Small Aircraft Runway Length Analysis Tool Quick User Guide (version 1.2.8)

ACRP Project 03-54

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Small Aircraft Runway Length Analysis Tool
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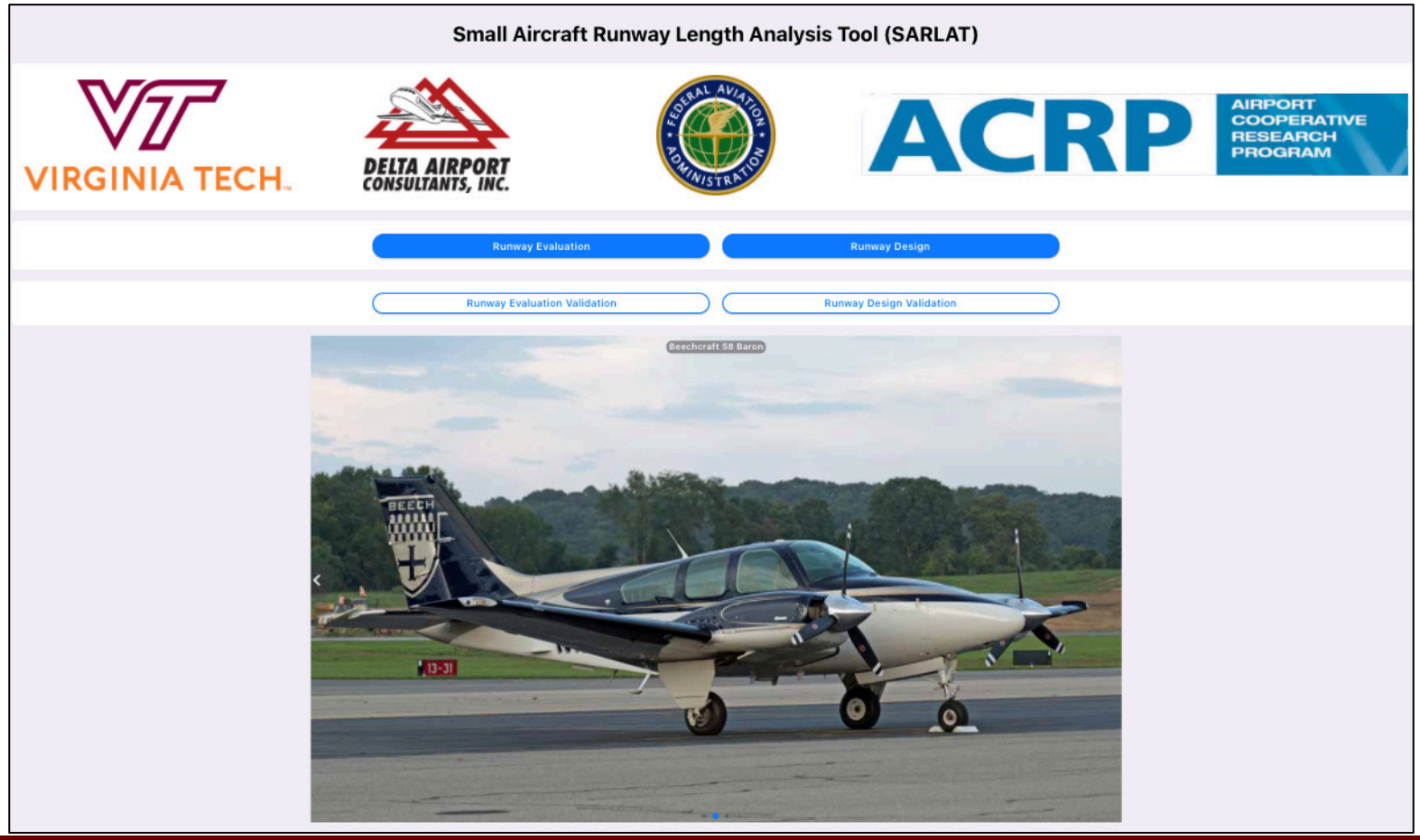


Installation Instructions for Windows OS

Step 1: Download the Small Aircraft Runway Length Analysis Tool (SARLAT) setup file from:

Windows: https://www.dropbox.com/s/i6c085iisvcozbm/SARLAT-1.2.8%2BSetup.exe?dl=0

Step 2: Locate the downloaded file on your hard drive folder

SARLAT-1.2.8+Setup.exe

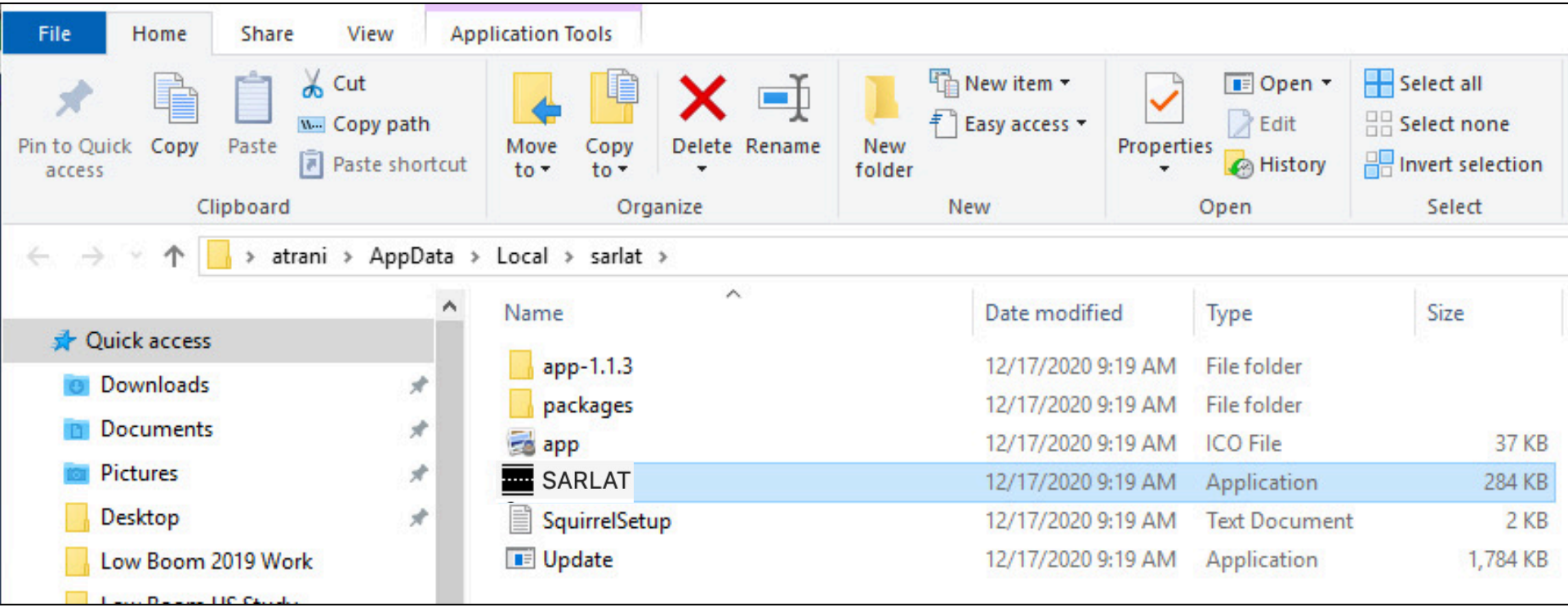
Step 3: Install the application

Double click on the **SARLAT-1.2.8+Setup.exe** file

Note: In Windows you do not need to have Administration privileges to install SARLAT

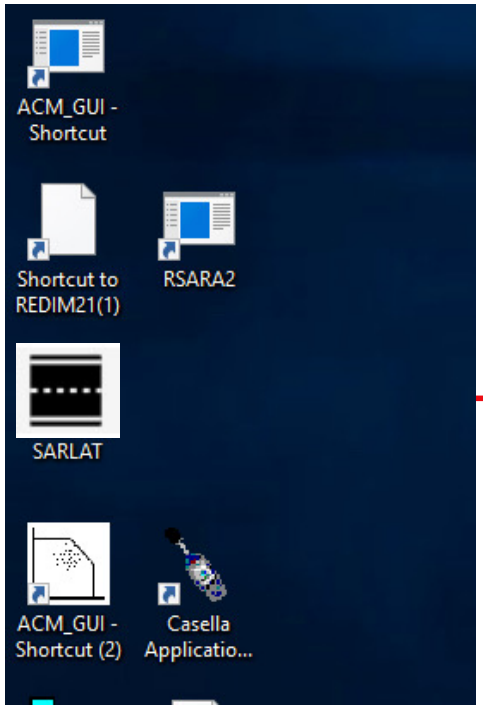
SARLAT Installation Files in Windows OS

- SARLAT is usually installed in your local drive under the name SARLAT
- The example shows SARLAT installed in the **user/AppData/local folder**



