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CHAPTER 14.- RUNWAY ANALYSIS

14.1 RUNWAY ANALYSIS HAWKER 850XP(TFE 731-5BR-1H)

Aircraft Performance Group Inc. From ARINC system provide Runway Analysis for AC Aviation Co., Ltd.

14.2 INTRODUCTION

Runway Analysis provides the means to determine maximum allowable takeoff and landing weights based upon:

- Airport characteristics consisting of airport elevation, runway gradient and length, runway contaminants, and the obstructions within the takeoff flight path,
- Environmental conditions consisting of temperature, wind, and pressure altitude.
- Aircraft Configurations consisting of power settings, flap settings, bleed configurations,
- and Minimum Equipment List (MEL) inoperative components.
- The performance and limitations are as outlined in the approved Airplane Flight Manual (AFM) for the specific aircraft considered. All takeoff and landing airport analysis data provided by Aircraft Performance Group complies with FAA regulations.

14.3 TAKEOFF

The maximum allowable takeoff weight is obtained by selecting the most limiting of the following:

1. Maximum certified takeoff structural weight.
2. Climb limited weight – the maximum weight at which the appropriate airworthiness climb gradients, for each takeoff segment, are attained for airport elevation and temperature.
3. Runway field length limit weight – the maximum weight at which the aircraft complies with the appropriate airworthiness rules governing runway length, runway gradient (slope), airport elevation, temperature, wind, pressure altitude, and runway contamination.
4. Obstruction limited weight – the maximum weight at which obstruction clearance required by the appropriate airworthiness rules can be attained. The obstruction limit weight is a function of aircraft configuration, obstacle height and distance, airport elevation, temperature, and wind. Unless otherwise stated, all takeoffs assume a straight out takeoff flight path along the extended runway centerline.
5. Brake energy – the maximum weight at which the aircraft brakes can absorb the amount of energy required to stop the aircraft.
6. Tire speed – the maximum weight so as not to exceed the maximum tire speed limitations.

NOTE: Some runways/airports require a “Special Departure Procedure” in order to optimize takeoff weight in terrain sensitive areas. The specific description of the Special Departure Procedure is outlined on a separate page attached to the takeoff airport analysis. These procedures describe the non-standard, one engine inoperative departure flight path. The maximum allowable takeoff weights, presented in the subsequent analysis, are based upon following the specific procedure(s) outlined.
14.4 LANDING
The maximum allowable landing weight is obtained by selecting the most limiting of the following:
1. Maximum certified landing structural weight.
2. Climb limited weight – the maximum weight at which the appropriate airworthiness climb gradients, in the approach and landing configuration, are attained for airport elevation and temperature.
3. Runway field length limit weight – the maximum weight at which the aircraft complies with the appropriate airworthiness rules governing runway length, runway gradient (slope), airport elevation, wind, pressure altitude, and runway contamination.

14.5 TAKEOFF PERFORMANCE CHART

14.5.1 DESCRIPTION / DEFINITIONS HAWKER BEECHCRAFT 850XP, TFE 731-5BR-1H

1. Chart Heading
The chart heading specifies the performance outlined (takeoff or landing), the airport by Identifier, City/State, and Airport Name, the airport elevation, and the Aircraft type and Engine.

2. Aircraft Configuration
Aircraft configurations upon which the attached data is based are presented in this block. Aircraft configurations consist of the following:
- Takeoff flaps setting:
  - 0 and 15 Degrees
  - 0 and 15 Degrees wet
  - 15 Degrees slush and compact snow

3. Special Departure Procedure
Some runways/airports require a “Special Departure Procedure” in order to optimize takeoff weight in terrain sensitive areas. The specific description of the Special Departure Procedure is outlined on a separate page attached to the takeoff airport analysis. These procedures describe the non-standard, one engine inoperative, departure flight path. The maximum allowable takeoff weights, presented in the subsequent analysis, are based upon the specific procedure(s) outlined. If there is no “DP” suffix to the runway identifier, the takeoff weights are predicated upon a STRAIGHT OUT departure.

