

Update Log for the *CompAero* and *TurbAero* Software Systems

Updates to the *CompAero* and *TurbAero* aerodynamic design and analysis software systems that some licensed users may need are listed below for convenience. The updates are listed by date so users can determine if they already have the update. Installation CDs always include the date prepared. Users can also refer to the date displayed by each individual program when it is run (date when it was compiled). Many of these updates are minor issues uncovered after years of use. Some are cosmetic and have no effect the results. Users probably won't need most changes nor even have an application for many of them. Check the updates to both systems and to each licensed system for any updates that may be significant to you. When requesting updates, note that executable files common to both systems are not interchangeable (separate updates are needed for each system). Help files and other support files are identical in both systems. The current version number for both systems is 2.0 (released on April 28, 2011). Programs that require the Flexware hardlock security key are designated as version 3.0 for specific identification. All programs display the version number and the date they were compiled when they are run.

Standard software support policies provide for partial or full software updates at little or no cost (see separate software support policy for details). Software updates are offered as a service to licensed users who choose to take advantage of it. Where an update fee is involved, it is based on offsetting preparation and shipping cost, only.

Updates to Both *CompAero* & *TurbAero*:

- 7/1/07: licensed users do not require any updates in this category accomplished prior to this date.
- 7/9/07: Added the capability to import gas models from a file (*.RK) created and saved using program *RKMOD*. This may be convenient for complex multi-component mixtures, to avoid the need to form the mixture several times for various programs. This was a user suggestion and has no effect on results.
- 7/31/07: updated all programs that use the equation of state to correct a unit conversion problem when the user-supplied pseudo-perfect gas data model is used with temperature units of deg F or deg C (does not affect the program generated pseudo-perfect gas model). This model is so rarely used that users may just want to remember to use absolute temperature units if this option is ever needed rather than order an updated CD.
- 8/8/07: fixed a potential crash in program *GASPATH* when curve file from program *BEZIER* is modified in an inconsistent manner (very unlikely, but possible).
- 8/18/07: fixed an error in *TDB2B* when it is run from a shell from another program (usually from *FLOW3D*). *TDB2B* was not properly handling cases where the calling program is able to supply the appropriate input file name. Rarely encountered since file names of input files created by *FLOW3D* are usually modified to identify the stream surface number anyway. Without this update, input file names must always be opened or entered directly to function properly. This error has been there for years and was only recently found by a new user.
- 8/27/07: created version 1.10 of both systems to complete precautionary measures started with a 4/7/07 upgrade. The user-supplied pseudo-perfect gas model was generalized to offer the same level of accuracy as when this model is formed by the internal equation-of-state package (e.g., if a user needs to generate constants for the model using an external equation of state). These precautionary steps were in response to one *CompAero* user's application of the pseudo-perfect gas model beyond the scope originally intended for it and to conditions for which it is inappropriate. *TurbAero* was also updated for compatibility with revised Help files, even though this model is rarely used for turbines. Both systems are now more general and protect users against misuse of this model. So far as is known, only one user has encountered the problems addressed.
- 9/29/07: fixed a minor error in output (DW/W) from *TDB2B*.
- 10/19/07: updated *B2B2D* and *TDB2B* to fix a blade pitch error in the axial blade cascade plots (cosmetic).
- 10/25/07: updated *B2B2D* and *TDB2B* to fix a data export error from the 3/8/07 and 3/10/07 updates of these programs. Can cause *TDB2B* to fail, but is simply cosmetic in *B2B2D*.
- 11/26/07: Updated *RIGPAC* and its help file to perform additional user-error checks on the geometry data import option to warn users of some obvious errors in their import selections (cosmetic).
- 1/16/08: updated *RIGPAC* and its help file to add another option to the Solid Works export option (user request). Also fixed a minor bug in the general geometry import routine (changing a previous import option to the blade camberline angle import option will cause a fatal error -- unlikely, but possible).
- 2/2/08: updated program *GASPATH* to correct an error on leading edge blade angle on interior streamlines for 2-D blades. Main impact is when exporting geometry to other programs (*CENCOM*, *RIFT* and *FLOW3D*). Note: a simple work-around is to have *GASPATH* create a *RIGPAC* input file and use it to export geometry.
- 2/25/08: updated *BEZIER* to display geometry for data point screen editing to scale in the x-y directions (normally unnecessary but extreme aspect ratio components can be a little confusing to edit without it).
- 3/22/08: updated *RIGPAC* to correct an error when exporting blade angles > 90 degrees.
- 4/25/08: fixed an error in *GASPATH* when the arc radius is specified for circular-arc blades.