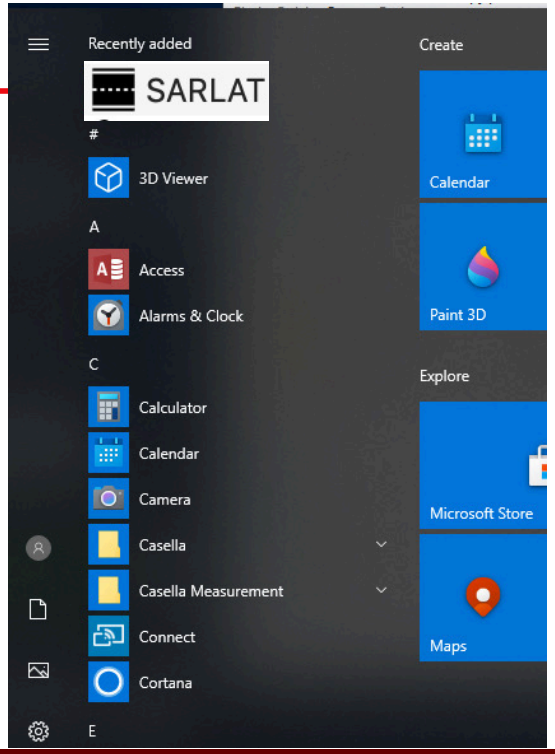
Running the Small Aircraft Runway Length Analysis Tool in **Windows** after Installation

- After installation, SARLAT creates an icon on the desktop automatically
- To run the application again, use the icon on the desktop



Small Aircraft Runway Length Analysis Tool Application icon installed on the Desktop

SARLAT can be executed from the **Applications Panel** in Windows



Installation Instructions for Mac OS

Step 1: Download the Small Aircraft Runway Length Analysis Tool (SARLAT) setup file from:

Mac: https://www.dropbox.com/s/sytgo4d3a060hkm/SARLAT-1.2.8-x64.dmg?dl=0

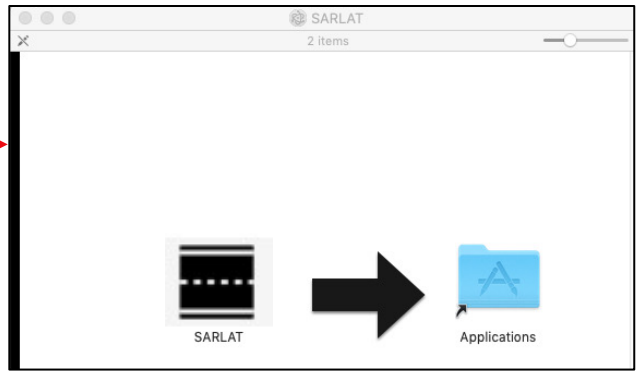
Step 2: Locate the downloaded file on your hard drive folder. The file is an Apple Disk Image file called **SARLAT-1.2.8.dmg**

Step 3: Install the application

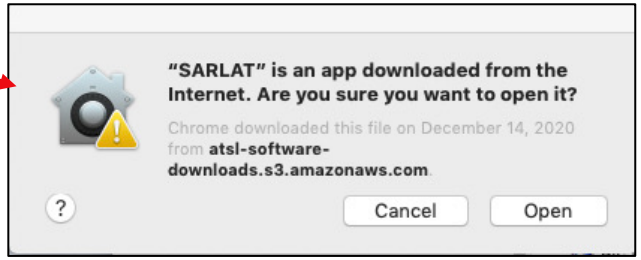
Double click on the **SARLAT-1.2.8.dmg** file on the Mac OS

Installation Instructions for Mac OS (2)

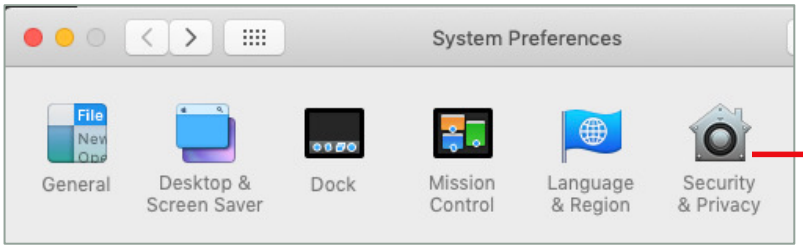
Step 4: Drag the SARLAT application icon to your Applications Folder

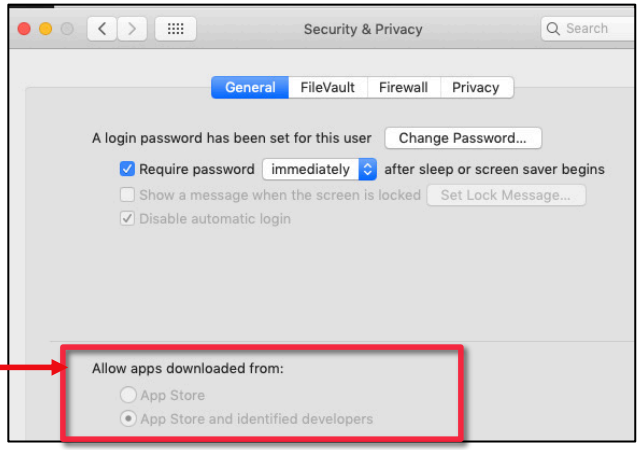


Step 5: Click **Open** in the security warning allowing the SARLAT application to run in your computer



Step 6: If necessary, allow the SARLAT application dialog in the **Security & Privacy** inside the **Systems Preferences**

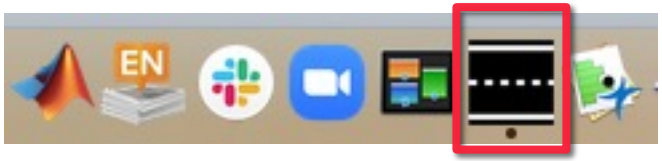




Running the Small Aircraft Runway Length Analysis Tool in **Mac OS** after Installation

- After installation, the SARLAT Application resides in the Applications Folder in your computer

- Double click in there SARLAT icon to run the application
- You can create a shortcut by dragging the SARLAT Application icon to the computer task bar

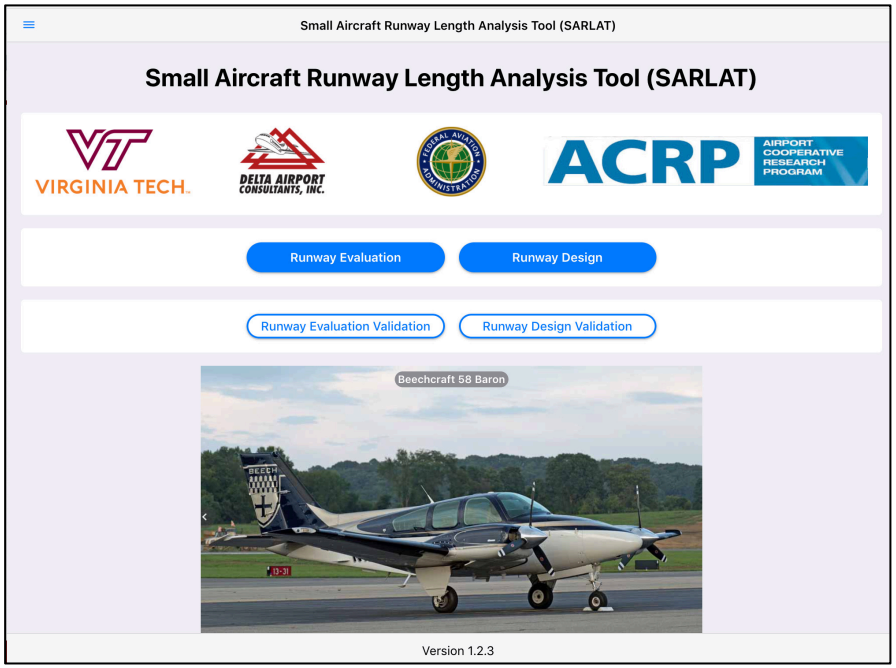


SARLAT Application Icon

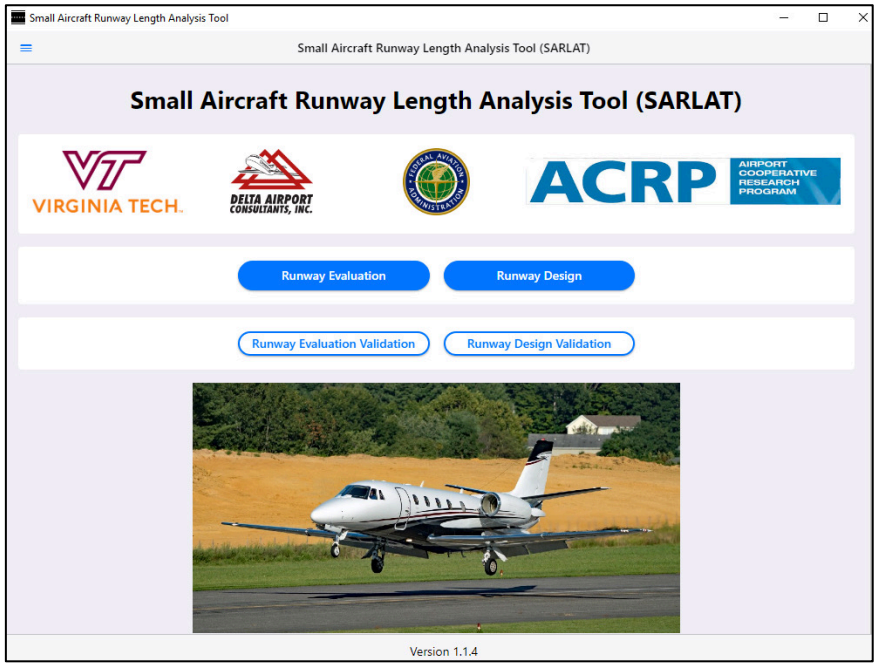
Small Aircraft Runway Length Analysis Tool