4. Runway Identifier
The runway identifier is specified as follows:
- Full length runways indicated by basic identifier i.e. 34L
- Intersection takeoffs include hyphen “-” i.e. 34L-A takeoff from intersection “A”
- Temporary runway lengths / closures include “TMP”, i.e. 34LTMP
- Special Departure Procedures include “DP” i.e. 34LDP

Declared distances used:
- Takeoff Run Available (TORA)
- Takeoff Distance Available (TODA)
- Accelerate Stop Distance Available (ASDA)

Associated runway slope/gradient (percent)
5. OAT
This is the surface temperature, in degrees Celsius, upon which the performance data is based. The maximum temperature shown on the chart corresponds to the maximum operational temperature for airport elevation.

6. Takeoff Thrust Setting
Engine Power (N1) settings for airport surface temperature and airport altitude are displayed for both Engine Anti-ice ON and OFF.

The zero wind runway limit weight displayed is the lowest of the following:
1. One Engine Inoperative Accelerate / Stop Limitations.
2. One Engine Inoperative Accelerate / GO limitations.
3. All Engine Operating Field limitations.
4. Minimum Control limitations.
5. Brake Energy limitations.
6. Tire Speed limitations.
7. Obstacle Clearance limitations.
8. Flight Path / Level-off Altitude limitations.

The limit codes associated with the zero wind runway limits are as follows:
- ST = Structural Limit
- FL = Field Length Limit
- O = Obstacle Limit
- TS = Tire Speed Limit
- BE = Brake Energy Limit
- MC = Minimum Control Speed Limit
- FP = Flight Path / Level-Off Altitude Limit

8. Climb Limit Weight
The climb limit is a weight that meets the minimum climb gradients required for each takeoff flight path segment as defined in the certification regulations. The climb limit is determined from the applicable "TAKEOFF WEIGHT LIMITED BY CLIMB REQUIREMENTS" chart within the AFM. The climb limit is dependent upon reported surface temperature and airport altitude only.

"THE LIMITING TAKEOFF WEIGHT IS THE LOWER OF THE RUNWAY LIMIT WEIGHT, THE CLIMB LIMIT WEIGHT, OR THE MAXIMUM CERTIFIED STRUCTURAL LIMIT WEIGHT. CORRECTIONS"

Corrections may be available to the zero wind runway limit weight and/or the Climb limit weight. A zero (0) may appear as a correction, which indicates that the adjustment item requires no correction. An ‘NA’ may appear as a correction, which indicates that the adjustment item is NOT AUTHORIZED for operations.

9. Wind Corrections
Corrections to the runway limit weight may be made for Headwind and must be made for Tailwind. Multiply the associated figure (HW+LBS/KT or TW–LBS/KT) or (HW+KGS/KT or TW–KGS/KT) by the number of knots of steady state Headwind or number of knots of steady state plus gusts of Tailwind. The resulting figure should be added/subtracted to/from the zero wind runway limit weight.
10. QNH / Non-Standard Pressure Altitude
Corrections to the runway limit weight may be made for high QNH (pressure) and must be made for low QNH (pressure). Multiply the associated correction factor for high pressure (QNH+LBS/.1 OR QNH+KGS/mb) or for low pressure (QNH-LBS/.1 or QNH-KGS/mb) by the difference in the altimeter setting from the standard (29.92 or 1013). The resulting amount should be added (high pressure) or subtracted (low pressure) from the zero wind runway limit weight to correct for non-standard pressure.

11. Engine Anti-ice ON Corrections
If the Engine Anti-ice is to be selected ON for takeoff, a weight penalty must be applied to both the runway limit and climb limit weights. Subtract the figure shown (ENG AI on-LBS or ENG AI on-KGS) from the zero wind runway limit weight and climb limit weight after considering temperature and wind as described above. The resultant figure is the maximum runway limit weight/climb limit weight with Engine Anti-ice ON.

