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# Implementation of Background-Noise Adjustment

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# Introduction

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The background noise adjustment procedure developed by the Volpe Center has been formally accepted by national and international certification authorities, and will be published as an appendix to both the FAA Advisory Circular AC36-4C and the ICAO ETM.

This presentation focuses on the implementation of the procedure as part of the acoustical data process.



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# History

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- Volpe development of background noise procedure on-going since 1996
- Attempt to integrate guidance provided by AC36-4B and ETM into coherent methodology
- Details of procedure presented at DER Seminar June 2001
- Many of the basic elements of the procedure used by majority of applicants since Volpe Validations started
- Approved by FAA as an Appendix to AC36-4C
- Approved (After Revision) by ICAO WG1 (CAEP 6)



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# Development of the Procedure

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- Comments from Industry and Authorities about issues with existing guidance in AC and ETM
- Interaction between Volpe and applicants during validation
- Need for a step-by-step procedure identified



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## Development of the Procedure (cont'd)

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- Elements of existing guidance used as basis
- Attempted to clarify guidance & resolve contradictions
- Incorporated common practices among applicants
- Result : Intricate, but coherent methodology



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# Elements of Background Noise Adjustment

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- Quantify background noise and separate into additive and non-additive components
- Identify masked aircraft data
- De-combine additive background from aircraft
- Reconstruct masked aircraft data
- Maintain identification of masked and reconstructed data (for tone-correction, etc.)



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# Test-Day Data Process: Part 1

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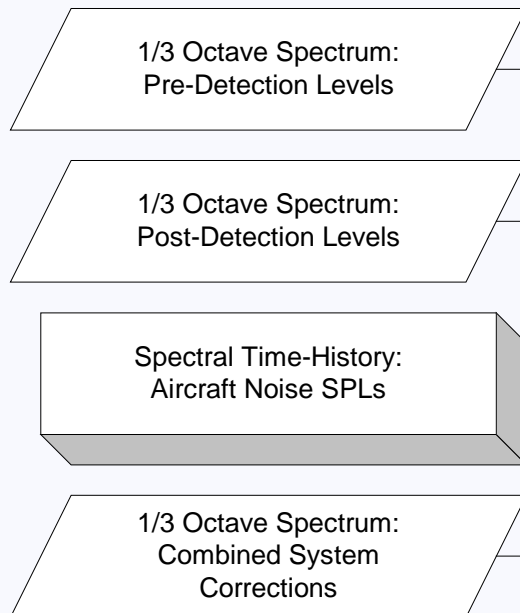
## Adjustment & Reconstruction of Test-Day Aircraft Data

- Step 1: Perform Part 1 of the Background Noise Adjustment Procedure – Identification of masked data & Adjustment of valid SPLs
- Step 2: Determine emission TXYZ coordinates, acoustic emission angle, and propagation distance for each record in the aircraft noise time-history
- Step 3: Determine atmospheric absorption coefficients for Test-Day conditions
- Step 4: Perform Part 2 of the background noise adjustment procedure – Reconstruction of masked SPLs

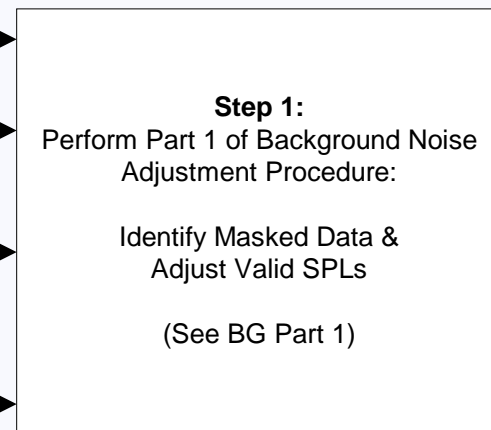


# Test-Day Process, Part 1, Step 1

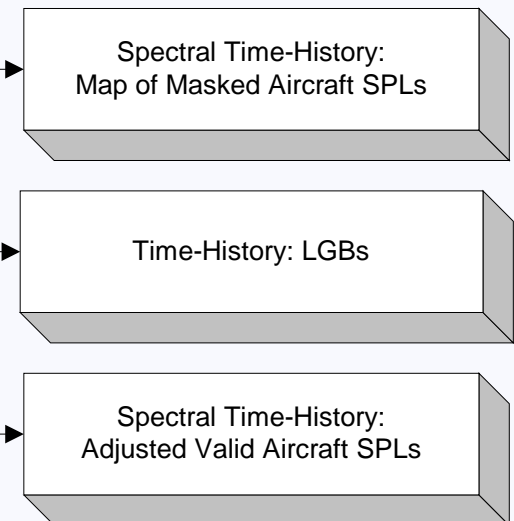
## Inputs



## Process



## Outputs







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# BG Process: Part 1

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## Determination of masking & adjustment of valid SPLs