- Functionality of the model is the same for both Windows and Mac OS users
- Tool is programmed using Javascript and Hypertext Markup Language (HTML)
- SARLAT does not require connection to the Internet or a server

Mac OS 10.14.6 Operating System

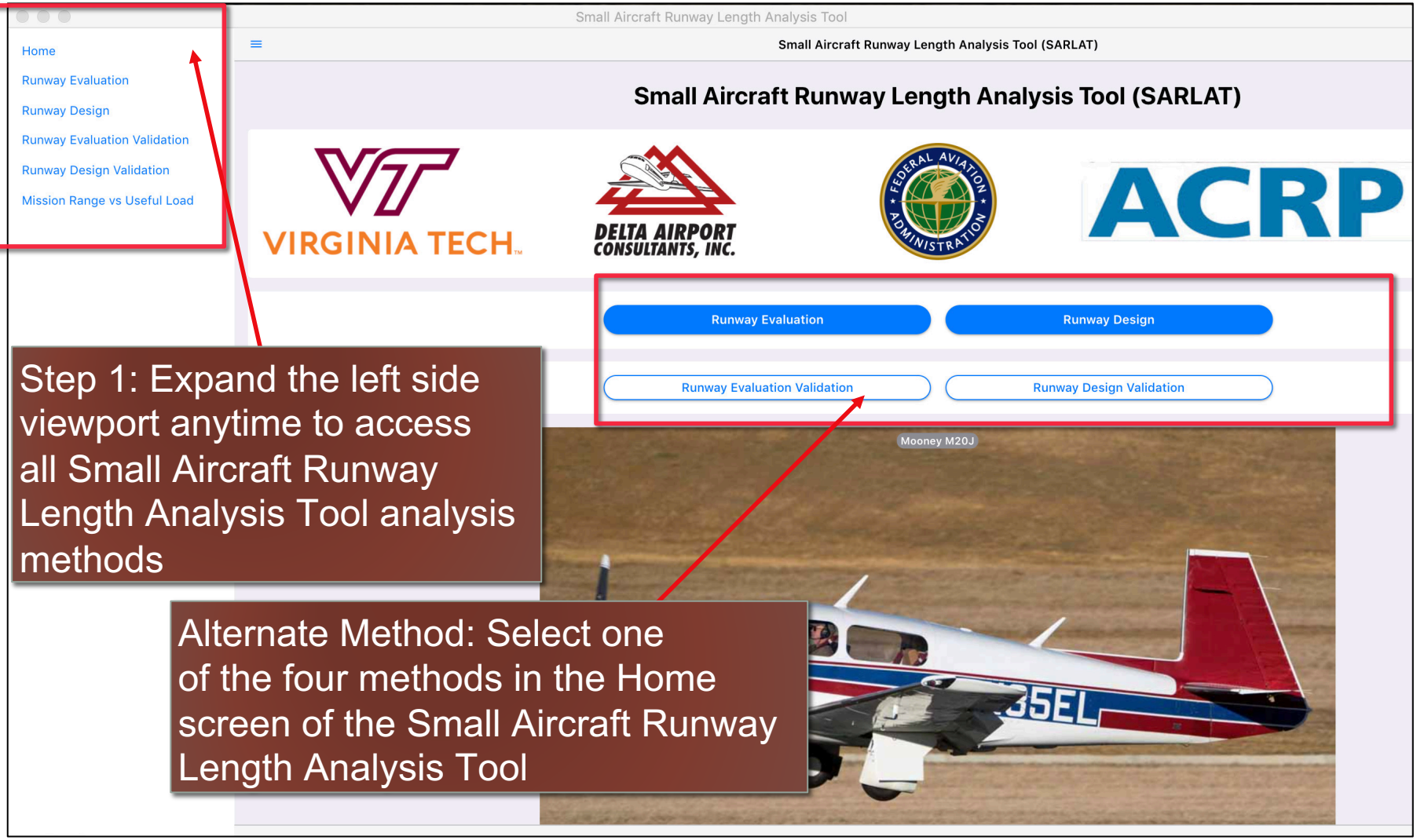


Windows 10 Operating System



Using the Small Aircraft Runway Length Analysis Tool

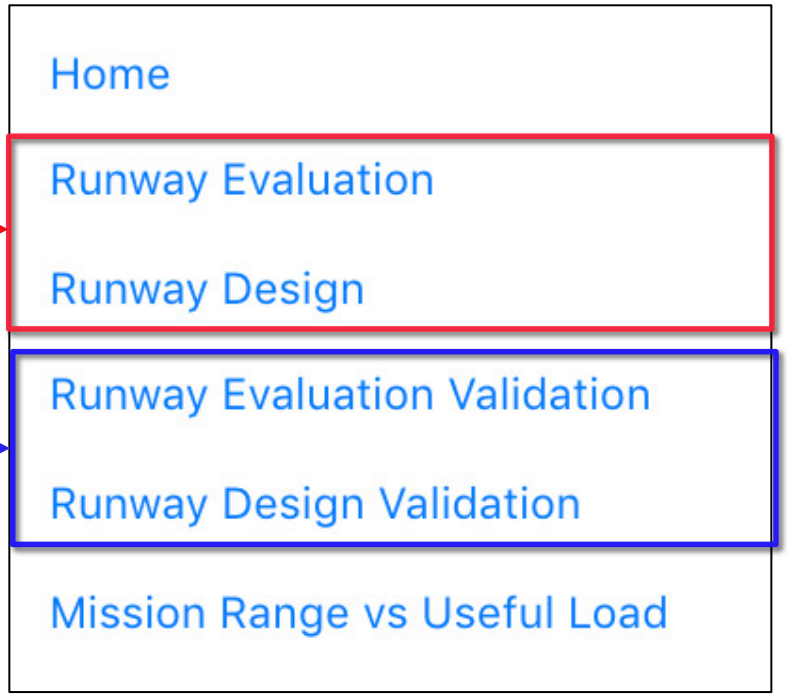
Small Aircraft Runway Length Analysis Tool **Menu Structure and Interface**



General Information About the Model

The Small Aircraft Runway Length Analysis Tool has **four modes of operation described below:**

- **Analysis modes:**
  a) Evaluation of an existing runway
  b) Design of a new runway
- **Validation modes:**
  a) Evaluation of an existing runway
  b) Design of a new runway



- Use the **Analysis Modes** to evaluate or design a new runway
- Use the **Validation Modes** to validate and visualize the runway performance of individual aircraft for a set of airport conditions

Small Aircraft Runway Length Analysis Tool: **Aircraft Database**

Detailed information for 42 General Aviation aircraft including twenty-eight piston-powered aircraft, nine turboprop-powered aircraft, and five turbofan-powered aircraft. The aircraft selected represent the most commonly used aircraft in the United States Aircraft Registry.

- Twenty-eight piston-powered aircraft (including two LSA)
- Nine turboprop-powered aircraft
- Two Light Sport Aircraft (LSA)
- Five twin-engine turbofan aircraft

Runway Evaluation Mode

Objective: Determine if a group of aircraft can safely operate from an existing runway

Runway Evaluation Mode

- **Objective:**
  - To evaluate if a given aircraft fleet can operate an existing airport
- **Output Produced**
  - Suitability of each aircraft to operate at the airport
    - Takeoff distances (dry and wet)
    - Landing distances (dry, wet, Part 135 dry, and Part 135 wet)
  - Aircraft useful load for the given runway length available and airport conditions

