyst may then "recalculate" and, exercising engineering judgment, change the input as required to achieve the desired performance. NOTE: It man be helpful to "recalculate" via accessing (and perhaps printing) the calculation's "Printable I/O Summary" (available via the footer of that same name) and then running the calculation anew via selecting the "New Calculation" footer.

Calculate

<-- To Coil Diagnostics Main Screen

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 36

Main	Contact	Projects	Misc	Logout

Engineering Software International

Heating Coil Diagnostics

Test Company

Project Title: (MISC)	**Date:** November 29, 2007
Project Number: (MISC)	**Member:** Al Black
Equipment Identifier: AAA	**Units:** IP

Tube Side: Liquid: Water
Freezing Temp: 32 °F
Elevation: 539 ft

Coil Description, Input

Coil Height: 36 in	Tubes High: 24.00
Coil Width: 60 in	Fin Type: Flat
Rows: 4	Fins per Inch: 6
Circuiting: Half	Fin Spacing: 0.167 in

Entering Conditions, Input

Air Flow Rate Actual, ACFM: 10000 acfm	Entering Liquid Temp: 200 °F
Entering Air Temp, EAT: 0 °F	

Performance Conditions

Leaving Air Temperature, LAT: 55 °F

Coil Performance, Output

Air Side

Air Flow Rate Standard, SCFM: 11,065 scfm	Entering Face Velocity: 738.00 ft/min
Coil Face Area: 15.00 ft^2	Leaving Dry Bulb Temp: 55.00 °F
Total Heat Transfer: 665,452 BTU/hr	Air Pressure Drop: 0.34 in w.c.

Liquid Side

Liquid Flow Rate: 8.00 gpm	Leaving Liquid Temperature: 27.30 °F
Liquid Pressure Drop: 0.40 ft	Liquid Temperature Drop: 172.7 °F
Liquid Volume of Coil: 7.50 gal	Liquid Velocity: 0.80 ft/sec

Printable I/O Summary

New Calculation

<-- To Miscellaneous Calculations

Fig. 37

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating and Cooling Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: **Units:** IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil	Elevation	Barometric Pressure
○ Cooling/Dehumidifying ● Heating	539 ft	14.412 psia 29.34 in Hg

FLUID

○ **Liquid**

● **Steam**

Enter One of the Following:

Saturated Steam Temperature: °F
Saturated Steam Pressure: psig
Saturated Steam Pressure: psia

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Proceed

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 38

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating Coil Diagnostics

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Steam
Saturated Steam Temp: 250 °F
Elevation: 539 ft

Physical Characteristics of Coil

Enter all of the following.

Coil Height, H:	[ ] in	Fin Type:	Flat
Coil Width, W:	[ ] in	Fins per Inch (FPI):	6 fins
Rows:	1	Fin Spacing:	0.167 in

Entering Conditions

Enter all of the following.

Air Flow Rate Actual, ACFM	[ ] ft³/min
Entering Air Temperature, EAT	[ ] °F

If this coil cannot provide the leaving conditions required with the fluid provided, the calculation will indicate the best it can do with the conditions given. The analyst may then "recalculate" and, exercising engineering judgment, change the input as required to achieve the desired performance. NOTE: It man be helpful to "recalculate" via accessing (and perhaps printing) the calculation's "Printable I/O Summary" (available via the footer of that same name) and then running the calculation anew via selecting the "New Calculation" footer.

Calculate

<-- To Coil Diagnostics Main Screen

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 39

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating Coil Diagnostics

Test Company

Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: AAA

Date: November 29, 2007
Member: Al Black
Units: IP

Tube Side: Steam
Saturated Steam Temp: 220.00 °F
Saturated Steam Pressure: 2.79 psig
Saturated Steam Pressure: 17.20 psia
Elevation: 539 ft

Coil Description, Input

Coil Height: 36 in
Coil Width: 60 in
Rows: 4

Tubes High: 24.00
Fin Type: Flat
Fins per Inch: 6
Fin Spacing: 0.167 in

Entering Conditions, Input

Air Flow Rate Actual, ACFM: 10000 acfm
Entering Air Temp, EAT: 0 °F

Saturated Steam Temp: 220 °F

Performance Conditions

Coil Performance, Output

Air Side

Air Flow Rate Standard, SCFM: 11,065 scfm
Coil Face Area: 15.00 ft^2
Total Heat Transfer: 1,786,738 BTU/hr

Entering Face Velocity: 738.00 ft/min
Leaving Dry Bulb Temp: 147.68 °F
Air Pressure Drop: 0.34 in w.c.

Printable I/O Summary

New Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 40

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating and Cooling Coil Selection

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: [ ] **Units:** IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil	Elevation	Barometric Pressure
(•) Cooling/Dehumidifying ( ) Heating	539 feet	14.412 psia 29.34 in Hg

FLUID

(•) **Liquid** ( ) **Refrigerant**

Water

Percent Glycol

NA %

Freezing Temperature

32 °F

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Piping Connections

(•) Same End ( ) Opposite End ( ) Either End

Proceed

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 41

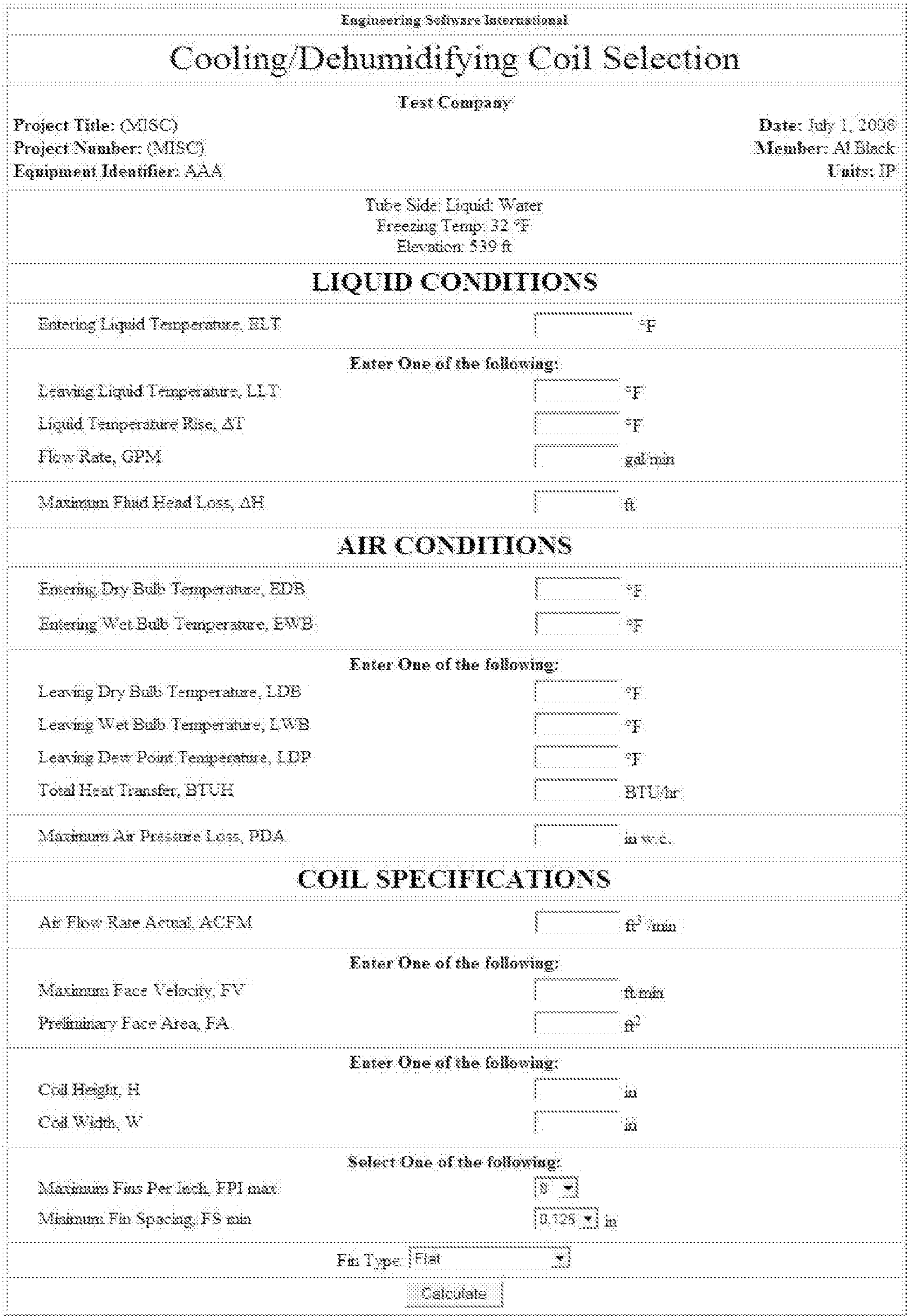

Engineering Software International
Cooling/Dehumidifying Coil Selection
Test Company
Project Title: (MISC)
Date: July 1, 2008
Project Number: (MISC)
Member: Al Black
Equipment Identifier: AAA
Units: IP
Tube Side: Liquid: Water
Freezing Temp: 32 °F
Elevation: 539 ft
LIQUID CONDITIONS
Entering Liquid Temperature, ELT
°F
Enter One of the following:
Leaving Liquid Temperature, LLT
°F
Liquid Temperature Rise, ΔT
°F
Flow Rate, GPM
gal/min
Maximum Fluid Head Loss, ΔH
ft
AIR CONDITIONS
Entering Dry Bulb Temperature, EDB
°F
Entering Wet Bulb Temperature, EWB
°F
Enter One of the following:
Leaving Dry Bulb Temperature, LDB
°F
Leaving Wet Bulb Temperature, LWB
°F
Leaving Dew Point Temperature, LDP
°F
Total Heat Transfer, BTUH
BTU/hr
Maximum Air Pressure Loss, PDA
in w.c.
COIL SPECIFICATIONS
Air Flow Rate Actual, ACFM
ft³/min
Enter One of the following:
Maximum Face Velocity, FV
ft/min
Preliminary Face Area, FA
ft²
Enter One of the following:
Coil Height, H
in
Coil Width, W
in
Select One of the following:
Maximum Fins Per Inch, FPI max
8
Minimum Fin Spacing, FS min
0.125
in
Fin Type:
Flat
Calculate

Fig. 42

Engineering Software International

Cooling/Dehumidifying Coil Selection

Test Company

Project Title: (MISC) **Date:** July 2, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Liquid: Water
Freezing Temp: 32 °F
Elevation: 539 ft

INPUT REQUIREMENTS

Entering Liquid Temperature, ELT	45 °F	Maximum Air Pressure Loss, PDA	1.5 in w.c.
Liquid Temperature Rise, ΔT	12 °F	Air Flow Rate Actual, ACFM	10000 ft^3/min
Maximum Fluid Head Loss, ΔH	15 ft	Maximum Face Velocity, FV	500 ft/min
Entering Dry Bulb Temperature, EDB	95 °F	Coil Height, H	48 in
Entering Wet Bulb Temperature, EWB	78 °F	Maximum Fins Per Inch, FPI max	8
Leaving Dry Bulb Temperature, LDB	55 °F	Minimum Fin Spacing, FS min	0.125
		Fin Type	Flat

COIL SELECTION

Coil Height, H	48.00 in	Leaving Dry Bulb, LDB	55.00 °F
Tubes High, TH	32 tubes	Leaving Wet Bulb, LWB	54.99 °F
Coil Width, W	57.00 in	Leaving Dew Point, LDP	54.98 °F
Air Flow Rate Standard, SCFM	9,256 ft^3/min	Liquid Head Loss, LPD	9.30 ft
Face Area, FA	19.00 ft^2	Liquid Flow Rate, GPM	107.00 gal/min
Face Velocity, FV	487 ft/min	Leaving Liquid Temp, LLT	59.24 °F
Rows	10 rows	Liquid Velocity, LV	3.90 ft/sec
Fins Per Inch, FPI	8 fins	Air Pressure Drop, APD	0.70 in w.c.
Circuiting	Full	Total Heat, TH	765,974 BTUh
Liquid Volume of Coil	23.70 gallons	Sensible Heat, SH	404,843 BTUh
		Sensible Heat Ratio, SHR	0.53

Fig. 43

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating and Cooling Coil Selection

Test Company

Project Title: (MISC) Date: October 22, 2007

Project Number: (MISC) Member: Al Black

Equipment Identifier: Units: IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil	Elevation	Barometric Pressure
◉ Cooling/Dehumidifying ○ Heating	539 feet	14.412 psia 29.34 in Hg

FLUID

○ **Liquid**

◉ **Refrigerant**

Suction Temperature

40 °F

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Piping Connections

◉ Same End ○ Opposite End ○ Either End

Proceed

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 44

Main | Contact | Projects | Misc | Logout

Engineering Software International

Cooling/Dehumidifying Coil Selection

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Refrigerant
Saturated Suction Temp: 40 °F
Elevation: 539 ft

AIR CONDITIONS

Entering Dry Bulb Temperature, EDB		°F
Entering Wet Bulb Temperature, EWB		°F

Enter One of the following:

Leaving Dry Bulb Temperature, LDB		°F
Leaving Wet Bulb Temperature, LWB		°F
Leaving Dew Point Temperature, LDP		°F
Total Heat Transfer, BTUH		BTU/hr

Maximum Air Pressure Loss, PDA		in w.c.