- Step 1: Test validity of additive (Pre-detection) background noise
- Step 2: Determine masking criteria
- Step 3: Identify masked aircraft data
- Step 4: De-combine additive background from aircraft
- Step 5: Adjust aircraft data for measurement system characteristics

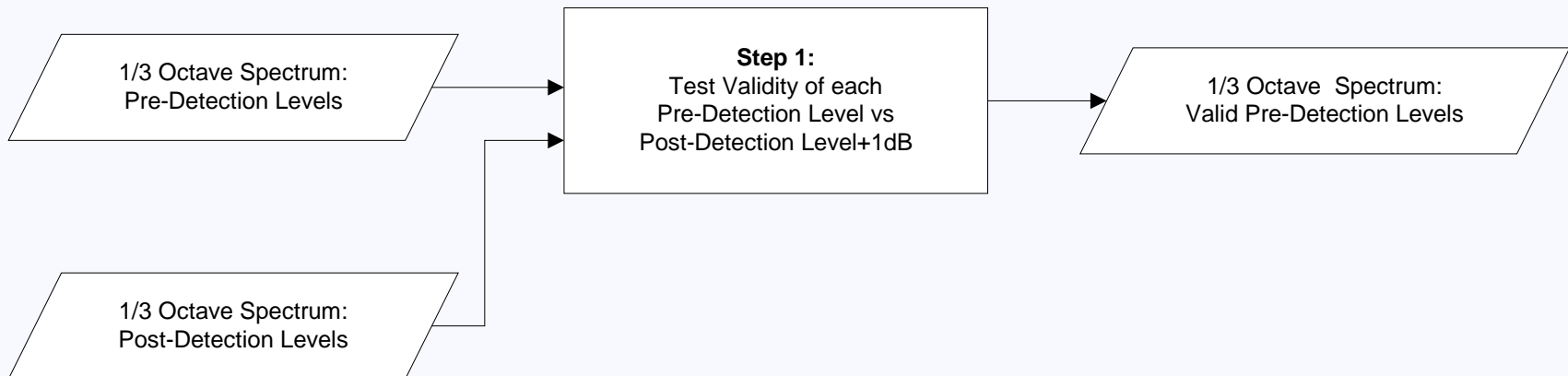


# BG Process, Part 1, Step 1

## Inputs

## Process

## Outputs



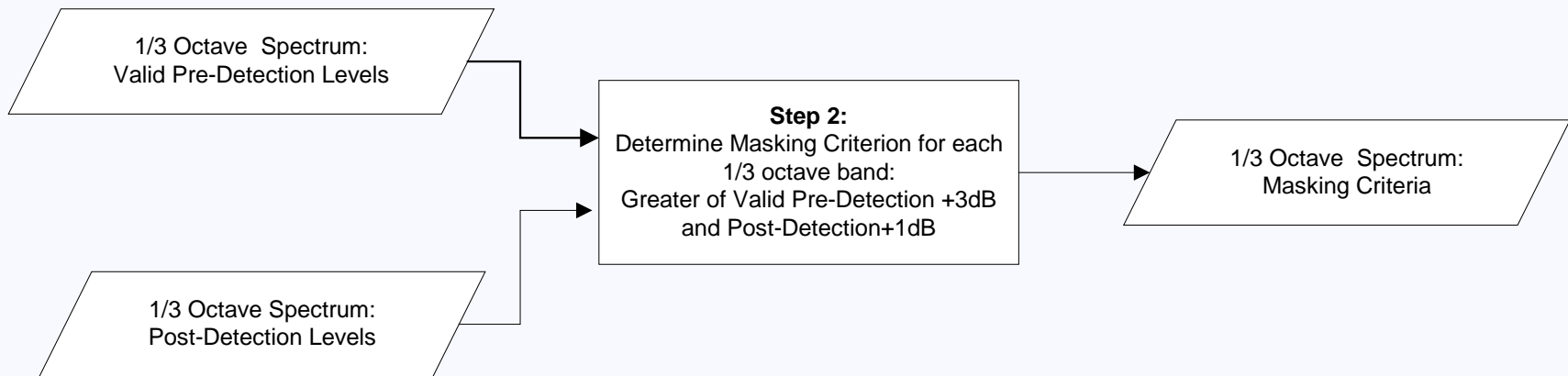


