

INM Version 7.0a Software Update

9/17/2008

Version Information

INM Version 7.0a is a software update to Version 7.0. You must already have INM Version 7.0 to use this software update. The INM 7.0a software update may be downloaded from the FAA web site at:

http://www.faa.gov/about/office_org/headquarters_offices/aep/models/inm_model/

If you do not have INM 7.0, you can order a CD-ROM containing INM 7.0 by downloading the INM Order Form from the FAA web site (above). After installing INM 7.0, you can download and apply the INM 7.0a software update.

The Version 7.0 User's Guide is the current manual for INM Version 7.0a software. The Version 7.0 Technical Manual is the current technical description of the methods used by INM 7.0a to calculate aircraft noise around airports. This document, *Inm70a.pdf*, records the changes to INM since the User's Guide and Technical Manual were published.

Installation Instructions

1. Use MS Windows to make a copy of your existing *INM7.0* directory. Select your *INM7.0* directory and, using the Windows File Manager under the "Edit" menu, select "copy" and then select "paste". This will create a new directory called "*Copy of INM7.0*".
2. Use the right button of your mouse to select the *Copy of INM7.0* directory created in step 1. Select "Rename" and rename the directory *INM7.0a*. Make sure that the attributes for the new *INM7.0a* directory as well as for all sub-directories and files are not set to "Read-only".
3. Download the *INM70a.EXE* file from the FAA Web site. Put it in the new *INM7.0a* directory.
4. Double click on the *INM70a.EXE* file name to automatically extract the updated files into the new *INM7.0a* directory. Select the "Unzip" button. This process will overwrite the old INM 7.0 files and replace them with those required for INM 7.0a. The distributed files are presented in Table 1:

Table 1. Files Distributed For INM 7.0a

File	Date
<i>inm.exe</i>	9/16/2008
<i>flight.exe</i>	9/16/2008
<i>compute.exe</i>	9/16/2008
<i>compu50.dll</i>	9/16/2008
<i>graph.dll</i>	9/16/2008
<i>terraincheck.dll</i>	9/16/2008
<i>inm70a.pdf</i>	9/17/2008
<i>sys_data*.dbf (21 files)</i>	8/21/2008
<i>sys_data\acft_sub.dbf</i>	9/11/2008
<i>sys_data\aircraft.dbf</i>	9/11/2008
<i>sys_data\helicopter.dbf</i>	9/12/2008
<i>sys_data\acdb70.bin</i>	9/12/2008
<i>sys_data\spectra.bin</i>	8/26/2008
<i>usr_data\sys_rwy.dbf</i>	9/11/2008

Documentation Updates

1. There were two new thrust types added for Decelerate approach procedure step types for INM 7.0 that were not fully documented in the INM 7.0 User's Guide. A list of flight procedure step types and the available parameters for each, including the available thrust types, is included in Appendix J of the User's Guide. An updated table for section J.1 of the User's Guide that includes the new L (LandGroundRoll) and V (ThrustReverser) thrust types for the B (Decelerate) step type is included below:

OP_TYPE	STEP_TYPE	FLAP_ID	THR_TYPE	PARAM1	PARAM2	PARAM3
A, D, T, F, V	V	ID		ALT	SPD	DIST
A, T, F, V	D	ID		ALT	SPD	ANG
A, T, F	L	ID		DIST	0	0
A, F	B		L, V	DIST	SPD	PCT
D, F	T	ID	T, C, H, Q	0	0	0
D, F	T	ID	U	0	0	THR
T	T	ID	T, C, H, Q	0	SPD	0
T	T	ID	U	0	SPD	THR
D, T, F	C	ID	T, C, H, Q, R	ALT	0	0
D, T, F	C	ID	K, U	ALT	0	THR
D, T, F	A	ID	T, C, H, Q, R	CLM	SPD	0
D, T, F	A	ID	K, U	CLM	SPD	THR
A, D, F, V	M	ID		ALT	SPD	ANG
F	S	ID		0	0	0
A	U	ID		ALT	SPD	DIST
A	W			ALT	SPD	DIST
A	E	ID		ALT	SPD	ANG
A	F			ALT	SPD	ANG
D, T, F	P		T, C, H, Q, R	PCT	SPD	0
D, T, F	P		K, U	PCT	SPD	THR