COIL SPECIFICATIONS

Air Flow Rate Actual, ACFM		ft^3 /min

Enter One of the following:

Maximum Face Velocity, FV		ft/min
Preliminary Face Area, FA		ft^2

Enter One of the following:

Coil Height, H		in
Coil Width, W		in

Select One of the following:

Maximum Fins Per Inch, FPI max	8	
Minimum Fin Spacing, FS min	0.125	in

Fin Type: Flat

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 45

Main | Contact | Projects | Misc | Logout

Engineering Software International

Cooling/Dehumidifying Coil Selection

Test Company

Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: AAA

Date: November 29, 2007
Member: Al Black
Units: IP

Tube Side: Refrigerant
Saturated Suction Temp: 40 °F
Elevation: 539 ft

INPUT REQUIREMENTS

Entering Dry Bulb Temperature, EDB	95 °F	Maximum Face Velocity, FV	500 ft/min
Entering Wet Bulb Temperature, EWB	78 °F	Coil Height, H	48 in
Leaving Dry Bulb Temperature, LDB	55 °F	Maximum Fins Per Inch, FPI max	8
Maximum Air Pressure Loss, PDA	1.5 in w.c.	Minimum Fin Spacing, FS min	0.125
Air Flow Rate Actual, ACFM	10000 ft^3/min	Fin Type	Flat

COIL SELECTION

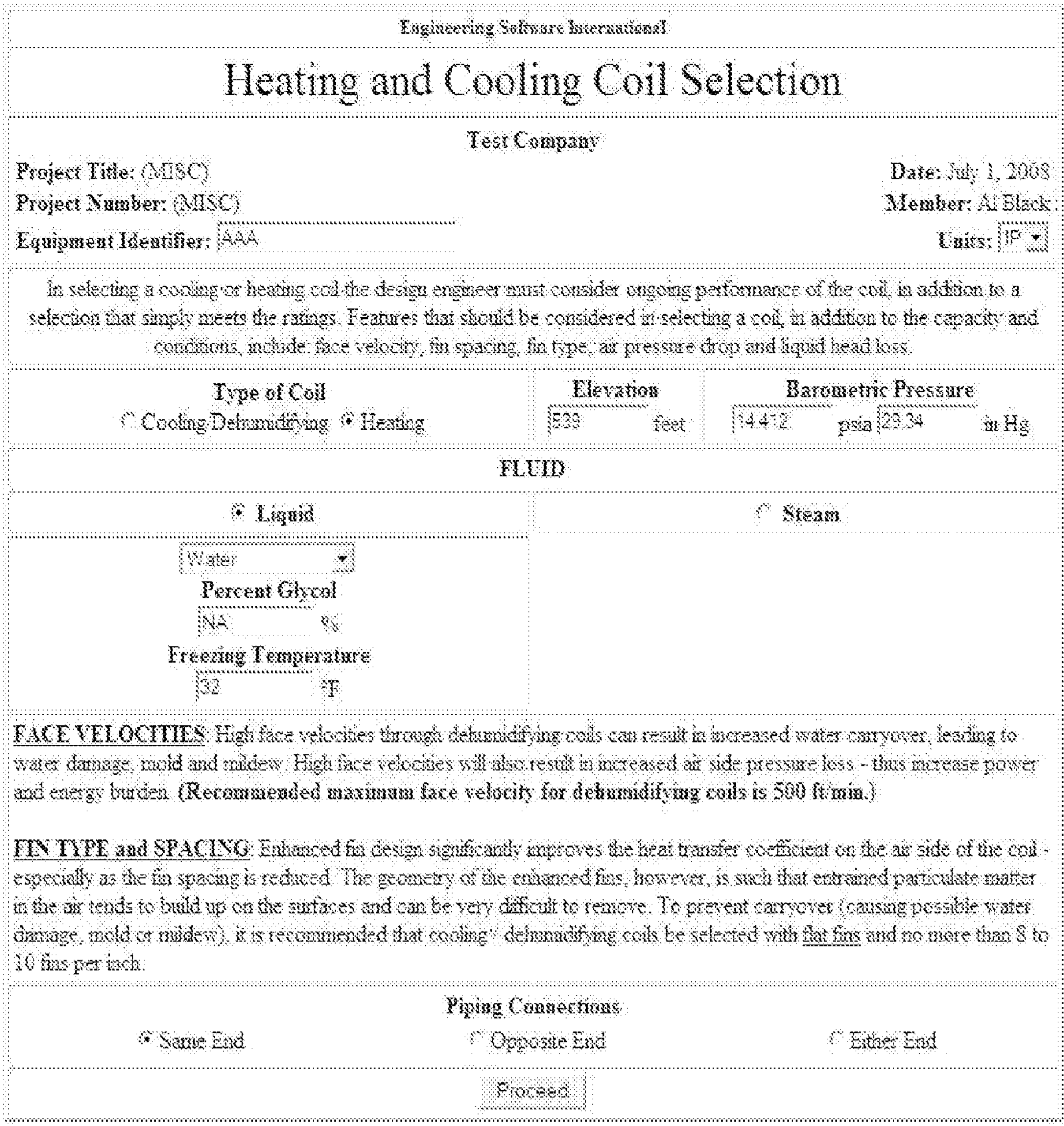
Coil Height, H	48.00 in	Leaving Dry Bulb, LDB	52.38 °F
Tubes High, TH	32 tubes	Leaving Wet Bulb, LWB	52.37 °F
Coil Width, W	57.00 in	Leaving Dew Point, LDP	52.36 °F
Air Flow Rate Standard, SCFM	9,256 ft^3/min	Air Pressure Drop, APD	0.70 in w.c.
Face Area, FA	19.00 ft^2	Total Heat, TH	831,906 BTUh
Face Velocity, FV	487 ft/min	Sensible Heat, SH	431,386 BTUh
Rows	10 rows	Sensible Heat Ratio, SHR	0.52
Fins Per Inch, FPI	8 fins		

Printable I/O Summary

New Calculation

<-- To Miscellaneous Calculations

Fig. 46



Engineering Software International

Heating and Cooling Coil Selection

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil
○ Cooling/Dehumidifying ● Heating

Elevation
539 feet

Barometric Pressure
14.412 psia 29.34 in Hg

FLUID

● **Liquid** ○ **Steam**

Water
Percent Glycol
NA %
Freezing Temperature
32 °F

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Piping Connections
● Same End ○ Opposite End ○ Either End

Proceed

Fig. 47

Engineering Software International

Heating Coil Selection

Test Company

Project Title: (MISC)	**Date:** July 1, 2008
Project Number: (MISC)	**Member:** Al Black
Equipment Identifier: AAA	**Units:** IP

Tube Side: Liquid: Water
Freezing Temp: 32 °F
Elevation: 539 ft

LIQUID CONDITIONS

Entering Liquid Temperature, ELT [ ] °F

Enter One of the following:

Leaving Liquid Temperature, LLT [ ] °F
Liquid Temperature Drop, ΔT [ ] °F
Flow Rate, GPM [ ] gal/min

Maximum Fluid Head Loss, ΔH [ ] ft

AIR CONDITIONS

Entering Air Temperature, EAT [ ] °F

Enter One of the following:

Leaving Air Temperature, LAT [ ] °F
Total Heat Transfer, BTUH [ ] BTU/hr

Maximum Air Pressure Loss, PDA [ ] in w.c.

COIL SPECIFICATIONS

Air Flow Rate Actual, ACFM [ ] ft^3/min

Enter One of the following:

Maximum Face Velocity, FV [ ] ft/min
Preliminary Face Area, FA [ ] ft^2

Enter One of the following:

Coil Height, H [ ] in
Coil Width, W [ ] in

Select One of the following:

Maximum Fins Per Inch, FPI max [6]
Minimum Fin Spacing, FS min [0.167] in

Fin Type: [Flat]

[Calculate]

Fig. 48

Main | Contact | Projects | Misc | Logout

Engineering Software International

Heating Coil Selection

Test Company

Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: AAA

Date: October 22, 2007
Member: Al Black
Units: IP

Tube Side: Steam
Saturated Steam Temp: 250 °F
Elevation: 539 ft

AIR CONDITIONS

Entering Air Temperature, EAT [ ] °F

Enter One of the following:

Leaving Air Temperature, LAT [ ] °F

Total Heat Transfer, BTUH [ ] BTU/hr

Maximum Air Pressure Loss, PDA [ ] in w.c.

COIL SPECIFICATIONS

Air Flow Rate Actual, ACFM [ ] ft^3 /min

Enter One of the following:

Maximum Face Velocity, FV [ ] ft/min

Preliminary Face Area, FA [ ] ft^2

Enter One of the following:

Coil Height, H [ ] in

Coil Width, W [ ] in

Select One of the following:

Maximum Fins Per Inch, FPI max [6]

Minimum Fin Spacing, FS min [0.167] in

Fin Type: [Flat]

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 49

Main	Contact	Projects	Misc	Logout

Engineering Software International

Heating and Cooling Coil Selection

Test Company

Project Title: (MISC) **Date:** October 22, 2007

Project Number: (MISC) **Member:** Al Black

Equipment Identifier: [ ] **Units:** IP

In selecting a cooling or heating coil the design engineer must consider ongoing performance of the coil, in addition to a selection that simply meets the ratings. Features that should be considered in selecting a coil, in addition to the capacity and conditions, include: face velocity, fin spacing, fin type, air pressure drop and liquid head loss.

Type of Coil	Elevation	Barometric Pressure
○ Cooling/Dehumidifying ● Heating	539 feet	14.412 psia 29.34 in Hg

FLUID

○ Liquid	● Steam
	Enter One of the Following: Saturated Steam Temperature: [ ] °F Saturated Steam Pressure: [ ] psig Saturated Steam Pressure: [ ] psia

FACE VELOCITIES: High face velocities through dehumidifying coils can result in increased water carryover, leading to water damage, mold and mildew. High face velocities will also result in increased air side pressure loss - thus increase power and energy burden. **(Recommended maximum face velocity for dehumidifying coils is 500 ft/min.)**

FIN TYPE and SPACING: Enhanced fin design significantly improves the heat transfer coefficient on the air side of the coil - especially as the fin spacing is reduced. The geometry of the enhanced fins, however, is such that entrained particulate matter in the air tends to build up on the surfaces and can be very difficult to remove. To prevent carryover (causing possible water damage, mold or mildew), it is recommended that cooling / dehumidifying coils be selected with flat fins and no more than 8 to 10 fins per inch.

Piping Connections

● Same End ○ Opposite End ○ Either End

Proceed

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 50

Main	Contact	Projects	Misc	Logout

Engineering Software International

Heating Coil Selection

Test Company

Project Title: (MISC) **Date:** October 22, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Steam
Saturated Steam Temp: 250 °F
Elevation: 539 ft

AIR CONDITIONS

Entering Air Temperature, EAT	[ ]	°F
Enter One of the following:		
Leaving Air Temperature, LAT	[ ]	°F
Total Heat Transfer, BTUH	[ ]	BTU/hr
Maximum Air Pressure Loss, PDA	[ ]	in w.c.

COIL SPECIFICATIONS

Air Flow Rate Actual, ACFM	[ ]	ft^3 /min
Enter One of the following:		
Maximum Face Velocity, FV	[ ]	ft/min
Preliminary Face Area, FA	[ ]	ft^2
Enter One of the following:		
Coil Height, H	[ ]	in
Coil Width, W	[ ]	in
Select One of the following:		
Maximum Fins Per Inch, FPI max	6	
Minimum Fin Spacing, FS min	0.167	in

Fin Type: Flat

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 51

Engineering Software International

Heating Coil Selection

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

Tube Side: Steam
Saturated Steam Temp: 220.00 °F
Saturated Steam Pressure: 2.79 psig
Saturated Steam Pressure: 17.20 psia
Elevation: 539 ft

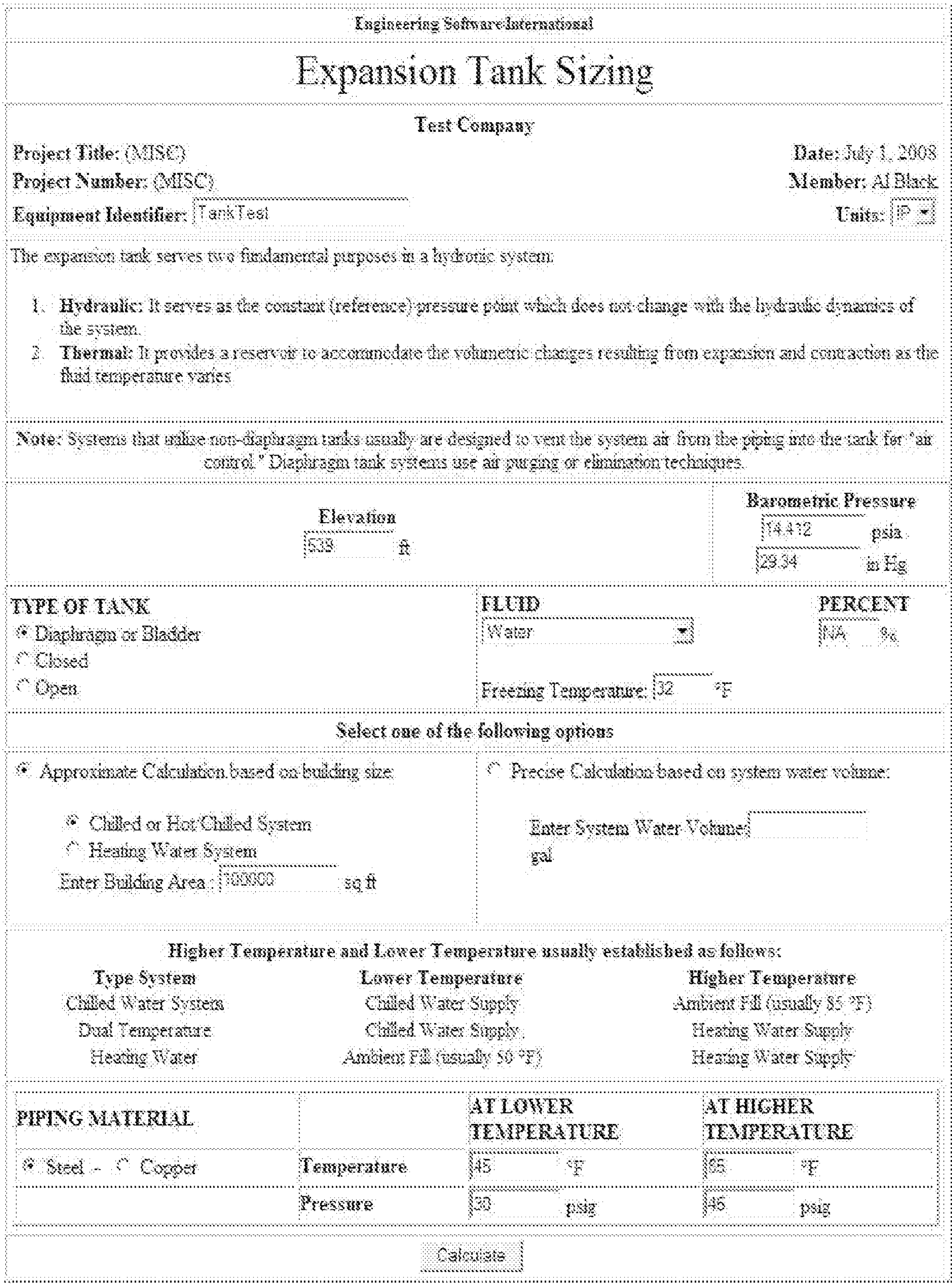
INPUT REQUIREMENTS

Entering Air Temperature, EAT	0 °F	Maximum Face Velocity, FV	800 ft/min
Leaving Air Temperature, LAT	55 °F	Coil Height, H	36 in
Maximum Air Pressure Loss, PDA	1.5 in w.c.	Maximum Fins Per Inch, FPI max	6
Air Flow Rate Actual, ACFM	10000 ft^3/min	Minimum Fin Spacing, FS min	0.167
		Fin Type	Flat

COIL SELECTION

Coil Height, H	36.00 in	Leaving Air Temperature, LAT	92.10 °F
Tubes High, TH	24 tubes	Air Pressure Drop, APD	0.20 in w.c.
Coil Width, W	57.00 in	Total Heat, TH	1,114,375 BTUh
Air Flow Rate Standard, SCFM	11,065 ft^3/min		
Face Area, FA	14.30 ft^2		
Face Velocity, FV	776 ft/min		
Rows	2 rows		
Fins Per Inch, FPI	6 fins		

Fig. 52


Engineering Software International

Expansion Tank Sizing

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: TankTest **Units:** IP

The expansion tank serves two fundamental purposes in a hydronic system:

1. **Hydraulic:** It serves as the constant (reference) pressure point which does not change with the hydraulic dynamics of the system.
2. **Thermal:** It provides a reservoir to accommodate the volumetric changes resulting from expansion and contraction as the fluid temperature varies.

