Performance Engineering

Chapter 14

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Chapter 14 Performance Engineering

14.1 Scope

Performance engineering department is primarily responsible for all technical matters of Nesma Airlines' fleet or for Aircraft performance. A performance engineer shall carry out calculations to provide technical support to the Flight Operations department, perform route study and ensure compliance with regulatory requirements.

Performance engineering office shall also be involved in evaluating new aircraft systems and modifications and define their operational impact in order to have adequate information and to ensure safe operations.

They also customize the Electronic Checklist and the Standard Operating Procedures (SOP) in coordination with the technical pilots and ensuring it is in accordance with manufacturer recommendations and Nesma Airlines requirements.

14.2 Acronyms

AEO	All Engine Operations
OEI	One Engine Inoperative
OCTOPUS	Operational and Certified Take-off and Landing Performance Universal Software
PEP	Performance Engineer's Program
PPM	Performance Program Manual
VMBE	Maximum Brake Energy Speed
MCDL	Master Configuration Deviation List

14.3 Performance Engineering Terminology

Fly Smart with Airbus: Airbus application for a class of Type A EFB applications. Refer to 8.12 Electronic Flight Bag (EFB) for more information.

OCTOPUS: Operational and Certified Take-off and landing Performance Universal Software. This program enables to compute performance under regulatory constraints for a given aircraft and to optimize takeoff and landing performance for given runways. It is sometimes referred to as the low speed database.

PEP: Performance Engineering Program. The official performance application of Airbus, it contains the performance database of Nesma Airlines' fleet as stated in the AFM PERF-OCTO. PEP implements OCTOPUS inside its modules.

PPM: Performance Program Manuals. The official set of documents provided by Airbus that contain instructions on how to use the PEP, its modules and operational procedures.

PAAdmin: Performance Application Administrator. This tool manages the packaging of the performance database into Fly Smart with Airbus readable format.

Airport Manager: a sub-module part of PEP that enable the reading or modifying of the airport database.

14.4 Performance Database Control

Aircraft performance database is provided exclusively from the manufacturer. It is documented in the AFM PERF-OCTO from the manufacturer side and it clarifies the appropriate scope of operations that the performance database fits in.
For Nesma Airlines Airbus fleet, the performance database is provided through Airbus electronic service and the “Airbus World” portal. The control procedures for the management and update of the performance database is as follows:

1. Airbus notifies Nesma Airlines’ administrator of the new update of the performance database. The update includes the list of modifications and bugs resolved.
2. Nesma Airlines’ administrator notifies the performance engineer and OCC manager of the new update (NB: concerned personnel receive notification email from Airbus of the new update).
3. The new update is installed.
4. Fly Smart database is updated according to 8.12.6 EFB Processes

Once a new database is provided, all performance calculations should be based on the latest update.
The performance database contains data about the fleet of Nesma Airlines. Prior to computation, an aircraft of interest shall be selected from the aircraft selection zone inside each module of the performance application.

14.5 Airport Manager

This tool has been designed as part of PEP or WINDOWS independent tool devoted to airport and runway data creation and storage.
All data provided through the AIRPORT MANAGER are usable in the TLO (Takeoff and Landing Optimization) and OFP (Operational Flight Path) PEP for WINDOWS components.
Airport Manager has a graphical user interface that allows the sorting, classification, storage and creation of airport data.
The Airport Manager application allows the importing of airport data files in different formats that include ASCII, XML, SITA, ICAO and IATA formats. Normal airport data are extracted either from Airport Information Publication (AIP) or through suppliers of airport data.
The normal airport data include TODA, TORA, ASDA, slope, magnetic heading and variation, runway slope, list of obstacles affecting the runway and their respective distances.
It also allows the modification of the airport/runway data and the addition of comments that shall appear in the generated documents (i.e. RTOW charts).
Functions of the Airport Manager include:

- Importing/Exporting airport data
- Modification of current data
- Creation of datasets and grouping of airports
- Filter views and sort airports

Reference Document: PPM-The Airport Manager

14.6 Flight Manual (FM)

This represents the aircraft performance database. The aircraft performance database provides the performance data applicable to an aircraft model.
This program enables to compute performance under regulatory constraints for a given aircraft and to optimize takeoff and landing performance for given runways. OCTOPUS is used for computations related to Airbus Fly by Wire aircraft and is an aircraft specific tool.
This database comes with the in-flight failure data file for landing and MCDL performance penalties.
The FM module is based on the OCTOPUS software. Version control of the OCTOPUS database is found in the AFM-PERF-OCTO.

14.6.1 Introduction

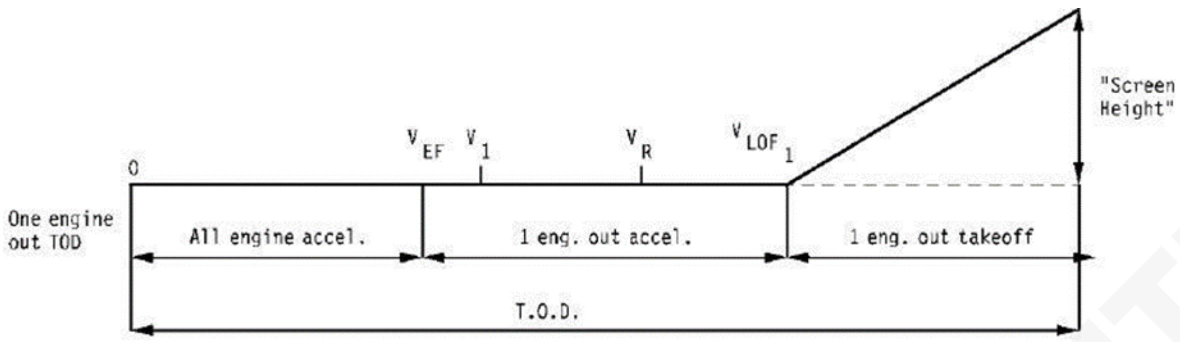
FM Module is used to obtain regulatory and operational aircraft performance. These data used to be presented in the Aircraft Flight Manual (AFM). The OCTOPUS FM module enables you to compute various regulatory data such as TOD, TOR, speeds (V1, V2), takeoff gradients, airspeed calibration, etc.

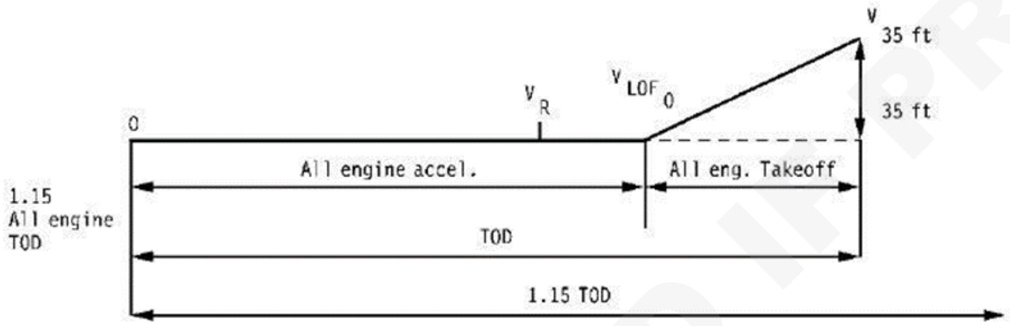
14.6.2 FM Modules

14.6.2.1 TOD Calculation

This module gives the takeoff distance at specific atmospheric conditions and engine status. The administrator can also select a range for speed ratios (V1/VR) and (V2/VS).
The takeoff distance (TOD) is the distance between brake release and the point where the regulatory 35ft height, (15ft height in case of wet or contaminated runway) is reached.
The regulations dictate that TOD should be the maximum of calculated TOD in case one engine inoperative and the distance when all engines are operative multiplied by 1.15.

$$TOD = max\{TOD_{OEI}\ , 1.15\ TOD_{AEO}\}$$





Input Data:

- Bleed status (Anti-ice, Air conditioning)
- Takeoff configuration
- Center of gravity (if applicable)
- Engine option (Always TOGA for certified limitation)
- Runway conditions (runway state, slope, width)
- Applicable CDL items
- Takeoff weight
- Atmospheric conditions (OAT, wind)
- Speed ratios (V1/VR) and (V2/VS)
- Pressure altitude