- 6/25/08: fixed an error in *RIGPAC* for circular-arc blades with two arcs when the arc radii are specified.
- 8/19/08: correct an error in *RIGPAC* when exporting a program *RIFT* input file (affects *TurbAero* only).
- 8/29/08: fixed an inconsistency in units labels in *RKMOD* (not an error).
- 11/19/08: updated *FLOW3D*, *B2B2D* and *TDB2B* to fix a problem associated with radial turbine impellers using splitter blades. Both systems were updated although the problem is unlikely to be encountered by *CompAero* users (only occurs if splitters start at the impeller inlet).
- 12/10/08: updated *FLOW3D* to correct an error in the blade-to-blade flow output. Both systems were updated although the problem is unlikely to be encountered by *CompAero* users (only occurs if splitters start at the impeller inlet).
- 2/5/09: updated *B2B2D* and *TDB2B* to fix a possible fatal error when boundary layers and loss are calculated for cases with Mach numbers essentially zero (unlikely to be encountered in any practical problem.)
- 3/2/09: updated *RIGPAC* and its help file to simplify conversions between 3D blades and 2D blades while retaining the existing blade design on one of the end-wall contours. For radial-element blades, it can now also use the shroud data and extrapolate beyond the shroud tip axial coordinate. Also updated its export to *FLOW3D* to use an average blade thickness when thicknesses are specified on both hub and shroud for 2D blades (since *FLOW3D* can only treat true 2D blades).
- 3/18/09: made some cosmetic changes to *RIGPAC* and *GASPATH* to improve the geometry plots and printer output.
- 3/27/09: made a minor correction to *GASPATH* to fix a problem with polar angle calculation when the blade lies in the third or fourth quadrant and the direction of rotation is reversed.
- 4/12/09: added some options to *GASPATH* and *RIGPAC* for 2D radial-element blades to simplify converting 3D blades to that blade style and to offer alternate choices for the camberline specification. Also updated the help file for *GASPATH*.
- 4/27/09: updated *GASPATH* and its help file to add the option to specify blade thickness distributions on both end walls for 2D blades (now basically has the same options as offered by *RIGPAC*).
- 5/4/09: updated *GASPATH* and its help file to add a few minor refinements to the 4/27/09 update.
- 5/6/09: fixed a minor bug in the *GASPATH* front-view plot (affects the general 3D, sculpted blade type only).
- 8/3/09: updated program *Volute* to improve the output and to add a data export capability for cross-section profile coordinates.
- 10/20/09: modified *RKMOD* to correct an error when adding a component to an existing fluid mixture. Although very unlikely, this error can occur in several other programs (no user has found it in the 10 years it has existed). As a precaution, *RIFT*, *AXTURB* and *CENCOM* were recompiled, to avoid a remote chance that it might also be encountered there.
- 2/10/10: updated *RIGPAC* to correct an error specific to input files exported from *RCDESIGN*.
- 3/5/10: updated *GASPATH* to fix a front-view plot error (program crash) for a user using 3D blades but with all blade angles set to 90 degrees. I doubt that anyone else will ever do that, so the modification is unlikely to be needed by other users.
- 6/10/10: updated *RIGPAC* to correct a minor error in the import data option (inconsistent with Help messages).
- 11/24/10: corrected an error in *GASPATH* caused by the 4/27/09 extension. When loading or editing the constant-thickness blade option data, an invalid property use error can crash the program.
- 2/5/11: updated *RKMOD* with the 2/5/11 *AXTURB* correction reported below. Also, recompiled all other programs in this category that use the equation-of-state routines as a precaution. Probably unnecessary, but it ensures that all future new or upgrade CDs issued after this date will contain the latest state routines throughout.
- 3/2/11: corrected an error in *RIGPAC* when exporting a *FLOW3D* input file with the general 3D blade type.
- 4/28/11: released version 2.0 of *CompAero* and *TurbAero* (programs requiring the Flexware hardlock security-key are designated as version 3.0).
- 5/5/11: updated *GASPATH* to prevent a program crash when user attempts to view or print invalid data for a vaneless passage design.
- 5/16/11: updated *RKMOD*, *B2B2D*, *FLOW3D* & *TDB2B* to include improved sonic velocity convergence achieved by the 5/16/11 *TurbAero* update reported below.
- 5/18/11: updated *EXHAUST* to include improved sonic velocity convergence achieved by the 5/16/11 *TurbAero* update reported below.
- 7/25/11: updated *RKMOD*. While assisting a user, noticed a possible vulnerability to a divide-by-zero failure in the convergence logic for non-ideal fluids. It has never happened to my knowledge and chances that it ever will are very remote. As a precaution, also recompiled *B2B2D*.
- 9/4/11: updated *RIGPAC* to correct a minor inconsistency that is unlikely to affect any user.