12. Rolling Takeoff
If the takeoff is to be accomplished utilizing a rolling takeoff, a weight penalty must be applied to the runway limit weight. Subtract the figure shown (ROLL T/O-LBS or ROLL T/O-KGS) from the zero wind runway limit weight after considering temperature and wind as described above. The resultant figure is the maximum runway limit weight with a Rolling Takeoff.

13. Acceleration Altitude (MSL)
The standard level-off height for flap retraction and acceleration to final climb speed is 1000 feet above ground level (AGL). In some cases, it may be necessary to extend the second segment climb to a nonstandard altitude in order to achieve obstacle clearance prior to level-off/acceleration. The required Acceleration Altitude, in feet MSL, is indicated below the specific runway limit weights.

14. Structural Limits Note
The maximum takeoff weight for runway limits and climb limits may exceed the Maximum Structural weight of the aircraft up to the limits provided by AFM charts. This is in order to apply penalty items without impacting maximum allowable takeoff weight in some cases. The note at the bottom of the page is a reminder to indicate that:

“THE LIMITING TAKEOFF WEIGHT IS THE LOWER OF THE RUNWAY LIMIT WEIGHT, THE CLIMB LIMIT WEIGHT, OR THE MAXIMUM CERTIFIED STRUCTURAL LIMIT WEIGHT.”
15. Date
Indicates the date the performance chart was prepared:

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Sample
14.5.2 LANDING PERFORMANCE CHART DESCRIPTION / DEFINITIONS HAWKER BEECHCRAFT 850XP, TFE 731-5BR-1H

1. Chart Heading
The chart heading specifies the performance outlined (takeoff or landing), the airport by Identifier, City/State, and Airport Name, the airport elevation, and the Aircraft type and Engine.

2. Approach Climb Limits
The approach climb limit weights meet the minimum climb gradients required for the approach climb (go-around) phase of landing as defined in the certification regulations. The approach climb limit weights are determined from the applicable Landing Weight Permitted by Climb Requirements Charts within the AFM. The approach climb limit is dependent upon reported surface temperature and airport altitude only. Corrections are displayed for Anti-ice ON.

3. Aircraft/Runway Configuration for Landing
Landing data is provided for the following aircraft/runway configurations:
- Landing Flaps 45 degrees
- Antiskid Operative
  - Landing distance factors of 60%, 80% and Unfactored
  - Dry and Wet runways
- Landing Flaps 25 degrees
  - Unfactored
  - Dry and Wet runways

4. Runway Identifier
The runway identifier is specified as follows:
- Full length runways indicated by basic identifier i.e. 34L
- Temporary runway lengths / closures include “TMP”, i.e. 34LTMP

Declared Distances used:
- Landing Distance Available (LDA)
Associated effective runway slope/gradient.

5. Landing Runway Limit Weight
The runway limit weight for landing distance available is displayed corresponding to given wind component and aircraft/runway configuration.

“The limiting landing weight is the lower of the runway limit weight, the approach climb limit weight, or the maximum certified structural limit weight.”

6. Critical Tailwind / Tailwind Penalty
The critical tailwind is the maximum tailwind component at which maximum structural landing weight may be achieved. At all greater tailwind components (to a maximum of –10 knots) the allowable landing weight must be reduced. If the tailwind component exceeds the critical tailwind, multiply the associated tailwind value by the number of knots of tailwind in excess of the critical tailwind. Subtract the resulting penalty weight from the zero wind landing limit weight.

Example: If the critical tailwind is 6 knots and there is a 10-knot tailwind, a downwind landing would require a weight penalty calculated as follows: You must take the difference of 4 knots (10 knots – 6 knots) and multiply it by the penalty figure given (SUB LB/KT or SUB KG/KT). The resulting weight should then be subtracted from the maximum zero wind weight. The reduction in landing weight will...
then allow you to land with the 10-knot tailwind component.