## BG Process, Part 1, Step 2

### Inputs

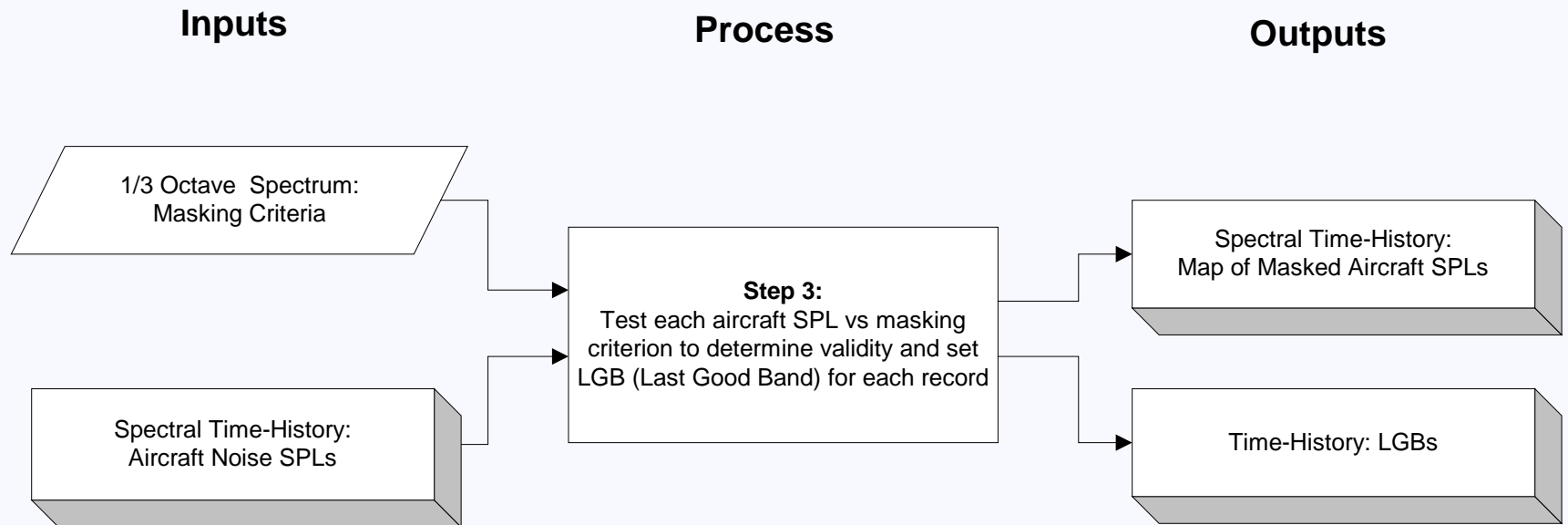
### Process

### Outputs





## BG Process, Part 1, Step 3





## BG Process, Part 1, Step 4

### Inputs

1/3 Octave Spectrum:  
Valid Pre-Detection Levels

Spectral Time-History:  
Aircraft Noise SPLs

Spectral Time-History:  
Map of Masked Aircraft SPLs

### Process

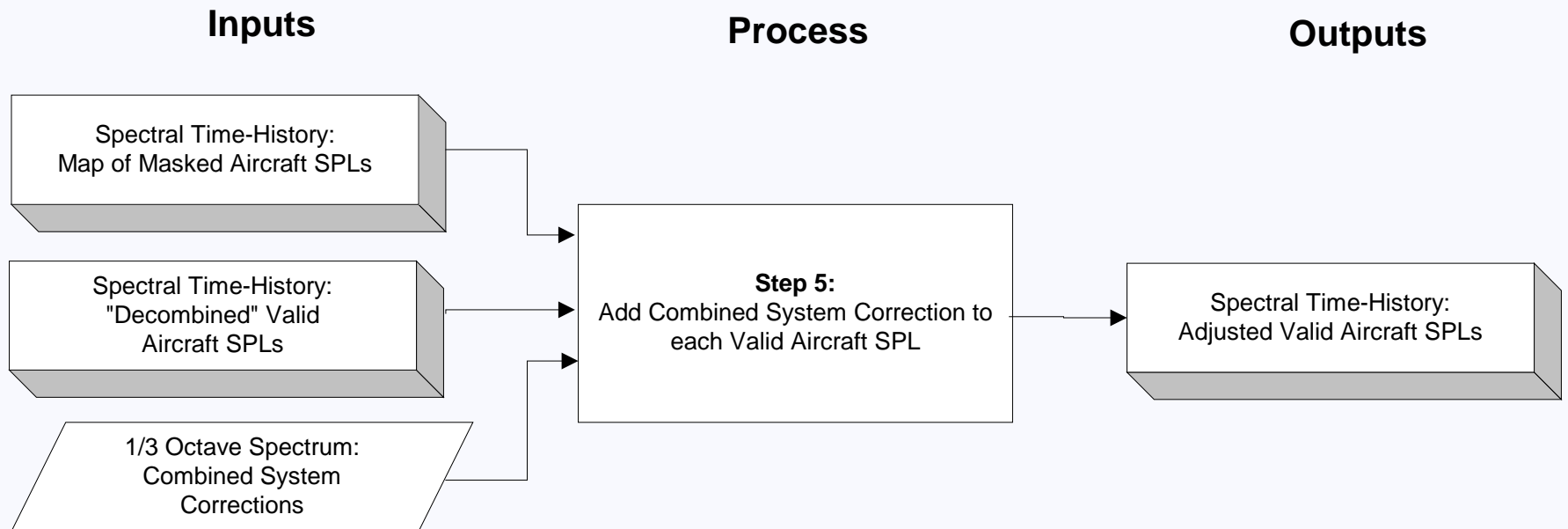
**Step 4:**  
Decombine Valid Pre-Detection Level  
from Valid Aircraft SPL