Updates to *CompAero* Only:

- 7/1/07: licensed users do not require any updates in this category accomplished prior to this date.
- 8/3/07: updated *CENCOM*, it was not saving power for the overall performance maps when section breaks are present (coolers, side loads, extractions).
- 10/2/07: updated *CENCOM* and its help file to allow different rotation speeds for stages in multistage runs.
- 10/19/07: updated *CENCOM* to correct some bugs in the 10/2/07 update. Also cleaned up the output and overall performance map for multi-section compressors.
- 10/26/07: updated *CENCOM* to correct cumulative stage exit power in output file for multistage runs.
- 12/9/07: updated program *SIZE* to change units in cross-section plots so the XY-ON option in the plot window displays (x, y) in the user's units (cosmetic).
- 12/12/07: updated program *SIZE* to avoid a potential blade angle convention error when creating a program *CENCOM* input file. Although no problems have been reported, I encountered one case where it happened.
- 1/18/08: updated program *SIZE*; it was not saving the tip flow coefficient when it is used to define the impeller tip velocity triangle.
- 1/20/08: updated *CENCOM*, to fix an obsolete print control code. It was not printing seal leakage data for very high stage inlet pressure cases (but the analysis was being done correctly).
- 3/27/08: updated *CENCOM*; some past update had caused the liquid knockout option to be dropped from the available list of components.
- 8/18/08: updated *AXCOM* and *AXDESIGN* to correct an error (factor of 10) in the outputs for heads.
- 8/30/08: recompiled *SIZE* and *CENCOM* per the cosmetic change in *RKMOD* on 8/29/08 (not an error).
- 9/8/08: updated *CENCOM* to correct stage flow coefficient and stage inlet volume flow listed in output when an inter-cooler is upstream (analysis otherwise correct).
- 1/10/09: updated *SIZE* to remove a possible fatal error due to a bad initial guess for volute mean radius. Will not occur if an outer casing diameter limit is imposed. Also very unlikely to occur when using typical length units (program had been in use for over eight years before it happened, while using unusual length units).
- 1/14/09: updated *AXCOM* to prevent a fatal round-off error encountered by one user (the reference inlet flow angle came out as a negligibly small negative, which raises a fatal error).
- 2/19/09: fixed an output error in *AXCOM* (occurs only if less than 4 streamlines are used).
- 3/7/09: made some cosmetic changes to *VDDDESIGN* to improve the geometry plots.
- 3/18/09: updated *CENCOM* to permit assigning the shaft seal outboard temperature and pressure directly.
- 4/7/09: revisited the 1/10/09: update to *SIZE*; the problem was fixed for elliptical volutes, but was later found to occur for rectangular volutes also.
- 6/20/09: version 1.50 released for sale. Enhancements include a new detailed geometry design program (*VOLUTE*) for centrifugal compressor volutes (view new User Guide for details).
- 9/10/09: added program *PTC10* to the system to correct centrifugal compressor test performance to design conditions following the ASME Power Test Code, PTC 10-1997. The purpose was to accomplish an independent check on compressor supplier corrections during witness test activity on behalf of the end user.
- 11/26/09: updated program *RCDESIGN* to fix a minor error that can offset the return channel vane leading edge under certain (unusual) conditions.
- 2/10/10: updated *RCDESIGN* to correct and add some export data options requested by a user. Also to corrected the option to export a *RIGPAC* input file.
- 2/25/10: updated *AXDESIGN* to prevent a program crash when attempting to view blade profile plots when not all defined blade rows are actually being designed in the current run.
- 3/21/10: corrected an error in the printed output in program *SIZE*. The values of two coefficients for the shroud blade angle distribution of 3D blades in the output were incorrect. Rather irrelevant since the design was correct and this distribution is not controllable by the user anyway.
- 3/24/10: updated program *VOLUTE* to eliminate a possible error when updating a *CENCOM* input file. If the input file was not previously saved by *CENCOM* an error occurs. Since volute optimization is normally the last step in the detailed design process, it is very unlikely but it did occur once. A simple fix is to save the file in *CENCOM* before attempting an update from *VOLUTE*. Normally that will always have been done anyway.
- 3/28/10: updated *CENCOM* to add warning messages when liquid flow prevents convergence in the impeller. One user had a failure on a case too close to the saturation line, but the cause of the failure was very difficult to identify. No real change to the analysis except for the warning message.