OP_TYPE

A = Approach
D = Depart
T = Touch&Go
F = CircuitFlight
V = OverFlight

STEP_TYPE

V = Level
D = Descend
L = Land
B = Decelerate
T = Takeoff
C = Climb
A = Accelerate
M = Cruise-Climb
S = Level-Stretch
U = Level-Decel
W = Level-Idle
E = Descend-Decel
F = Descend-Idle
P = Accel-Percent

THR_TYPE

T = MaxTakeoff
C = MaxClimb
N = MaxContinuous
H = ReduceTakeoff
Q = ReduceClimb
S = MaxTakeoffHiTemp
B = MaxClimbHiTemp
M = MaxContinuousHiTemp
G = ReduceTakeoffHiTemp
P = ReduceClimbHiTemp
I = IdleApproach
J = IdleApproachHiTemp
R = MinimumThrust
K = UserCutback
U = UserValue
L = LandGroundRoll
V = ThrustReverser

PARAM

THR = Thrust
ALT = Altitude
SPD = Speed
DIST = Distance
ANG = Angle
PCT = Percent
CLM = Climb Rate

- While the “Modified NPD Curve” Checkbox is not a new feature in INM 7.0a, many users found the recent AEDT newsletter article ‘A Note on the “Modified NPD Curve” Checkbox’ to be helpful in understanding this feature in INM. Therefore, the article is reproduced below.

Recently, several questions have been posed to the INM Technical Support Team concerning the “Modify NPD (Noise-Power-Distance) Curves” functionality found in the Case Setup menu of INM. This functionality was added to INM in Version 6.0, and allows for the adjustment of NPD data according to user-specified

meteorological data. Since this functionality will also be included in AEDT, a detailed description of the “Modified NDP Curves” functionality is presented below.

An unchecked “Modify NDP Curves” checkbox (the default) indicates that aircraft noise data are used “as-is”, or unadjusted for study-specific atmospherics. As described in the INM Technical Manual, INM NPD data are calculated using the SAE-AIR-1845 average atmosphere. SAE-AIR-1845 specifies a hypothetical atmosphere using average atmospheric absorption rates. These average atmospheric absorption rates are used in the calculation of the AEDT (and INM) standard NPD data. Since these average absorption rates are inherent in the NPD data, SAE-ARP-866A is not applied when “Modify NDP Curves” is unchecked. Although the specific, user-defined atmospheric values are not used to modify noise data, they are used to calculate aircraft performance.

A checked “Modify NDP Curves” checkbox indicates an adjustment to aircraft noise data based on user-defined temperature and humidity values (see Figure 1). These user-specified, atmospheric parameters are used to calculate atmospheric absorption coefficients according to SAE-ARP-866A, which are in turn used to adjust standard NPD noise data to the study-specific airport conditions. These user-defined, atmospheric parameters are also used to calculate aircraft performance.

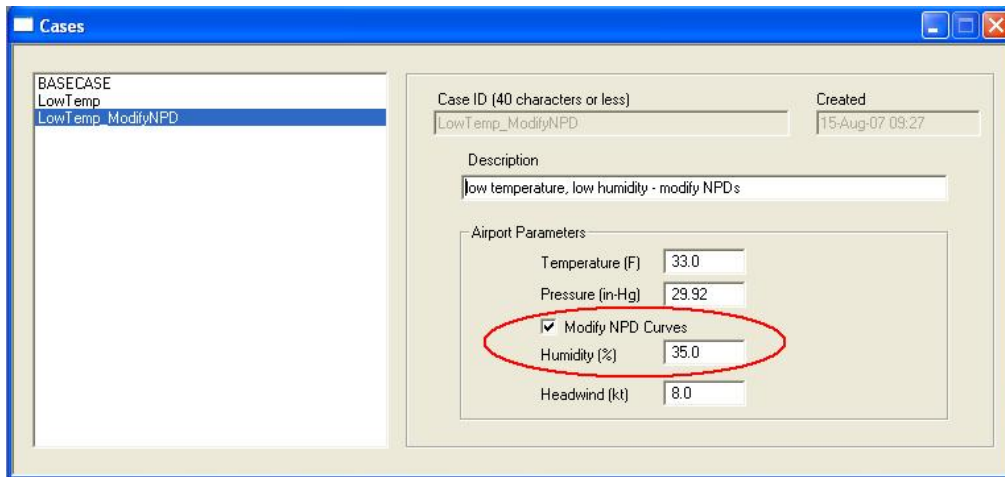


Figure 1. Setup -> Case Pulldown Menu (from INM 7.0)

Due to the inherent difference between these two atmospheric absorption implementations, there is currently no way to exactly match the hypothetical SAE-AIR-1845 atmosphere (default) in AEDT (or INM) when “Modify NDP Curves” is checked. Instead, good engineering judgment should be used when determining whether or not to modify the noise data for atmospheric conditions in a given study.