Outputs:

- TOD (OEI, 1.15 AEO)
- Speeds (V1, VR, V2, VLF) CAS and IAS
- EPR

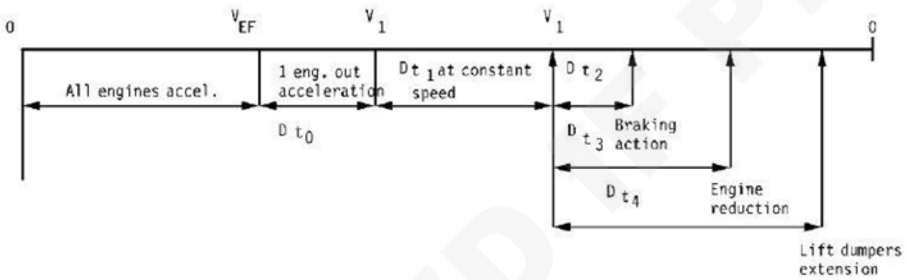
14.6.2.2 TOR Calculation

This module gives the takeoff run at specific atmospheric conditions and engine status. The administrator can also select a range for speed ratios (V1/VR) and (V2/VS).
The TOR is the distance between brake release and middle of takeoff segment (on dry runways).
Inputs & outputs: The same as TOD calculation except TOR distance as output instead of TOD.

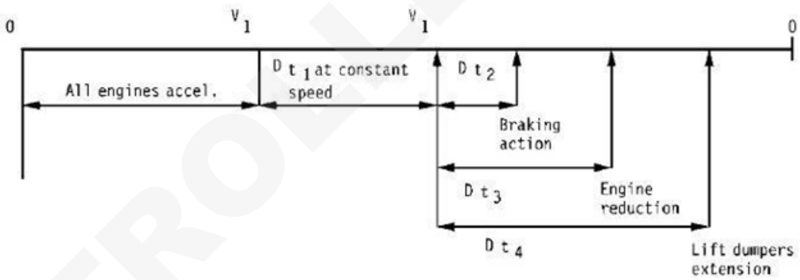
14.6.2.3 ASD Calculation

This module gives the accelerate stop distance at specific atmospheric conditions and engine status. The administrator can also select a range for speed ratios (V1/VR) and (V2/VS).
It is calculated in cases of two engines operative and one engine inoperative. Since these two cases are governed by special time sequences, the most limiting distance is considered. The user can also calculate the ASD with V1 limited by VMBE.

One engine out ASD



All engines ASD



Input Data:

- Same as TOD & TOR
- Credit for reversers (All reversers operative, all reversers inoperative, one inside reverser inoperative, one outside reverser inoperative)
- Anti-skid status (on, off, partially off)
- Brakes (operative, one brake inoperative, two brakes inoperative)
- Tachometer status (operative, 1 tachometer inoperative)
- Spoilers (operative, inoperative, one pair inoperative, two pairs inoperative)
- Ground idle (No, Yes)

Output Data:

- Same as TOD calculation except ASD instead of TOD
- Brake Energy for AEO and OEI

14.6.2.4 First Segment Gradient

The takeoff first segment is the segment between liftoff and the point at which V2 is achieved. During the first segment, operating engines are at takeoff thrust, the flaps/slats are in takeoff configuration and landing gear retraction is initiated once safely airborne with positive climb. The first segment ends when the landing gear is fully retracted.
The minimum landing gradient for Airbus twin-engine aircraft is 0.0 % and 0.5 % for the quad-engine aircraft.

Input Data:

- Same as TOD & TOR
- Engine anti-ice valve blocked open (Yes, No)
- CDL items
- Type of gradient computation (gradient calculation, weight calculation)

Output Data:

- Weight (it is either user defined or computed depending on the type of gradient computation selected in the input)
- 1^{st} segment (it is also user defined or computed)
- VLOF (lift off speed)
- V2/VS (ratio between V2 and VS)

14.6.2.5 Second Segment Gradient:

It begins when the landing gear is fully retracted. Engines are at takeoff thrust and the flaps/slats are in the takeoff configuration. This segment ends at the higher of 400' or specified acceleration altitude. In most cases, the second segment is the performance-limiting segment of the climb.
Its input data are the same like the data used in the first gradient computation with some specific inputs that are needed in the second gradient computation.
The minimum regulatory gradient for twin engine aircraft is 2.4 % and 3.0 % for quad engine aircraft.

Input Data:

- Same as First Segment Gradient
- Landing gear status (extended, retracted)
- Dispatch in derated mode
- Type of gradient computation
- Calculation Option (Normal, Regulatory Values)

Output Data:

- Weight (as in first gradient output)
- 2^{nd} segment gradient (as in first gradient output)
- Weight for minimum regulatory gradient (only of Regulatory Values is selected in the calculation options)
- Regulatory second segment (only of Regulatory Values is selected in the calculation options)
- Regulatory indicated/calibrated speeds: speeds corresponding to minimum regulatory minimum gradient (only of Regulatory Values is selected in the calculation options)

14.6.2.6 Complete Takeoff

This function groups all previous functions: calculation of TOR, TOD, ASD, first segment gradient and second segment gradient.
It combines all the inputs and outputs of all the previous functions. List of inputs and outputs are stated in the following tables.

Input Table:

Parameter	Options
Aircraft/runway tab	
Air conditioning	ON/OFF
Anti-ice	OFF/Engine Only/Engine + Wing
Takeoff configuration	CONF 1+F/CONF 2/CONF 3
CG Position	Basic/Extended Forward
Engine Option	TOGA
Runway Condition	Dry/Wet/Slush/Water/Compact Snow/Ice
Runway Slope/Width	
Special Cases	
Reversers credit	All reversers inoperative All reversers operating One reverser inoperative
Anti-Skid	On Totally Off Partially Off
Braking Failed	0 Brake inoperative 1 Brake inoperative
Auto brake	OFF
Flight with landing gear extended	Yes No
Spoilers	All spoilers operating All spoilers inoperative 1 pair inoperative 2 pairs inoperative
Ground idle failed	Yes No
Eng A-ice valve blocked open	No

	Yes
Tachometer Failure	No Yes
Dispatch in rated N1 mode	No Yes
CDL Items	
ATA21-01 Ram air inlet flap	
ATA21-01 Ram air inlet flap (MOD 26363)	
ATA21-02 Ram air outlet flap	
Calculation Data 1	
V1 speeds	V1/VR ratio/CAS/IAS
V2 speeds	V2/Vs ratio/CAS/IAS
Weight	Used only if not selected as a calculation type
Wind	Headwind or Tailwind
Cross wind	
Pressure altitude	
Temperature	

Output Data:

Label	Description
TOD OEI	TOD One Engine Inoperative
1.15 TOD AEO	1.15 TOD All Engine Operative
TOR OEI	TOR One Engine Inoperative
1.15 TOR AEO	1.15 TOR All Engine Operative
ASD OEI	ASD One Engine Inoperative
ASD AEO	ASD All Engine Operative
BRK ENER AEO	Braking energy ratio all engine operative
BRK ENER OEI	Braking energy ratio one engine out
V1 CAS and V1 IAS	V1 in CAS and in IAS
VR CAS and VR IAS	VR in CAS and in IAS
VLOF0 CAS and VLOF0 IAS	Lift-off speed all engine operative in CAS and in IAS
VLOF1 CAS and VLOF1 IAS	Lift-off speed one engine out in CAS and in IAS
V2 CAS and V2 IAS	
1ST SEG GRAD	First segment gradient
2ND SEG GRAD	Second segment gradient

14.6.2.7 Final Takeoff Gradient

This parameter is calculated in en-route configuration (landing gear retracted, slats and flaps configuration clean), maximum continuous engine rating, and one engine out. The minimum gradient for twin-engine aircraft is 1.2% and 1.7% for quad-engine aircraft.