Runway Evaluation Mode

Step 1: Select Runway Evaluation mode

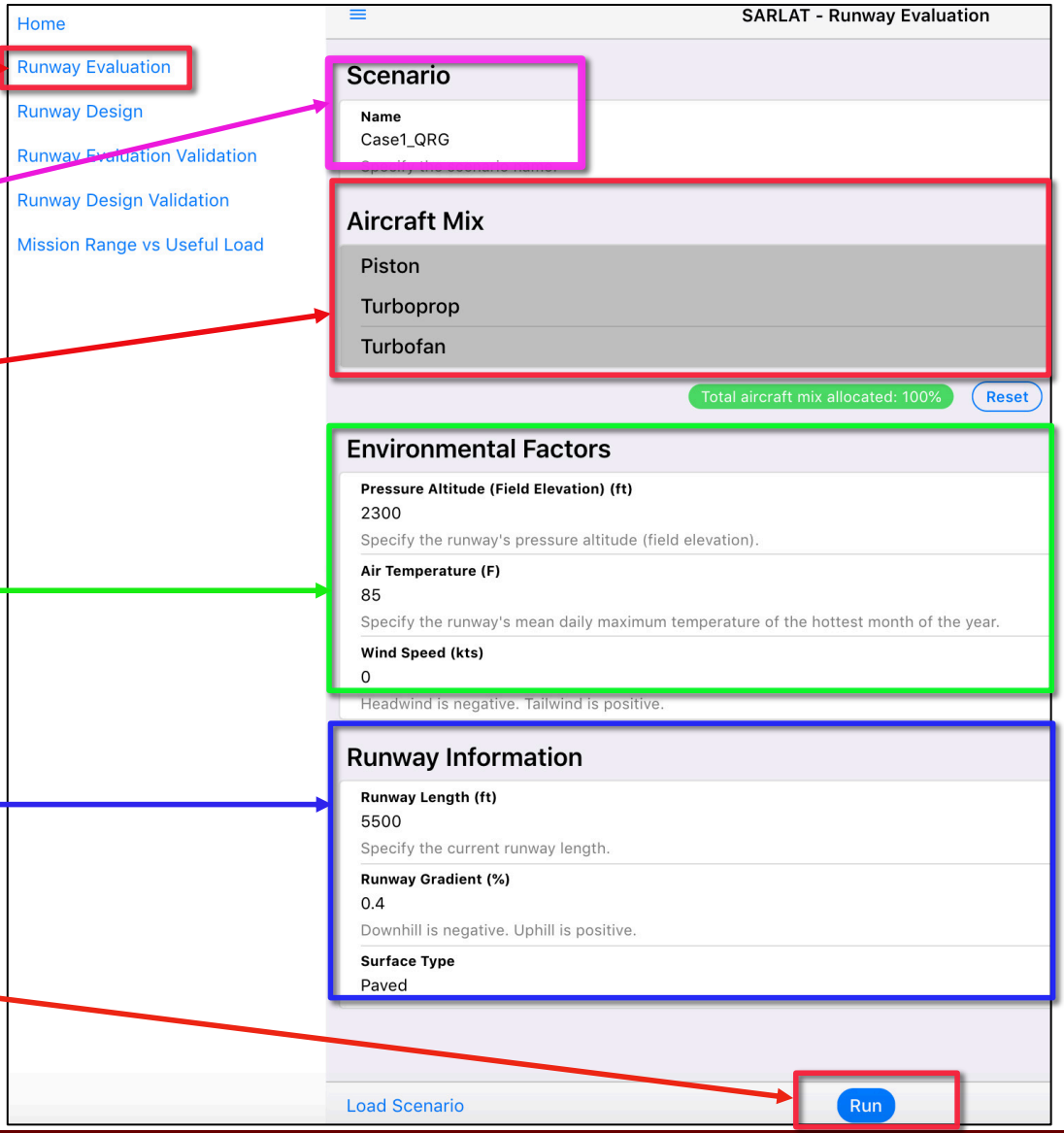
Step 2: Select a scenario name

Step 3: Select the aircraft using the airport and enter the fleet mix (expandable list)

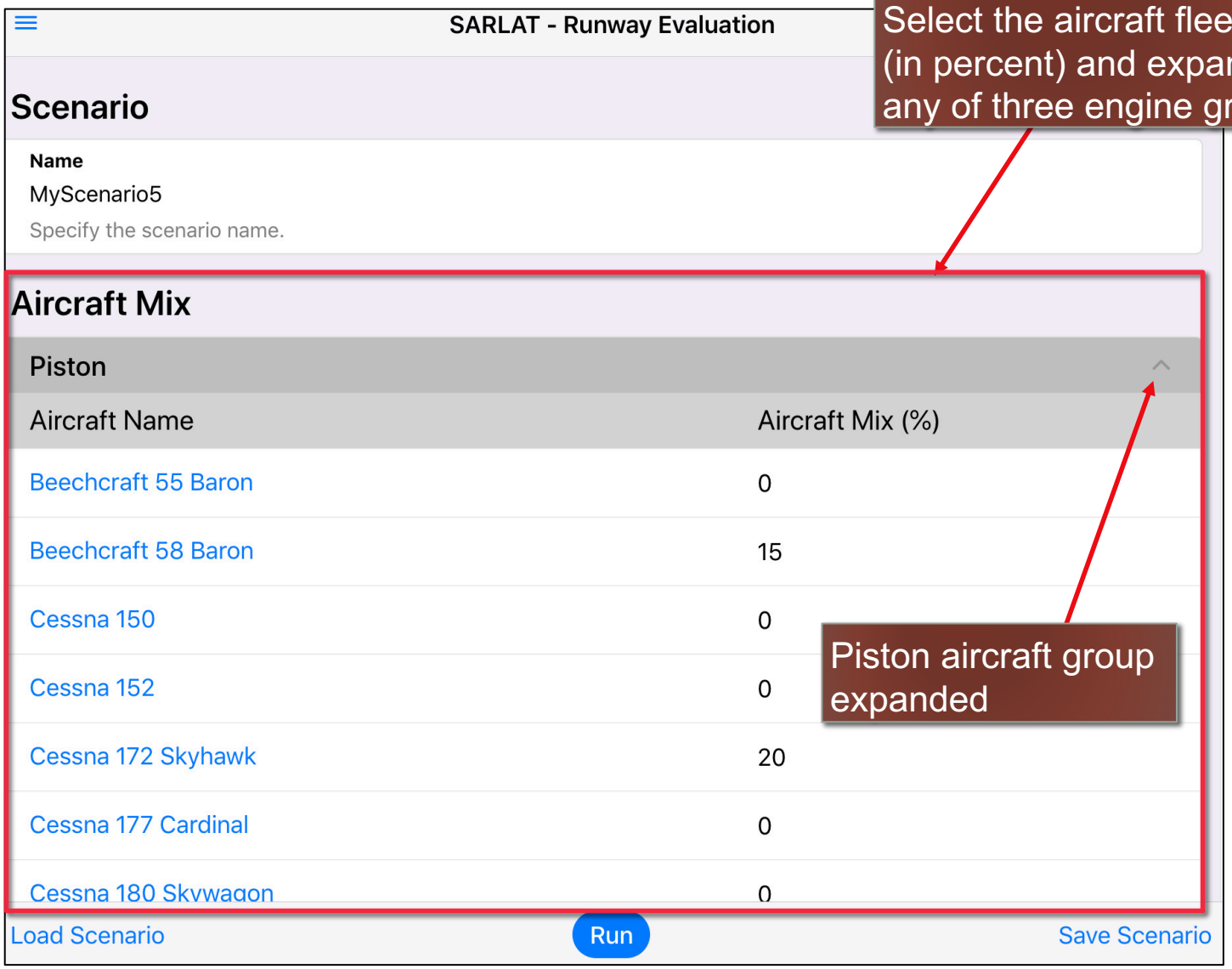
Step 4: Enter the airport environmental conditions

Step 5: Enter the runway information

Step 6: Run the case



Runway Evaluation Mode (Aircraft Fleet Mix)



Runway Evaluation Output (Case 1)

Evaluation Conditions

Pressure altitude = 2,300 feet
Runway length = 5,500 feet
Design temperature = 85 deg. F.
Runway gradient = 0.4%
Surface = paved

Runway Evaluation Conditions

Landing Suitability Table Includes 14 CFR Part 135 Landing Checks

Takeoff Weights and Useful Load Constraints

Case1_QRG

Runway Takeoff and Landing Restrictions

Pressure Altitude: 2300 ft | Air Temperature: 85 F | Wind Speed: 0 kts | Runway Length: 5500 ft | Gradient: 0.4 % | Surface Type: Paved

Aircraft Name	Aircraft Mix	Takeoff Weight (Useful Load)		Landing at Maximum Landing Weight					
				No Correction		Part 135 Eligible		Part 135	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Piston									
Beechcraft 58 Baron	40%	5400 lbs 100 %	5400 lbs 100 %	✓	✓				
Cessna 172 Skyhawk	30%	2300 lbs 100 %	2300 lbs 100 %	✓	✓				
Turboprop									
Beechcraft King Air 350ER	10%	14932 lbs 74 %	12872 lbs 41 %	✓	✓			✓	✓
Jet									
Cessna 560 XL	20%	20200 lbs 100 %	19841 lbs 95 %	✓	✓	✓	✓	✗	✗

Export table to Excel

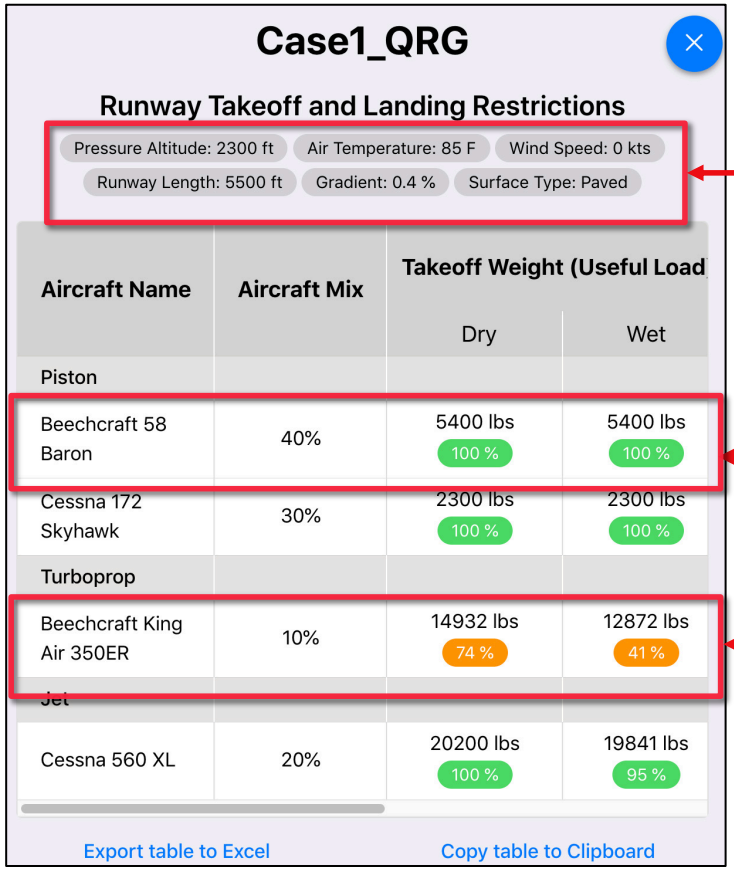
Copy table to Clipboard

Runway Evaluation Output (Case 1)

