

Subject: Calculation of Minimum Line-Up Distance Correction

Objective:

With the adoption of ICAO Annex 14, 8th Edition (July 2018) the calculation of Minimum Line-Up Distance Correction has evolved. Landing Gear to pavement clearance requirements for aircraft with an Outer Main Gear Wheel Span (OMGWS) between 9m and not including 15m have been reduced to 4 m down from 4.5 m influencing thereby the calculation results for A300, A330, A340, A350 and A380 families of aircraft.

Hence Airbus propose an update of the tables of Minimum Line-up Distance Corrections on Take-Off Distance Available (TODA) and Accelerate-Stop Distance Available (ASDA) contained in Airbus manuals and also takes the opportunity of the new issue of this technical note to introduce the A330neo aircraft (e.g. A330-800 and A330-900).

For any question, please contact airport operations department

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Record of revisions

Issue	Date	Summary and reasons for changes
1.0	21/03/2011	Initial issue
2.0	26/07/2019	Reduced OMGWS clearance and introduction of A330neo A/C

1 INTRODUCTION

With the adoption of ICAO Annex 14, 8th Edition (July 2018) the calculation of Minimum Line-Up Distance Correction has evolved. Landing Gear to pavement clearance requirements for aircraft with an Outer Main Gear Wheel Span (OMGWS) between 9m and not including 15m have been reduced to 4 m down from 4.5 m influencing thereby the calculation results for A300, A330, A340, A350 and A380 families of aircraft.

Hence Airbus propose an update of the tables of Minimum Line-up Distance Corrections on Take-Off Distance Available (TODA) and Accelerate-Stop Distance Available (ASDA) contained in Airbus manuals and also takes the opportunity of the new issue of this technical note to introduce the A330neo aircraft (e.g. A330-800 and A330-900).

Methodology:

Three classic manoeuvres are considered:

1. 90° turn on runway entry
2. 180° turn on runway turn pad
3. 180° turn on a given runway width

Used assumptions:

1. Recommendations contained in Annex 14 regarding the minimum clearance between aircraft wheels and pavement edges are taken into account and should be met.
2. Runway width considered are 30m (for A320 family), 45m (ICAO standard runway width) and 60m.
3. Effective steering angles for the aircraft (used for the calculation of turning radii) take into account slippage effect.
4. Standard turnpad geometry as defined in ICAO Annex 14
5. Assumptions on thrust and braking application represent the Flight Crew Techniques Manual (FCTM) operational procedures for tight turns i.e. use of asymmetric thrust and differential braking to initiate the turn only.

The values presented hereafter are theoretical values taking into account aircraft geometry combined with the effective steering angle. This effective steering angle is lower than the maximum steering angle recalled in the tables (and that represents a full steering tiller input). Where the turn with a maximum effective steering angle does not lead to an aligned position for take-off, the angle is set to a lower value.

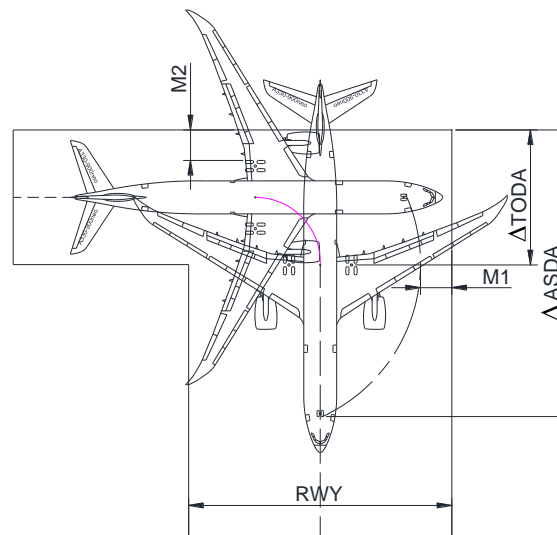
2 90° TURN ON RUNWAY ENTRY

This manoeuvre consists in a 90° turn at minimum turn radius starting with the Main Landing Gear (MLG) edge at a distance M2 from taxiway edge, and finishing with the aircraft aligned on the centreline of the runway with the MLG centre describing a quarter circle.

During the turn, M1 will respect the pavement edge clearance and M2 will be at the minimum value as described in ICAO Annex 14.

In some cases (narrow runway compared to aircraft wheel base) the maximum effective steering angle would result in a NLG clearance lower than M1. Hence a reduction of the NLG effective steering angle is necessary to respect the M1 margin.