Input Data:

- Same as Complete Takeoff
- Green dot speed is added as an option in the speed tab
- Calculation option (weight based or gradient based)

Output Data:

- Weight corresponding to user input or calculated based on the required gradient
- FTG: Final Takeoff Gradient, it is either calculated or inputted by user
- W REGUL FTG: Weight for minimum regulatory final takeoff gradient if calculation option “Regulatory values given” is chosen
- REGUL FTG: Minimum regulatory final takeoff gradient if calculation option “Regulatory values given” is chosen
- REG SP (CAS/IAS): Speed (IAS) corresponding to the user defined weight with regular minimum final takeoff gradient

14.6.2.8 Approach Climb Gradient

Gradient in approach configuration, landing gear retracted one engine is wind milling (inoperative), engine at go-around thrust. Normally, the approach flaps configuration is 1 degree below the landing configuration. Minimum gradient is 2.1 % for twin-engine aircraft and 2.7% for quad engine aircraft.

Input Data:

Parameter	Options
Aircraft/runway tab	
Air conditioning	ON/OFF
Anti-ice	OFF/Engine Only/Engine + Wing
Configuration	CONF 1+F/CONF 2/CONF 3
CG Position	Basic/Extended Forward
Engine Option	TOGA
Runway Condition	Dry/Wet/Slush/Water/Compact Snow/Ice
Ice Accretion	Yes/No
Runway Slope/Width	
Special Cases	
Flight with landing gear extended	• Yes • No
Eng A-ice valve blocked open	• No • Yes
Dispatch in rated N1 mode	• No • Yes
CDL Items	
ATA21-01 Ram air inlet flap	
ATA21-01 Ram air inlet flap (MOD 26363)	
ATA21-02 Ram air outlet flap	

Calculation Data 1	
Gradient type	Weight or gradient based
Gradient option	Normal/Regulatory
Approach Type	Normal/CAT II

Output Data:

Label	Description
Weight	Input or calculated based on gradient
ACG	Approach climb gradient defined by user
W REGUL ACG	weight for minimum regulatory approach climb gradient
REGUL ACG	minimum regulatory approach climb gradient
SPEED (CAS/IAS)	User defined speed
REGUL SP (CAS/IAS)	Speed corresponding to the computed weight and regular approach climb gradient

14.6.2.9 Landing Climb Gradient

Gradient in landing configuration, landing gear extended, all engines operating and with go around thrust available 8 seconds after Go-Around. The minimum landing climb gradient is 3.2%.
The objective of this constraint is to ensure aircraft climb capability in case of a missed approach with all engines operating. For Airbus Fly by Wire aircraft, the available landing configurations are CONF 3 and FULL.
For all Airbus aircraft, this constraint is covered by the approach climb requirement. In its operational documentation (FCOM), Airbus publishes the maximum weight limited by the approach climb gradient only. Landing climb performance should be calculated from the landing climb gradient module inside the FM.
Input and output data of the landing climb gradient are the same as the approach climb gradient except that landing gradient is defined instead of the approach gradient.

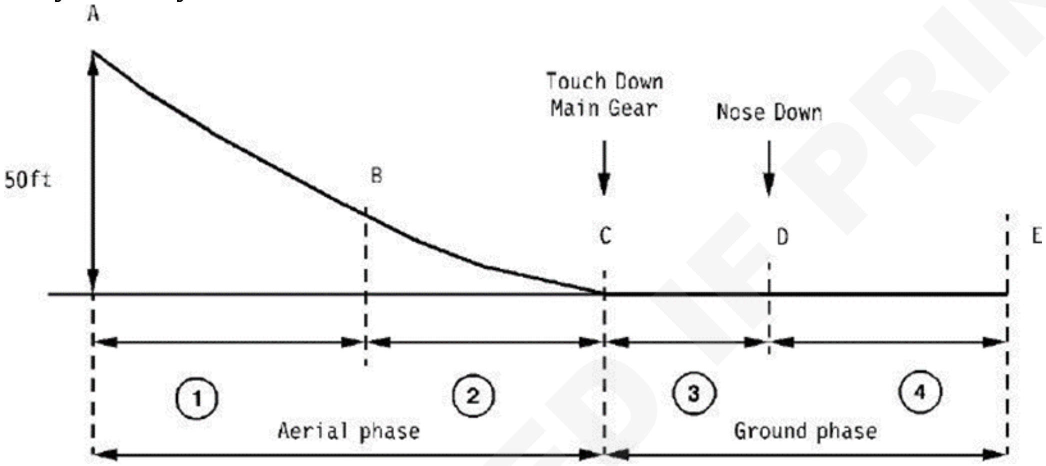
14.6.2.10 Required Landing Distance (RLD)

The RLD is based on certified landing performance also known as Actual Landing Distance (ALD), is introduced to assist operators in defining the minimum distance required at destination, and allow flight dispatch.

Before departure, operators must check that the Landing Distance Available (LDA) at destination is at least equal to the Required Landing Distance (RLD) for the forecasted landing weight and conditions.

The landing distance consists of two phases: air phase and ground phase. The calculation basis for these two phases depends on the runway state:

- **Dry Runway:**



The aircraft's landing weight must permit landing within 60% of the Landing Distance Available at both the destination and any alternate airport.

This would give for a dry runway:

$$RLD_{Dry} = ALD/0.6 \leq LDA$$

- **Contaminated Runway:**
  If the surface is contaminated, the required landing distance must be at least the greater of the required landing distance on a wet runway and 115% of the landing distance determined in accordance with approved contaminated landing distance data.

Input Data:

Parameter	Options
Aircraft/runway tab	
Runway Condition	Dry/Wet/Slush/Snow/Ice
Configuration	CONF FULL/CONF 3
CG Position	Basic/Extended Forward
Special Cases	
Reversers credit	• All reversers inoperative • All reversers operating • One reverser inoperative
Anti-Skid	• On • Totally Off Partially Off
Braking Failed	• Brake inoperative • Brake inoperative
Spoilers	• All spoilers operating • All spoilers inoperative • pair inoperative • 2 pairs inoperative
Ground idle failed	• Yes • No
Tachometer Failure	• No • Yes
CDL Items	
ATA21-01 Ram air inlet flap	
ATA21-01 Ram air inlet flap (MOD 26363)	
ATA21-02 Ram air outlet flap	
Calculation Data 1	
K(V/VS)	
D V (CAS)	

Output Data:

Label	Description
LD	Landing Distance
REGUL COEF	Value of regulatory coefficient
REQUIRED LD	Required landing distance
VFA CAS/IAS	V Final Approach in CAS/IAS
BRK ENER AEO	Braking energy ratio, all engine operative

14.6.2.11 Operational Landing Distance

The Operational Landing Distance calculation mode enables to compute the advisory landing distances to be used by the flight crew for in-flight landing distance assessment.

Input Data:

Parameter	Options
Aircraft/runway tab	
Runway state	Dry/Wet/Slush/Snow/Ice
Reported Braking Action	6-Dry/5-Good/4-Good To Medium/3-Medium/2-Medium To Poor/1-Poor
Runway Slope	User input
Configuration	CONF FULL/CONF 3
CG Position	Basic/Extended Forward
Landing Technique	Manual A/Throttle On Manual A/Throttle Off Autoland (ILS Glide)
Special Cases	
Reversers credit	• All reversers inoperative • All reversers operating • One reverser inoperative
Anti-Skid	• On • Totally Off Partially Off
Braking Failed	• Brake inoperative • Brake inoperative
Spoilers	• All spoilers operating • All spoilers inoperative • pair inoperative • 2 pairs inoperative
Ground idle failed	• Yes No
Tachometer Failure	• No • Yes

CDL Items	
ATA21-01 Ram air inlet flap	
ATA21-01 Ram air inlet flap (MOD 26363)	
ATA21-02 Ram air outlet flap	
Calculation Data 1	
Speed type	FMS Speeds
Additional D V (CAS)	User input
Braking Mode	Low/Med/Max Pedal
Weight	User input
Over Weight Landing	
Temperature	User input
Ice Accretion	
Wind	User input
Pressure Altitude	User input
Landing Distance Factor	User input (1.15 default)
Aerial Phase Type	Fixed/Calculated
MOD25225	If applicable on A320 aircraft

Output Data:

Label	Description
AIRBORNE DIST	Airborne distance
GROUND DIST	Ground distance
OLD	Operational landing distance = airborne distance + ground distance
FACTORED OLD	OLD multiplied by the LD Factor
VAPP CAS/IAS	VAPP in CAS/IAS
BRK ENER AEO	Braking energy ratio, all engine operative
VLS CAS	Lowest Selectable speed
VREF CAS	Reference Speed (VLS in CONF FULL)
DELTA VREF	Speed increment due to a failure
APPR COR	Speed increment due to the wind, auto-thrust and ice accretion
DV WIND	Speed increment due to the wind
DV A/THR	Speed increment due to the auto-thrust use
DV ICE ACCR	Speed increment due to ice accretion
DV CDL	Speed increment due to a CDL item
DV ADDITIONAL	Additional speed increment
LD REF	Appearing only in the case of in-flight failure, it corresponds to the OLD without the failure in CONF FULL
FAILURE COEF	OLD divided by LDREF
ROW LDG DIST	“Runway Overrun Warning” Landing Distance

If the in-flight failure is selected, atop of this these additional parameters linked to the in-flight failure are provided:

- Flap lever position for landing
- Number of spoilers inoperative
- Numbers of ailerons inoperative
- Body gears brakes status
- Wing gears brakes status
- Number of thrust reversers inoperative
- Flap/Slat status

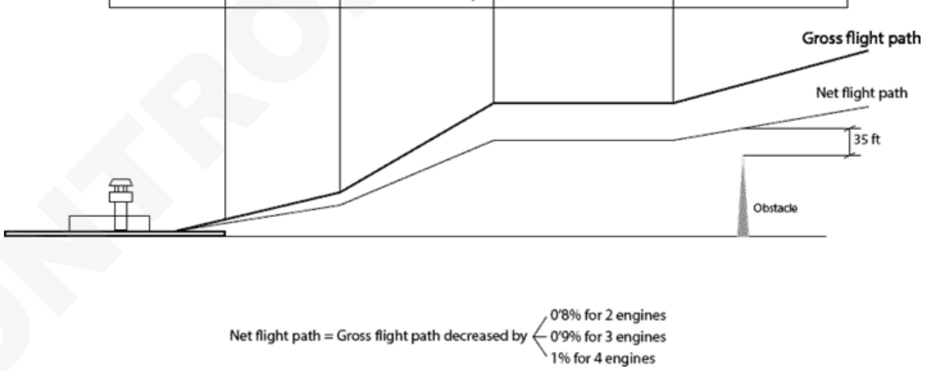
14.6.2.12 Takeoff Flight Path (TOFP)

It starts with brake release and takes place at maximum takeoff engine rating. It includes four phases:

1. First phase: TOD calculation until screen height. This phase is calculated at maximum takeoff thrust.
2. Second phase: or the takeoff first segment. It starts at screen height and it is the landing gear retraction phase. It is calculated at constant weight (TO weight) and constant speed (V2).
3. Third phase: or the takeoff second segment. It starts immediately after gear retraction and it is conditioned by maximum time of maximum takeoff rating use.
4. Fourth phase: an acceleration to level-off phase. In this phase, flaps and slats are retracted. The final speed depends on the weight and altitude and is established through the FM module. This third segment gradient should remain above 1.2 % for twin-engine aircraft and 1.7 % for four-engine aircraft.

The takeoff flight path is calculated taking into account possible deviations from the ideal due to circumstances such as weather, wind, and below average engine performance.
The below figure and table shows typical aircraft performance for the takeoff path.

	Segment 1	Segment 2	Segment 3	Segment 4
START	35 ft	L/G RETRACTED	ACC. ALTITUDE ≥400 ft over runway	CLEAN
THRUST	TOGA	TOGA	TOGA	M.C.T.
SPEED	V2	V2	ACCELERATION	VCLEAN
LANDING GEAR	DOWN	UP	UP	UP
FLAPS	T.O.	T.O.	RETRACTING	RETRACTED
GRADIENT	2 engines > 0.0%	2 engines > 2.4%		2 engines > 1.2%
	3 engines > 0.3%	3 engines > 2.7%		3 engines > 1.5%
	4 engines > 0.5%	4 engines > 3.0%		4 engines > 1.7%
END	L/G Retracted	ACC ALTITUDE ≥400 ft over runway	Clean	≥1500 ft over runway



Input Data:

Parameter	Options
Aircraft/runway tab	
Runway state	Dry/Wet/Slush/Snow/Ice
Air conditioning	On/Off
Anti-ice	On/Off
Runway Slope	User input
Runway Width	User input
Configuration	CONF 1+F/CONF 2/CONF 3
Engine Option	TOGA
CG Position	Basic/Extended Forward
Special Cases	
Flight with Landing gear extended	Yes/No
Engine Anti-ice valve blocked open	Yes/No
Hydraulic pump failure	Yes/No
Dispatch in N1 rated mode	Yes/No
CDL Items	
ATA21-01 Ram air inlet flap	
ATA21-01 Ram air inlet flap (MOD 26363)	
ATA21-02 Ram air outlet flap	
Calculation Data 1	
V1 type	V1/VR ratio/IAS/CAS
V2 type	V2/VS ratio/IAS/CAS/V2min
TOFP option	Weight at brake release/Second segment gradient

Weight	User input
Temperature	User input
Wind	User input
Cross wind	User input
Pressure Altitude	User input
FTO Check[2]	Yes/No
Extended Second Segment	Yes/No
Turn[3]	Yes/No

Output Data:

Label	Description
WEIGHT AT BRAKE RELEASE	
SECOND SEGMENT GRADIENT	
V2 / VS VALUE	
N1 or EPR or THR	Power management parameter value
FINAL TAKE-OFF	Final takeoff gradient
OPT. FTO V/VS	Optimum V/Vs ratio for FTO calculation
X	Longitudinal net path coordinates from brake release up to regulatory time
Y	Lateral net path coordinates from brake release up to regulatory time
TIME	Time for net path coordinates from brake release up to regulatory time
HEIGHT	Net path height from end of TOD up to regulatory time
BANK ANGLE	

[2] where the "FTO check" option is set to YES, the level-off height can be decreased in order to respect the regulatory final takeoff gradient when needed (in this case, the flight path is ended before the maximum takeoff thrust time). This reduction can be performed up to the regulatory height of 1500 ft.

[3] If turn is selected, new inputs are required like the radius of turn and bank angle. These values shall be determined by the user.

14.6.2.13 Stalling Speed

This module calculates the stalling speed given certain conditions.

Input Data:

Parameter	Options
VS Data	
Context	Takeoff/Landing/Flight
Gears	Up/Down
Configuration	CONF 0/CONF 1/CONF 1+F/CONF 2/CONF 3/CONF FULL
CG Position	Basic/Extended Forward
CDL Items	
ATA21-01 Ram air inlet flap	
ATA21-01 Ram air inlet flap (MOD 26363)	
ATA21-02 Ram air outlet flap	

Output Data:

Label	Description
VS CAS	Calibrated Stall speed

14.7 Takeoff and Landing Optimizations (TLO)

For performance purposes, all Nesma Airlines aircraft are Class A (multi-engines turbojet powered aircraft with a maximum passenger configuration of more than 9 and a maximum take-off weight exceeding 5700 kg).

Nesma Airlines should ensure data or products (Such data or products typically include GPWS terrain and obstacle databases, airport analysis data, weight/mass and balance data and performance data) purchased or otherwise acquired from an external vendor or supplier meet the product technical requirements specified by Nesma Airlines prior to being used in the conduct of operations. Otherwise letter of conformity/acceptance from the original equipment manufacturer and/or the applicable state is being satisfactory, in order to ensure currency, accuracy, and completion of such data.

Performance limitations are defined as per Aircraft Flight Manual (AFM) and as illustrated in 14.6 Flight Manual (FM). Nesma Airlines bears the responsibility of completely respecting the certified limits of its aircraft and abiding by the respective regulations regarding safe takeoff and landing. In normal operations, tailored airport calculations shall be used. In emergencies where tailored data are not available, limitations established in the AFM LIM and performance data established in FCOM PERF may be used.

14.7.1 Takeoff Optimization

This module provides the regulatory takeoff weight for a specific airport. This step is a mandatory step in cockpit preparation. Pilots should have quick access to maximum allowable takeoff weight and associated speeds.