Evaluation Conditions	Pressure altitude = 2,300 feet Runway length = 5,500 feet Design temperature = 85 deg. F. Runway gradient = 0.4% Surface = paved

Provides the operational weight restrictions for each aircraft

Aircraft useful load is reported as output



Case1_QRG

Runway Takeoff and Landing Restrictions

Pressure Altitude: 2300 ft | Air Temperature: 85 F | Wind Speed: 0 kts
Runway Length: 5500 ft | Gradient: 0.4 % | Surface Type: Paved

Aircraft Name	Aircraft Mix	Takeoff Weight (Useful Load	
		Dry	Wet
Piston			
Beechcraft 58 Baron	40%	5400 lbs 100 %	5400 lbs 100 %
Cessna 172 Skyhawk	30%	2300 lbs 100 %	2300 lbs 100 %
Turboprop			
Beechcraft King Air 350ER	10%	14932 lbs 74 %	12872 lbs 41 %
Jet			
Cessna 560 XL	20%	20200 lbs 100 %	19841 lbs 95 %

Export table to Excel Copy table to Clipboard

Runway Evaluation Conditions

The Beechcraft Baron 58 can operate from the runway at 100% useful load

The Beechcraft King Air 350ER can operate at 74% useful load in dry runway conditions.
Can operate at 41% useful load in wet runway conditions.

Mission Range vs. Useful Load Tradeoff (Case 1)

Evaluation Conditions

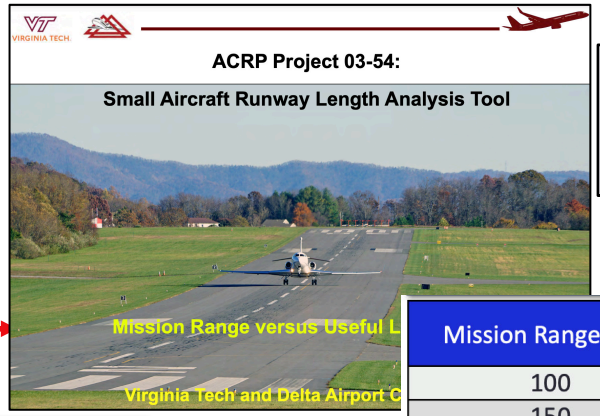
Pressure altitude = 2,300 feet
Runway length = 5,500 feet
Design temperature = 85 deg. F.
Runway gradient = 0.4%
Surface = paved

Provides information to translate useful load to mission range

Output for Case 1 (King Air 350ER)

		Takeoff Weight (Useful Load)	
		Dry	Wet
Turboprop			
Beechcraft King Air 350ER	10%	14932 lbs 74 %	12872 lbs 41 %

- Home
- Runway Evaluation
- Runway Design
- Runway Evaluation Validation
- Runway Design Validation
- Mission Range vs Useful Load



Select the Mission Range Document Link

Mission Range (nm)	Maximum Number of Passengers	Useful Load (%)
100	10	50.4
150	10	53.5
200	10	56.4
300	10	61.5
600	10	73.7
1000	10	87.0
1316	10	97.4
1400	10	100.0
1500	9	100.0
1600	8	100.0
1700	7	100.0
1800	6	100.0
1900	5	100.0
2223	3	100.0

All values in the table assume two pilots and 30 lbs of luggage for each pilot

The Beechcraft King Air 350ER can takeoff at 74% useful load in dry runway conditions.
The King Air B350ER can fly 10 passengers 600 nm with useful load of 74%.
The King Air B350ER is limited to 41% useful load (can take 10 passengers for less than 100 nm).

Runway Evaluation Output (Case 1)

Evaluation Conditions

Pressure altitude = 2,300 feet
Runway length = 5,500 feet
Design temperature = 85 deg. F.
Runway gradient = 0.4%
Surface = paved

Landing table shows suitability to operate at maximum allowable landing weight

Case1_QRG

Runway Takeoff and Landing Restrictions

Pressure Altitude: 2300 ft | Air Temperature: 85 F | Wind Speed: 0 kts
Runway Length: 5500 ft | Gradient: 0.4 % | Surface Type: Paved

Runway Evaluation Conditions

Aircraft Name	Aircraft Mix	Landing at Maximum Landing Weight					
		No Correction		Part 135 Eligible		Part 135	
		Dry	Wet	Dry	Wet	Dry	Wet
Piston							
Beechcraft 58 Baron	40%	✓	✓				
Cessna 172 Skyhawk	30%	✓	✓				
Turboprop							
Beechcraft King Air 350ER	10%	✓	✓			✓	✓
Jet							
Cessna 560 XL	20%	✓	✓	✓	✓	✗	✗

The Beechcraft Baron 58 can land in dry or wet runway conditions at maximum allowable landing weight

The Cessna Citation 560 XL can land in dry and wet runway conditions.
The aircraft cannot operate if 14 CFR Part 135 standard criteria is used (landing distance is 60% of the runway length available)
The aircraft van operate if Part 135 Eligible requirements are used (landing distance is 80% of the runway length available)

Runway Evaluation Output (Case 1)

Evaluation Conditions

Pressure altitude = 2,300 feet
Runway length = 5,500 feet
Design temperature = 85 deg. F.
Runway gradient = 0.4%
Surface = paved

Export table to Excel Copy table to Clipboard

Aircraft Name	FAA Type Designator	Engine Type	Aircraft Design Group (ADG)	Aircraft Approach Category (AAC)	Weight Category	Operating Empty Weight (OEW)
Piston						
Beechcraft 58 Baron	BE58	Piston	I	B	T	4000 lbs
Cessna 172 Skyhawk	C172	Piston	I	A	S	1419 lbs
Turboprop						
Beechcraft King Air 350ER	B350	Turboprop	II	B	L	10385 lbs
Pilatus PC 12 NG	PC12	Turboprop	II	B	S	6173 lbs
Socata TBM 700	TBM7	Turboprop	I	A	S	4050 lbs

Export results to Excel or to the clipboard

Aircraft table with general information about each aircraft

Aircraft grouped in three engine categories

Runway Design Mode

- **Objective:**
  - To estimate the unconstrained runway length required by the proposed aircraft fleet
- **Output Produced**
  - Takeoff runway distance requirements (dry and wet)
  - Landing runway distance requirements (dry, wet, Part 135 dry and Part 135 wet)

Runway Design Mode

Objective: Determine the runway length needed for a fleet of aircraft

Runway Design Mode

Step 1: Select Runway Design mode

Step 2: Name your scenario

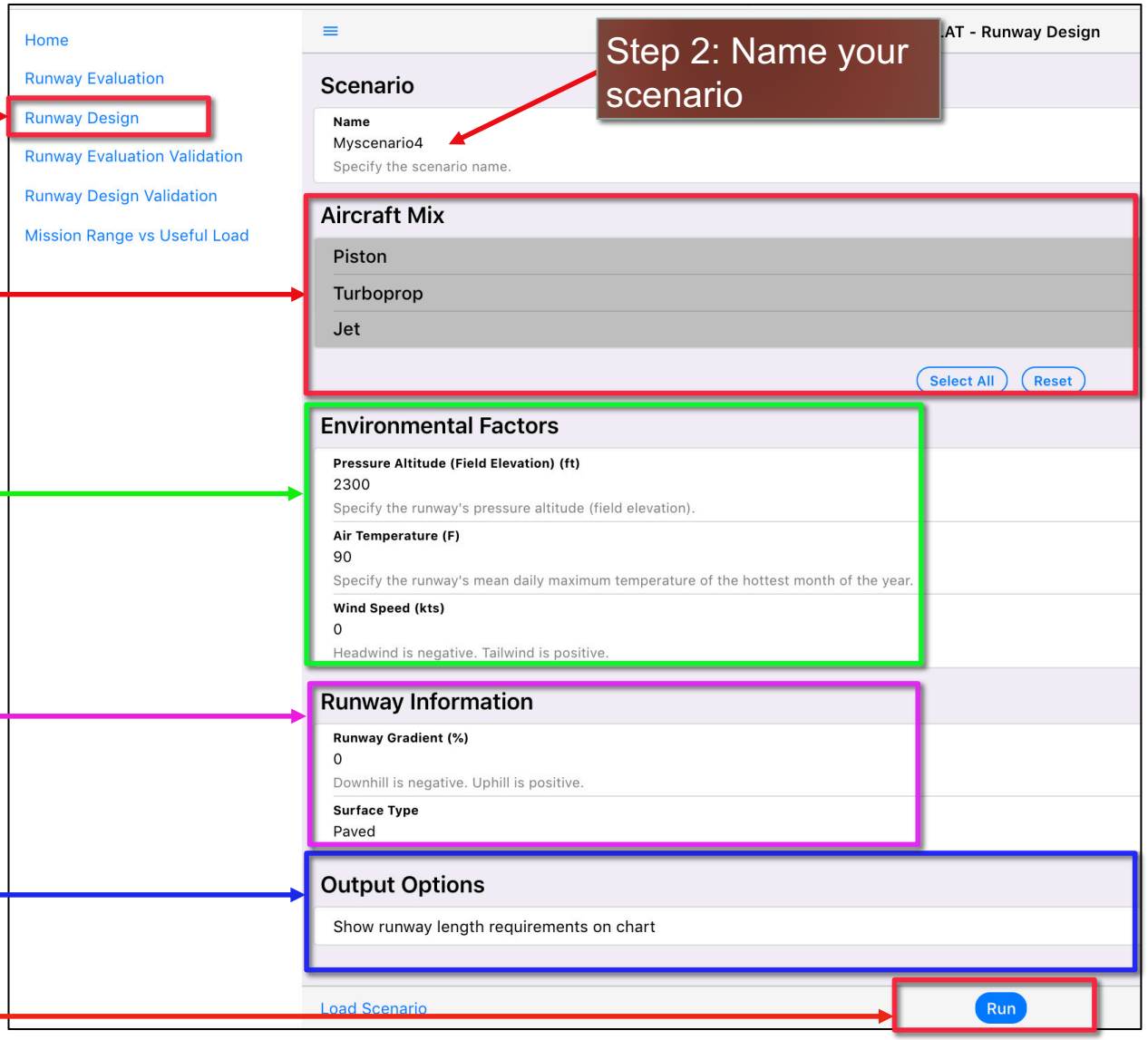
Step 3: Select the aircraft to be considered in the runway design