The following examples illustrate the use of different atmospheric values in INM 7.0, and are provided to better characterize the effects of these differences on noise and performance data (see Table 2).

Table 2. Examples of Different INM Setup Parameters

Ex.	Temp. (°F)	RH (%)	Modify NPD Curves?	Performance Atm. (°F)	NPD Atm. (°F, %)
1	77°F	70%	No (unchecked)	77°F	SAE-AIR-1845 average absorption rate
2	77°F	70%	Yes (checked)	77°F	77°F, 70%
3	33°F	35%	No (unchecked)	33°F	SAE-AIR-1845 average absorption rate
4	33°F	35%	Yes (checked)	33°F	39°F, 35%

These parameters were implemented in INM examples study “test50”, and the differences between these examples may be seen in Figures 2 and 3 below. The figures show DNL contours from 55 dB to 85 dB (in 10 dB intervals).

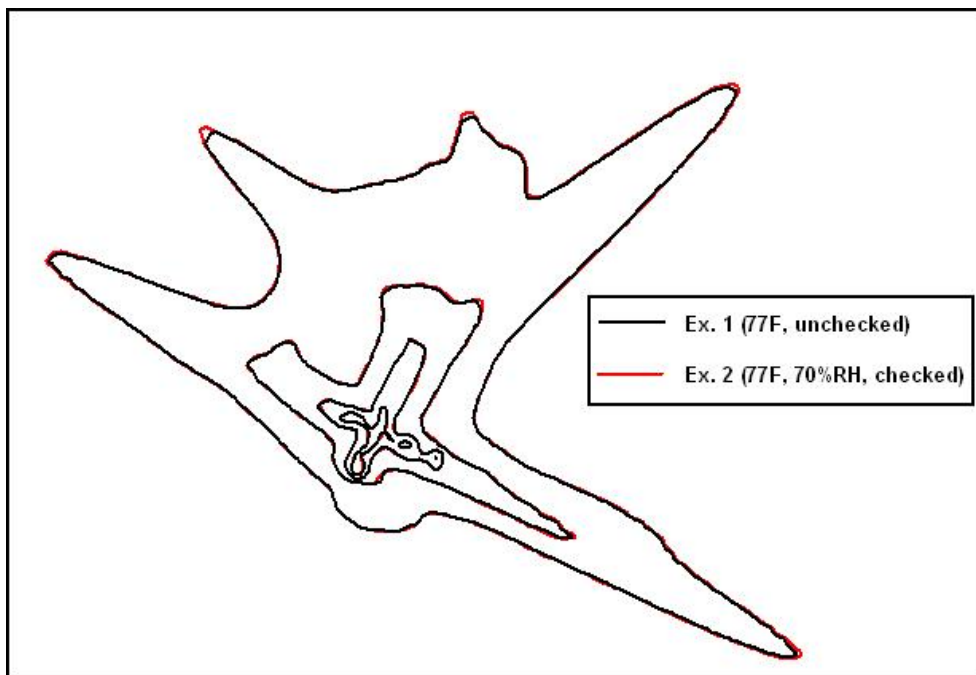


Figure 2. Comparison of Example 1 and 2 from Table 2

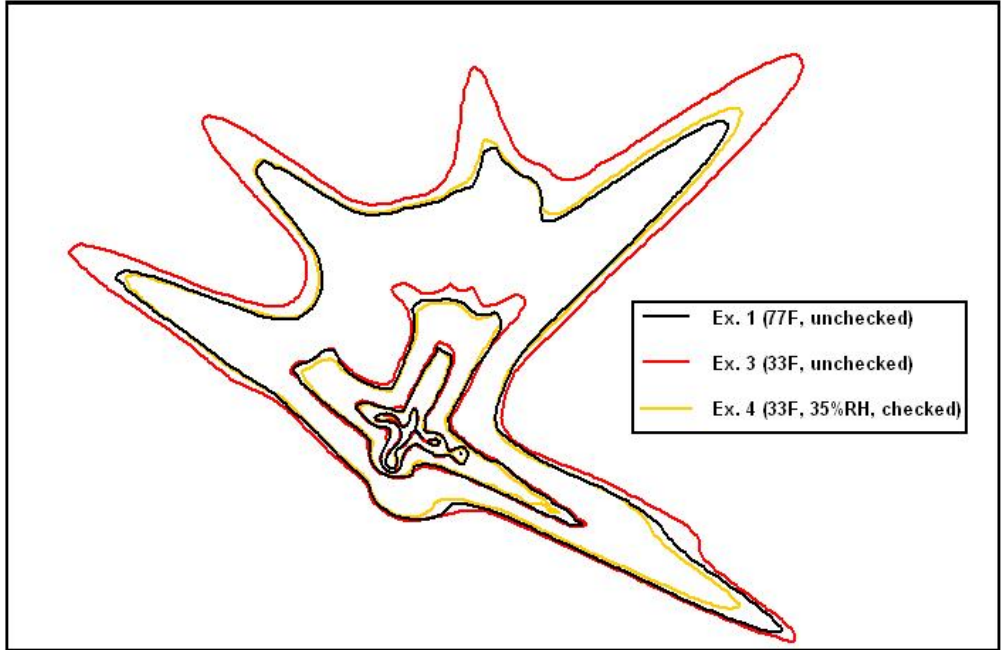


Figure 3. Comparison of Example 1, 2, and 4 from Table 2

In general, for the conditions tested, user-modified atmospheric absorption results in similar noise levels as the standard, unmodified INM under minimum absorption conditions; e.g. ~70-80°F, ~70% RH (see Figure 2). However, user-modified atmospheric absorption results in slight reductions when compared to unmodified noise levels in most cases. These differences tend to increase with increasing slant range distance, and tend to be the largest for low humidity; low temperature cases (see Figure 3)¹. In general, the use of the “Modify NPD Curves” feature is recommended for studies where there are significant variations from minimum absorption conditions (~70-80°F, ~70% RH).

- Equation 3-49 for calculating the advancing tip Mach Number, used in the source noise adjustment due to advancing tip Mach Number (found on page 95 of the “INM Version 7.0 Technical Manual”), has been updated to fix a typographical error only (this change to the documentation was already reflected in the algorithm implemented in INM 7.0). The units used for airspeed (V), operational airspeed (V_T) and reference airspeed for the noise curve (V_R) are all “knots”, instead of “feet per minute.” Equation 3-49 has been updated below to reflect this change.

$$M_{ADV} = \frac{(1.688 \cdot V) + \left(\frac{\pi \cdot D \cdot RPM}{60} \right)}{C} \quad \text{Eq. 0-1}$$