- 12/16/10: updated *AXCOM* to correct a minor error that allowed an invalid plot to be viewed. Very unimportant, but could crash the program.
- 1/20/11: updated *SIZE* to correct an error in the file SaveAs menu option.
- 1/30/11: updated *CENCOM* to correct an error when deleting a vaneless passage using the annular bend option.
- 2/5/11: per the 2/5/11 *AXTURB* update, below, recompiled all programs in this category that use the equation-of-state routines as a precaution. Probably unnecessary, but it ensures that all future new or upgrade CDs issued after this date will contain the latest state routines throughout.
- 2/11/11: updated *CENCOM* to impose a scale factor on impeller thrust forces in the output to avoid the need for scientific (E) format when forces are too large for the column output without it. A user needed more significant digits than provided by the scientific format.
- 3/11/11: updated *CENCOM* to add stage discharge mass flow to the on-screen summary. Mostly for my own benefit to avoid need to run interactive checks to support concerned user (this is not specifically included in the stage performance output file and users sometimes get uneasy about it).
- 3/25/11: updated *CENCOM* to provide better user guidance in error messages supplied when liquid phase is encountered. No change in actual analysis.
- 4/28/11: released *CompAero*, version 2.0 (programs requiring the Flexware hardlock security-key are designated as version 3.0).
- 5/16/11: updated *SIZE* and *CENCOM* to include improved sonic velocity convergence achieved by the 5/16/11 TurbAero update reported below.
- 5/18/11: updated *AXCOM*, *AXDESIGN*, *RCDESIGN*, *VLDESIGN* and *VDDESIGN* to include improved sonic velocity convergence achieved by the 5/16/11 TurbAero update reported below.
- 5/31/11: updated *SIZE* to add the option to override the default impeller blade thickness. While I have never encountered a need for this, it was requested by a licensed user who is also a very experienced designer.
- 6/26/11: updated *AXDESIGN* to correct a minor error in the GUI for the station geometry input window (appearance issue only).
- 7/2/11: updated *SIZE* to correct its export to *VOLUTE* (initial value of aspect ratio incorrect in some cases).
- 7/12/11: updated *CENCOM* to correct a minor bug. Disk seal leakage was not being calculated for a single seal fin. Also there was a minor error in the seal geometry output for that case.
- 7/19/11 updated *SIZE* to improve the effective impeller tip width exported to *CENCOM* input files (significant only for mixed flow impellers).
- 7/25/11: Recompiled *CENCOM*, *AXCOM*, *AXDESIGN*, *RCDESIGN*, *VLDESIGN*, *VDDESIGN* and *SIZE* as a precaution motivated by the remote possibility of an error as noted in the 7/25/11 *RKMOD* update, above.
- 8/14/11: updated *CENCOM* to prevent an abrupt program crash when the user specifies a vaned diffuser or return channel throat area > the inlet area. An obvious input error that should never occur, but did in one case. Now resets the throat area and flags the input error in the geometry output to tell the user what is wrong.
- 8/30/11: updated *CENCOM* to impose a lower limit on disk & cover clearance / tip diameter as a safety limit to prevent unexplained program crashes caused by user input errors/omissions.
- 10/5/11: updated *SIZE* to fix an option flag check that can fail when exporting a *CENCOM* input file for extremely small stage sizes (the volute geometry was not being included).
- 10/11/11: updated *CENCOM* to prevent a possible crash if user attempts to view stage performance plots for a stage having no impeller (very unlikely, but it did happen once)
- 12/19/11: updated *CENCOM* to allow performance analysis of a return channel that is not preceded by a crossover component (an unusual case encountered on a consulting project).