Step 4: Enter the airport environmental conditions

Step 5: Enter the runway grade and surface

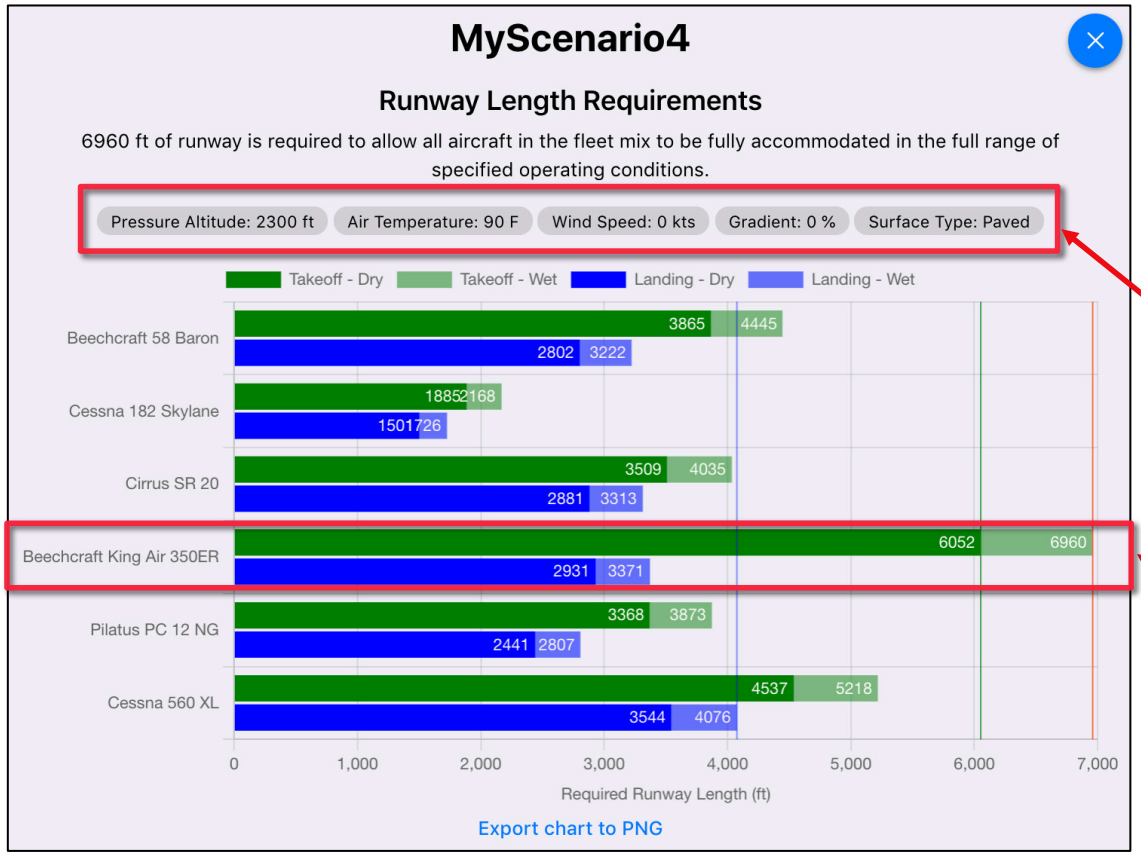
Step 6: Select the output options

Step 7: Run the case



Runway Design Output (1)

Design Conditions	Pressure altitude = 2,300 feet Design temperature = 90 deg. F. Useful load = 90% turbofan and turboprop, 100% for piston Wind speed = 0 knots Runway gradient = 0%



- Provides a graphical output of runway length requirements for each aircraft
- The critical aircraft is indicated with a vertical line (red)
- The Beechcraft King Air B350ER is the critical aircraft

Runway Design Conditions

6,960-foot runway needed (wet pavement)
6,052-foot runway needed (dry pavement)

Runway Design Output (2)

Design Conditions	
	Pressure altitude = 2,300 feet Design temperature = 90 deg. F. Useful load = 90% jets, 100% others Wind speed = 0 knots Runway gradient = 0%

- Provides a table output of runway length requirements for each aircraft
- Two takeoff conditions provided (wet/dry)
- Multiple landing conditions provided (wet, dry and Part 135)

Aircraft Name	Useful Load (%)	Takeoff (ft)		Landing (ft)					
				No Correction		Part 135 Eligible		Part 135	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Piston									
Beechcraft 58 Baron	100	3865	4445	2802	3222				
Cessna 182 Skylane	100	1885	2168	1501	1726				
Turboprop									
Beechcraft King Air 350ER	60	5120	5888	2931	3371			4191	4820
Pilatus PC 12 NG	90	3368	3873	2441	2807				
Jet									
Cessna 560 XL	90	4537	5218	3544	4076				

Takeoff distance output

Landing distance output

Runway Evaluation Validation Mode

- **Objective:**
  - Provides a graphical depiction of aircraft takeoff weight and runway length required for various design parameters (temperature, runway grade, and wind speed)
- **Output Produced**
  - Plot of runway length versus takeoff weight

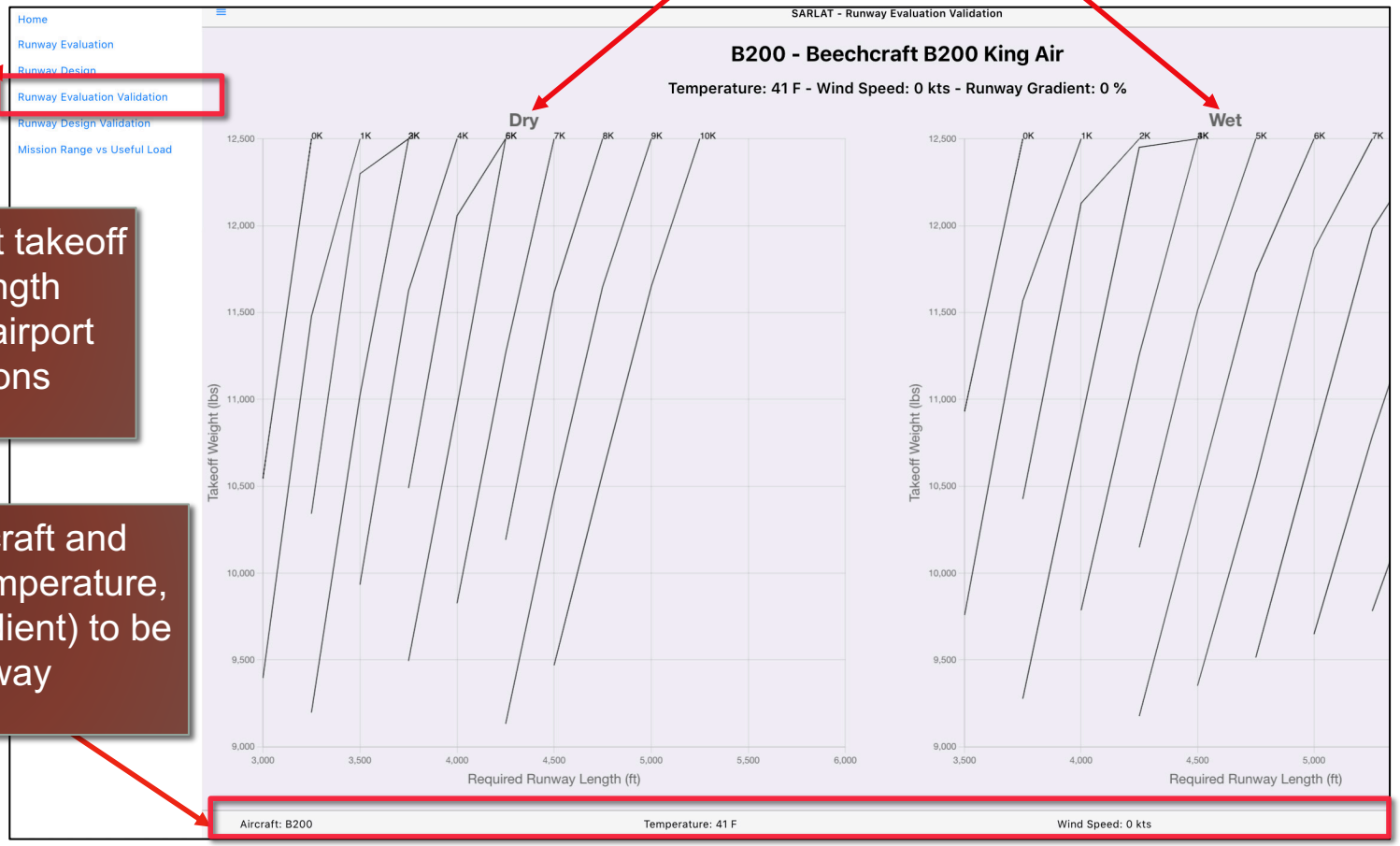
Runway Evaluation Validation Mode

Step 1: Select Runway Evaluation Validation mode

Dry and Wet pavement conditions are reported

Plot shows the aircraft takeoff weight and runway length required for selected airport environmental conditions

Step 2: Select the aircraft and airport conditions (Temperature, Wind Speed and Gradient) to be considered in the runway evaluation.