7. Date
Indicates the date the performance chart was prepared:

--- APF -KAPF ---  LANDING PERFORMANCE  --- APF -KAPF ---
ELEVATION 8  TFE 731-5B-1H ENG  NAPLES, FL  NAPLES MINI

*** APPROACH CLIMB LIMITS - APPROACH FLAPS 15 ***
TEMP(C)  -20  45  49
CLMB WT  23350, 23350, 22608.

CORRECTIONS:  ENG ANTIICE ON SUBTRACT 0 POUNDS ABOVE -20. DEGREES C

*** LANDING FIELD LENGTH LIMITS - LANDING FLAPS 45 ***

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| 5000FT | 0           | 23350 | 22833 | 23350 | 23350 | 23350 | 23350 | 23350 | 23350 |
|        | -0.03       | 10   | 23350 | 23350 | 23350 | 23350 | 23350 | 23350 | 23350 |
|        | 20          | 23350 | 23350 | 23350 | 23350 | 23350 | 23350 | 23350 | 23350 |
| CRT TW | -5          | -5   | -10 | -10 | -10 | -10 | -10 | -10 | -10 |
| SUB LB/KT | -549 | -567 | 0   | 0   | 0   | 0   | 0   | 0   | 0   |

PN 140-590035-0005  02May13

Sample
14.6 TAKEOFF PERFORMANCE CHART DESCRIPTION

- Chart Heading – The chart heading specifies the performance criteria that were used in the Runway Analysis. Items included are Aircraft Type, Engine Type, Airplane Flight Manual Revision Number, Flap Setting, Airport IATA/ICAO identifier, Airport Name, Airport City/State/Territory, Airport Elevation, and Obstacle Criteria.
- Configuration – This section provides a list of variables that affect aircraft performance. A few examples of configuration items are Bleeds On/Off, APR On/Off, Anti-Skid Inoperative, Runway Contaminants, etc. These options are selectable when computing a new analysis.
- Runway Notes – This section provides information about the selected runways, including intersection information, temporary runway details, etc.
- Temperature – The surface temperature upon which the performance data is based. The maximum temperature shown on the chart corresponds to the maximum operational temperature for airport elevation.
- Takeoff Power Setting – The takeoff thrust power setting, whether in torque, EPR, or N1, for airport surface temperature and elevation.
- Runway/Obstacle Weight Limits – The zero wind, standard atmospheric pressure weight limit which takes into account the following limitations: Accel-Go, Accel-Stop, Minimum Control Speeds, All-Engines Operating Go, Brake Energy, Tire Speed, Obstacle Clearance, and Flight Path/ Level-Off Altitude Limitations. Corrections are given for wind and non-standard pressure.
- V1 – V1 will be listed for optimized calculations only. This speed is presented for use at the zero wind, standard pressure limit weight. This speed is optimized for the corresponding takeoff weight limit and may be used for lower weights provided that V1 does not exceed Vr for the actual takeoff weight. The V1 displayed should not be used for non-standard conditions.
- Climb Limit – The climb limit is a weight that meets the minimum climb gradients required for each takeoff flight path segment as defined in the certification regulations. The climb limit is based on reported surface temperature and airport elevation only. The Climb Limit is INDEPENDENT of runway in use or any obstruction/terrain clearance criteria.

Runway Identifiers
- Full-length runways are indicated by the basic identifier, i.e. 34L
- Intersection departures include the intersection identifier, i.e. 34L-A
- Temporary/construction runway lengths are designated by the letters “TMP” or “TP”, i.e. 34LTMP
- Special Departure Procedures include the text “DP”, i.e. 34LDP
- Runways designated with the letters “SHP” are for use when a ship is present on the departure

End

- Non-standard runway identifiers, such as intersections, temporary runways, etc. will be accompanied by a “Runway Note” on the report page. These notes help to further clarify what is being taken into account for that particular runway.
  - Intersections will list the intersection identifier and available runway length
    - i.e. RWY 34L-K INTXN T/O FROM K - 9341 FT
  - Temporary runways will include what temporary considerations are taken
    - i.e. RWY 34LTMP FOR USE WHEN SOUTH 370 FT CLOSED

NOTE: Some runways/airports require a “Special Departure Procedure” in order to optimize takeoff weight in terrain/obstacle sensitive areas. The specific description of the Special Departure Procedure is outlined on a separate page attached to the takeoff airport analysis. These procedures describe the non-standard,
one engine inoperative, departure flight path. The maximum allowable takeoff weights presented in the subsequent analyses are based upon the specific procedure(s) outlined. If there is no “DP” attached to the runway identifier, the takeoff weights are predicated upon a STRAIGHT OUT departure.