The paper that contains this information is called the Regulatory Takeoff Weight charts (RTOW chart). The charts must be generated for each runway heading, and can be produced for different takeoff conditions at the convenience of the applicant (temperature, wind, QNH, flap setting, runway status, and inoperative items).

All RTOW calculations are regulatory calculations, i.e. they are based upon the assumption of critical engine failure and net flight path as defined in the regulations.

The RTOW chart provides the following information:

- Maximum takeoff weight
- Flexible Temperature (if applicable)
- Takeoff speeds (V1, V2, VR)
- Associated Limitation
- Minimum and maximum acceleration height

Instructions on how to use the temperature-based RTOW charts are provided in the FCOM PER-TOF-TOC-10.

The takeoff chart calculations need the airport data that shall be provided from the airport manager. In all cases, the takeoff performance shall be defined per specific runway and airport given the atmospheric conditions, pressure altitude, wind corrections, runway state (dry, wet, snow, etc.) and/or other limitations defined by the manufacturer.

Performance calculations shall take into account the runway limitations and respective aircraft performance. Takeoff shall be proven safe and complying with regulations and standard procedures before actual dispatch.

Takeoff weight optimization takes into account the effect of TODA, TORA, ASDA, runway slope, runway conditions (dry, wet, slush, etc) and surrounding obstacles.

In many cases, Nesma Airlines takeoffs use engine reduced thrust when the actual takeoff weight is lower than the maximum takeoff weight and in accordance with engines' certified limits established in the AFM.

Engine reduced thrust can be carried out through Flexible Temperature or Engine Derate. Flexible temperature is a temperature that reduces engine maximum takeoff thrust to increase engine life and reliability. Flexible takeoff is permitted on dry and wet runways while it is not allowed on contaminated runways.

Input Data:

Parameter	Options
Calculation Options	
V1/VR	Full range/custom range
V2/Vs1g	Full range/custom range
Calculation Mode	Polynomial method/First principle
Output	Standard/Detailed
Alignment Allowance	User input (loss of runway length due to aircraft alignment prior to takeoff)
All Engine Climb Gradient	On/Off
Dry Check	On/Off (used to ensure the highest of wet/dry calculation is taken into account)
Performance Modifications	User input
Minimum level-off height	User input
Extended second segment	On/Off
Turn	On/Off (on opens new dialog for turn angle)
Check Minimum Gradient	On/Off
Runway	
Selection of runway from airport manager	
Chart Data	
Line Parameter	Temperature/Weight
Column Parameter	Takeoff configuration/Wind speed[4]
Influence parameters	Runway state/Pressure Altitude/Air conditioning
Common Parameters	Takeoff thrust/Anti-ice/Air conditioning

Output Data:

Label	Description
Takeoff Weight	
Takeoff Speeds	V1/VR/V2
Flex Temperature	If applicable
Limitation code	Codes for the most limiting parameters (TORA, Obstacles, 2nd segment gradient, etc)
V2/VS	V2 to stall speed ratio

For Nesma Airlines' operations, all the takeoff related calculations are carried out through the EFB takeoff performance module as controlled and documented in 8.12 Electronic Flight Bag (EFB).

14.7.2 All Engine Climb Gradient (AECG)

In normal operations, the aircraft takes off with all engine operating. In that case, it should be able to adhere to the required climb characteristics (i.e. SID gradient) required by the authorities. The all engine climb performance shows the gradients the aircraft is able to achieve when all its engines are operating at specific temperature, pressure altitude and takeoff weights. All engine climb performance measures the ability of the aircraft to clear distant obstacles in normal flight conditions.

[4] As per Nesma Airlines policy, the column parameter shall be the takeoff configuration and wind speed. Although, many other parameters exist.

AECG GENERIC TABLE

A320-232 - AE232C01	35.0.0 25-Nov-17	TOGA
AIR COND. On Anti-icing Off Thr Red / Acc Height = 1500 FT / 1500 FT Acceleration to 250 KT		Valid for airports from -1000 to 3000 ft

All engines climb gradient (%) - Airport Pressure altitude = -1000 ft

WEIGHT 1000 KG	ISA deviation (DEG C)														
	ISA-15			ISA-10			ISA-5			ISA			ISA+5		
	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft
50	30.77%	11.73%	15.25%	30.78%	11.74%	15.24%	30.79%	11.74%	15.23%	30.80%	11.74%	15.22%	30.81%	11.74%	15.21%
53	----	----	----	28.12%	10.89%	14.20%	28.13%	10.89%	14.19%	28.13%	10.89%	14.18%	28.14%	10.89%	14.17%
56	25.78%	10.11%	13.26%	25.79%	10.12%	13.26%	25.79%	10.12%	13.25%	25.80%	10.12%	13.24%	25.81%	10.12%	13.23%
59	23.71%	9.42%	12.41%	23.71%	9.43%	12.41%	23.72%	9.43%	12.40%	23.72%	9.43%	12.39%	23.73%	9.43%	12.39%
62	21.86%	8.80%	11.64%	21.86%	8.80%	11.63%	21.87%	8.81%	11.63%	21.87%	8.81%	11.62%	21.88%	8.81%	11.61%
65	20.21%	8.22%	10.93%	20.21%	8.22%	10.92%	20.21%	8.22%	10.92%	20.21%	8.22%	10.91%	20.22%	8.22%	10.90%
68	18.71%	7.69%	10.28%	18.72%	7.69%	10.27%	18.72%	7.69%	10.26%	18.72%	7.69%	10.26%	18.72%	7.69%	10.25%
70	17.80%	7.35%	9.87%	17.80%	7.36%	9.86%	17.80%	7.36%	9.85%	17.80%	7.36%	9.85%	17.80%	7.36%	9.84%
72	16.93%	7.04%	9.48%	16.94%	7.04%	9.47%	16.94%	7.04%	9.47%	16.94%	7.04%	9.46%	16.94%	7.04%	9.46%
74	16.12%	6.74%	9.11%	16.13%	6.74%	9.10%	----	----	----	16.13%	6.74%	9.09%	16.13%	6.74%	9.09%
76	15.36%	6.45%	8.76%	15.36%	6.45%	8.75%	15.36%	6.45%	8.74%	15.36%	6.45%	8.74%	15.36%	6.45%	8.73%
77	14.99%	6.30%	8.58%	14.99%	6.30%	8.58%	14.99%	6.31%	8.57%	14.99%	6.31%	8.56%	14.99%	6.31%	8.56%

Gradient correction per 1000 ft of Airport Pressure altitude

WEIGHT 1000 KG	ISA deviation (DEG C)														
	ISA-15			ISA-10			ISA-5			ISA			ISA+5		
	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft
50	-0.51%	-0.32%	-0.55%	-0.51%	-0.32%	-0.55%	-0.51%	-0.33%	-0.55%	-0.51%	-0.33%	-0.55%	-0.51%	-0.33%	-0.55%
53	----	----	----	-0.48%	-0.31%	-0.52%	-0.48%	-0.31%	-0.52%	-0.48%	-0.31%	-0.52%	-0.48%	-0.31%	-0.52%
56	-0.45%	-0.29%	-0.49%	-0.45%	-0.29%	-0.49%	-0.45%	-0.29%	-0.49%	-0.45%	-0.29%	-0.49%	-0.45%	-0.29%	-0.49%
59	-0.43%	-0.27%	-0.46%	-0.43%	-0.27%	-0.46%	-0.43%	-0.27%	-0.46%	-0.43%	-0.27%	-0.46%	-0.43%	-0.27%	-0.46%
62	-0.40%	-0.26%	-0.44%	-0.40%	-0.26%	-0.44%	-0.40%	-0.26%	-0.44%	-0.40%	-0.26%	-0.44%	-0.40%	-0.26%	-0.44%
65	-0.38%	-0.24%	-0.42%	-0.38%	-0.24%	-0.42%	-0.38%	-0.24%	-0.42%	-0.38%	-0.24%	-0.42%	-0.38%	-0.24%	-0.42%
68	-0.36%	-0.23%	-0.40%	-0.36%	-0.23%	-0.40%	-0.36%	-0.23%	-0.40%	-0.36%	-0.23%	-0.40%	-0.36%	-0.23%	-0.40%
70	-0.35%	-0.22%	-0.39%	-0.35%	-0.22%	-0.39%	-0.35%	-0.22%	-0.39%	-0.35%	-0.22%	-0.39%	-0.35%	-0.22%	-0.39%
72	-0.34%	-0.22%	-0.38%	-0.34%	-0.22%	-0.38%	-0.34%	-0.22%	-0.38%	-0.34%	-0.22%	-0.38%	-0.34%	-0.22%	-0.38%
74	-0.33%	-0.21%	-0.37%	-0.33%	-0.21%	-0.37%	----	----	----	-0.33%	-0.21%	-0.37%	-0.33%	-0.21%	-0.37%
76	-0.32%	-0.21%	-0.36%	-0.32%	-0.21%	-0.36%	-0.32%	-0.21%	-0.36%	-0.32%	-0.21%	-0.36%	-0.32%	-0.21%	-0.36%
77	-0.32%	-0.21%	-0.35%	-0.32%	-0.21%	-0.35%	-0.32%	-0.21%	-0.35%	-0.32%	-0.21%	-0.35%	-0.32%	-0.21%	-0.35%