Note: Systems that utilize non-diaphragm tanks usually are designed to vent the system air from the piping into the tank for "air control." Diaphragm tank systems use air purging or elimination techniques.

Elevation 538 ft

Barometric Pressure 14.412 psia 29.34 in Hg

TYPE OF TANK
- ◉ Diaphragm or Bladder
- ○ Closed
- ○ Open

FLUID Water

PERCENT NA %

Freezing Temperature: 32 °F

Select one of the following options

◉ Approximate Calculation based on building size:
- ◉ Chilled or Hot/Chilled System
- ○ Heating Water System

Enter Building Area : 100000 sq ft

○ Precise Calculation based on system water volume:

Enter System Water Volume: gal

Higher Temperature and Lower Temperature usually established as follows:

Type System	Lower Temperature	Higher Temperature
Chilled Water System	Chilled Water Supply	Ambient Fill (usually 85 °F)
Dual Temperature	Chilled Water Supply	Heating Water Supply
Heating Water	Ambient Fill (usually 50 °F)	Heating Water Supply

PIPING MATERIAL		AT LOWER TEMPERATURE	AT HIGHER TEMPERATURE
◉ Steel - ○ Copper	Temperature	45 °F	85 °F
	Pressure	30 psig	46 psig

Calculate

Fig. 53

Engineering Software International

Expansion Tank Sizing

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: TankTest **Units:** IP

The expansion tank serves two fundamental purposes in a hydronic system:

1. **Hydraulic:** It serves as the constant (reference) pressure point which does not change with the hydraulic dynamics of the system.
2. **Thermal:** It provides a reservoir to accommodate the volumetric changes resulting from expansion and contraction as the fluid temperature varies.

Note: Systems that utilize non-diaphragm tanks usually are designed to vent the system air from the piping into the tank for "air control." Diaphragm tank systems use air purging or elimination techniques.

Elevation	Barometric Pressure
539 ft	14.412 psia 29.34 in Hg

TYPE OF TANK
◉ Diaphragm (Bladder)
○ Closed
○ Open

FLUID: Water

PERCENT: NA%

FREEZING TEMP: 32 °F

Select one of the following options

◉ Approximate Calculation based on building size:

◉ Chilled or Hot/Chilled System
○ Heating Water System

Building Area: 100000 sq ft

Estimated Water Volume: 2991 gal

Higher Temperature and Lower Temperature usually established as follows:

Type System	Lower Temperature	Higher Temperature
Chilled Water System	Chilled Water Supply	Ambient Fill (usually 85 °F)
Dual Temperature	Chilled Water Supply	Heating Water Supply
Heating Water	Ambient Fill (usually 50 °F)	Heating Water Supply

PIPING MATERIAL		AT LOWER TEMPERATURE	AT HIGHER TEMPERATURE
Steel	**Temperature**	45 °F	85 °F
	Pressure	30 psig	45 psig

Tank Volume: 39 gal

Normally Select a Standard Tank or Tanks of the Closest Larger Size (Volume).

Enter Actual Total Size (Volume) of Tank or Tanks: 50 gal

Calculate

Fig. 54

Engineering Software International

Expansion Tank Sizing

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: TankTest **Units:** IP

The expansion tank serves two fundamental purposes in a hydronic system:

1. **Hydraulic:** It serves as the constant (reference) pressure point which does not change with the hydraulic dynamics of the system.
2. **Thermal:** It provides a reservoir to accommodate the volumetric changes resulting from expansion and contraction as the fluid temperature varies.

Note: Systems that utilize non-diaphragm tanks usually are designed to vent the system air from the piping into the tank for "air control." Diaphragm tank systems use air purging or elimination techniques.

Elevation	**Barometric Pressure**
539 ft	14.412 psia 29.34 in Hg

TYPE OF TANK
- Diaphragm (Bladder)
- Closed
- Open

FLUID: Water

PERCENT: NA%

FREEZING TEMP: 32 °F

Select one of the following options

- Approximate Calculation based on building size:
  - Chilled or Hot/Chilled System
  - Heating Water System

  Building Area: 100000 sq.ft

  Estimated Water Volume: 2991 gal

Higher Temperature and Lower Temperature usually established as follows:

Type System	**Lower Temperature**	**Higher Temperature**
Chilled Water System	Chilled Water Supply.	Ambient Fill (usually 85 °F)
Dual Temperature	Chilled Water Supply	Heating Water Supply
Heating Water	Ambient Fill (usually 50 °F)	Heating Water Supply

PIPING MATERIAL		**AT LOWER TEMPERATURE**	**AT HIGHER TEMPERATURE**
Steel	**Temperature**	45 °F	85 °F
	Pressure	30 psig	45 psig

Tank Volume: 39 gal

Normally Select a Standard Tank or Tanks of the Closest Larger Size (Volume).

Actual Total Size (Volume) of Tank or Tanks: 50 gal

Actual Pressure at Higher Temperature: 41 psig

New Expansion Tank Sizing Calculation

Fig. 55

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Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black

To perform a calculation for any process select the process in the menu below and click on "Proceed."

Menu of Processes

- ◉ 1. Expansion (Power) Process
- ○ 2. Fuel Heat Required to Generate Steam
- ○ 3. Control Valve Sizing
- ○ 4. Steam Orifice Size/Capacity
- ○ 5. Differences Between Two State Points

Proceed

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 56

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Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** December 13, 2007

Project Number: (MISC) **Member:** Al Black

Equipment Identifier: AAA **Units:** IP

EXPANSION (POWER) PROCESS

When thermal energy is converted to shaft energy (work) through an expansion process, the most work that can be achieved from a unit mass of the steam is that resulting from an ideal adiabatic reversible or isentropic expansion. With the throttle conditions and condensing temperature or exhaust pressure known, this program will provide the steam flow requirements in both pounds of steam per horsepower hour and pounds of steam per kilowatt hour, as well as the steam properties at both the initial and the final state points.

INITIAL (THROTTLE) CONDITIONS

○ Superheated

Pressure psia

Temperature °F

◉ Saturated

Pressure 500 psia OR **Temperature** °F

Quality 100 %

OUTLET CONDITIONS - ENTER ONE ONLY

Absolute Pressure psia OR **Condensing Temperature** 100 °F

SELECT ONE

◉ Isentropic expansion

○ Nonisentropic Expansion Efficiency %

Calculate

<-- To Steam Processes Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 57

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

ISENTROPIC EXPANSION (POWER) PROCESS

When thermal energy is converted to shaft energy (work) through an expansion process, the most work that can be achieved from a unit mass of the steam is that resulting from an ideal adiabatic reversible or isentropic expansion. With the throttle conditions and condensing temperature or exhaust pressure known, this program will provide the steam flow requirements in both pounds of steam per horsepower hour and pounds of steam per kilowatt hour, as well as the steam properties at both the initial and the final state points.

INITIAL (THROTTLE) CONDITIONS

○ Superheated ◉ Saturated

Pressure
500 psia

Quality
100%

OUTLET CONDITIONS - ENTER ONE ONLY

Condensing Temperature
100 °F

Steam Rate

8.75 lb/kW-hr **6.53 lb/hp-hr**

Steam Properties

Property	Symbol	Units	Initial	Final
Condition			Saturated	Saturated
Pressure	p	psia	500.00	0.95051
Temperature	t	°F	467.04	100.00
Quality	x	%	100	72.053
Density	ρ	lb/ft^3	1.0774	0.39671E-02
Specific Volume	v	ft^3/lb	0.92815	252.07
Enthalpy	h	BTU/lb	1205.0	814.98
Entropy	s	BTU/lb-°F	1.4642	1.4642
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	N/A	N/A
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	N/A	N/A
Internal Energy	u	BTU/lb	1119.1	770.65
Sonic Velocity	a	ft/sec	N/A	N/A
Thermal Conductivity	k	BTU/hr-ft-°F	N/A	N/A
Viscosity	μ	lbm/ft-sec	N/A	N/A
Prandtl Number	Pr	dimensionless	N/A	N/A

Fig. 58

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Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

EXPANSION (POWER) PROCESS

When thermal energy is converted to shaft energy (work) through an expansion process, the most work that can be achieved from a unit mass of the steam is that resulting from an ideal adiabatic reversible or isentropic expansion. With the throttle conditions and condensing temperature or exhaust pressure known, this program will provide the steam flow requirements in both pounds of steam per horsepower hour and pounds of steam per kilowatt hour, as well as the steam properties at both the initial and the final state points.

INITIAL (THROTTLE) CONDITIONS

○ Superheated
Pressure psia
Temperature °F

◉ Saturated
Pressure 500 psia OR **Temperature** °F
Quality 100 %

OUTLET CONDITIONS - ENTER ONE ONLY

Absolute Pressure psia OR **Condensing Temperature** 100 °F

SELECT ONE

○ Isentropic expansion
◉ Nonisentropic Expansion Efficiency 65 %

Calculate

<-- To Steam Processes Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 59

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

NON-ISENTROPIC EXPANSION (POWER) PROCESS
Efficiency = 65 %

When thermal energy is converted to shaft energy (work) through an expansion process, the most work that can be achieved from a unit mass of the steam is that resulting from an ideal adiabatic reversible or isentropic expansion. With the throttle conditions and condensing temperature or exhaust pressure known, this program will provide the steam flow requirements in both pounds of steam per horsepower hour and pounds of steam per kilowatt hour, as well as the steam properties at both the initial and the final state points.

INITIAL (THROTTLE) CONDITIONS

Superheated

Saturated

Pressure
500 psia

Quality
100%

OUTLET CONDITIONS - ENTER ONE ONLY

Condensing Temperature
100 °F

Steam Rate

13.46 lb/kW-hr **10.04 lb/hp-hr**

Steam Properties

Property	Symbol	Units	Initial	Ideal Final	Actual Final
Condition			Saturated	Saturated	Saturated
Pressure	p	psia	500.00	0.95051	0.95051
Temperature	t	°F	467.04	100.00	100.00
Quality	x	%	100	72.053	85.22
Density	ρ	lb/ft^3	1.0774	0.39671E-02	0.33542E-02
Specific Volume	v	ft^3/lb	0.92815	252.07	298.13
Enthalpy	h	BTU/lb	1205.0	814.98	951.48
Entropy	s	BTU/lb-°F	1.4642	1.4642	1.7081
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	N/A	N/A	N/A
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	N/A	N/A	N/A
Internal Energy	u	BTU/lb	1119.1	770.65	899.05
Sonic Velocity	a	ft/sec	N/A	N/A	N/A
Thermal Conductivity	k	BTU/hr-ft-°F	N/A	N/A	N/A
Viscosity	μ	lbm/ft-sec	N/A	N/A	N/A
Prandtl Number	Pr	dimensionless	N/A	N/A	N/A

Fig. 60

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Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

FUEL HEAT REQUIRED TO GENERATE STEAM

The fuel heat required to generate steam is the heating value of the fuel (the "higher heating value") per pound of steam generated. The **combined efficiency** as used in this calculation accounts for all non-steam losses including incomplete combustion, latent stack, dry stack, and furnace losses.

Feedwater Conditions

Pressure 500 psia AND Temperature 100 °F

Steam Conditions

◉ Saturated	Pressure	500	psia	OR	Temperature		°F
○ Superheated	Pressure		psia	AND	Temperature		°F

Combined Efficiency 85 %

Calculate

<-- To Steam Processes Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 61

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

FUEL HEAT REQUIRED TO GENERATE STEAM

The fuel heat required to generate steam is the heating value of the fuel (the "higher heating value") per pound of steam generated. The **combined efficiency** as used in this calculation accounts for all non-steam losses including incomplete combustion, latent stack, dry stack, and furnace losses.

Feedwater Conditions

Pressure 500 psia AND Temperature 100 °F

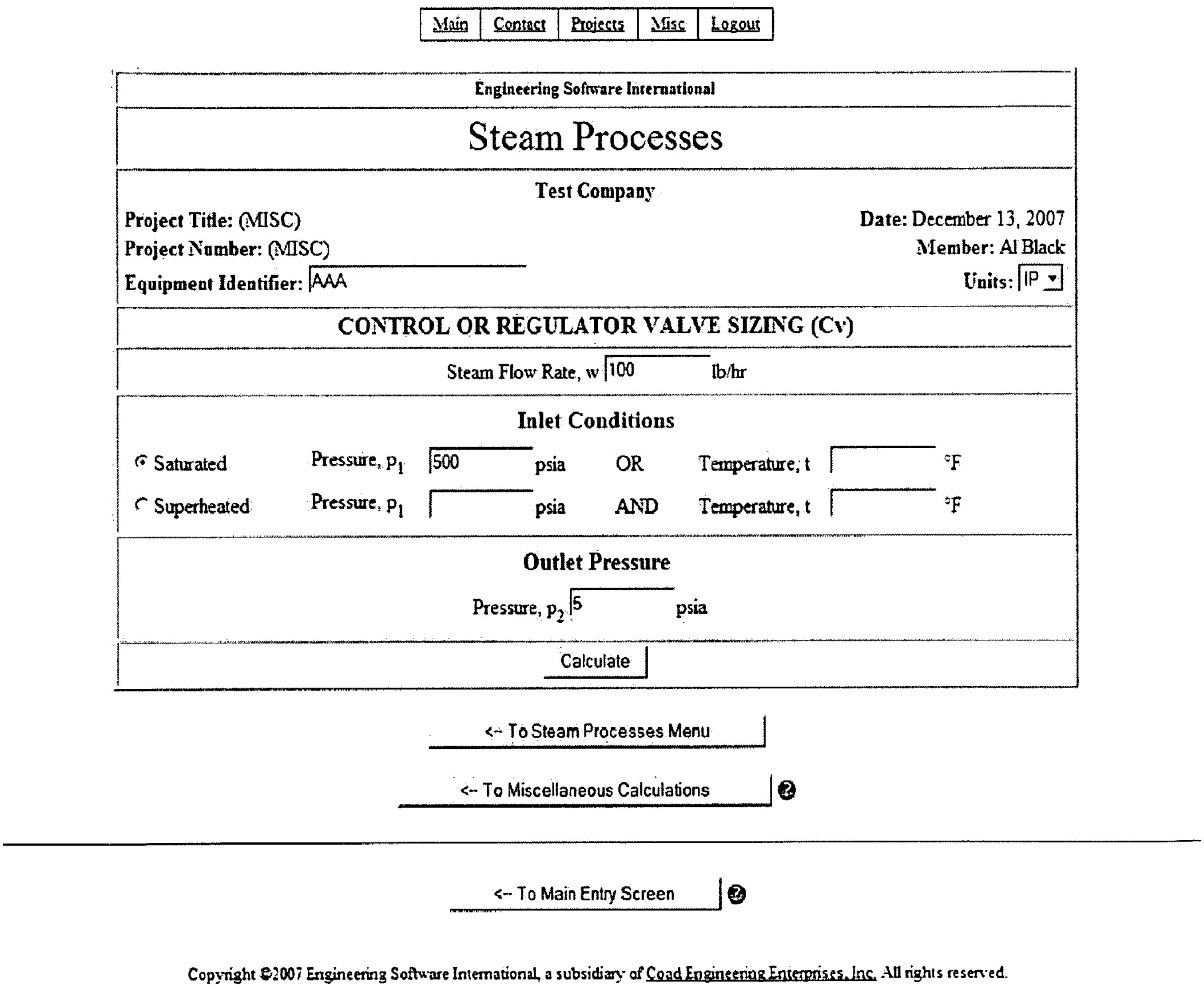
Steam Conditions (Saturated)