In the following table, these cases are given in *italic characters*.



90° turn on runway entry														
Aircraft model	Max steering angle [degrees]	Max. effective or used steering angle [degrees]	30m wide runway				45m wide runway (STANDARD WIDTH)				60m wide runway			
			Minimum line-up distance correction				Minimum line-up distance correction				Minimum line-up distance correction			
			On TODA		On ASDA		On TODA		On ASDA		On TODA		On ASDA	
			[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]
A318	75	71.8	10.8	36	21.1	69	Same as 30m				Same as 30m			
A319	75	71.8	11.1	36	22.1	73	Same as 30m				Same as 30m			
A320	75	71.8	11.6	38	24.3	80	Same as 30m				Same as 30m			
A321	75	69.2/73.1	13.9	46	30.8	101	12.6	41	29.5	97	Same as 45m			
A300	65	63.7	N/A				18.8	62	37.5	123	Same as 45m			
A310	65	64.4	N/A				16.8	55	32.0	105	Same as 45m			
A330-200 (1)	65	62.2	N/A				22.0	72	44.2	145	Same as 45m			
A330-200 (2) A330-800	72	68.1	N/A				19.2	63	41.4	136	Same as 45m			
A330-300 (1)	65	62.1	N/A				23.7	78	49.1	161	Same as 45m			
A330-300 (2) A330-900	72	67.8	N/A				20.7	68	46.0	151	Same as 45m			
A340-200 (1)	65	65.3	N/A				21.0	69	44.2	145	Same as 45m			
A340-200 (2)	72	71.5	N/A				18.1	59	41.3	135	Same as 45m			
A340-300 (1)	65	65.9	N/A				21.7	71	47.1	154	Same as 45m			
A340-300 (2)	72	70.6/72.2	N/A				19.3	63	44.7	147	18.5	61	43.9	144
A340-500	70	65.3/68.0	N/A				23.1	76	51.1	168	21.6	71	49.6	163
A340-600	76	56.8/73.7	N/A				32.0	105	65.2	214	20.0	66	53.2	175
A350-800	72	68.1	N/A				20.4	67	45.3	149	Same as 45m			
A350-900	72	64.2/69.2	N/A				24.3	80	52.9	174	21.3	70	50.0	164
A350-1000	75	58.0/71.1	N/A				30.6	100	63.1	207	21.4	70	53.9	177
A380-800	70	61.8/69.5	N/A				27.2	89	57.0	187	22.3	73	52.2	171

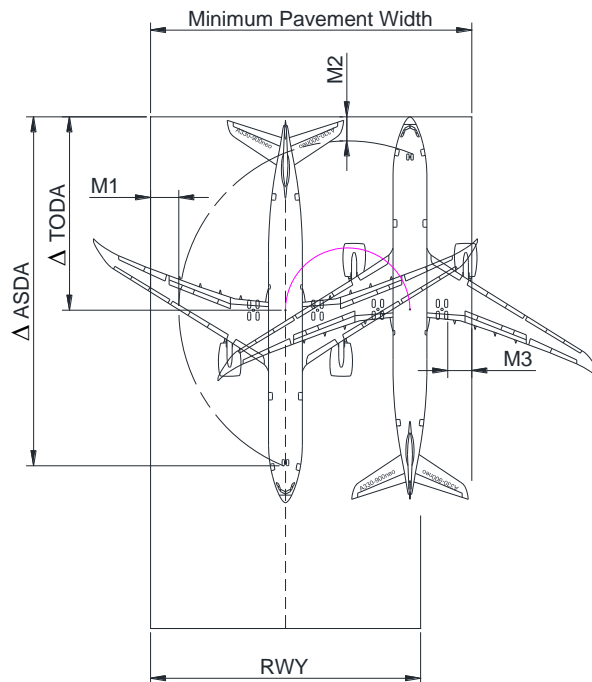
- (1) Reduced max steering angle modification
 (2) Full max steering angle capability
 (normal) maximum steering
 (*italic*) *reduced steering angle*

3 180° TURN ON RUNWAY TURN PAD

This manoeuvre consists in a 180° turn on a standard ICAO runway turn pad geometry (ICAO Doc 9157, Aerodrome Design Manual, Part 1 – Runways). It starts with MLG edge at a distance M3 from runway edge, and it finishes with the aircraft aligned on the centreline of the runway. During the turn, M1 will respect the pavement edge clearance while M2 and M3 will be at the minimum value as described in ICAO Annex 14.