14.6.1 DEFINITIONS/ABBREVIATIONS

Obstacle Criteria – Obstacle clearance criteria including horizontal and vertical obstacle clearance requirements. The available options are FAA_CIRC, ICAO, AUS, and HKG.

- FAA_CIRC – Obstacle clearance criteria as outlined in FAA AC 120-91 “Area Analysis Method”
- ICAO - Obstacle clearance criteria as outlined in EASA-OPS 1.495
- AUS - Obstacle clearance criteria as outlined in CASA CAO Section 20.7.1B
- HKG - Obstacle clearance criteria as outlined in CAD Cap 448C Schedule 15.

TORA – Takeoff Run Available – the runway length declared available and suitable for the ground run of an aircraft taking off

TODA – Takeoff Distance Available - the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA

ASDA – Accelerate Stop Distance Available – the runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting a takeoff

LDA – Landing Distance Available – the runway length declared available and suitable for landing an aircraft

LVL OFF – The level-off altitude/acceleration altitude in Height above Mean Sea Level (AMSL) to be used with the Runway Analysis. This altitude must be used in accordance with the flight path profile in the aircraft’s AFM. Leveling off above or below the APG provided level-off altitude may result in obstacle clearance violations or exceed engine takeoff thrust time limits. Customers may have APG set a minimum level-off height of at least 400 ft. Depending on aircraft type, this height may be increased to allow for an extended second segment climb for obstacle clearance requirements.

Procedure for Determining Maximum Allowable Weight – Takeoff

1. Locate the row that corresponds with the desired temperature
2. Read the Power Setting to be used at this temperature
3. Determine the Uncorrected Runway/Obstacle Weight Limit for the desired runway
4. Make the appropriate corrections for wind, QNH, and/or Bleeds and other options. This is the Corrected Runway/Obstacle Weight Limit
5. Determine the Uncorrected Level-Off Height
6. Make the appropriate corrections for wind, QNH, and/or Bleeds and other options. This is the Corrected Level Off Height
7. Determine the Uncorrected Climb Weight Limit for the given temperature
8. Make the appropriate corrections for QNH and/or Anti-Ice. This is the Corrected Climb Weight Limit
The Maximum Takeoff Weight is the lowest of the Corrected Runway/Obstacle Weight Limit, the Corrected Climb Weight Limit, and the Structural Takeoff Weight Limit.

Procedure for Determining Maximum Allowable Weight – Takeoff (Continued)

**EXAMPLE:**
Runway 33DP
Temperature = 5 degrees
Wind = 4 kt headwind
QNH = 29.75 in Hg
Power Setting = 92.7
Uncorrected Runway/Obstacle Weight Limit = 43,792 lbs
Wind Correction = 76 lbs * 4 kts = 304 lbs
QNH Correction = 29.92 - 29.75 = 0.17 * -212 lbs per 0.1 = 1.7 * -212 lbs = -360.4 lbs
Corrected Runway/Obstacle Weight Limit = 43,792 + 304 -360.4 = 43,745 lbs
Corrected Level Off Height = 9,338 ft MSL
No correction required for Wind or QNH in this scenario
Corrected Level Off Height = 9,338 ft MSL
Uncorrected Climb Limit = 48,200 lbs
QNH Correction = 29.92 - 29.75 = 0.17 * -177 lbs per 0.1 = 1.7 * -177 lbs = -300.9 lbs
Corrected Climb Weight Limit = 48,200 lbs - 300.9 lbs = 47,899 lbs
Structural Takeoff Weight Limit = 48,200 lbs
Maximum Takeoff Weight is the lowest of the Runway/Obstacle, Climb, and Structural Limit Weights. Therefore, the Maximum Takeoff Weight for this example is 43,745 lbs