Pressure 500 psia

Combined Efficiency: 85 %

Fuel Heat Required: 1336.0 BTU/lb steam

Fig. 62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Steam Processes
Test Company
Project Title: (MISC)
Date: December 13, 2007
Project Number: (MISC)
Member: Al Black
Equipment Identifier: AAA
Units: IP
CONTROL OR REGULATOR VALVE SIZING (Cv)
Steam Flow Rate, w 100 lb/hr
Inlet Conditions
Saturated Pressure, p1 500 psia OR Temperature, t °F
Superheated Pressure, p1 psia AND Temperature, t °F
Outlet Pressure
Pressure, p2 5 psia
Calculate
<-- To Steam Processes Menu
<-- To Miscellaneous Calculations
<-- To Main Entry Screen
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Fig. 63

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) Date: July 1, 2008
Project Number: (MISC) Member: Al Black
Equipment Identifier: AAA Units: IP

CONTROL OR REGULATOR VALVE SIZING (Cv)

Steam Flow Rate, w 100 lb/hr

Inlet Conditions

◉ Saturated Pressure, p_1 500 psia

○ Superheated

Outlet Pressure

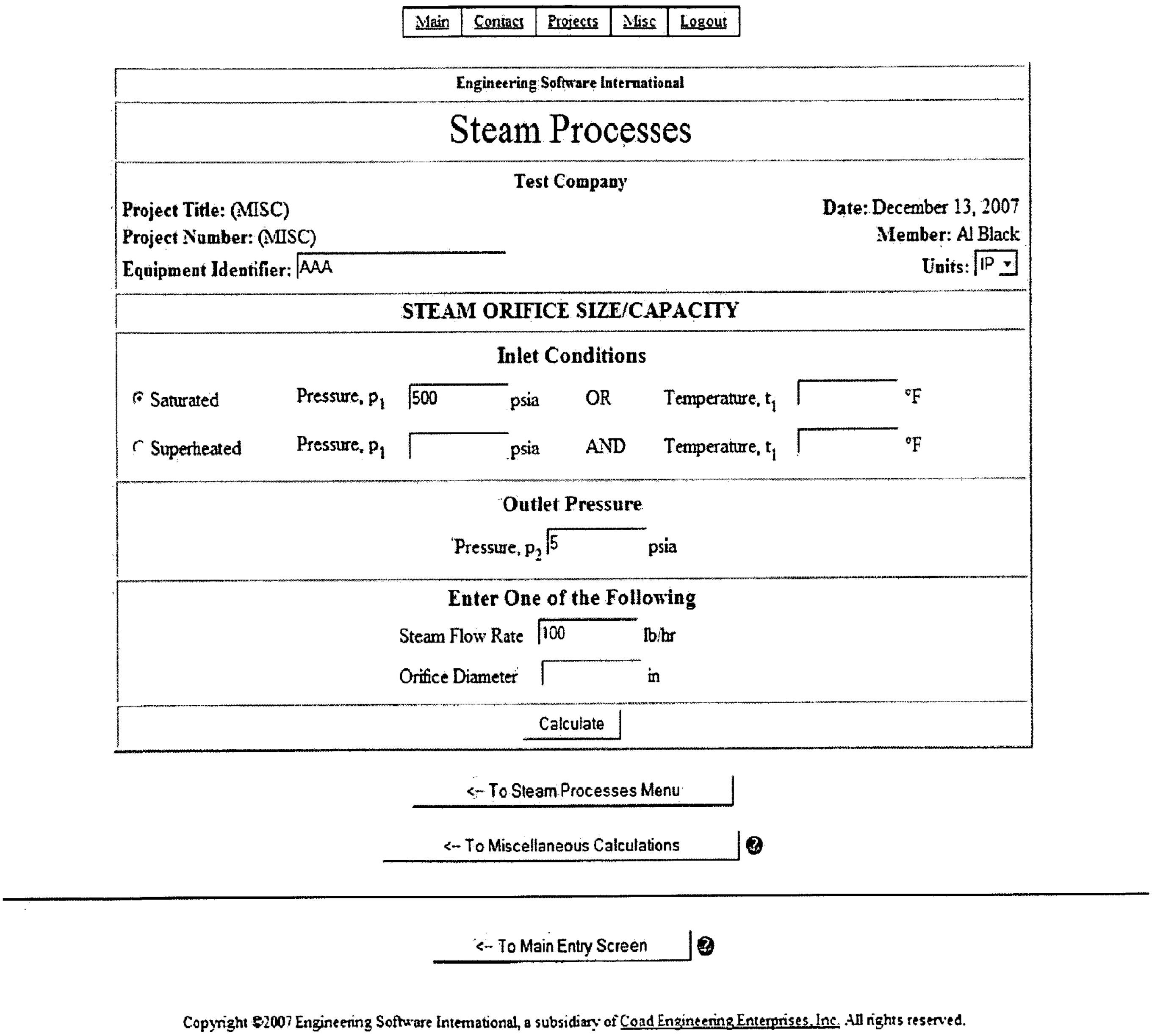
Pressure, p_2 5 psia

Flow Characteristic	Critical
Valve Constant Cv	0.12

Steam Properties

Property	Symbol	Units	Inlet	Outlet
Condition			Saturated	Superheated
Pressure	p	psia	500.00	5.0000
Temperature	t	°F	467.04	321.92
Quality	x	%	100	N/A
Density	ρ	lb/ft^3	1.0774	0.10766E-01
Specific Volume	v	ft^3/lb	0.92815	92.881
Enthalpy	h	BTU/lb	1205.0	1205.0
Entropy	s	BTU/lb-°F	1.4642	1.9502
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	N/A	0.35100
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	N/A	0.46310
Internal Energy	u	BTU/lb	1119.1	1119.0
Sonic Velocity	a	ft/sec	N/A	1682.7
Thermal Conductivity	k	BTU/hr-ft-°F	N/A	0.16988E-01
Viscosity	μ	lbm/ft-sec	N/A	0.98431E-05
Prandtl Number	Pr	dimensionless	N/A	0.96595

Fig. 64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Steam Processes
Test Company
Project Title: (MISC)
Date: December 13, 2007
Project Number: (MISC)
Member: Al Black
Equipment Identifier: AAA
Units: IP
STEAM ORIFICE SIZE/CAPACITY
Inlet Conditions
Saturated
Pressure, p1 500 psia
OR
Temperature, t1 °F
Superheated
Pressure, p1 psia
AND
Temperature, t1 °F
Outlet Pressure
Pressure, p2 5 psia
Enter One of the Following
Steam Flow Rate 100 lb/hr
Orifice Diameter in
Calculate
<-- To Steam Processes Menu
<-- To Miscellaneous Calculations
<-- To Main Entry Screen
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Fig. 65

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) Date: July 1, 2008
Project Number: (MISC) Member: Al Black
Equipment Identifier: AAA Units: IP

STEAM ORIFICE SIZE/CAPACITY

Inlet Conditions

◉ Saturated Pressure, p_1 500 psia

○ Superheated

Outlet Pressure

Pressure, p_2 5 psia

Steam Flow Rate 100.00 lb/hr

Flow Characteristic **Critical**

Orifice Diameter **0.091 in**

Steam Properties

Property	Symbol	Units	Inlet	Outlet
Condition			Saturated	Superheated
Pressure	p	lb/in^2	500.00	5.0000
Temperature	t	°F	467.04	321.92
Quality	x	%	100	N/A
Density	ρ	lb/ft^3	1.0774	0.10766E-01
Specific Volume	v	ft^3/lb	0.92815	92.881
Enthalpy	h	BTU/lb	1205.0	1205.0
Entropy	s	BTU/lb-°F	1.4642	1.9502
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	N/A	0.35100
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	N/A	0.46310
Internal Energy	u	BTU/lb	1119.1	1119.0
Sonic Velocity	a	ft/sec	N/A	1682.7
Thermal Conductivity	k	BTU/hr-ft-°F	N/A	0.16988E-01
Viscosity	μ	lbm/ft-sec	N/A	0.98431E-05
Prandtl Number	Pr	dimensionless	N/A	0.96595

Fig. 66

Main	Contact	Projects	Misc	Logout

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

STEAM ORIFICE SIZE/CAPACITY

Inlet Conditions

◉ Saturated	Pressure, p_1	500	psia	OR	Temperature, t_1	°F
○ Superheated	Pressure, p_1		psia	AND	Temperature, t_1	°F

Outlet Pressure

Pressure, p_2 5 psia

Enter One of the Following

Steam Flow Rate [ ] lb/hr

Orifice Diameter 0.100 in

Calculate

<-- To Steam Processes Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 67

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) Date: July 1, 2008
Project Number: (MISC) Member: Al Black
Equipment Identifier: AAA Units: IP

STEAM ORIFICE SIZE/CAPACITY

Inlet Conditions

◉ Saturated Pressure, p_1 500 psia

○ Superheated

Outlet Pressure

Pressure, p_2 5 psia

Orifice Diameter 0.100 in

Flow Characteristic **Critical**
Steam Flow Rate **120.87 lb/hr**

Steam Properties

Property	Symbol	Units	Inlet	Outlet
Condition			Saturated	Superheated
Pressure	p	lb/in^2	500.00	5.0000
Temperature	t	°F	467.04	321.92
Quality	x	%	100	N/A
Density	ρ	lb/ft^3	1.0774	0.10766E-01
Specific Volume	v	ft^3/lb	0.92815	92.881
Enthalpy	h	BTU/lb	1205.0	1205.0
Entropy	s	BTU/lb-°F	1.4642	1.9502
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	N/A	0.35100
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	N/A	0.46310
Internal Energy	u	BTU/lb	1119.1	1119.0
Sonic Velocity	a	ft/sec	N/A	1682.7
Thermal Conductivity	k	BTU/hr-ft-°F	N/A	0.16988E-01
Viscosity	μ	lbm/ft-sec	N/A	0.98431E-05
Prandtl Number	Pr	dimensionless	N/A	0.96595

Fig. 68

Main	Contact	Projects	Misc	Logout

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** December 13, 2007

Project Number: (MISC) **Member:** Al Black

Calculation Identifier: AAA **Units:** IP

DIFFERENCES BETWEEN TWO STATE POINTS

This program will provide the properties at each of two state points selected and show the difference between each property in absolute value between the two state points.

State Point One

Enter all data required on any single line in one of the boxes below.

Saturated

(•) Pressure 500 psia Quality 100 %

( ) Temperature °F Quality %

( ) **Superheated or Supercritical Vapor or Subcooled Liquid**

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure psia Temperature °F

State Point Two

Enter all data required on any single line in one of the boxes below.

Saturated

( ) Pressure psia Quality %

( ) Temperature °F Quality %

(•) **Superheated or Supercritical Vapor or Subcooled Liquid**

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure 5 psia Temperature 322 °F

Calculate

<-- To Steam Processes Menu

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 69

Engineering Software International

Steam Processes

Test Company

Project Title: (MISC) **Date:** July 1, 2008
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

DIFFERENCES BETWEEN TWO STATE POINTS

This program will provide the properties at each of two state points selected and show the difference between each property in absolute value between the two state points.

State Point One

Saturated

Pressure: 500 psia
Quality: 100%

State Point Two

Superheated or Supercritical Vapor or Subcooled Liquid

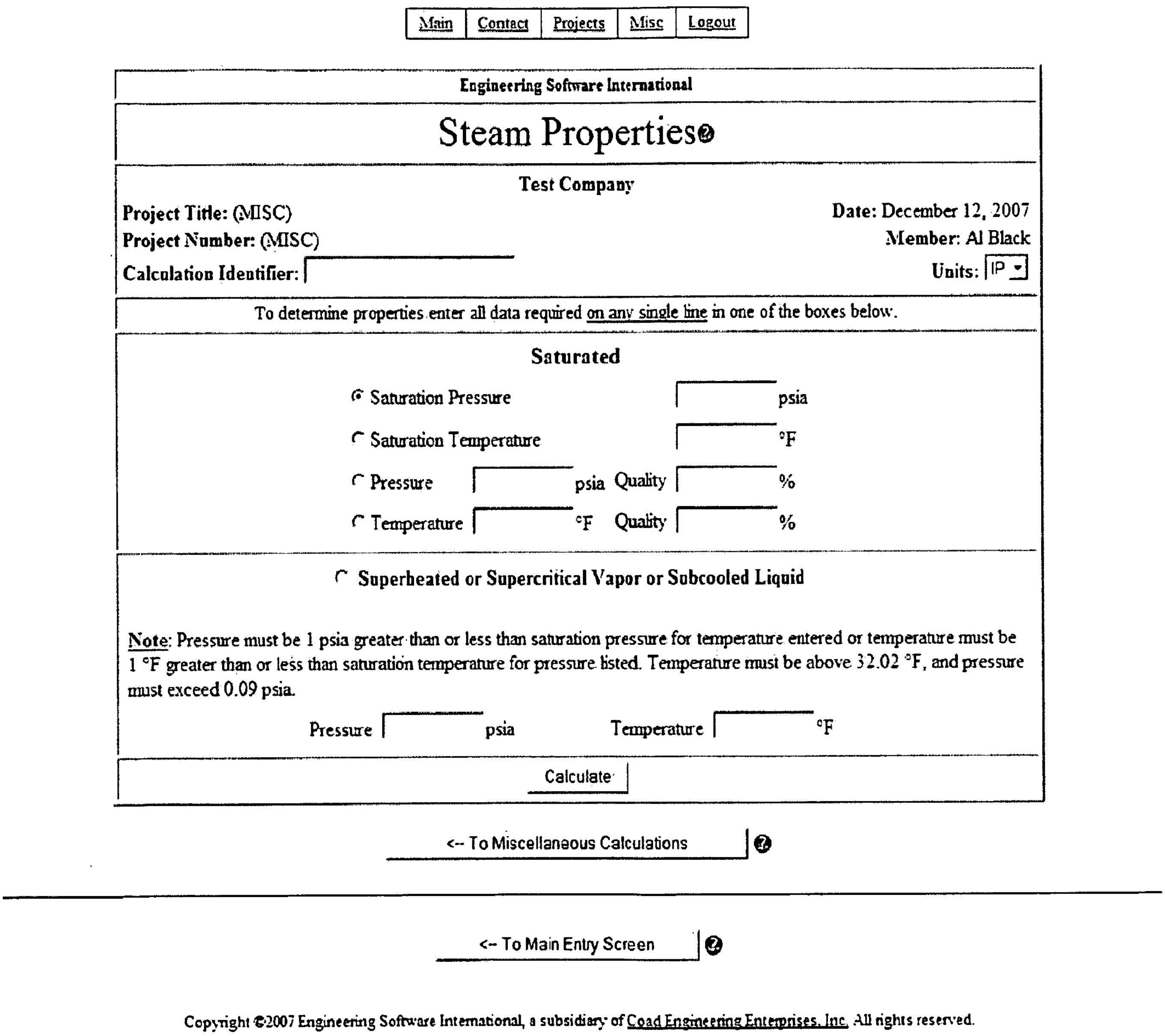
Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure: 5 psia Temperature: 322 °F

Steam Properties

Property	Symbol	Units	State Point 1 Properties	State Point 2 Properties	|Difference|
Condition			Saturated	Superheated	N/A
Pressure	p	psia	500.00	5.0000	495.00
Temperature	t	°F	467.04	322.00	145.04
Quality	x	%	100	N/A	N/A
Density	ρ	lb/ft^3	1.0774	0.10765E-01	1.0667
Specific Volume	v	ft^3/lb	0.92815	92.891	91.962
Enthalpy	h	BTU/lb	1205.0	1205.0	0.35610E-01
Entropy	s	BTU/lb-°F	1.4642	1.9502	0.48598
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	N/A	0.35101	N/A
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	N/A	0.46310	N/A
Internal Energy	u	BTU/lb	1119.1	1119.1	0.34549E-01
Sonic Velocity	a	ft/sec	N/A	1682.8	N/A
Thermal Conductivity	k	BTU/hr-ft-°F	N/A	0.16990E-01	N/A
Viscosity	μ	lbm/ft-sec	N/A	0.98442E-05	N/A
Prandtl Number	Pr	dimensionless	N/A	0.96594	N/A

Fig. 70


Main
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Engineering Software International
Steam Properties
Test Company
Project Title: (MISC)
Date: December 12, 2007
Project Number: (MISC)
Member: Al Black
Calculation Identifier:
Units: IP
To determine properties enter all data required on any single line in one of the boxes below.
Saturated
Saturation Pressure psia
Saturation Temperature °F
Pressure psia Quality %
Temperature °F Quality %
Superheated or Supercritical Vapor or Subcooled Liquid
Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.
Pressure psia Temperature °F
Calculate
<-- To Miscellaneous Calculations
<-- To Main Entry Screen
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Fig. 71

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

To determine properties enter all data required on any single line in one of the boxes below.