¹ When assessing noise levels due to atmospheric parameters, it is important to note that aircraft performance is also dependent on temperature, and the resulting thrust changes will also result in noise level differences.

where

V airspeed (kts),
V_T operational airspeed (kts),
V_R reference airspeed for the noise curve (kts),
D main rotor diameter (ft),
RPM blade rotations per minute, and
C speed of sound in air (feet/s), as defined by:

$$C = 49.018 \cdot (459.63 + T)^{1/2} \quad \text{Eq. 0-2}$$

where

T temperature (F).

Database Modifications

1. Data for the Cessna Mustang Model 510 Very Light Jet (VLJ) with PW615F engines were added to the INM database. The aircraft identifier is **CNA510** and the noise identifier is **PW615F**. The single procedural approach profile is a standard 3-degree descent. There are three sets of procedural departure profiles: FLAPS_0, FLAPS_15, and STANDARD, all of which are limited to stage length 1. The STANDARD departure profile is identical to the FLAPS_15 profile.
2. The T-6 Texan has been added to the standard aircraft substitution list for INM 7.0a. The new substitution identifier is **T6** and it is substituted with the **GASEPV** aircraft.
3. The INM aircraft **PA31** is now substituted for the **PA31CH** substitution aircraft. Previously the **BEC58P** was used for the **PA31CH**.
4. The INM aircraft **PA30** is now substituted for the **PA39** substitution aircraft. Previously the **BEC58P** was used for the **PA39**.
5. The profile weight for the **A319-131** STANDARD approach profile has been changed from 371000 to 124020 pounds to correct a database error. This is a fixed-point profile so the weight change has no impact on the INM's calculations.
6. Data for Spectral Class **110**, a departure class applicable to the **DC3**, **DC6**, **HS748A**, and **SF340** aircraft, have been updated to fix a database error. The level at 6300 Hz was changed from 62.3 to 51.4 dB and the level at 10000 Hz was changed from 55.4 to 40.4 dB.
7. The level noise adjustment coefficients (B₀, B₁, and B₂ for each of the Left, Center and Right NPDs) for the helicopter **MD600N** were changed to 0.0. The previous coefficients resulted in incorrect duration adjustments and source noise adjustments due to advance tip Mach numbers for airspeeds significantly different from the level flight reference speed.