Runway Design Validation Mode

- **Objective:**
  - Provides a graphical depiction of aircraft takeoff weight and runway length required for various design parameters (temperature, runway grade, and useful load
- **Output Produced**
  - Plot of runway length versus takeoff weight

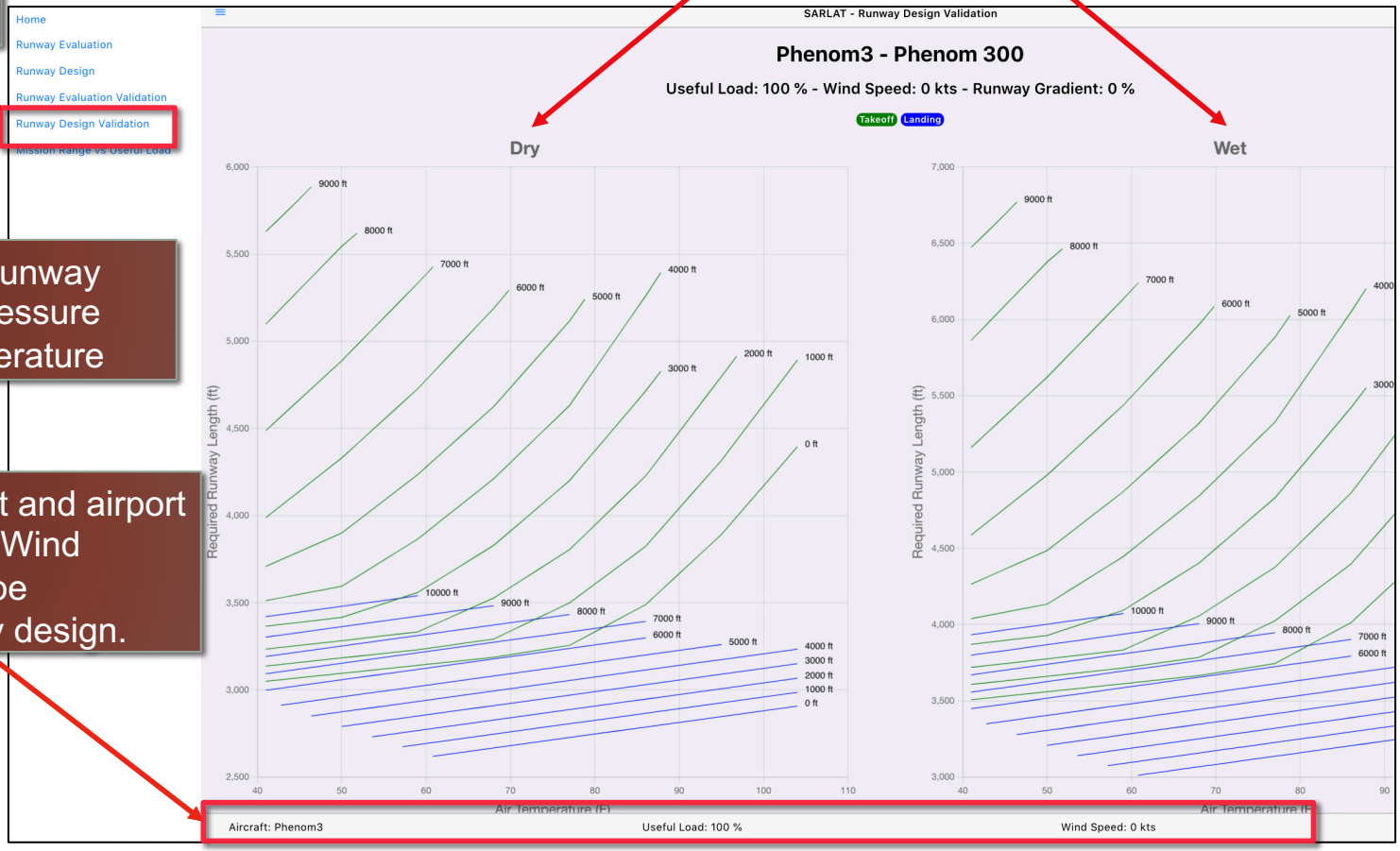
Runway Design Validation Mode

Step 1: Select Runway Design Validation mode

Dry and Wet pavement conditions are reported

Plot shows the required runway length as a function of pressure altitude and airfield temperature

Step 2: Select the aircraft and airport conditions (Useful Load, Wind Speed and Gradient) to be considered in the runway design.



SARLAT Tool **Takeoff Runway Length** Reports

- For turbofan and turboprop aircraft weighing 12,500 lbs or more, we report **Accelerate and Stop Distance (ASD)**
- For turboprop aircraft weighing less than 12,500 lbs, we report **Takeoff Distance to Clear a 50-foot Obstacle**
- For multi-engine, piston-powered aircraft, we report **Accelerate and Stop Distance (ASD*)**
- For single engine piston-powered aircraft, we report **Takeoff Distance to Clear a 50-foot Obstacle**

* For AIP projects, use the takeoff charts included in Appendix D comparing takeoff and accelerate-stop-distance for twin-engine piston aircraft.
* Twin engine, piston-powered aircraft are 5-15 times more prone to engine failures compared to twi-engine turboprops.

SARLAT Tool **Landing Runway Length** Reports

- For all types of aircraft, we report **uncorrected dry pavement landing distance**
- For all types of aircraft, we report **wet pavement landing distance (dry landing distance corrected)**
- For **turbofan-powered aircraft** operating under 14 CFR Part 135 rules, we report corrected dry pavement landing distance (1.67 times the uncorrected dry landing distance)
- For **turbofan-powered aircraft** operating under 14 CFR Part 135 rules, we report corrected wet pavement landing distance (1.92 times the uncorrected dry landing distance)
- For **turboprop-powered** aircraft operating under 14 CFR Part 135 rules, we report corrected dry pavement landing distance (1.43 times the uncorrected dry landing distance)

SARLAT Tool Runway Length Input Limits

Parameter	Lower Limit	Upper Limit	Remarks
Temperature (deg. Fahrenheit)	41	104	
Pressure Altitude (feet)	0	None	Most aircraft performance data is reported to 8,000 feet altitude
Wind (knots)	-10	5	Headwind is negative
Runway Gradient (%)	0	2	Assumes both runway ends of the runway are used (uphill is positive)
Runway Surface Conditions	Dry, Wet, Grass*, and Gravel*		

* Only for selected aircraft with such data in the Pilot Operating Handbook

Infeasible Operating Conditions: **Runway Evaluation Mode**

Example:

- Demanding airport conditions
- Some aircraft cannot operate from a 5,500 ft. runway at 90 deg. Fahrenheit temperature with a practical useful load

Aircraft with red cross mark cannot operate at the airport conditions provided

Design Conditions	Pressure altitude = 5,900 feet Runway length = 5,500 feet Design temperature = 83 deg. F. Runway gradient = 0.4% Surface = dry