Saturated

Saturation Pressure 500 psia
Saturation Temperature °F
Pressure psia Quality %
Temperature °F Quality %

Superheated or Supercritical Vapor or Subcooled Liquid

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure psia Temperature °F

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 72

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

Saturation Pressure: 500 psia

Properties of Saturated Liquid and Saturated Vapor

Property	Symbol	Units	Liquid(f)	Vapor(g)	Difference(fg)
Pressure	p	psia	500.00	500.00	N/A
Temperature	t	°F	467.04	467.04	N/A
Density	ρ	lb/ft^3	50.628	1.0774	N/A
Specific Volume	v	ft^3/lb	0.19752E-01	0.92815	0.90839
Enthalpy	h	BTU/lb	449.54	1205.0	755.43
Entropy	s	BTU/lb-°F	0.64905	1.4642	0.81518
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	0.75955	0.57172	N/A
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	1.1435	0.90632	N/A
Internal Energy	u	BTU/lb	447.71	1119.1	671.38
Sonic Velocity	a	ft/sec	3878.9	1650.5	N/A
Thermal Conductivity	k	BTU/hr-ft-°F	0.36409	0.28394E-01	N/A
Viscosity	μ	lbm/ft-sec	0.73935E-04	0.11549E-04	N/A
Prandtl Number	Pr	dimensionless	0.83593	1.3271	N/A

Printable I/O Summary

New Steam Properties Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 73

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) Date: December 12, 2007
Project Number: (MISC) Member: Al Black
Calculation Identifier: AAA Units: IP

To determine properties enter all data required on any single line in one of the boxes below.

Saturated

Saturation Pressure ______ psia
Saturation Temperature 500 °F
Pressure ______ psia Quality ______ %
Temperature ______ °F Quality ______ %

Superheated or Supercritical Vapor or Subcooled Liquid

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure ______ psia Temperature ______ °F

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 74

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

Saturation Temperature: 500 °F

Properties of Saturated Liquid and Saturated Vapor

Property	Symbol	Units	Liquid(f)	Vapor(g)	Difference(fg)
Pressure	p	psia	680.55	680.55	N/A
Temperature	t	°F	500.00	500.00	N/A
Density	ρ	lb/ft^3	48.920	1.4803	N/A
Specific Volume	v	ft^3/lb	0.20441E-01	0.67555	0.65511
Enthalpy	h	BTU/lb	487.94	1202.3	714.38
Entropy	s	BTU/lb-°F	0.68906	1.4335	0.74440
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	0.74762	0.61037	N/A
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	1.1908	1.0288	N/A
Internal Energy	u	BTU/lb	485.37	1117.2	631.88
Sonic Velocity	a	ft/sec	3626.4	1637.8	N/A
Thermal Conductivity	k	BTU/hr-ft-°F	0.35201	0.31219E-01	N/A
Viscosity	μ	lbm/ft-sec	0.68326E-04	0.12013E-04	N/A
Prandtl Number	Pr	dimensionless	0.83209	1.4252	N/A

Printable I/O Summary

New Steam Properties Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 75

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007

Project Number: (MISC) **Member:** Al Black

Calculation Identifier: AAA **Units:** IP

To determine properties enter all data required on any single line in one of the boxes below.

Saturated

- ○ Saturation Pressure [ ] psia
- ○ Saturation Temperature [ ] °F
- ● Pressure [500] psia Quality [50] %
- ○ Temperature [ ] °F Quality [ ] %

○ **Superheated or Supercritical Vapor or Subcooled Liquid**

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure [ ] psia Temperature [ ] °F

[Calculate]

[<-- To Miscellaneous Calculations]

[<-- To Main Entry Screen]

Fig. 76

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

Pressure: 500 psia
Quality: 50%

Properties Within Saturation Region

Property	Symbol	Units	Value
Pressure	p	psia	500.00
Temperature	t	°F	467.04
Quality	x	% vapor	50
Density	ρ	lb/ft^3	2.1099
Specific Volume	v	ft^3/lb	0.47395
Enthalpy	h	BTU/lb	827.26
Entropy	s	BTU/lb-°F	1.0566
Internal Energy	u	BTU/lb	783.41

Printable I/O Summary

New Steam Properties Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 77

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

To determine properties enter all data required on any single line in one of the boxes below.

Saturated

- ○ Saturation Pressure [ ] psia
- ○ Saturation Temperature [ ] °F
- ○ Pressure [ ] psia Quality [ ] %
- ◉ Temperature [500] °F Quality [50] %

○ **Superheated or Supercritical Vapor or Subcooled Liquid**

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure [ ] psia Temperature [ ] °F

Calculate

<-- To Miscellaneous Calculations

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Fig. 78

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

Temperature: 500 °F
Quality: 50%

Properties Within Saturation Region

Property	Symbol	Units	Value
Pressure	p	psia	680.55
Temperature	t	°F	500.00
Quality	x	% vapor	50
Density	ρ	lb/ft^3	2.8736
Specific Volume	v	ft^3/lb	0.34800
Enthalpy	h	BTU/lb	845.13
Entropy	s	BTU/lb-°F	1.0613
Internal Energy	u	BTU/lb	801.32

Printable I/O Summary

New Steam Properties Calculation

<-- To Miscellaneous Calculations

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Fig. 79

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

To determine properties enter all data required on any single line in one of the boxes below.

Saturated

- Saturation Pressure ____ psia
- Saturation Temperature ____ °F
- Pressure ____ psia Quality ____ %
- Temperature ____ °F Quality ____ %

Superheated or Supercritical Vapor or Subcooled Liquid

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure 500 psia Temperature 400 °F

Calculate

<-- To Miscellaneous Calculations

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Fig. 80

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

Pressure: 500 psia
Temperature: 400 °F

Subcooled Liquid

Property	Symbol	Units	Value
Pressure	p	psia	500.00
Temperature	t	°F	400.00
Density	ρ	lb/ft^3	53.737
Specific Volume	v	ft^3/lb	0.18609E-01
Enthalpy	h	BTU/lb	375.33
Entropy	s	BTU/lb-°F	0.56596
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	0.78835
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	1.0769
Internal Energy	u	BTU/lb	373.61
Sonic Velocity	a	ft/sec	4344.7
Thermal Conductivity	k	BTU/hr-ft-°F	0.38260
Viscosity	μ	lbm/ft-sec	0.88489E-04
Prandtl Number	Pr	dimensionless	0.89666

Printable I/O Summary

New Steam Properties Calculation

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Fig. 81

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

To determine properties enter all data required on any single line in one of the boxes below.

Saturated

Saturation Pressure psia
Saturation Temperature °F
Pressure psia Quality %
Temperature °F Quality %

Superheated or Supercritical Vapor or Subcooled Liquid

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure 500 psia Temperature 500 °F

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 82

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

Pressure: 500 psia
Temperature: 500 °F

Superheated Vapor

Property	Symbol	Units	Value
Pressure	p	psia	500.00
Temperature	t	°F	500.00
Density	ρ	lb/ft^3	1.0070
Specific Volume	v	ft^3/lb	0.99303
Enthalpy	h	BTU/lb	1231.9
Entropy	s	BTU/lb-°F	1.4928
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	0.49720
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	0.75478
Internal Energy	u	BTU/lb	1140.1
Sonic Velocity	a	ft/sec	1716.8
Thermal Conductivity	k	BTU/hr-ft-°F	0.28132E-01
Viscosity	μ	lbm/ft-sec	0.12142E-04
Prandtl Number	Pr	dimensionless	1.1727

Printable I/O Summary

New Steam Properties Calculation

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Fig. 83

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Engineering Software International

Steam Properties

Test Company

Project Title: (MISC) **Date:** December 12, 2007

Project Number: (MISC) **Member:** Al Black

Calculation Identifier: AAA **Units:** IP

To determine properties enter all data required on any single line in one of the boxes below.

Saturated

Saturation Pressure psia

Saturation Temperature °F

Pressure psia Quality %

Temperature °F Quality %

Superheated or Supercritical Vapor or Subcooled Liquid

Note: Pressure must be 1 psia greater than or less than saturation pressure for temperature entered or temperature must be 1 °F greater than or less than saturation temperature for pressure listed. Temperature must be above 32.02 °F, and pressure must exceed 0.09 psia.

Pressure 500 psia Temperature 900 °F

Calculate

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 84

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Engineering Software International

Steam Properties❷

Test Company

Project Title: (MISC) **Date:** December 12, 2007
Project Number: (MISC) **Member:** Al Black
Calculation Identifier: AAA **Units:** IP

Pressure: 500 psia
Temperature: 900 °F

Supercritical Vapor

Property	Symbol	Units	Value
Pressure	p	psia	500.00
Temperature	t	°F	900.00
Density	ρ	lb/ft^3	0.63592
Specific Volume	v	ft^3/lb	1.5725
Enthalpy	h	BTU/lb	1466.9
Entropy	s	BTU/lb-°F	1.6992
Sp.Ht.Const.Vol.	c_v	BTU/lb-°F	0.41079
Sp.Ht.Const.Pres.	c_p	BTU/lb-°F	0.54145
Internal Energy	u	BTU/lb	1321.4
Sonic Velocity	a	ft/sec	2158.2
Thermal Conductivity	k	BTU/hr-ft-°F	0.38905E-01
Viscosity	μ	lbm/ft-sec	0.18741E-04
Prandtl Number	Pr	dimensionless	0.93898

Printable I/O Summary ❷

New Steam Properties Calculation ❷

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Fig. 85

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Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL ◉ Steel ○ Copper ○ PVC or CPVC	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc NA % Freezing Temp 32 °F	
Mean Fluid Temperature °F	Design Head Loss ft/100 ft	Maximum Velocity ft/sec	Minimum Pipe Size 0	
Flow Rate **gpm**	**Pipe Size** **inches**	**Head Loss** **ft/100 ft**	**Press Drop** **psi/100 ft**	**Velocity** **ft/sec**
	Add Entry ❷			

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 86

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Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel Copper PVC or CPVC	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc NA % Freezing Temp 32 °F	
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0	
Flow Rate **gpm**	**Pipe Size** **inches**	**Head Loss** **ft/100 ft**	**Press Drop** **psi/100 ft**	**Velocity** **ft/sec**
0.1	Add Entry			

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 87

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Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking: 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F	
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in	
Flow Rate gpm	**Pipe Size inches**	**Head Loss ft/100 ft**	**Press Drop psi/100 ft**	**Velocity ft/sec**
0.10	1/8	1.35	0.58	0.56
1.0	Add Entry ❷			

Finalize Calculation ❷

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 88

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Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F	
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in	
Flow Rate gpm	**Pipe Size inches**	**Head Loss ft/100 ft**	**Press Drop psi/100 ft**	**Velocity ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10	Add Entry ❷			

Finalize Calculation ❷

<- To Miscellaneous Calculations ❷

<- To Main Entry Screen ❷

Fig. 89

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Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking: 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F	
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in	
Flow Rate gpm	**Pipe Size inches**	**Head Loss ft/100 ft**	**Press Drop psi/100 ft**	**Velocity ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100	Add Entry ❷			

Finalize Calculation ❷

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 90

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Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in

Flow Rate gpm	**Pipe Size inches**	**Head Loss ft/100 ft**	**Press Drop psi/100 ft**	**Velocity ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100.00	3	2.39	1.04	4.34
1000	Add Entry			

Finalize Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 91

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Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking: 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in

Flow Rate gpm	**Pipe Size inches**	**Head Loss ft/100 ft**	**Press Drop psi/100 ft**	**Velocity ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100.00	3	2.39	1.04	4.34
1,000.00	8	1.55	0.67	6.41
10000	Add Entry ❷			

Finalize Calculation ❷

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 92

Main | Contact | Projects | Misc | Logout

Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking: 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	PIPE STRENGTH Standard	FLUID Water Percent Conc 0% Freezing Temp 32 °F	
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in	
Flow Rate gpm	**Pipe Size inches**	**Head Loss ft/100 ft**	**Press Drop psi/100 ft**	**Velocity ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100.00	3	2.39	1.04	4.34
1,000.00	8	1.55	0.67	6.41
10,000.00	24	0.59	0.26	7.56
100000	Add Entry			

Finalize Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 93

| Main | Contact | Projects | Misc | Logout |

Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	PIPE STRENGTH Standard	FLUID Water Percent Conc 0% Freezing Temp 32 °F
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in

Flow Rate gpm	**Pipe Size inches**	**Head Loss ft/100 ft**	**Press Drop psi/100 ft**	**Velocity ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100.00	3	2.39	1.04	4.34
1,000.00	8	1.55	0.67	6.41
10,000.00	24	0.59	0.26	7.56
100,000.00	72	0.17	0.07	7.88
1000000	Add Entry ❷			

Finalize Calculation ❷

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 94

Main	Contact	Projects	Misc	Logout

Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking: 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in

Flow Rate gpm	Pipe Size inches	Head Loss ft/100 ft	Press Drop psi/100 ft	Velocity ft/sec
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100.00	3	2.39	1.04	4.34
1,000.00	8	1.55	0.67	6.41
10,000.00	24	0.59	0.26	7.56
100,000.00	72	0.17	0.07	7.88
138000	Add Entry			

Finalize Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 95

Main	Contact	Projects	Misc	Logout

Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking: 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F	
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in	
Flow Rate **gpm**	**Pipe Size** **inches**	**Head Loss** **ft/100 ft**	**Press Drop** **psi/100 ft**	**Velocity** **ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100.00	3	2.39	1.04	4.34
1,000.00	8	1.55	0.67	6.41
10,000.00	24	0.59	0.26	7.56
100,000.00	72	0.17	0.07	7.88
138,000.00	84	0.14	0.06	7.99
	Add Entry ❷			

Finalize Calculation ❷

<-- To Miscellaneous Calculations ❷

<-- To Main Entry Screen ❷

Fig. 96

Main	Contact	Projects	Misc	Logout

Engineering Software International

Hydronic Pipe Sizing

Test Company

Project Title: (MISC) **Date:** December 13, 2007
Project Number: (MISC) **Member:** Al Black
Equipment Identifier: AAA **Units:** IP

In the design of hydronic pipe systems, greater temperature ranges within practical limits are encouraged since they will decrease the flow rate resulting in smaller pipes (and there by lower costs) and lower pumping horsepower (requiring less power and energy). Keep in mind the need to vent the high points, drain the system, clean and flush the system and provide for service isolation and overpressure relief as required.