All engines climb gradient (%) - Airport Pressure altitude = -1000 ft

WEIGHT 1000 KG	ISA deviation (DEG C)					
	ISA+10			ISA+15		
	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft
50	30.82%	11.74%	15.21%	30.83%	11.09%	14.21%
53	28.15%	10.89%	14.17%	28.16%	10.27%	[illegible]
56	25.81%	10.12%	13.23%	[illegible]	[illegible]	[illegible]
59	23.73%	9.43%	12.38%	23.73%	[illegible]	[illegible]
62	21.88%	8.81%	11.61%	21.88%	8.27%	10.81%
65	20.22%	8.22%	10.90%	20.22%	[illegible]	10.14%
68	18.72%	7.69%	10.25%	18.72%	7.21%	9.52%
70	17.80%	7.36%	[illegible]	17.81%	6.89%	9.13%
72	16.94%	7.04%	9.45%	16.94%	6.58%	8.76%
74	16.13%	6.74%	9.08%	16.13%	6.29%	8.41%
76	15.36%	6.45%	8.73%	15.36%	6.01%	8.08%
77	14.99%	6.31%	8.56%	14.99%	5.87%	7.91%

Gradient correction per 1000 ft of Airport Pressure altitude

WEIGHT 1000 KG	ISA deviation (DEG C)					
	ISA+10			ISA+15		
	V2+10	MIN Gra	10000ft	V2+10	MIN Gra	10000ft
50	-0.51%	-0.33%	-0.55%	-0.51%	-0.31%	-0.52%
53	-0.48%	-0.31%	-0.52%	-0.48%	-0.29%	-0.49%
56	-0.45%	-0.29%	-0.49%	-0.45%	-0.27%	-0.46%
59	-0.43%	-0.27%	-0.46%	-0.43%	-0.26%	-0.44%
62	-0.40%	-0.26%	-0.44%	-0.40%	-0.25%	-0.42%
65	-0.38%	-0.24%	-0.42%	-0.38%	-0.23%	-0.40%
68	-0.36%	-0.23%	-0.40%	-0.36%	-0.22%	-0.38%
70	-0.35%	-0.22%	-0.39%	-0.35%	-0.21%	-0.37%
72	-0.34%	-0.22%	-0.38%	-0.34%	-0.21%	-0.36%
74	-0.33%	-0.21%	-0.37%	-0.33%	-0.20%	-0.35%
76	-0.32%	-0.21%	-0.36%	-0.32%	-0.20%	-0.34%
77	-0.32%	-0.21%	-0.35%	-0.32%	-0.20%	-0.34%

Gradient correction for different target height (from the gradient value at 10000 ft)

6000 ft	7000 ft	8000 ft	9000 ft	10000 ft
-0.42 %	-0.15 %	-0.01 %	0.02 %	0.00 %

14.7.3 Landing Optimization

Before dispatching an aircraft Nesma Airlines shall verify landing requirements based on aircraft operational constraints developed in its AFM.

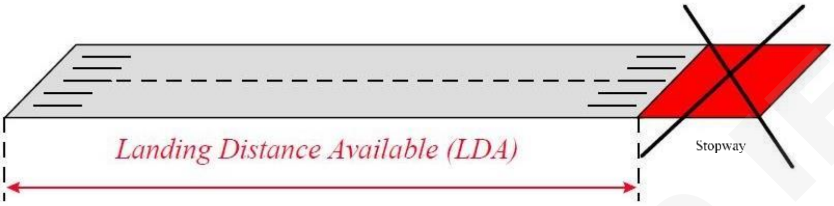
In normal operations, landing requirements are not limiting and the aircraft is authorized to land at maximum structural landing weight. However, in case of inoperative items, very high requirement of go-around gradient, contaminated runway or adverse weather conditions, landing weight could be significantly penalized.

14.7.3.1 Landing Terminology

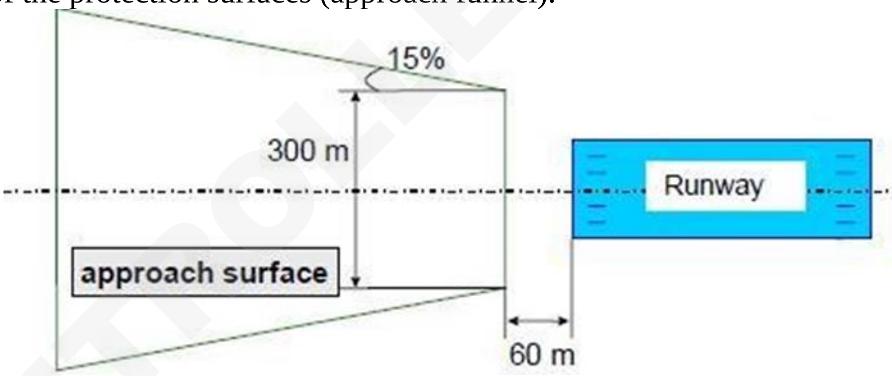
14.7.3.1.1 Landing Distance Available (LDA)

Landing distance available has two definitions depending whether there are limiting obstacles in the approach funnel or not.

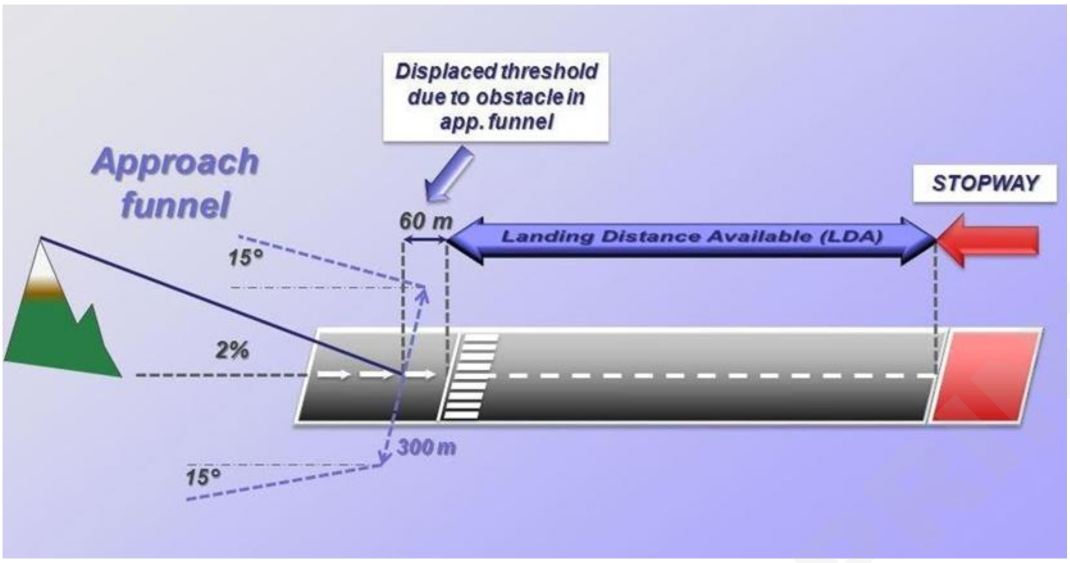
With no obstacle in the landing path: the landing distance available is the same as the Takeoff Run Available (TORA). Stop way is not used in lading performance calculations.