### Outputs

Spectral Time-History:  
"Decombed" Valid  
Aircraft SPLs

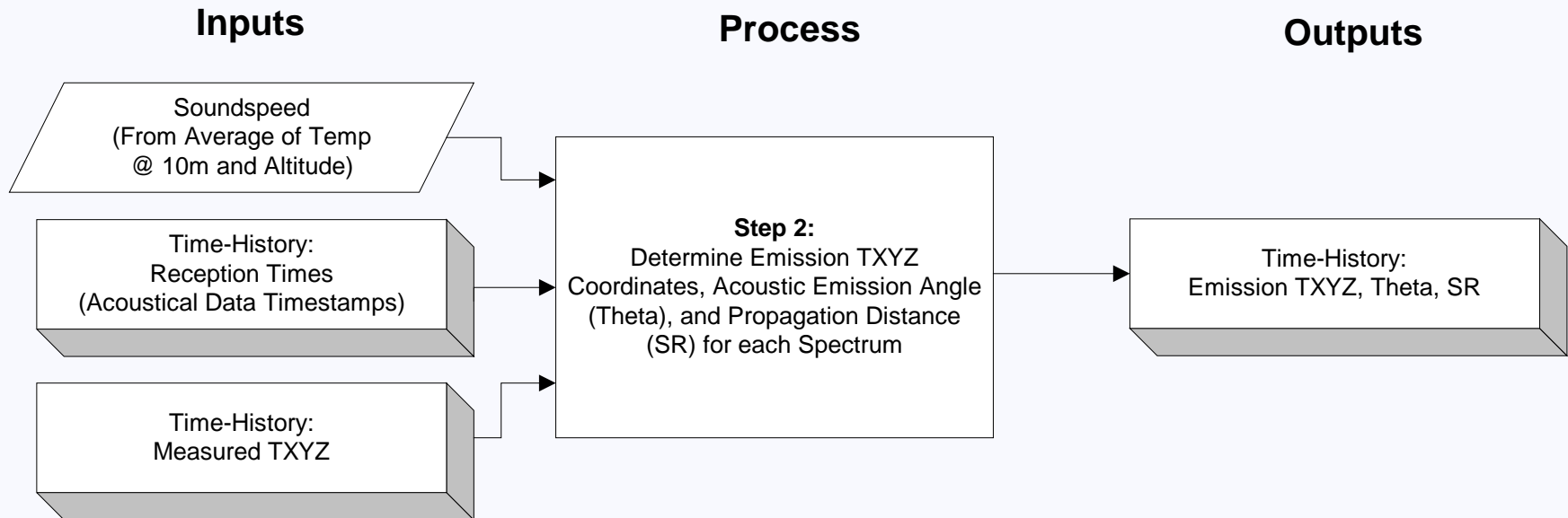


## BG Process, Part 1, Step 5





# Test-Day Process, Part 1, Step 2



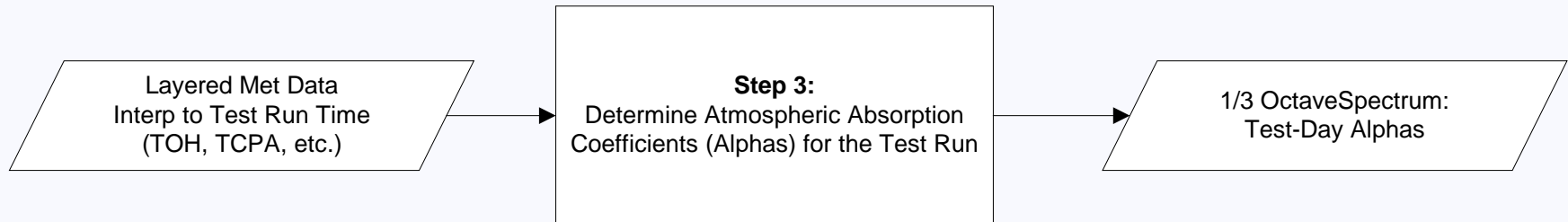


# Test-Day Process, Part 1, Step 3

## Inputs

## Process

## Outputs





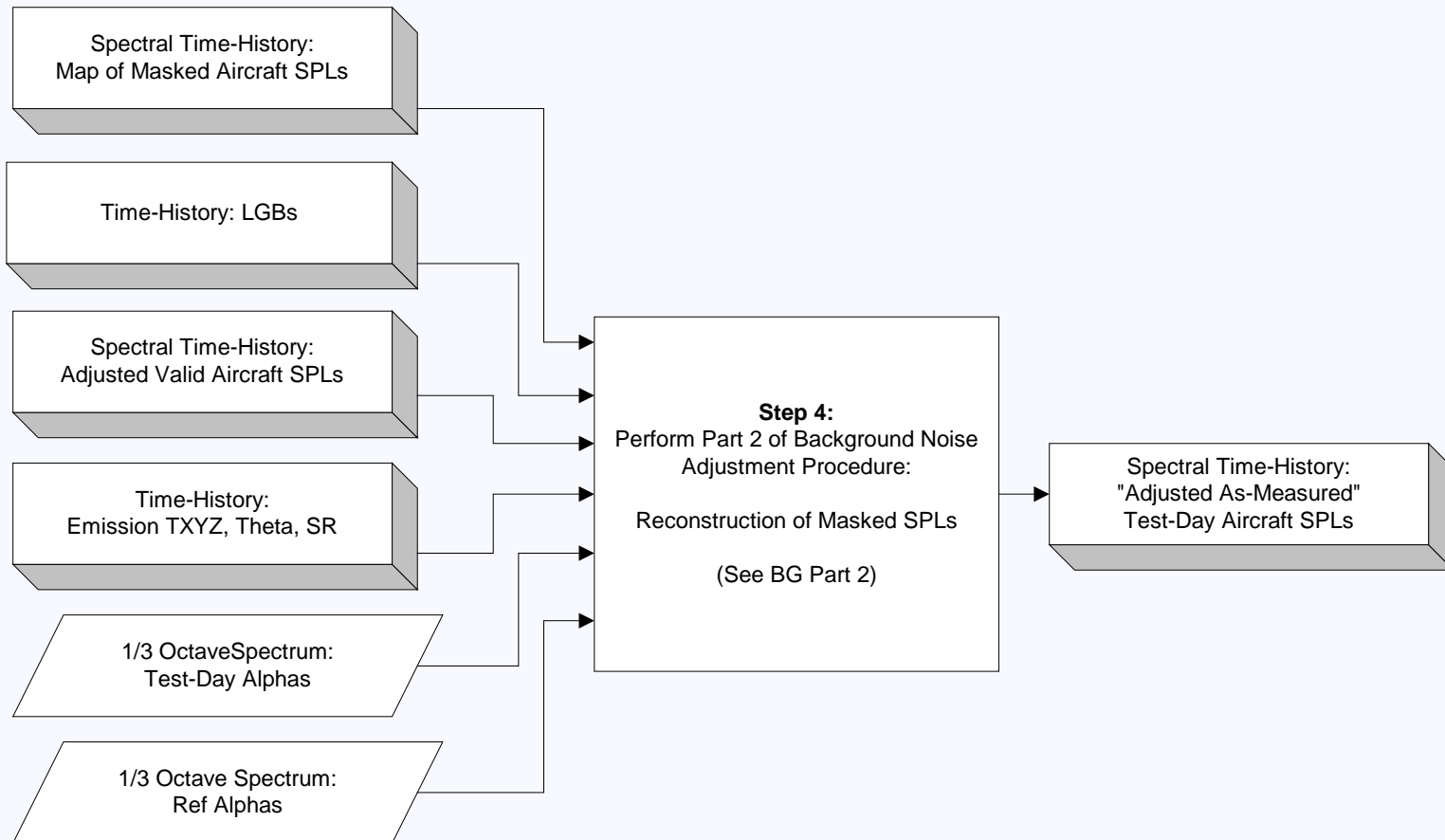