Upon calculating at least one Flow Rate, an additional footer/button labeled "Finalize Calculation" will appear. When you're done adding entries, click the "Finalize Calculation" button to end a series of calculations. NOTE: Clicking: 'To Miscellaneous Calculations' or 'To Project Information' or 'To Main Entry Screen' will also end a series of calculations. (You may then either view a Printable I/O Summary--or start a new Hydronic Pipe Sizing calculation).

	PIPE MATERIAL Steel	**PIPE STRENGTH** Standard	**FLUID** Water Percent Conc 0% Freezing Temp 32 °F	
Mean Fluid Temperature 60 °F	Design Head Loss 4 ft/100 ft	Maximum Velocity 8 ft/sec	Minimum Pipe Size 0 in.	
Flow Rate **gpm**	**Pipe Size** **inches**	**Head Loss** **ft/100 ft**	**Press Drop** **psi/100 ft**	**Velocity** **ft/sec**
0.10	1/8	1.35	0.58	0.56
1.00	3/8	4.28	1.85	1.68
10.00	1-1/4	1.77	0.77	2.15
100.00	3	2.39	1.04	4.34
1,000.00	8	1.55	0.67	6.41
10,000.00	24	0.59	0.26	7.56
100,000.00	72	0.17	0.07	7.88
138,000.00	84	0.14	0.06	7.99

Printable I/O Summary

New Calculation

<-- To Miscellaneous Calculations

<-- To Main Entry Screen

Fig. 97

Member: Saul Zackson
Date Calculated: January 8, 2008
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Calculation Identifier: Saul-1
Psychrometric Properties - Printable Input Summary
\- - - - - - - - - - -
Elevation: 400 ft; (Pressure: 14.48 psia / 29.49 in Hg)
\- - - - - - - - - - -
Dry Bulb Temperature: 70 deg F
Wet Bulb Temperature: 60 deg F
\- - - - - - - - - - -

Psychrometric Properties - Printable Output Summary
\- - - - - - - - - - -

Property	Symbol	Value	Unit
Dry Bulb Temperature	tdb	70	deg F
Wet Bulb Temperature	twb	60	deg F
Dew Point Temperature	tdp	53.74	deg F
Humidity Ratio	w	62.36	grains/lb
Humidity Ratio	w	0.008909	lb/lb
Relative Humidity	rh	56.29	%
Enthalpy	h	26.53	BTU/lb
Specific Volume	v	13.75	ft^3/lb
Vapor Pressure	p_H	0.2045	psia

Within ASHRAE Comfort Zone for Summer? NO
Within ASHRAE Comfort Zone for Winter? YES
\- - - - - - - - - - -

FIG. 98

Member: Al Black
Date Calculated: October 31, 2007
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: AH-7W
Psychrometric Processes - Printable Input/Output Summary

****

Elevation: 4226 ft (Barometric Pressure: 12.586 psia / 25.62 in Hg)

Sensible Heating or Cooling Process

Input:
Initial Air Flow Rate: 7900 acfm

Input	Initial State	Final State
Dry Bulb Temperature	97 deg F	
Wet Bulb Temperature	62.9 deg F	
Dry Bulb Temperature		52.00 deg F

Output:

		Initial State	Final State	|Difference|
Dry Bulb Temperature	tdb	97.00 deg F	52.00 deg F	45.00 deg F
Wet Bulb Temperature	twb	62.90 deg F	46.45 deg F	16.45 deg F
Dew Point Temperature	tdp	41.88 deg F	41.88 deg F	0.00 deg F
Humidity Ratio	w	45.76 gr/lb	45.76 gr/lb	0.00 gr/lb
Humidity Ratio	w	0.006537 lb/lb	0.006537 lb/lb	0.000000 lb/lb
Relative Humidity	rh	15.09 %	68.25 %	53.16 %
Enthalpy	h	30.50 BTU/lb	19.57 BTU/lb	10.93 BTU/lb
Specific Volume	v	16.56 ft^3/lb	15.22 ft^3/lb	1.34 ft^3/lb
Vapor Pressure	p_H	0.1309 psia	0.1309 psia	0.0000 psia
Air Flow Rate	ACFM	7900 acfm	7261 acfm	639 acfm

Cooling Energy Requirement: 312802 BTU/hr

****

Elevation: 4226 ft (Barometric Pressure: 12.586 psia / 25.62 in Hg)

Mixing Process

Input:
Chained process. Stream 1 based on previous process in chain.
Mixed Air Flow Rate: 22555 acfm

Input	Stream 1	Stream 2
Volume Flow Rate	(chained)	
Dry Bulb Temperature	(chained)	
Wet Bulb Temperature	(chained)	
Dry Bulb Temperature		75 deg F
Relative Humidity		50 %

Output:

		Stream 1	Stream 2	Mixed Stream
Dry Bulb Temperature	tdb	52.00 deg F	75.00 deg F	67.38 deg F
Wet Bulb Temperature	twb	46.45 deg F	61.88 deg F	57.28 deg F
Dew Point Temperature	tdp	41.88 deg F	55.12 deg F	51.33 deg F
Humidity Ratio	w	45.76 gr/lb	75.68 gr/lb	65.71 gr/lb

Fig. 99

Humidity Ratio	w	0.006537 lb/lb	0.010812 lb/lb	0.009388 lb/lb
Relative Humidity	rh	68.25 %	50.00 %	56.37 %
Enthalpy	h	19.57 BTU/lb	29.83 BTU/lb	26.41 BTU/lb
Specific Volume	v	15.22 ft^3/lb	16.01 ft^3/lb	15.75 ft^3/lb
Vapor Pressure	p_H	0.1309 psia	0.2150 psia	0.1871 psia
Air Flow Rate	ACFM	7261 acfm	15293 acfm	22555 acfm

\- - - - -

Energy Requirement Summary:

Cooling (Sensible): 312802 BTU/hr

Cooling (Total): 312802 BTU/hr

FIG. 99

Member: Saul Zackson
Date Calculated: January 7, 2008
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Calculation Identifier: Saul-1
Steam Properties - Printable Input/Output Summary
PROPERTIES WITHIN SATURATION REGION

Inputs:
Temperature (deg F) : 100
Quality (%) : 80

Outputs:

Property	Symbol	Units	Value
Pressure	p	psia	0.95051
Temperature	t	deg F	100.000
Quality	x	(% vapor)	80
Density	(rho)	lb/ft^3	0.35731E-02
Specific Volume	v	ft^3/lb	279.87
Enthalpy	h	BTU/lb	897.37
Entropy	s	BTU/lb-deg F	1.6114
Internal Energy	u	BTU/lb	848.15

FIG. 100

```
Member: David Pollack
Date Calculated: December 2, 2007
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Calculation Identifier: DP Test

Hydronic Pipe Sizing - Printable Input/Output Summary:
- - - - - - - - - - -
Pipe Material:                PVC or CPVC
Pipe Strength:                Schedule 40
Fluid Concentration Percent: 0%
Fluid Freezing Temperature:  32 deg F
Mean Fluid Temperature:      44 deg F
Design Head Loss:            44 ft/100ft
Maximum Velocity:            44 ft/sec
Minimum Pipe Size:           0 in
- - - - - - - - - - -
Entry #1:
          Entered:
                    Flow Rate:      44 gal/min
          Returned:
                    Head Loss:      23.60 ft/100 ft
                    Pressure Drop:  10.23 psi/100 ft
                    Fluid Velocity: 9.44 ft/sec
                    Pipe Size:      1-1/4 in
- - - - - - - - - - -
```

FIG. 101

```
Member: Al Black
Date Calculated: October 17, 2007
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Calculation Identifier: AlTest#2
Heating & Cooling Load Calculation - Printable I/O Summary

Title: Al\\\'s Test run
Description: Before and after comparisons of executable code with 2 digit
             identification of wall type, etc.
Latitude: 38 deg North
Elevation: 539 ft
Construction Weight: Medium
```