Updates to TurbAero Only:

- 7/1/07: licensed users do not require any updates in this category accomplished prior to this date.
- 11/5/07: revised *AIRFOIL* and its help file to fix an error in geometry scaling and to add the option to scale single blade sections as well as all geometry. Also included sorting multiple blade sections by increasing radius each time the data are saved to make sure importing into *AXTURB* will function correctly.
- 11/7/07: revised *AIRFOIL* and its help file to allow user to view all blade data available for import by *AXTURB* in the *AXTURB* input nomenclature (cosmetic).
- 4/16/08: updated *RIFT* to refine its convergence logic when two or more components approach choke at almost the same time. Very rare, but in one recent case run for a consulting client, it had problems identifying which component was controlling choke. Also had to tighten the convergence tolerance on choke to adequately handle cases like this.

- 4/16/08: corrected a bad input data check in *RIFTNOZ* that can malfunction when using temperature units of degrees C or F.
- 4/30/08: corrected deviation angle output in *RIFT* when the rotor exit angle is > 90 degrees (cosmetic, no effect on results).
- 5/15/08: updated *RIFT* to correct a program failure when using the user supplied pseudo-perfect gas model. Also recompiled *AXTURB* just in case (due to its similar logic), although no similar failure has been reported in it to date.
- 8/6/08: updated *AXTURB* and its help file to improve convergence for poorly designed turbines (specifically on a user's problem for a stage with a negative 150% hub reaction). Also added the capability to specify inlet total enthalpy rather than total temperature. This allows treating turbines having liquid phase flow at the inlet. Hence, it allows the user to treat multistage turbines in sections when liquid phase flow is encountered. This may be helpful in treating poorly designed multistage turbines that cannot be converged when all stages are modeled together.
- 8/29/08: made some cosmetic changes to the tabular output in *RIFT*.
- 8/30/08: recompiled *AFTSIZE*, *RIFTSIZE* and *AXTURB* per the cosmetic change in *RKMOD* on 8/29/08 (not an error).
- 10/12/08: corrected a unit conversion error in *RIFT* related to disk seal leakage. Affects only output data, but can crash the program.
- 10/16/08: corrected an error in the gas power output in *RIFT* when disk seal leakage is included.
- 12/17/08: corrected an error in blade forces and bending moments output by *AXTURB*. All were too large by a factor of two. Also impacted the blade force portion of the thrust calculations.
- 12/18/08: program *BLADE* from the *CompAero* system was added to the *TurbAero* system. This program models standard axial-flow compressor blade sections. Some users have found this program useful to design blade sections for simple wind turbines. The user guide (*TurbAero.pdf*) was also updated with this addition.
- 3/6/09: made some cosmetic changes to *RIFTSIZE* to improve the geometry plots.
- 3/19/09: updated *AXTURB* to activate the option to use the pseudo-perfect gas model (the flag telling it to load viscosity data when that model is used had been omitted). Probably of little interest since that model is unlikely to ever be used for a turbine performance analysis.
- 4/18/09: updated *RIFT* to add some output related to windage and disk friction losses; motivation was to satisfy some personal consulting needs to supply a client with key parameters used in the prediction model.
- 5/9/09: updated *AFTSIZE* and its help file to add an option to design a stage with a rotor only (no nozzle).
- 5/18/09: updated *AFTSIZE* to add some refinements to the design option for a rotor only (no nozzle).
- 6/20/09: version 1.50 released for sale. Enhancements include a new detailed geometry design program (*VOLUTE*) for radial-inflow turbine volutes (view new User Guide for details).
- 7/10/09: updated *AXTURB* to correct a convergence problem with the assigned discharge pressure option. The problem was that a safety limit had incorrect units, leading to very slow convergence on a specific case.
- 8/15/09: updated *AXTURB* to flag the map as modified when points are added so it will regenerate the map again (not a serious issue -- you can simply reopen the input file after saving the changes to accomplish this).
- 10/18/09: updated *AXTURB* and its help file to adapt its performance map utility and the Sinda/Fluint interface to special needs of users whose applications involve very low pressure ratios (e.g., wind and wave turbines). Also updated *RIFT* and its help file to maintain consistency with the Sinda/Fluint interface common to both programs. Users involved with more typical turbine applications should not need these updates.
- 11/9/09: updated *AXTURB* to correct a potential error in handling partial admission losses. It was found possible to miss the power correction when partial admission loss is the only parasitic work present.
- 2/1/10: updated *RIFT* to prevent a false indication of 100% liquid at the inlet during the initial guess of mass flow for the assigned discharge pressure option (very rare, but possible).
- 3/3/10: updated *RIFTSIZE* to eliminate a potential program crash that can occur when switching from a 2D radial-element impeller blade to a 3D ruled surface blade.
- 3/13/10: updated *AFTSIZE* to prevent a possible equation of state error problem. A user entered an impossible inlet temperature by mistake, requiring continuing through many error messages to end the automatic sizing so that the input data could be edited. Added a check to terminate the calculations immediately when impossible inlet or discharge conditions are encountered.
- 7/12/10: updated *AFTSIZE* to remove an irrelevant error check for "rotor-only" designs and fix a fatal error if users attempt to restore the program's original default estimates for unspecified data (this probably has never been used, but it is an available option). Also edited the help file for *AIRFOIL* to clarify comments about the angle conventions used.