In the case that the maximum steering angle would lead to a non-aligned aircraft when crossing the runway centreline, the steering angle is set to a lower value to obtain the correct alignment.

In the following table, these cases are given in *italic characters*.



180° turn on runway turn pad														
Aircraft model	Max steering angle [degrees]	Max. effective or used steering angle [degrees]	30m wide runway				45m wide runway (STANDARD WIDTH)				60m wide runway			
			Minimum line-up distance correction				Minimum line-up distance correction				Minimum line-up distance correction			
			On TODA		On ASDA		On TODA		On ASDA		On TODA		On ASDA	
			[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]
A318	75	71.8	14.3	47	24.5	80	Same as 30m				Same as 30m			
A319	75	71.8	15.0	49	26.0	85	Same as 30m				Same as 30m			
A320	75	71.8	16.7	55	29.3	96	Same as 30m				Same as 30m			
A321	75	69.2/73.1	21.4	70	38.3	126	21.0	69	37.9	124	Same as 45m			
A300	65	63.7	N/A				25.3	83	44.0	144	Same as 45m			
A310	65	64.4	N/A				21.3	70	36.6	120	Same as 45m			
A330-200 (1)	65	62.2	N/A				29.6	97	51.7	170	Same as 45m			
A330-200 (2) A330-800	72	68.1	N/A				28.4	93	50.6	166	Same as 45m			
A330-300 (1)	65	62.1	N/A				33.2	109	58.6	192	Same as 45m			
A330-300 (2) A330-900	72	67.8	N/A				31.9	105	57.3	188	Same as 45m			
A340-200 (1)	65	65.3	N/A				30.0	99	53.2	175	Same as 45m			
A340-200 (2)	72	71.5	N/A				29.0	95	52.2	171	Same as 45m			
A340-300 (1)	65	65.9	N/A				32.3	106	57.7	189	Same as 45m			
A340-300 (2)	72	70.6/72.2	N/A				31.5	103	56.9	187	31,7	104	57,1	187
A340-500	70	65.3/68.0	N/A				35.3	116	63.3	208	34,7	114	62,7	206
A340-600	76	56.8/73.7	N/A				44.2	145	77.4	254	39,2	129	72,4	238
A350-800	72	68.1	N/A				31.3	103	56.2	184	Same as 45m			
A350-900	72	64.2/69.2	N/A				36.4	119	65.0	213	35,2	115	63,9	210
A350-1000	75	58.0/71.1	N/A				42.8	140	75.3	247	38,9	128	71,4	234
A380-800	70	61.8/69.5	N/A				38.5	126	68.4	224	36,6	120	66,4	218

(1) For aircraft equipped with reduced max steering angle modification

(2) Full max steering angle capability

(normal) maximum steering

(italic) reduced steering angle

4 180° TURN ON A GIVEN RUNWAY WIDTH

For this manoeuvre, the pavement width is considered to be the runway width, which is a frozen parameter (30m, 45m or 60m).

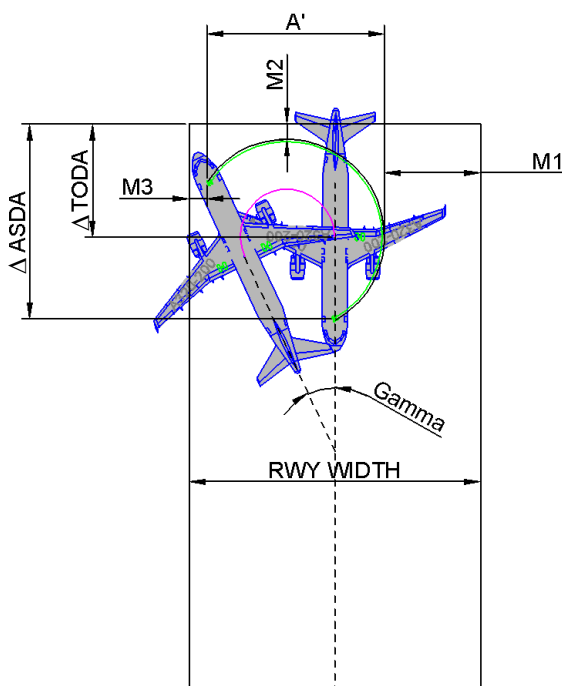
As per the “180 deg turn on runway” standard operating procedures described in the Flight Crew Techniques Manuals (FCTM), the aircraft is initially angled with respect to runway centreline when starting the 180 deg turn. The value of this angle depends on the aircraft type, and is mentioned in the FCTM.