Fig. 102

Indoor Cooling Space Temperature: 75 deg F
Indoor Cooling Space Relative Humidity: 50 %
Design Dew Point Temperature: 76 deg F
Mean Coincident Dry Bulb Temperature: 84 deg F
Single Cooling Design Month Selected: July
Cooling Design Dry Bulb: 95 deg F
Cooling Design Wet Bulb: 78 deg F
Cooling Design Temperature Range: 19 deg F
Outdoor Heating Dry Bulb Temperature: 0 deg F
Indoor Heating Space Temperature: 70 deg F
Indoor Heating Space Relative Humidity: 0 %

```
Wall Types:
      Wall Type #1 (Type 1 Wall)
            U-value: 0.05
            Color: Dark
            Construction Weight: Medium
      Wall Type #2 (Type 2 Wall)
            U-value: 0.06
            Color: Dark
            Construction Weight: Medium
      Wall Type #3 (Type 3 Wall)
            U-value: 0.07
            Color: Dark
            Construction Weight: Medium
      Wall Type #4 (Type 4 Wall)
            U-value: 0.08
            Color: Dark
            Construction Weight: Medium
      Wall Type #5 (Type 5 Wall)
            U-value: 0.09
            Color: Dark
            Construction Weight: Medium


Window Types:
      Window #1 (Type 1 Window)
            U-value: 0.50
            Interior Shading Coefficient: 1.0
            Glass Shading Coefficient: 0.50
      Window #2 (Type 2 Window)
            U-value: 0.60
            Interior Shading Coefficient: 1.0
            Glass Shading Coefficient: 0.60
      Window #3 (Type 3 Window)
            U-value: 0.70
            Interior Shading Coefficient: 1.0
            Glass Shading Coefficient: 0.70
      Window #4 (Type 4 window)
            U-value: 0.80
            Interior Shading Coefficient: 1.0
            Glass Shading Coefficient: 0.80
      Window #5 (Type 5 window)
            U-value: 0.90
            Interior Shading Coefficient: 1.0
            Glass Shading Coefficient: 0.90
Door Types:
      Door Type #1 (Door Type 1)
            U-value: 1.0
            Color: Dark
            Construction Weight: Light
      Door Type #2 (Door Type 2)
            U-value: 1.1
            Color: Dark
            Construction Weight: Light
      Door Type #3 (Door Type 3)
            U-value: 1.2
            Color: Dark
            Construction Weight: Light
```

```
      Door Type #4 (Door Type 4)
            U-value: 1.3
            Color: Dark
            Construction Weight: Light
      Door Type #5 (Door Type 5)
            U-value: 1.4
            Color: Dark
            Construction Weight: Medium

Roof Types:
      Roof Type #1 (Type 1 Roof)
            U-value: 0.05
            Color: Dark
            Construction Weight: Light
      Roof Type #2 (Type 2 Roof)
            U-value: 0.06
            Color: Dark
            Construction Weight: Light
      Roof Type #3 (Type 3 Roof)
            U-value: 0.07
            Color: Dark
            Construction Weight: Light
      Roof Type #4 (Type 4 Roof)
            U-value: 0.08
            Color: Dark
            Construction Weight: Light
      Roof Type #5 (Type 5 Roof)
            U-value: 0.09
            Color: Dark
            Construction Weight: Light

Floor Types:
      Floor Type #1 (Exp Floor Type 1)
            U-value: 0.1
            Construction Weight: Medium
      Floor Type #2 (Exp Floor Type 2)
            U-value: 0.2
            Construction Weight: Medium
      Floor Type #3 (Exp Floor Type 3)
            U-value: 0.3
            Construction Weight: Medium
      Floor Type #4 (Exp Floor Type 4)
            U-value: 0.4
            Construction Weight: Medium
      Floor Type #5 (Exp Floor Type 5)
            U-value: 0.5
            Construction Weight: Medium

Master Exterior Shading Geometries (ESGs):
      ESG #1 (ESG Type 1)
            Window Width: 1
            Window Height: 1
            Overhang Projection: 1
            Overhang Offset: 0
            Left Fin Projection: 0
            Left Fin Offset: 0
            Right Fin Projection: 0
```

```
      Right Fin Offset: 0
ESG #2 (ESG Type 2)
      Window Width: 1
      Window Height: 1
      Overhang Projection: 0
      Overhang Offset: 0
      Left Fin Projection: 1
      Left Fin Offset: 0
      Right Fin Projection: 0
      Right Fin Offset: 0
ESG #3 (ESG Type 3)
      Window Width: 1
      Window Height: 1
      Overhang Projection: 0
      Overhang Offset: 0
      Left Fin Projection: 0
      Left Fin Offset: 0
      Right Fin Projection: 1
      Right Fin Offset: 0
ESG #4 (ESG Type 4)
      Window Width: 1
      Window Height: 1
      Overhang Projection: 2
      Overhang Offset: 0
      Left Fin Projection: 0
      Left Fin Offset: 0
      Right Fin Projection: 0
      Right Fin Offset: 0
ESG #5 (ESG type 5)
      Window Width: 1
      Window Height: 1
      Overhang Projection: 0
      Overhang Offset: 0
      Left Fin Projection: 2
      Left Fin Offset: 0
      Right Fin Projection: 0
      Right Fin Offset: 0
ESG #6 (ESG Type 6)
      Window Width: 1
      Window Height: 1
      Overhang Projection: 0
      Overhang Offset: 0
      Left Fin Projection: 0
      Left Fin Offset: 0
      Right Fin Projection: 2
      Right Fin Offset: 0
ESG #7 (ESG Type 7)
      Window Width: 1
      Window Height: 1
      Overhang Projection: 3
      Overhang Offset: 0
      Left Fin Projection: 0
      Left Fin Offset: 0
      Right Fin Projection: 0
      Right Fin Offset: 0
ESG #8 (ESG Type 8)
      Window Width: 1
```

```
        Window Height: 1
        Overhang Projection: 0
        Overhang Offset: 0
        Left Fin Projection: 3
        Left Fin Offset: 0
        Right Fin Projection: 0
        Right Fin Offset: 0
  ESG #9 (ESG type 9)
        Window Width: 1
        Window Height: 1
        Overhang Projection: 0
        Overhang Offset: 0
        Left Fin Projection: 0
        Left Fin Offset: 0
        Right Fin Projection: 3
        Right Fin Offset: 0

Master Loads:
Occupant Load (Sensible): 250 BTU/hr
Occupant Load (Latent): 250 BTU/hr
Occupied Operation Start Time: Continuous
Occupied Operation Stop Time: N/A
```

```
Individual Space Input:
Zone #1 (Single Zone):
      Space #1 (Interior Space):
            # Additional Identical Spaces: 0
            Exclude from Cooling Load Calculations?: No
            Exclude from Heating Load Calculations?: No

            Space Area: 1000 sq ft
            Ceiling Height: 15 ft

            Ventilation Rate: 250 cfm
            Infiltration Rate: 250 cfm

            Occupancy: 10
            Occupant Load/Person (Sensible): 250 BTU/hr
            Occupant Load/Person (Latent): 250 BTU/hr

            Appliance Loads:
            Appliance Load (Sensible): 1000 W

            Lighting: 1200 W
            Lighting Decimal Fraction to Return: 0.5
```

```
Zone #1 (Single Zone):
      Space #2 (Wall Space):
            # Additional Identical Spaces: 0
            Exclude from Cooling Load Calculations?: No
            Exclude from Heating Load Calculations?: No

            Space Area: 1000 sq ft
            Ceiling Height: 15 ft

            Ventilation Rate: 0 cfm
            Infiltration Rate: 250 cfm

            Occupancy: 0
            Occupant Load/Person (Sensible): 250 BTU/hr
            Occupant Load/Person (Latent): 250 BTU/hr

            Appliance Loads:

            Lighting: 0 W
            Lighting Decimal Fraction to Return: 0.5

            Wall Exposures:
                  Wall #1:

                        Wall Type: Type 1 Wall
                        Net Area: 230 sq ft
                        Decimal Fraction to Return: 0.3
                        Direction: 0

                        Window Type: Type 1 Window
                        ESG: ESG Type 1
                        Window Area: 220 sq ft
                  Wall #2:

                        Wall Type: Type 2 Wall
                        Net Area: 240 sq ft
                        Decimal Fraction to Return: 0.3
                        Direction: 45

                        Window Type: Type 2 Window
                        ESG: ESG Type 2
                        Window Area: 210 sq ft
                  Wall #3:

                        Wall Type: Type 3 Wall
                        Net Area: 250 sq ft
                        Decimal Fraction to Return: 0.3
                        Direction: 90

                        Window Type: Type 3 Window
                        ESG: ESG Type 3
                        Window Area: 200 sq ft
                  Wall #4:

                        Wall Type: Type 4 Wall
                        Net Area: 260 sq ft
                        Decimal Fraction to Return: 0.3
```

```
            Direction: 135

            Window Type: Type 4 window
            ESG: ESG Type 4
            Window Area: 190 sq ft
      Wall #5:

            Wall Type: Type 5 Wall
            Net Area: 270 sq ft
            Decimal Fraction to Return: 0.3
            Direction: 180

            Window Type: Type 5 window
            ESG: ESG type 5
            Window Area: 180 sq ft
      Wall #6:

            Wall Type: Type 1 Wall
            Net Area: 280 sq ft
            Decimal Fraction to Return: 0.3
            Direction: 225

            Window Type: Type 2 Window
            ESG: ESG Type 6
            Window Area: 170 sq ft
Door Exposures:

      Door #1:
            Door Type: Door Type 1
            Area: 12 sq ft
            Direction: 0

            Window Type: Type 1 Window
            ESG: ESG Type 6
            Window Area: 12 sq ft

      Door #2:
            Door Type: Door Type 2
            Area: 13 sq ft
            Direction: 45

            Window Type: Type 2 Window
            ESG: ESG Type 7
            Window Area: 11 sq ft

      Door #3:
            Door Type: Door Type 3
            Area: 14 sq ft
            Direction: 90

            Window Type: Type 3 Window
            ESG: ESG Type 8
            Window Area: 10 sq ft

      Door #4:
            Door Type: Door Type 4
            Area: 15 sq ft
```

```
Direction: 135

Window Type: Type 4 window
ESG: ESG type 9
Window Area: 9 sq ft
```

```
Zone #1 (Single Zone):
      Space #3 (Exposed Floor Space):
            # Additional Identical Spaces: 0
            Exclude from Cooling Load Calculations?: No
            Exclude from Heating Load Calculations?: No

            Space Area: 900 sq ft
            Ceiling Height: 15 ft

            Ventilation Rate: 0 cfm
            Infiltration Rate: 225 cfm

            Occupancy: 0
            Occupant Load/Person (Sensible): 250 BTU/hr
            Occupant Load/Person (Latent): 250 BTU/hr

            Appliance Loads:

            Lighting: 0 W
            Lighting Decimal Fraction to Return: 0.5

            Floor Exposures:

                  Floor #1:
                        Floor Type: Exp Floor Type 1
                        Area: 900 sq ft

                  Floor #2:
                        Floor Type: Exp Floor Type 2
                        Area: 800 sq ft

                  Floor #3:
                        Floor Type: Exp Floor Type 3
                        Area: 700 sq ft

                  Floor #4:
                        Floor Type: Exp Floor Type 4
                        Area: 600 sq ft

                  Floor #5:
                        Floor Type: Exp Floor Type 5
                        Area: 500 sq ft
```

```
Zone #1 (Single Zone):
      Space #4 (Slab Loss Space):
            # Additional Identical Spaces: 0
            Exclude from Cooling Load Calculations?: No
            Exclude from Heating Load Calculations?: No

            Space Area: 800 sq ft
            Ceiling Height: 15 ft

            Ventilation Rate: 0 cfm
            Infiltration Rate: 200 cfm

            Occupancy: 0
            Occupant Load/Person (Sensible): 250 BTU/hr
            Occupant Load/Person (Latent): 250 BTU/hr

            Appliance Loads:

            Lighting: 0 W
            Lighting Decimal Fraction to Return: 0.5

            Floors : Winter loss from slab Perimeters:

                  Winter Slab Loss
                        Permimeter Slab Loss: 1 Btu/hr-ft-deg F
                        Net Perimeter Length: 100 ft

                  Winter Slab Loss
                        Permimeter Slab Loss: 2 Btu/hr-ft-deg F
                        Net Perimeter Length: 90 ft

                  Winter Slab Loss
                        Permimeter Slab Loss: 3 Btu/hr-ft-deg F
                        Net Perimeter Length: 80 ft

                  Winter Slab Loss
                        Permimeter Slab Loss: 4 Btu/hr-ft-deg F
                        Net Perimeter Length: 70 ft

                  Winter Slab Loss
                        Permimeter Slab Loss: 5 Btu/hr-ft-deg F
                        Net Perimeter Length: 60 ft
```

```
Zone #1 (Single Zone):
      Space #5 (Space over Unconditioned):
            # Additional Identical Spaces: 0
            Exclude from Cooling Load Calculations?: No
            Exclude from Heating Load Calculations?: No

            Space Area: 700 sq ft
            Ceiling Height: 15 ft

            Ventilation Rate: 0 cfm
            Infiltration Rate: 175 cfm

            Occupancy: 0
            Occupant Load/Person (Sensible): 250 BTU/hr
            Occupant Load/Person (Latent): 250 BTU/hr

            Appliance Loads:

            Lighting: 0 W
            Lighting Decimal Fraction to Return: 0.5

            Floors over unconditioned spaces:

                  U Value: 0.1 Btu/hr-sq ft-deg F
                  Net Floor Area: 100 sq ft
                  Cooling Temperature of Unconditioned Space: 85 deg F
                  Heating Temperature of Unconditioned Space: 60 deg F

                  U Value: 0.2 Btu/hr-sq ft-deg F
                  Net Floor Area: 50 sq ft
                  Cooling Temperature of Unconditioned Space: 86 deg F
                  Heating Temperature of Unconditioned Space: 59 deg F

                  U Value: 0.3 Btu/hr-sq ft-deg F
                  Net Floor Area: 33 sq ft
                  Cooling Temperature of Unconditioned Space: 87 deg F
                  Heating Temperature of Unconditioned Space: 58 deg F

                  U Value: 0.4 Btu/hr-sq ft-deg F
                  Net Floor Area: 25 sq ft
                  Cooling Temperature of Unconditioned Space: 88 deg F
                  Heating Temperature of Unconditioned Space: 57 deg F

                  U Value: 0.5 Btu/hr-sq ft-deg F
                  Net Floor Area: 20 sq ft
                  Cooling Temperature of Unconditioned Space: 89 deg F
                  Heating Temperature of Unconditioned Space: 56 deg F

                  U Value: 0.6 Btu/hr-sq ft-deg F
                  Net Floor Area: 17 sq ft
                  Cooling Temperature of Unconditioned Space: 90 deg F
                  Heating Temperature of Unconditioned Space: 55 deg F

                  U Value: 0.7 Btu/hr-sq ft-deg F
                  Net Floor Area: 14 sq ft
                  Cooling Temperature of Unconditioned Space: 91 deg F
                  Heating Temperature of Unconditioned Space: 54 deg F
```

U Value: 0.8 Btu/hr-sq ft-deg F
Net Floor Area: 12 sq ft
Cooling Temperature of Unconditioned Space: 92 deg F
Heating Temperature of Unconditioned Space: 53 deg F

U Value: 0.9 Btu/hr-sq ft-deg F
Net Floor Area: 11 sq ft
Cooling Temperature of Unconditioned Space: 93 deg F
Heating Temperature of Unconditioned Space: 52 deg F

U Value: 1.0 Btu/hr-sq ft-deg F
Net Floor Area: 10 sq ft
Cooling Temperature of Unconditioned Space: 94 deg F
Heating Temperature of Unconditioned Space: 51 deg F

```
Zone #1 (Single Zone):
      Space #6 (Space Adjoining):
            # Additional Identical Spaces: 0
            Exclude from Cooling Load Calculations?: No
            Exclude from Heating Load Calculations?: No

            Space Area: 700 sq ft
            Ceiling Height: 15 ft

            Ventilation Rate: 0 cfm
            Infiltration Rate: 175 cfm

            Occupancy: 0
            Occupant Load/Person (Sensible): 250 BTU/hr
            Occupant Load/Person (Latent): 250 BTU/hr

            Appliance Loads:

            Lighting: 0 W
            Lighting Decimal Fraction to Return: 0.5

            Partitions adjoining unconditioned spaces:

                  U Value: 0.1 Btu/hr-sq ft-deg F
                  Net Partition Area: 100 sq ft
                  Cooling Temperature of Unconditioned Space: 85 deg F
                  Heating Temperature of Unconditioned Space: 60 deg F

                  U Value: 0.2 Btu/hr-sq ft-deg F
                  Net Partition Area: 50 sq ft
                  Cooling Temperature of Unconditioned Space: 86 deg F
                  Heating Temperature of Unconditioned Space: 59 deg F

                  U Value: 0.3 Btu/hr-sq ft-deg F
                  Net Partition Area: 33 sq ft
                  Cooling Temperature of Unconditioned Space: 87 deg F
                  Heating Temperature of Unconditioned Space: 58 deg F

                  U Value: 0.4 Btu/hr-sq ft-deg F
                  Net Partition Area: 25 sq ft
                  Cooling Temperature of Unconditioned Space: 88 deg F
                  Heating Temperature of Unconditioned Space: 57 deg F

                  U Value: 0.5 Btu/hr-sq ft-deg F
                  Net Partition Area: 20 sq ft
                  Cooling Temperature of Unconditioned Space: 89 deg F
                  Heating Temperature of Unconditioned Space: 56 deg F

                  U Value: 0.6 Btu/hr-sq ft-deg F
                  Net Partition Area: 17 sq ft
                  Cooling Temperature of Unconditioned Space: 90 deg F
                  Heating Temperature of Unconditioned Space: 55 deg F

                  U Value: 0.7 Btu/hr-sq ft-deg F
                  Net Partition Area: 14 sq ft
                  Cooling Temperature of Unconditioned Space: 91 deg F
                  Heating Temperature of Unconditioned Space: 54 deg F
```

U Value: 0.8 Btu/hr-sq ft-deg F
Net Partition Area: 12 sq ft
Cooling Temperature of Unconditioned Space: 92 deg F
Heating Temperature of Unconditioned Space: 53 deg F

U Value: 0.9 Btu/hr-sq ft-deg F
Net Partition Area: 11 sq ft
Cooling Temperature of Unconditioned Space: 93 deg F
Heating Temperature of Unconditioned Space: 52 deg F

U Value: 1.0 Btu/hr-sq ft-deg F
Net Partition Area: 10 sq ft
Cooling Temperature of Unconditioned Space: 94 deg F
Heating Temperature of Unconditioned Space: 51 deg F

Output Summary:

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Zone #1 (Single Zone)- Space #1 (Interior Space)

Area = 1000 Square Feet
Volume = 15000 Cubic Feet

	Cooling		Heating	
Space Sensible Peak at	July 100 hrs		January 2400 hrs	
	Sensible Btu/hr	Latent Btu/hr	Unoccupied Gross Sensible Btu/hr	Occupied Net Sensible Btu/hr
Solar	0		0	0
Transmission	0		0	0
Infiltration	0	0	18979	0
People	2500	2500	0	-2500
Internal	5459	0	0	-5459
Space Total	7959	2500	18979	-7959
Unit Load Btu/hr ft^2	8.0		19.0	-8.0
Ventilation Load	2440	12792	N/A	18979

Ventilation = 250 cfm = 25.0 cfm/person = 0.25 cfm/ft^2

Infiltration = 250 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 1200 W = 1.20 W/ft^2

Appliances (Sensible) = 1000 W = 1.00 W/ft^2

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Zone #1 (Single Zone)- Space #2 (Wall Space)

Area = 1000 Square Feet
Volume = 15000 Cubic Feet

	Cooling		Heating	
Space Sensible Peak at	July 1500 hrs		January 100 hrs	
	Sensible Btu/hr	Latent Btu/hr	Unoccupied Gross Sensible Btu/hr	Occupied Net Sensible Btu/hr
Solar	41952		0	0
Transmission	15958		66720	66720
Infiltration	0	0	18979	0
People	0	0	0	0
Internal	0	0	0	0
Space Total	57910	0	85699	66720
Unit Load Btu/hr ft^2	57.9		85.7	66.7
Ventilation Load	0	0	N/A	0

Ventilation = 0 cfm = 0.00 cfm/ft^2

Infiltration = 250 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 0 W = 0.00 W/ft^2

Appliances (Sensible) = 0 W = 0.00 W/ft^2

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Zone #1 (Single Zone)- Space #3 (Exposed Floor Space)

Area = 900 Square Feet
Volume = 13500 Cubic Feet

	Cooling		Heating	
Space Sensible Peak at	July		January	
	2400 hrs			100 hrs
			Unoccupied	Occupied
			Gross	Net
	Sensible	Latent	Sensible	Sensible
	Btu/hr	Btu/hr	Btu/hr	Btu/hr
Solar	0		0	0
Transmission	11966		66500	66500
Infiltration	0	0	17081	0
People	0	0	0	0
Internal	0	0	0	0
	----------	----------	----------	----------
Space Total	11966	0	83581	66500
Unit Load Btu/hr ft^2	13.3		92.9	73.9
Ventilation Load	0	0	N/A	0