Runway Takeoff and Landing Restrictions

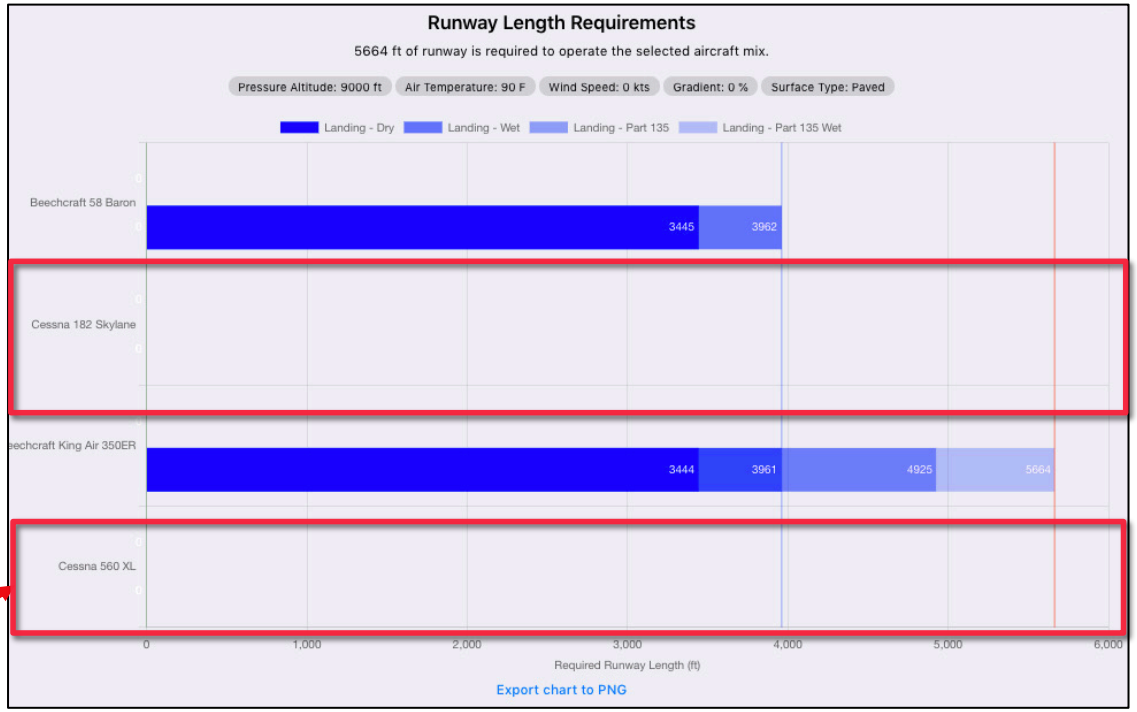
Pressure Altitude: 5900 ft | Air Temperature: 83 F | Wind Speed: 0 kts | Runway Length: 5500 ft | Gradient: 0.4 % | Surface Type: Paved

Aircraft Name	Aircraft Mix	Takeoff Weight (Useful Load)		Landing at Maximum La			
				No Correction		Part 135 Elig	
		Dry	Wet	Dry	Wet	Dry	W
Piston							
Beechcraft 58 Baron	15%	5400 lbs 100 %	4832 lbs 59 %	✓	✓		
Cessna 172 Skyhawk	20%	2300 lbs 100 %	2300 lbs 100 %	✓	✓		
Turboprop							
Beechcraft King Air 350ER	15%	11163 lbs 13 %	✗	✓	✓		
Pilatus PC 12 NG	15%	10450 lbs 100 %	10049 lbs 91 %	✓	✓		
Socata TBM 700	15%	6579 lbs 100 %	6579 lbs 100 %	✓	✓		

Infeasible Operating Conditions: **Runway Design Mode**

Example:

- Demanding airport design conditions
- 9000 feet pressure altitude
- 90 deg. F. design temperature



Aircraft not reported in bar plot cannot operate at the airport design conditions

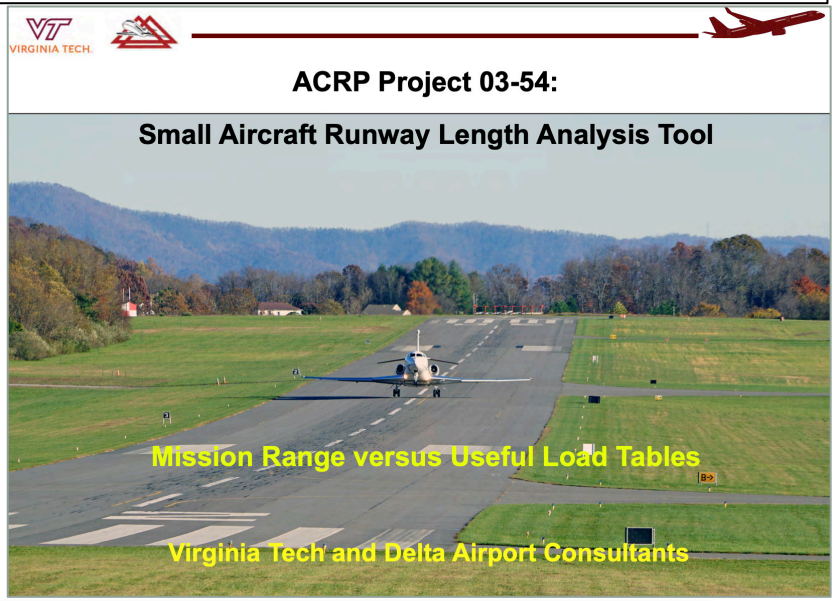
Aircraft Name	Error
Beechcraft 58 Baron	Temperature is above maximum takeoff temperature.
Cessna 182 Skylane	Altitude is above maximum takeoff altitude.
Cessna 182 Skylane	Altitude is above maximum takeoff altitude.
Beechcraft King Air 350ER	Temperature is above maximum takeoff temperature.
Cessna 560 XL	Temperature is above maximum takeoff temperature.
Cessna 560 XL	Altitude is above maximum takeoff altitude.

Mission Range versus Useful Load Tables

- **Objective:**
  - Illustrate the tradeoffs between the maximum number of passengers carried, mission range and useful load
- **Output Produced**
  - Tables with mission range, number of passengers and useful load for each aircraft
  - Mission range and useful load tables are presented for Large aircraft with maximum takeoff weights equal or greater than 12,500 lbs.
  - Tables are presented for the Beechcraft King Air B350, Beechcraft King Air B200, Cessna Citation 560 XLS, Embraer Phenom 300, and Cessna CitationJet 3

Mission Range versus Payload Tables

Step 1: Select the Mission range vs. useful load



Tables are presented for:

- Beechcraft King Air B350,
- Beechcraft King Air B200,
- Cessna Citation 560 XLS,
- Embraer Phenom 300, and Cessna CitationJet 3

Step 2: Mission range vs. useful load document opens in your browser

Range vs Useful Load Table for Beechcraft B350ER

Table assumes a full load of passengers except when mission range requires off loading passengers to carry more fuel.

For example: a mission range of 300 nm carrying 10 passengers is equivalent to 61.5% useful load for this aircraft.

Mission Range (nm)	Maximum Number of Passengers	Useful Load (%)
100	10	50.4
150	10	53.5
200	10	56.4
300	10	61.5
600	10	73.7
1000	10	87.0
1316	10	97.4
1400	10	100.0
1500	9	100.0
1600	8	100.0
1700	7	100.0
1800	6	100.0
1900	5	100.0
2223	3	100.0

All values in the table assume two pilots and 30 lbs of luggage for each pilot

Runway Evaluation Example

SARLAT - Runway Evaluation

Piston

Turboprop

Turbofan

Total aircraft mix allocated: 100% Reset

Environmental Factors

Pressure Altitude (Field Elevation) (ft)

2130

Specify the runway's pressure altitude (field elevation).

Air Temperature (F)

85

Specify the runway's mean daily maximum temperature of the hottest month of the year.

Wind Speed (kts)

0

Headwind is negative. Tailwind is positive.

Runway Information

Runway Length (ft)

5500

Specify the current runway length.

Runway Gradient (%)

0.0

Critical Aircraft
is the Beechcraft B350ER

Design Conditions
5,500 foot runway
2,130 ft. pressure altitude
85 deg. F. design temperature
0 % effective grade
Zero wind

Beechcraft King Air B350ER

Runway Evaluation Output

Runway Takeoff and Landing Restrictions

Pressure Altitude: 2130 ft | Air Temperature: 85 F | Wind Speed: 0 kts | Runway Length: 5500 ft | Gradient: 0.0 % | Surface Type: Paved

Aircraft Name	Aircraft Mix	Takeoff Weight (Useful Load)		Landing at Maximum Landing Weight					
				No Correction		Part 135 Eligible		Part 135	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Turboprop									
Beechcraft King Air 350ER	100%	15688 lbs 87 %	13664 lbs 54 %	✓	✓			✓	✓

Export table to Excel Copy table to Clipboard

- The Beechcraft King Air B350ER can operate at 87% useful load from the 5,500-foot runway, 2130-foot pressure altitude, 0.0% gradient and 85 deg. Fahrenheit
- The aircraft can operate at 54% useful load from the 5,500-foot runway under the same conditions

- **Of interest to the airport design team if how many passengers and mission range can be flown with 87% and 54% useful load**

Runway Evaluation Output: Converting Useful Load to Mission Range

Aircraft Name	Aircraft Mix	Takeoff Weight (Useful Load)		Landing at Maximum Landing Weight					
				No Correction		Part 135 Eligible		Part 135	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Turboprop									
Beechcraft King Air 350ER	100%	15688 lbs 87 %	13664 lbs 54 %	✓	✓			✓	✓

Mission Range (nm)	Maximum Number of Passengers	Useful Load (%)
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1000	10	87.0

Beechcraft King Air B350ER mission range vs useful load table

- The King Air B350ER can fly 165 nm and 10 passengers with a useful load of 54% 54%
- The King Air B350ER can fly 1,000 nm and 10 passengers with a useful load of 87%

Exporting and Saving Scenario Runs

- SARLAT can export data for use in spreadsheets or the clipboard
- SARLAT can load saved scenarios
- SARLAT can save the graphical output produced in Portable Graphics Format (PNG)
- SARLAT exports table results in two formats:
  - Clipboard
  - Excel

Providing Feedback to Improve the SARLAT Tool

- We welcome your feedback
- Please contact:

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