### 14.7 Landing Performance Chart Description

- **Chart Heading** – The chart heading specifies the performance criteria that were used in the Runway Analysis. Items included are Aircraft Type, Engine Type, Airplane Flight Manual Revision Number, Flap Setting, Airport IATA/ICAO identifier, Airport Name, Airport City/State/Territory, and Airport Elevation.
- **Configuration** – This section provides a list of variables that affect aircraft performance. A few examples of configuration items are Bleeds On/Off, APR On/Off, Anti-Skid Inoperative, Runway Contaminants, etc. These options are selectable when computing a new analysis.
- **Runway Notes** – This section provides information about the selected runways, including intersection information, temporary runway details, etc.
- **Approach Climb Limits** – The approach climb weight limit meets the minimum climb gradients required for the approach climb (go-around) phase of landing as defined in the certification regulations. The approach climb weight limit is based on reported surface temperature and airport altitude only. The approach climb weight limit is independent of runway in use, missed approach procedure to be used, and any obstacle/terrain clearance criteria.
- **Field Length Weight Limits/Distances** – The zero wind runway weight limit corresponding to the runway’s landing distance available (LDA). Landing weight limits and distances required are shown for:
  - Dry runway and WET runway (note: The WET runway performance data is based upon a factor of 115% as outlined within applicable regulations) Regulatory Destination
    - **Airport factors of:**
      - 60% (1.67)
80% (1.43)
100% - UNFACTORED
- Wind components of -10 Tailwind, 0 wind, 10 and 40 knots of Headwind.
- Destination airport temperature.

Runway Identifiers
- Full-length runways are indicated by the basic identifier, i.e. 34L
- Temporary/construction runway lengths are designated by the letters “TMP” or “TP”, i.e. 34LTMP
- Non-standard runway identifiers, such as temporary runways, etc. will be accompanied by a "Runway Note" on the report page. These notes help to further clarify what is being taken into account for that particular runway.
- Temporary runways will include what temporary considerations are taken
  - i.e. RWY 34LTMP FOR USE WHEN SOUTH 370 FT CLOSED

Procedure for Determining Maximum Allowable Weight – Landing

1. Locate the limit weight for the required Approach Climb Gradient and temperature. This becomes your Approach Climb Weight Limit.

2. Locate the section under Field Length Weight Limits/Distances that corresponds with the desired runway. LDA, Slope, and Runway Condition are provided for your information.
3. Locate the set of rows that correspond with the actual headwind, reported by ATIS or METAR
4. Locate the row that corresponds with the desired temperature
5. Locate the column that corresponds with the desired landing factor
6. Read the Field Length Weight Limit from the appropriate column/row
7. Read the corresponding Landing Distance Required for that limit weight
- This distance already takes into account the landing factor required, NOT the actual landing distance.

The Maximum Landing Weight is the lowest of the Approach Climb Weight Limit, the Field Length Weight Limit, and the Structural Landing Weight Limit.

EXAMPLE:
Runway 10
Temperature = 32 degrees
Wind = 10 kt headwind
Required Approach Climb Gradient = 2.1%
Operational Landing Factor Required = 60%
Approach Climb Weight Limit = 38,000 lbs
Field Length Weight Limit = 34,107 lbs
Landing Distance Required = 4,800 ft
Structural Landing Weight Limit = 38,000 lbs

Maximum Landing Weight is the lowest of the Approach, Field Length, and Structural Landing Weight Limit. Therefore, the Maximum Landing Weight for this example is 34,107 lbs.

NOTE: Landing pages only display a limited number of temperatures due to the amount of data presented. If a different landing temperature is desired, use the “Use Temp” feature just prior to clicking “Compute” when running a new analysis. Be sure to specify the desired temperature and ensure the “Use Temp” box is checked before clicking compute. Alternatively, temperature step size can be adjusted for each aircraft by request. Please contact APG for further information.