During the turn, M1, M2 and M3 clearances must meet the minimum value as described in ICAO Annex 14.

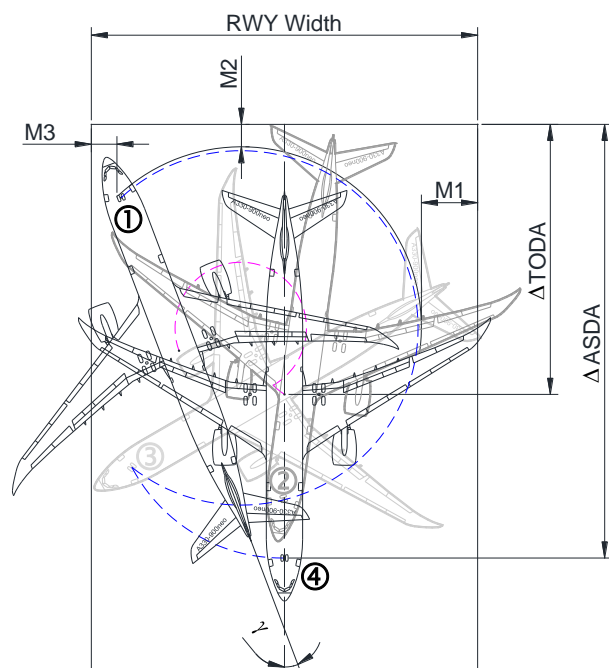
There are two different manoeuvres possible:

Option 1: With the max steering angle and the turn initiated at a distance greater than the minimum edge distance of the ICAO aircraft type, the aircraft is **directly aligned** on the runway.

Option 2: With the max steering angle and the turn initiated at the minimum edge distance of the ICAO aircraft type ①, the aircraft is not directly aligned on the runway ②. In this case the aircraft continues over the runway centreline and steers back when appropriate③. This option is called **reversing alignment**④.



180° Turn on Runway
Option 1 with direct alignment



180° Turn on Runway
Option 2 with reversing alignment

180° turn on runway given runway width														
Aircraft model	FCOM Divergence angle (gamma) [degrees]	Max. effective steering angle [degrees]	30m wide runway				45m wide runway (STANDARD WIDTH)				60m wide runway			
			Minimum line-up distance correction				Minimum line-up distance correction				Minimum line-up distance correction			
			On TODA		On ASDA		On TODA		On ASDA		On TODA		On ASDA	
			[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]	[m]	[ft]
A318	25	71.8	14.1	46	24.4	80	Same as 30m				Same as 30m			
A319	25	71.8	15.0	49	26.0	85	Same as 30m				Same as 30m			
A320	25	71.8	21.3	70	33.9	111	16.7	55	29.3	96	Same as 45m			
A321	25	73.1	Not Possible				21.0	69	37.9	124	Same as 45m			
A300	25	63.7	N/A				39.0	128	57.7	189	24.8	81	43.5	143
A310	25	64.4	N/A				26.7	88	41.9	138	21.8	72	37.1	122
A330-200 (1)	20	62.2	N/A				Not Possible				43.3	142	65.5	215
A330-200 (2) A330-800	20	68.1	N/A				Not Possible				28.9	95	51.1	168
A330-300 (1)	20	62.1	N/A				Not Possible				53.2	175	78.6	258
A330-300 (2) A330-900	20	67.8	N/A				Not Possible				42.6	140	68.0	223
A340-200 (1)	20	65.3	N/A				Not Possible				40.6	133	63.8	209
A340-200 (2)	20	71.5	N/A				Not Possible				29.5	97	52.7	173
A340-300 (1)	20	65.9	N/A				Not Possible				46.4	152	71.8	236
A340-300 (2)	20	72.2	N/A				Not Possible				31.7	104	57.1	187
A340-500	15	68.0	N/A				Not Possible				47.0	154	74.9	246
A340-600	15	73.7	N/A				Not Possible				Not Possible			
A350-800	20	68.1	N/A				Not Possible				40.2	132	65.0	213
A350-900	20	69.2	N/A				Not Possible				49.2	162	77.9	256
A350-1000	20	71.1	N/A				Not Possible				Not Possible			
A380-800	15	69.5	N/A				Not Possible				49.1	161	78.9	259

(1) For aircraft equipped with reduced max steering angle modification

(2) Full max steering angle capability

(normal) direct alignment

(italic) reversing alignment