8. Several runway end elevations in the system database have been modified to ensure consistency with the elevation values for their respective airports. For all instances in the database where a given runway end elevation differed from the corresponding airport elevation by more than 100 feet, the runway end elevation was set equal to the airport elevation. This was done to eliminate potential database errors which could have adverse impacts within INM studies due to the change that was made for INM 7.0 to reference flight path altitudes to runway end elevations rather than airport elevations. As always, the system airport data included with the INM is meant to serve as a starting point for INM study creation, and should be checked against outside sources and modified as appropriate as part of any study definition to ensure that the data are up to date and accurately represent the airport being modeled.

Program Modifications

1. Added the option of disabling the run-time message box that appears when the INM generates warnings during a run. The message box can be disabled using the “Disable confirmation on warnings” checkbox under Window // Options. The message box informing of run-time errors cannot be disabled.
2. Modified the INM to allow user input of aircraft thrust values to 9 digits to support the addition of larger, user-defined aircraft.
3. Updated the Scenario Run Input report that can be generated under Output // Scenario Run Input Report to display the metric used for non single-metric runs.

Reported Problems Fixed

1. Fixed a problem related to the difference between runway end and airport elevation values. Previously, when the defined runway end for a given flight operation was given an elevation different from the study elevation (i.e. runway elevation 10 feet higher than airport elevation), a sign error would cause the INM to reference the calculated flight path altitudes for that operation to an incorrect elevation (i.e. a value 10 feet lower than the study elevation). This problem caused INM 7.0 to use incorrect source-to-receiver distance values for these operations. It also resulted in the use of incorrect lateral attenuation values when the problem caused flight path segment altitudes to be incorrectly lower than grid point elevations.
2. Fixed a problem with the application of behind start-of-takeoff-roll noise directivity. Previously, the directivity would not be applied unless both the airport and runway end elevations were set to the same value. The directivity is applied for departure flight path segments that are on the ground. The noise computation engine of INM determined whether a given flight path segment was on the ground based on a difference calculation with the airport elevation (or flat earth, when terrain was not

utilized) rather than the runway end elevation. This caused an incorrect determination of whether a segment was on the ground, when the runway or helipad elevation was different from the airport elevation. This also could result in the incorrect application of reverse thrust.

3. Fixed a problem with opening Micropath 3CD terrain files at run time for files with filenames starting with the number “0”, i.e. “09080.3cd”.
4. Fixed a problem causing the INM to assign the same aircraft ID to all records within detailed grid output instead of assigning the proper aircraft ID for each operation.
5. Fixed a problem that occurred when copying STANDARD flight profile data using the INM’s internal COPY/PASTE functionality. During that process, any STANDARD profile ID occurring in a record is now renamed to STANDAR*. Previously, the STANDARD profile ID was not being altered, allowing users to generate user-defined profile data using the STANDARD ID. INM 7.0 does not allow the use of the STANDARD ID within user-defined data, so problems were encountered when users attempted to view user-defined data using that ID within the GUI.
6. Fixed a problem that allowed users to assign new fixed-point profile points to STANDARD INM flight profiles defined using procedure steps, and allowed users to assign new procedure steps to STANDARD INM flight profiles defined using fixed points. This mix of user-defined and STANDARD data could cause warning messages when trying to view the data within the GUI.
7. Fixed a problem that occurred when creating a new Scenario under Setup // Scenarios, then clicking on the Add “+” button on the INM taskbar to create another Scenario instead of first clicking the Accept “√” button on the taskbar. Previously this could cause an error message to be displayed and result in the Scenario not being properly added to the study.
8. Fixed a problem within the detailed grid output merging process that is part of running detailed grids in Multi-threaded mode that previously caused run-time errors.
9. Fixed a problem that caused run-time errors when running multiple Scenarios utilizing terrain data in multi-threaded mode.
10. Updated the INM to automatically re-order vector track segments at run time if they are not properly ordered due to user input within the underlying .dbf files. Out-of-order vector track segment data previously caused problems at run-time. Fixed track points were already being automatically re-ordered at runtime within INM 7.0.
11. Added a new run-time error message to the INM to distinguish between errors caused by duplicate track points and errors caused by out of order track points. Previously both conditions produced the same error message.