# Test-Day Process, Part 1, Step 4

## Inputs

## Process

## Outputs





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## BG Process: Part 2

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### Reconstruction of masked aircraft data

- Step 1: Reconstruct masked low-frequency SPLs by averaging adjacent valid SPLs
- Step 2: Reconstruct masked high-frequency SPLs by means of:
  - A) Frequency extrapolation
  - B) Time extrapolation



# BG Process, Part 2, Step 1

## Inputs

Spectral Time-History:  
Adjusted Valid Aircraft SPLs

Spectral Time-History:  
Map of Masked Aircraft SPLs

## Process

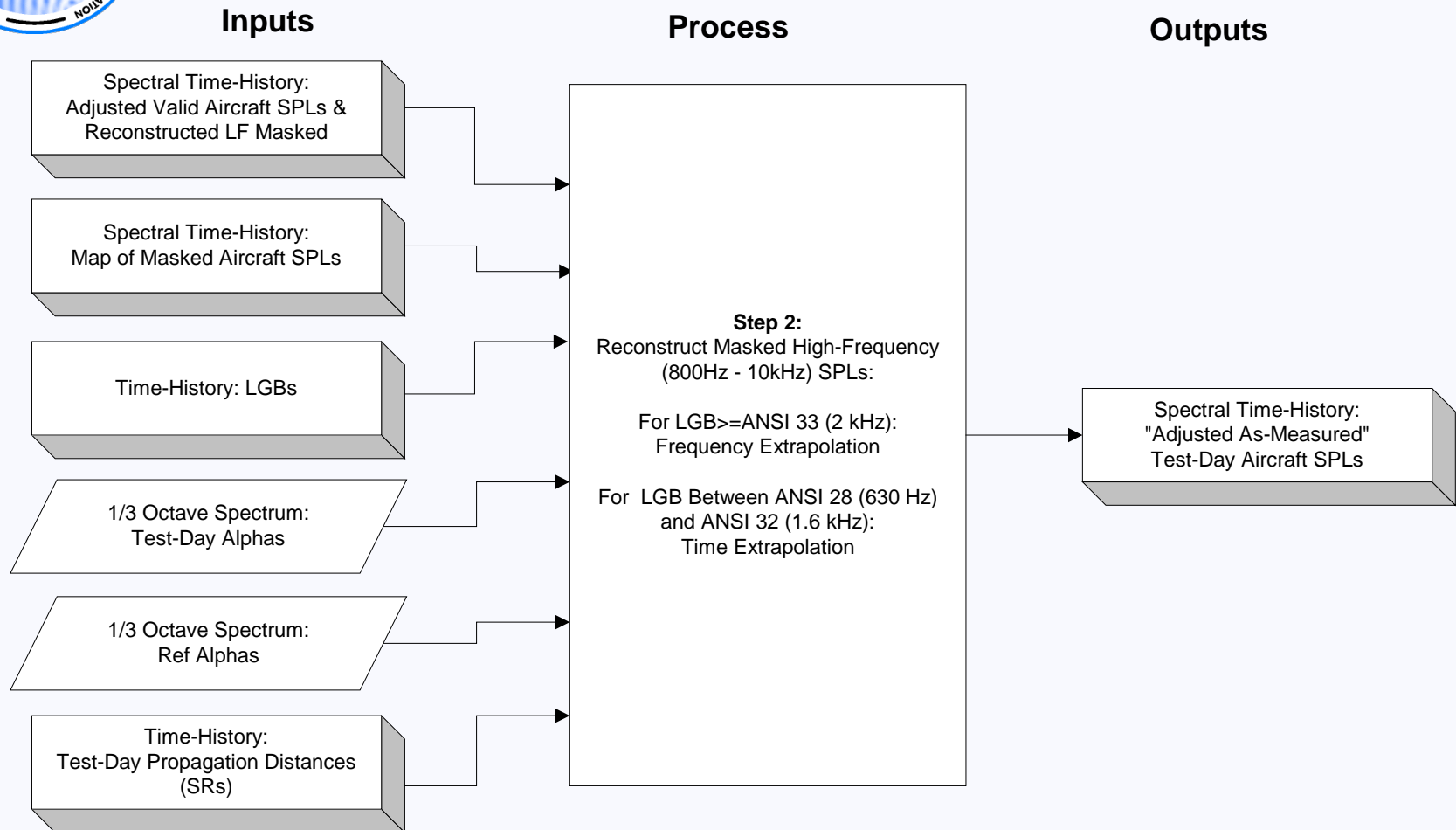
**Step 1:**  
Reconstruct Masked Low-Frequency  
(50Hz - 630Hz) SPLs