- 7/28/10; updated *AFTSIZE* to revise the estimates for blade and seal data used in the preliminary design phase. The new estimates result in a more reliable *AIRFOIL* input file when exported from this program for the detailed design phase. This is particularly targeted to improvement of the recent extension of the software to the “rotor-only” class of designs, such as wind turbines.
- 1/7/11, updated *RIFTSIZE*; a rather unimportant update to simplify input file exports to *RIFT* for cases that do not start with a volute as the first component.
- 2/4/11: updated *AXTURB*. A licensed user encountered an unusual case where the calculated vapor sonic sound speed was in error due to presence of liquid. That caused a convergence failure on the choke flow iteration. It is likely that the next (2/5/11) *AXTURB* update was at least part of the cause of this problem.
- 2/5/11: updated *AXTURB* and *RIFT*. A user found an efficiency deviation on a condensing axial-flow turbine that was traced to a typo error in the vapor saturation temperature calculation routine. Error occurred if pressure < 1% of critical pressure. Also recompiled all other programs in this category that use the equation-of-state routines as a precaution. Probably unnecessary, but it ensures that all future new or upgrade CDs issued after this date will contain the latest state routines throughout.
- 4/5/11: updated *RIFT* to supply more complete rotor exit data useful for updating *RIFTSIZE* input files when iterating these programs in the preliminary design process.
- 4/5/11: updated *RIFTSIZE* to correct a minor error in the export of *RIFT* input files when an exhaust diffuser is present.
- 4/28/11: released *TurbAero*, version 2.0 (programs requiring the Flexware hardlock security-key are designated as version 3.0)
- 5/16/11: updated *RIFTSIZE*, *RIFTNOZ* & *RIFT* to improve convergence on sonic velocity for an application using a specific refrigerant fluid (eliminated a series of confusing non-convergence warnings). Problem appeared to be quite specific to this fluid and the inlet conditions used, but the improved convergence is quite significant. The same fluid and application also produced an invalid pseudo-perfect gas model ($C_p / C_v < 1$). Although this has never happened before, added a simple correction when that happens.
- 5/18/11: updated *AXTURB* and *AFTSIZE* to include improved sonic velocity convergence achieved by the 5/16/11 *TurbAero* update reported above
- 7/25/11: Recompiled *RIFT*, *AXTURB*, *AFTSIZE* and *RIFTSIZE* as a precaution motivated by the remote possibility of an error as noted in the 7/25/11 *RKMOD* update, above.
- 11/26/11: Updated *RIFT* to improve the nozzle predictions for very highly loaded nozzle blades. A licensed user had very highly loaded blades mainly due to lack of an inlet volute. Predictions appeared to be overly pessimistic due to excessive boundary layer blockage, based on the client’s CFD analysis.