With obstacles in the landing path: in this case, the LDA may be shortened if an obstacle exists in the approach funnel. Approach funnel is defined in ICAO annex 8 specifies the dimension of the protection surfaces (approach funnel).



If the obstacle lies within the approach funnel, a displaced threshold is defined considering a 2% plane tangential to the most penalizing obstacle plus a 60 m margin.



14.7.3.1.2 Approach Climb

The go-around in approach configuration. This corresponds to an aircraft's climb capability, assuming that one engine is inoperative. The approach climb also assumes the aircraft in approach configuration (CONF 2 or 3 for Airbus Fly-by-Wire aircraft) and gears are retracted. Approach climb requirements may limit the maximum landing weight below the maximum structural weight. Refer to 14.6.2.8 Approach Climb Gradient..

14.7.3.1.3 Landing Climb

The go-around in landing configuration. This corresponds to an aircraft's climb capability assuming all engines are operating. It assumes the lading configuration (CONF 3 or FULL for Airbus Fly-by-Wire aircraft) and gears extended. The landing climb is less limiting for Airbus aircraft and is always covered by the approach climb characteristics. Refer to 14.6.2.9 Landing Climb Gradient.

14.7.3.2 Landing Performance

In all cases the Required Landing Distance (RLD) shall be lower that the LDA. Refer to14.6.2.10 Required Landing Distance (RLD).
In addition, the landing weight should be the minimum of the maximum landing weight or the landing weight limited by performance.
For Airbus Fly-by-Wire aircraft, RLD shall be checked before dispatching an aircraft. However, it is advised to consult the calculations of Operational Landing Distance during in-flight landing assessment to take into account the Reported Braking Action (RBA) instead of the runway condition, the go-around gradient, in-flight system failure or ECAM warnings and overweight landing procedures. Refer to 14.6.2.11 Operational Landing Distance.

14.7.3.3 Establishment of Landing Charts

Landing charts are established using the aircraft performance database to assess the landing requirements of a given airport at given atmospheric conditions.
Landing chart is established for different landing configurations (CONF 3 or FULL) and wind speeds. It is temperature-based chart, that generates the performance limited landing weight for different temperature values for a given runway a given conditions.
For airports with go-around gradient higher than the minimum certified gradients for the aircraft (2.1% for twin engine and 2.7% for quad engine), significantly short runways or apparent limiting obstacles, Nesma Airlines' performance engineering department generates a landing chart to verify the landing capability of the aircraft.
Landing charts shall be available for new airport studies and shall only be onboard the aircraft for runways which are limited by landing performance weight.

Input Data:

Parameter	Options
Calculation Options	
V/VS1g	Full Optimization/Point Optimization
Additional D.V	Incremental increase to VAPP speed
Wet Check	Yes/No
Approach Gradient	Input
Landing Gradient	Input
Landing Distance Factor	Input (factor of landing distance margins)
Aerial Phase Type	Calculated/Fixed (to account for touchdown zone)
Landing Technique	Autoland/Manual with Auto Thrust/Manual without Auto Thrust
Runway	
Selection of runway from airport manager	
Chart Data	
Row Parameter	Temperature
Column Parameter	Landing configuration/Wind speed
Influence parameters	Runway state/Pressure Altitude/Anti-ice
Common Parameters	Takeoff thrust/Anti-ice/Air conditioning

Output:

A320232 - JAA	IAE V2527-A5 engines	Default -		36	35.0.0 21-Dec-17 AE232C01 V20
AT DISPATCH QNH 1013.25 HPA Air cond. Off Anti-icing Off All reversers inoperative Wet check		Elevation 0 FT Isa temp 15 C Rwy slope 0.00 % LDA 3000 M			DRY

OAT C	CONF 3 GA: CONF 2			CONF FULL GA: CONF 3		
	TAILWIND -10 KT	WIND 0 KT	HEADWIND 10 KT	TAILWIND -10 KT	WIND 0 KT	HEADWIND 10 KT
50	85.3 159 6 1631/ 2719	86.8 161 3 1457/ 2428	86.8 161 3 1389/ 2315	85.8 155 3 1515/ 2525	85.8 155 3 1315/ 2192	85.8 155 3 1252/ 2086
45	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2563	89.9 164 3 1466/ 2444	88.8 158 3 1594/ 2656	88.8 158 3 1385/ 2308	88.8 158 3 1319/ 2198
40	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2563	89.9 164 3 1466/ 2444	88.8 158 3 1594/ 2656	88.8 158 3 1385/ 2308	88.8 158 3 1319/ 2198
35	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2564	89.9 164 3 1467/ 2444	88.8 158 3 1594/ 2656	88.8 158 3 1385/ 2308	88.8 158 3 1319/ 2198
30	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2564	89.9 164 3 1467/ 2444	88.8 158 3 1594/ 2656	88.8 158 3 1385/ 2308	88.8 158 3 1319/ 2198
25	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2563	89.9 164 3 1466/ 2444	88.8 158 3 1594/ 2656	88.8 158 3 1385/ 2308	88.8 158 3 1319/ 2198
20	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2564	89.9 164 3 1467/ 2444	88.9 158 3 1594/ 2657	88.9 158 3 1385/ 2308	88.9 158 3 1319/ 2198
15	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2564	89.9 164 3 1467/ 2444	88.9 158 3 1594/ 2657	88.9 158 3 1385/ 2308	88.9 158 3 1319/ 2198
10	85.3 159 6 1631/ 2719	89.9 164 3 1538/ 2564	89.9 164 3 1467/ 2445	88.9 158 3 1594/ 2657	88.9 158 3 1385/ 2309	88.9 158 3 1319/ 2198
5	85.3 159 6 1631/ 2719	89.9 164 3 1539/ 2564	89.9 164 3 1467/ 2445	88.9 158 3 1594/ 2657	88.9 158 3 1385/ 2309	88.9 158 3 1319/ 2199
0	85.3 159 6 1631/ 2719	89.9 164 3 1539/ 2564	89.9 164 3 1467/ 2445	88.9 158 3 1595/ 2658	88.9 158 3 1385/ 2309	88.9 158 3 1319/ 2199
	INFLUENCE OF RUNWAY CONDITION					
STANDING	-17.2 -16	-6.0 -6	-1.3 -1	-8.7 -8	0.0 0	0.0 0
WATER	-17.2 -16	-6.0 -6	-1.3 -1	-8.7 -8	0.0 0	0.0 0
	INFLUENCE OF ANTI-ICING ONLY AT OR BELOW OAT = 10 C					
Engine	0.0 0	-2.0 -2	-2.0 -2	-2.0 -2	-2.0 -2	-2.0 -2
& Wing	0.0 0	-2.0 -2	-2.0 -2	-2.0 -2	-2.0 -2	-2.0 -2

VFA Speed correction VFA 0.8 KT/1000 KG	1=max weight 2=landing distance 3=approach climb 4=landing climb 5=tire speed 6=braking energy
MLW(1000 KG) VFA(kt) code ALD-RLD	LABEL FOR INFLUENCE: NO COMBINATION: DW(1000KG) DVFA(KT) COMBINE: DW(1000KG) DVFA(KT)

For Nesma Airlines' operations, landing charts are no longer used, all the landing related calculations are carried out through the EFB landing performance module as controlled, and documented in 8.12.15.2 Update Procedures. EFB landing performance module includes both in-flight landing and dispatch landing calculations.

14.8 In-Flight Performance (IFP)

The IFP program is part of the Performance Engineers' Package. The IFP program provides the flight operations staff members with an exhaustive and comprehensive tool for aircraft high-speed performance calculation.
The IFP is the official tool provided by Airbus to construct flight performance tables that used to be found in the FCOM. IFP is considered a complementary tool to the flight planning system. The IFP uses the aircraft high-speed database for calculation of different parameters, this includes each flight phase (climb, cruise, descent, holding) parameters (aircraft weight, TAS, Mach number, fuel flow, drag, lift, angle of attack…) can be assessed accurately.