12. Added additional checking to ensure that the internal run status for a Scenario is properly modified if the Scenario produces errors within NMPlot. Previously a Scenario would be incorrectly labeled as having been run without issues thereby preventing the creation of updated files during the next run of that Scenario.
13. Fixed a problem that caused the INM to double the output noise values during the annualization process if the desired metric is selected within both the Noise Metric drop-down list and the Calculate Metrics box within the Run // Run Options window.
14. Fixed a problem that resulted in the NPD OpMode being improperly set within the flight.pth file for certain flight path segments due to a floating point precision error.
15. Fixed a problem that caused the INM to produce an error message at run time when a Case Copy was performed under Setup // Case Copy and the two identical Cases were then run within a single Scenario.
16. Fixed a problem that occurred when scaling LAMAX metric detailed grid noise values during the annualization process under Output // Annualize Scenario that resulted in percent values of 100 being calculated as 200.
17. Fixed a problem that could cause the INM to freeze when writing graphical track data for multi-case Scenarios to the Output Graphics window.
18. Fixed a problem within the Input Graphics window that prevented the very first track defined for a study from being a Touch-and-Go (TGO) track. Previously the INM automatically assigned the track type to TAXI for these TGO tracks, and would not allow the track type to be re-assigned to TAXI. It would not allow TGO tracks to be created unless other track types were created first.
19. Fixed a problem with INM's automated version conversion when opening an INM 6 series study within INM 7.0 that incorrectly converted study elevation values for metric studies to feet instead of meters.
20. Fixed a problem with INM's automated version conversion when opening an INM 6 series study within INM 7.0 that incorrectly generated duplicate STANDARD flight profile records within the Group Percents data.
21. Fixed a problem that prevented the INM from updating the Description field for Scenarios in the Setup // Scenarios window after a Scenario record had already been committed.
22. Fixed a problem within the helicopter ground track definition process for metric INM studies. Previously, the degree parameter for helicopter ground track segments in metric studies was incorrectly getting converted, resulting in incorrectly oriented helicopter ground tracks.

23. Updated the INM to allow for viewing of ground tracks and runways in the Output Graphics window when contours were not run for the Scenario. Previously an NMPlot error message was generated when trying to view such Scenarios in the Output Graphics window.
24. Fixed a problem that caused the output from Operations // View Calculated Flights to not include flight operations from military aircraft for the “View Summary” option. Other options did include military aircraft operations.
25. Fixed a problem with running standard grids but no contours with Grid Float terrain data.
26. Updated the INM to delete all relevant Scenario files when a Case is deleted from a Scenario. Previously all of the Case files were deleted but some Case-specific Scenario files were not deleted.
27. Fixed a problem with the export of Overflight and Taxi ground tracks to ESRI shapefiles. Previously these types of tracks were not being exported.
28. Fixed a problem that prevented a Scenario from running if it only included run-up operations.
29. Fixed a problem with the export of grid point data to ESRI shapefiles. Previously the INM exported grid point locations but not grid point values.
30. Fixed a problem in the Input Graphics window that caused all available helipads to be displayed even if only a subset of the helipads was selected for display.
31. Fixed a problem that caused the INM to report a segment duration of zero for very short takeoff ground roll flight path segments in the flight.pth file and the flight.txt file generated under Output // Flight Path Report.
32. Fixed a problem that caused the incorrect reference speeds to be used for the level flight segments in helicopter approach and departure operations, and resulted in incorrect duration adjustments and source noise adjustments due to advance tip Mach numbers.
33. Fixed a problem that may have resulted in incorrect noise fraction adjustments (NF_{adj}) under rare circumstances due to a floating point precision error. This was resolved with a low end cap on NF_{adj} .
34. Fixed a problem where incorrect spectral classes were referenced for helicopter Taxi operations. Helicopter Taxi operations now reference the corresponding departure spectral classes.

35. Fixed a problem that caused calculated arrival flight paths to touchdown prior to the defined runway end location if that runway end's Threshold Crossing Height value was set to zero under Tracks // Runway Ends and Helipads..