Ventilation = 0 cfm = 0.00 cfm/ft^2

Infiltration = 225 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 0 W = 0.00 W/ft^2

Appliances (Sensible) = 0 W = 0.00 W/ft^2

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Zone #1 (Single Zone)- Space #4 (Slab Loss Space)

Area = 800 Square Feet
Volume = 12000 Cubic Feet

	Cooling		Heating	
Space Sensible Peak at	July		January	
	100 hrs			100 hrs
	Sensible Btu/hr	Latent Btu/hr	Unoccupied Gross Sensible Btu/hr	Occupied Net Sensible Btu/hr
Solar	0		0	0
Transmission	0		77000	77000
Infiltration	0	0	15183	0
People	0	0	0	0
Internal	0	0	0	0
	----------	----------	----------	----------
Space Total	0	0	92183	77000
Unit Load Btu/hr ft^2	0.0		115.2	96.3
Ventilation Load	0	0	N/A	0

Ventilation = 0 cfm = 0.00 cfm/ft^2

Infiltration = 200 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 0 W = 0.00 W/ft^2

Appliances (Sensible) = 0 W = 0.00 W/ft^2

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Zone #1 (Single Zone)- Space #5 (Space over Unconditioned)

Area = 700 Square Feet
Volume = 10500 Cubic Feet

	Cooling		Heating	
Space Sensible Peak at	July		January	
	100 hrs			100 hrs
	Sensible Btu/hr	Latent Btu/hr	Unoccupied Gross Sensible Btu/hr	Occupied Net Sensible Btu/hr
Solar	0		0	0
Transmission	1440		1440	1440
Infiltration	0	0	13285	0
People	0	0	0	0
Internal	0	0	0	0
	----------	----------	----------	----------
Space Total	1440	0	14725	1440
Unit Load Btu/hr ft^2	2.1		21.0	2.1
Ventilation Load	0	0	N/A	0

Ventilation = 0 cfm = 0.00 cfm/ft^2

Infiltration = 175 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 0 W = 0.00 W/ft^2

Appliances (Sensible) = 0 W = 0.00 W/ft^2

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Zone #1 (Single Zone)- Space #6 (Space Adjoining)

Area = 700 Square Feet
Volume = 10500 Cubic Feet

	Cooling		Heating	
Space Sensible Peak at	July		January	
	100 hrs			100 hrs

	Sensible Btu/hr	Latent Btu/hr	Unoccupied Gross Sensible Btu/hr	Occupied Net Sensible Btu/hr
Solar	0		0	0
Transmission	1440		1440	1440
Infiltration	0	0	13285	0
People	0	0	0	0
Internal	0	0	0	0
Space Total	1440	0	14725	1440
Unit Load Btu/hr ft^2	2.1		21.0	2.1
Ventilation Load	0	0	N/A	0

Ventilation = 0 cfm = 0.00 cfm/ft^2

Infiltration = 175 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 0 W = 0.00 W/ft^2

Appliances (Sensible) = 0 W = 0.00 W/ft^2

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Summary for Zone 1

Area = 5100 Square Feet
Volume = 76500 Cubic Feet

Space Loads Only

	Cooling		Heating	
Space Sensible Peak at	July		January	
	1500 hrs			100 hrs
			Unoccupied Gross	Occupied Net
	Sensible Btu/hr	Latent Btu/hr	Sensible Btu/hr	Sensible Btu/hr
Solar	41952		0	0
Transmission	27374		213100	213100
Infiltration	0	0	96792	0
People	2500	2500	0	-2500
Internal	5459	0	0	-5459
	----------	----------	----------	----------
Space Total	77285	2500	309892	205141
Unit Load Btu/hr ft^2	15.2		60.8	40.2
Sum of Peaks	80716			
Ventilation Load	2440	12792	N/A	18979

Ventilation = 250 cfm = 25.0 cfm/person = 0.05 cfm/ft^2

Infiltration = 1275 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 1200 W = 0.24 W/ft^2

Appliances (Sensible) = 1000 Btu/hr = 0.20 Btu/(hr ft^2)

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

Sensible Heat Ratio 0.97

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Total Zone 1 Loads

	Cooling		Heating	
Zone Sensible Peak at	July		January	
	1500 hrs			100 hrs
	Sensible Btu/hr	Latent Btu/hr	Unoccupied Gross Sensible Btu/hr	Occupied Net Sensible Btu/hr
Space Total	77285	2500	309892	205141
Ventilation Load	2440	12792	0	18979
Return Loads	2883	0	2152	105
Zone Totals	82608	15292	312045	224225
Sum of Peaks	86191			

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Summary for Building

Area = 5100 Square Feet
Volume = 76500 Cubic Feet

Space Loads Only

	Cooling		Heating	
Space Sensible Peak at	July		January	
	1500 hrs			100 hrs
	Sensible Btu/hr	Latent Btu/hr	Unoccupied Gross Sensible Btu/hr	Occupied Net Sensible Btu/hr
Solar	41952		0	0
Transmission	27374		213100	213100
Infiltration	0	0	96792	0
People	2500	2500	0	-2500
Internal	5459	0	0	-5459
Space Total	77285	2500	309892	205141
Unit Load Btu/hr ft^2	15.2		60.8	40.2
Sum of Peaks	80716			
Ventilation Load	2440	12792	N/A	18979

Ventilation = 250 cfm = 25.0 cfm/person = 0.05 cfm/ft^2

Infiltration = 1275 cfm = 0.25 cfm/ft^2 = 1.00 Air changes/hr

Lighting = 1200 W = 0.24 W/ft^2

Appliances (Sensible) = 1000 Btu/hr = 0.20 Btu/(hr ft^2)

Appliances (Latent) = 0 Btu/hr = 0.00 Btu/(hr ft^2)

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Heating & Cooling Loads Calculation (Project Title: MISC)
Calculation Identifier: AlTest#2

Total Building Loads

	Cooling		Heating	
Building Sensible Peak at	July		January	
	1500 hrs			100 hrs
			Unoccupied Gross	Occupied Net
	Sensible Btu/hr	Latent Btu/hr	Sensible Btu/hr	Sensible Btu/hr
Space Total	77285	2500	309892	205141
Ventilation Load	2440	12792	0	18979
Return Loads	2883	0	2152	105
Building Totals	82608	15292	312045	224225
Sum of Peaks	86191			

Building Cooling Load 97900 Btu/hr = 8.2 Tons (July, 1500 hrs)

Building Heating Load 234232 Btu/hr = 234 MBH (January, 100 hrs)

Inside Surface Temperatures
Tinside = 70.00 deg F
Toutside = 0.00 deg F
Rfilm = 0.68 hr ft^2 deg F/Btu

Wall No. 1 67.62 deg F
Wall No. 2 67.14 deg F
Wall No. 3 66.67 deg F
Wall No. 4 66.19 deg F
Wall No. 5 65.72 deg F
Wall No. 6 22.40 deg F
Wall No. 7 17.64 deg F
Wall No. 8 12.88 deg F
Wall No. 9 8.12 deg F
Wall No. 10 3.36 deg F

Roof No. 1 67.62 deg F
Roof No. 2

FIG. 102

Member: Al Black
Date Calculated: January 4, 2008
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: AAA
Expansion Tank Sizing - Printable Summary of Input and Output

Input

Building Area: 100000 sq ft
System Volume: (Estimate Based on Area) 2991 gal
Pipe Material: Steel

Property	Value
Unit Convention	IP (English)
Tank Type	Diaphragm (Bladder)
Fluid Type	Ethylene Glycol Mixture
Percent Concentration	33.29 %
Freezing Temperature	0.07 deg F
Lower Temperature	45 deg F
Higher Temperature	85 deg F
Pressure (Lower Temperature)	30 psig
Pressure (Higher Temperature)	45 psig

Output

Tank Size	77 gal

Actual Total Size (Volume) of Tank or Tanks:	15 gal
Actual Pressure at Higher Temperature:	-172 psig

FIG. 103

Member: Ed Howland
Date Calculated: August 6, 2007
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: Esd test of 479 cooling
Cooling/Dehumidifying Coil Diagnostics - Printable Summary of Input and Output

Input

Tube Side Fluid: Water
Freezing Temp 32 deg F
Elevation 0 ft

Physical Characteristics of Coil

Coil Height	48 in
Coil Width	60 in
Rows	2
Circuiting	Half
Tubes High	32
Fin Type	Flat
Fins per Inch	8
Fin Spacing	0.125 in

Entering Conditions

Air Flow Rate	10000 acfm
Entering Air Dry Bulb Temp	95 deg F
Entering Air Wet Bulb Temp	75 deg F
Entering Liquid Temp	45 deg F

Performance Conditions
Liquid Flow Rate, GPM: 10 gal/min

Output

ARI Error: Liquid Velocity is Below 1 ft/sec

Air Flow Rate	9,455 scfm
Coil Face Area	20.00 sq ft
Total Heat Transfer	143,388 BTU/hr
Sensible Heat Transfer	143,388 BTU/hr
Sensible Heat Ratio	1.00
Entering Face Velocity	473 ft/min
Leaving Dry Bulb Temp	81.13 deg F
Leaving Wet Bulb Temp	71.14 deg F
Leaving Dew Point Temp	66.77 deg F
Air Pressure Drop	0.1 in w.c.

Liquid Flow Rate	10.0 gpm
Liquid Pressure Drop	0.2 ft
Liquid Volume of Coil	5.00 gal
Leaving Liquid Temp	73.54 deg F
Liquid Temp Rise	28.54 deg F
Liquid Velocity	0.7 ft/sec

FIG. 104

Member: David Pollack
Date Calculated: January 12, 2008
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: DP Test
Heating and Cooling Coil Selection - Printable Summary of Input and Output

Freezing Temp: 32.00 deg F
Elevation: 564 ft

EDB= 80.00 deg F EWB= 67.00 deg F Acfm= 10000 Scfm= 9536
LDB= 55.00 deg F
ELT= 44.00 deg F Min LLT= 12.00 deg F

Coil Height= 48 in Coil Width= 57 in Tubes High= 32
Face Area= 19.0 sq ft Face Velocity= 502 fpm
Max Fins Per Inch= 8 Fin Type= Flat
Max Head Loss= 10.0 ft Max Air dP= 1.0 in w.c.

	Fin	Row	Cir	Qtotal Btuh	Qsens Btuh	LDB deg F	LWB deg F	LDP deg F	LLT deg F	Gpm	Vw fps	PDw ft h2o	PDa in h2o	SHR	
>	8	8	0.5	361056	260697	55.00	54.95	54.92	62.80	38.2	2.8	3.27	0.61	0.72	<
	8	10	0.5	360123	260697	55.00	54.99	54.98	66.70	31.6	2.3	7.38	0.76	0.72	
	8	12	0.5	359886	260697	55.00	55.00	55.00	68.31	28.3	2.1	7.30	0.91	0.72	
	8	6	1.0	364716	260697	55.00	54.82	54.69	53.39	77.3	2.8	3.16	0.45	0.71	
	8	8	1.0	361056	260697	55.00	54.95	54.92	59.22	47.2	1.7	1.79	0.61	0.72	
	8	10	1.0	360123	260697	55.00	54.99	54.98	63.29	37.2	1.3	1.48	0.76	0.72	
	8	12	1.0	359886	260697	55.00	55.00	55.00	66.22	32.2	1.2	1.28	0.91	0.72	
	8	6	2.0	364716	260697	55.00	54.82	54.69	50.25	116.1	2.1	0.94	0.45	0.71	
	8	8	2.0	361056	260697	55.00	54.95	54.92	55.01	65.3	1.2	0.47	0.61	0.72	
	8	10	2.0	360122	260697	55.00	54.99	54.98	58.80	46.4	0.9	0.35	0.76	0.72	H
	8	12	2.0	359886	260697	55.00	55.00	55.00	61.81	40.2	0.7	0.31	0.91	0.72	H

H Liquid Velocity Below 1 fps

FIG. 105

Member: Bill Coad
Date Calculated: April 19, 2007
Unit Convention: IP
Project Title: (MISC)
Project Number: (MISC)
Equipment Identifier: Orifice #1a
Steam Processes - Printable Summary of Input and Output
STEAM ORIFICE SIZE/CAPACITY

Input

Inlet Conditions:
(Saturated)
Pressure, p_1: 114.7 psia
Outlet Pressure:
Pressure, p_2: 24.700 psia

Orifice Diameter: 1.899 in
Flow Characteristic: Critical
Steam Flow Rate: 10000.00 lb/hr

Outputs

Property	Symbol	Units	Inlet	Outlet
Condition			Saturated	Superheated
Pressure	p	psia	114.70	24.700
Temperature	t	deg F	337.87	298.88
Quality	x	%	100	N/A
Density	(rho)	lb/ft	0.25692	0.55476E-01
Specific Volume	v	ft^3/lb	3.8922	18.026
Enthalpy	h	BTU/lb	1190.0	1190.0
Entropy	s	BTU/lb-deg F	1.5920	1.7558
Sp.Ht.Const.Vol.	c_v	BTU/lb-deg F	N/A	0.36588
Sp.Ht.Const.Pres.	c_p	BTU/lb-deg F	N/A	0.48804
Internal Energy	u	BTU/lb	1107.3	1107.6
Sonic Velocity	a	ft/sec	N/A	1646.1
Thermal Conductivity	k	BTU/hr-ft-deg F	N/A	0.16873E-01
Viscosity	(mu)	lbm/ft-sec	N/A	0.94608E-05
Prandtl Number	Pr	dimensionless	N/A	0.98512

FIG. 106

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/041989

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G06F 17/50 (2009.01)
USPC - 703/7
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - F24F 11/00; G06F 17/50, 19/00 (2009.01)
USPC - 700/97, 98, 117, 207, 275, 276; 703/1, 6, 7

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2007/0168164 A1 (MASSARO et al) 19 July 2007 (19.07.2007) entire document	1-4, 12-15, 19-21, 24, 26-29, 32, 37, 39, 40, 44, 45, 48, 49, 55, 56, 58, 59, 63, 66-70 --- 5-11, 16-18, 22, 23, 25, 30, 31, 33-36, 38, 41-43, 46, 47, 50-54, 57, 60-62, 64, 65, 71, 72
Y	US 2003/0074164 A1 (SIMMONS et al) 17 April 2003 (17.04.2003) entire document	5, 10, 11, 16-18, 23, 35, 38, 41-43, 46, 47, 51-54, 60
Y	US 2006/0234621 A1 (DESROCHERS et al) 19 October 2006 (19.10.2006) entire document	6-11, 22, 31, 33-36, 54, 61, 62, 64, 65
Y	US 2002/0052941 A1 (PATTERSON) 02 May 2002 (02.05.2002) entire document	25, 30, 33-36, 50, 57, 62, 71, 72

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Date of the actual completion of the international search	Date of mailing of the international search report
15 June 2009	24 JUN 2009

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