## Outputs

Spectral Time-History:  
Adjusted Valid Aircraft SPLs &  
Reconstructed LF Masked



## BG Process, Part 2, Step 2





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## Test-Day Data Process: Part 2

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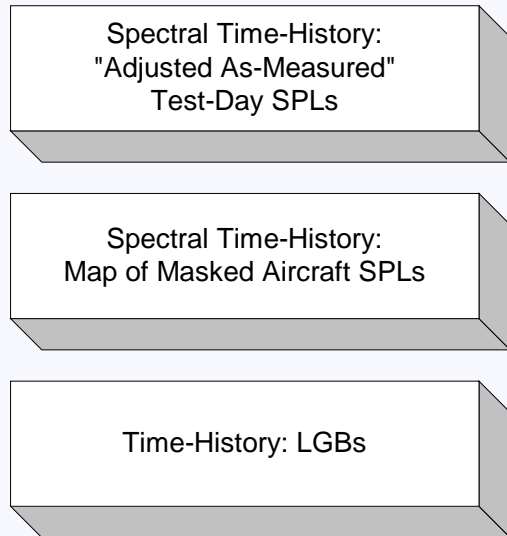
### Calculation of Time-History Metrics and EPNL

- Step 1: Calculate noise metrics for each record in the aircraft noise time-history
- Step 2: Determine and apply the bandsharing adjustment to PNLTM
- Step 3: Calculate Test-Day EPNL:
  - A) Identify 10 dB-down points
  - B) Energy-sum PNLTs within 10dB-down period