14.8.1 IFP Calculation Types

IFP enables to compute either instantaneous point performance data or integrated performance data between two points. The user can select from point calculation or integrated calculation from a drop-down menu.

Point Computation

This is typically a snapshot of aircraft performance at given conditions. This is used to compute aircraft instantaneous performance data. In point calculation, the user can calculate the performance parameters for:

- Climb, cruise, descent and holding
- Climb ceiling
- Buffeting
- Optimum/maximum cruising altitude
- Flight parameters at given speed/altitude/CI

Integrated Computation

Integrated calculations result in the fuel consumption time or distance elapsed since a given starting point. Use this option to compute average data between two points.

14.8.2 IFP Calculation Options

There exist two options of calculation modes for IFP module. Standard and standard with FMS speeds.

Standard Option

It is typically the book level performance. For each flight phase, point or integrated calculations can be used. Computation for performance can be carried out for:

- Climb
- Cruise
- Descent
- Acceleration/Deceleration
- Holding
- Buffeting
- Descent/Cruise

Standard with FMS Speeds

This hybrid option allows the calculation of performance data with the standard FMS database that is installed on some types of aircraft.

The available calculations depend greatly on the type of aircraft and the type of the FMS database installed (FMS1 or FMS2). But for Nesma Airlines aircraft the following options are available for calculation:

- Climb
- Cruise
- Descent
- Holding

Point and integrated calculations are available for FMS-based calculations.

14.8.3 Climb

Climb performance is available for point and integrated calculation and is available in both standard option and standard with FMS option.

Standard calculations with FMS speeds allow the calculation of climb characteristics using cost index.

The following calculation options are available for the climb performance.

Option	Calculation Type	Mode
Standard	Point	Climb at given CAS/Mach Law
		Climb at given/maximum rate
		Climb at maximum gradient
		Climb versus speed
		Climb ceiling versus speed at given rate
		Climb ceiling versus speed at given gradient
		Climb ceiling versus weight at given rate
		Climb ceiling versus weight at given gradient
	Integrated	Climb at given CAS/Mach Law
		Climb at maximum gradient
		Climb at maximum gradient
	Point	Climb at given cost index
Standard with FMS Speeds		Climb at given CAS/Mach Law
	Integrated	Climb at given cost index
		Climb at given CAS/Mach Law

Input Data:

Parameter	Options	Calculation Type
Aerodynamic Data		
Configuration	Clean/CONF 1/CONF 1 + F/CONF 2/CONF 3/CONF 4	Standard/Standard with FMS speeds
Center of Gravity	User Input	
Drag	Drag Factor/Drag Correction	
Aircraft Status	CDL list	
Buffet Margin	User Input	Standard
Moving Parts	Airbrakes Extended Landing gear extended Landing gear doors open	
Engine Data		
Engine Level	Average/Minimum	Standard/Standard with FMS speeds
Thrust	Max Climb/Max Continuous/Takeoff	
Maximum rating	User Input	
Fuel lower heating value	User input	
Bleed selection	Air conditioning/Anti-ice	
Engines situation	All Engine Operating/One Engine out	
Fuel consumption factor	User Input	
Atmospheric Data		
Temperature		Standard/Standard with FMS speeds
Wind	Analytical/Tabulated	

Calculation Data		
Climb rate	Input List	Standard/Standard with FMS speeds
Climb profile	User input	
Weight	Input list	
Altitude	Input List	For some modules only
Time/Distance/Fuel	User input/Database value	For integrated calculation only

Output Data:

Output from IFP climb performance module can be formatted in either detailed or tabulated formats. They both contain the same data.
At given conditions the following data are obtained.

Label	Description
Alt	Altitude
MACH	Mach number that achieves the required characteristics
CAS/TAS	Calibrated and true airspeeds
Wind	Wind speed (user input)
Rate	Rate of climb (ft/min)
GRDT	Climb gradient
WFE	Fuel consumption (Kg/hr)
EGT	Exhaust Gas Temperature
EPR	Engine Pressure Ratio
CL/CD	Lift/Drag Coefficients

14.8.4 Cruise

Cruise performance is available for point and integrated calculation and is available in both standard option and standard with FMS option as well.
Just like climb calculation, standard calculations with FMS speeds allow the calculation of cruise characteristics using cost index.
The following calculation options are available for the climb performance.

Option	Calculation Type	Mode
Standard	Point	Cruise at given CAS/Mach Law
		Cruise at maximum speed
		Cruise at optimum speed
		Cruise versus speed
		Maximum cruise altitude at given speed
		Maximum cruise altitude at optimum speed
		Optimum cruise altitude at given speed
		Optimum cruise altitude at optimum speed
		Cruise at green dot speed
		Maximum cruise altitude at green dot speed
	Integrated	Cruise at given CAS/Mach Law
		Cruise at maximum speed
		Cruise at optimum speed
		Optimum cruise altitude at given speed
		Optimum cruise altitude at optimum speed
		Cruise at green dot speed
		Optimum cruise altitude at green dot speed
Standard with FMS Speeds	Point	Climb at given cost index
		Climb at given CAS/Mach Law

		Maximum cruise altitude at given Mach/CAS
		Maximum cruise altitude at given cost index
		Optimum cruise altitude at given cost index
	Integrated	Climb at given cost index
		Climb at given CAS/Mach Law
		Cruise at optimum altitude and given cost index

Input Data:

Parameter	Options	Calculation Type
Aerodynamic Data		
Configuration	Clean/CONF 1/CONF 1 + F/CONF 2/CONF 3/CONF 4	Standard/Standard with FMS speeds
Center of Gravity	User Input	
Drag	Drag Factor/Drag Correction	
Aircraft Status	CDL list	
Buffet Margin	User Input	Standard
Moving Parts	Airbrakes Extended Landing gear extended Landing gear doors open	
Engine Data		
Engine Level	Average/Minimum	Standard/Standard with FMS speeds
Thrust	Max Climb/Max Continuous/Takeoff	
Maximum rating	User Input	
Fuel lower heating value	User input	

Bleed selection	Air conditioning/Anti-ice	
Engines situation	All Engine Operating/One Engine out	
Fuel consumption factor	User Input	
Atmospheric Data		
Temperature		Standard/Standard with FMS speeds
Wind	Analytical/Tabulated	
Calculation Data		
Rate of climb limitation	User input	Standard/Standard with FMS speeds
Climb profile	User input	
Weight	Input list	
Altitude	Input List	For some modules only
Speed	Input List	For integrated calculation only

Output Data:

Label	Description
MACH	Mach number that achieves the required characteristics
CAS/TAS	Calibrated and true airspeeds
Wind	Wind speed (user input)
Rate	Rate of climb (ft/min)
GRDT	Climb gradient
WFE	Fuel consumption (Kg/hr)
EGT	Exhaust Gas Temperature
EPR	Engine Pressure Ratio
CL/CD	Lift/Drag Coefficients
SR	Specific Range

14.9 Aircraft Performance Monitoring (APM)

Aircraft performance monitoring is performed in the frame of fuel conservation and of aircraft drag assessment. It is a procedure devoted to gathering aircraft data in order to determine the actual performance level of each airplane of the fleet with respect to the manufacturer's book level. The book level is established by the manufacturer and represents the average performance of a brand new airframes and engines.

Performance monitoring is based on statistical approach and accounts for two deterioration origins; engine performance degradation (fuel consumption increase for a given thrust) and airframe deterioration (increased drag).

The aims of APM is to adjust the aircraft performance factor in both the computerized flight plan and aircraft FMS for better fuel prediction.

The actual performance level - represented by flight and engine parameters - is recorded during cruise by the ACMS (Aircraft Condition Monitoring System) and is provided as Cruise Performance Report <02>.

The APM calculates the aircraft cruise performance in a statistical deterministic way. That is without use of mathematical methods from the field of probability, optimal estimation or filter techniques just by using the familiar equations of lift, drag and fuel flow for a given set of stabilized in-flight measured input values.

Reference to the scientific basis, methodology and results obtained from calculations are elaborated in the PPM-APM User Guide.

Output Date:

Label	Description
DSR	Degradation in specific range due to wear out of engine and fuselage

Aircraft Leasing

Chapter 15