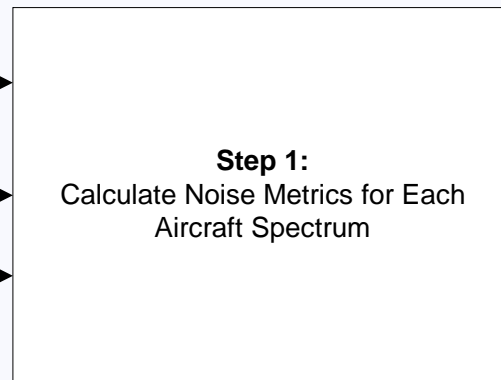


# Test-Day Process, Part 2, Step 1

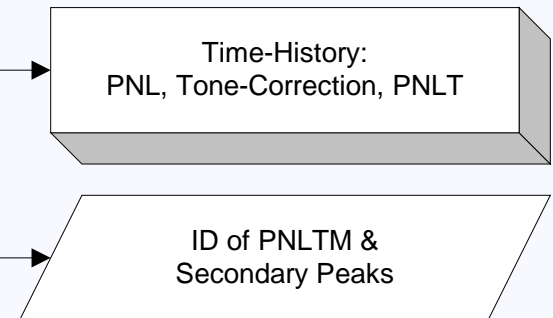
## Inputs



## Process



## Outputs



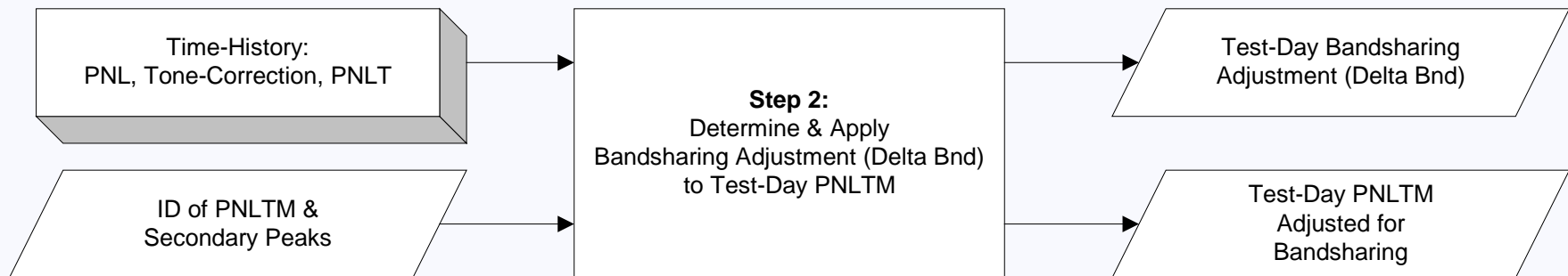


## Test-Day Process, Part 2, Step 2

### Inputs

### Process

### Outputs



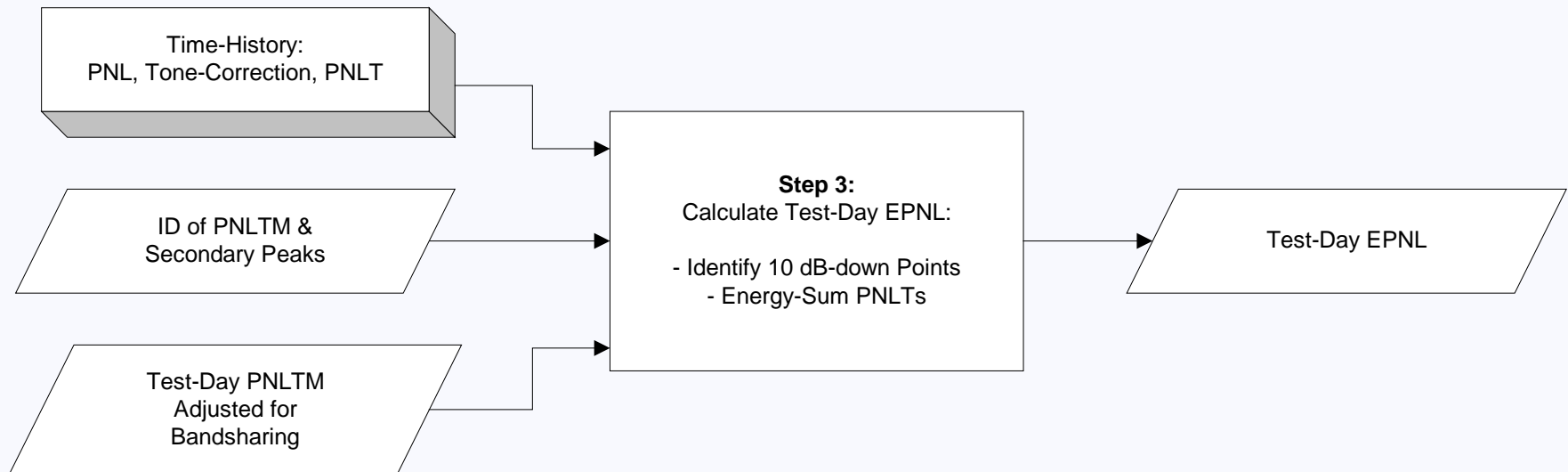


## Test-Day Process, Part 2, Step 3

### Inputs

### Process

### Outputs







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# Conclusion

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- Existing guidance materials for handling background noise provided technically complex methods, but were also difficult to implement.
- Development of a procedure that incorporated all important elements of existing guidance, resulted in a methodology that is also complex, but can be implemented in a straightforward manner.
- The complexity of the procedure requires that it be incorporated into the general Test-Day data process in a specific manner.
- JAA has been distributing this procedure to international applicants for several years.
- Comments, feedback and suggestions are welcome.