Technical report
IN-044/2020

Incident involving a Boeing 737-800 aircraft, registration EI-EBC, and a Beechcraft B200 aircraft, registration EC-MUP on 23 October 2020 at Málaga Airport

GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA
UNDERSECRETARIAT
CIVIL AVIATION ACCIDENT AND INCIDENT INVESTIGATION COMMISSION

Notice

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission regarding the circumstances of the accident object of the investigation, its probable causes and its consequences.

In accordance with the provisions in Article 5.4.1 of Annexe 13 of the International Civil Aviation Convention; and with Articles 5.5 of Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010; Article 15 of Law 21/2003 on Air Safety; and Articles 1, 4 and 21.2 of RD 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent their recurrence. The investigation is not intended to attribute any blame or liability, nor to prejudge any decisions that may be taken by the judicial authorities. Therefore, and according to the laws detailed above, the investigation was carried out using procedures not necessarily subject to the guarantees and rights by which evidence should be governed in a judicial process.

Consequently, the use of this report for any purpose other than the prevention of future accidents may lead to erroneous conclusions or interpretations.

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Abbreviations

º	Sexagesimal degree
°C	Degrees Celsius
A/C	Aircraft
ACP	Area control procedural rating
ACS	Area control surveillance rating
ADI	Aerodrome control instrument rating
ADV	Aerodrome control visual rating
AENA	Spanish Airports and Air Navigation
AESA	Spain's National Aviation Safety Agency
AIP	Aeronautical Information Publication
AIR	Aerodrome control endorsement
AMSL	Above mean sea level
APP	Approach control procedural rating
APS	Approach control surveillance rating
ATC	Air traffic control
ATPL	Airline transport pilot license
ATPL (A)	Airline transport pilot license (aircraft)
ATS	Air traffic service
CEANITA	Commission for the study and analysis of air traffic incident notifications
CIAIAC	Civil Aviation Accident and Incident Investigation Commission
CLD	Departure clearance message
CPL	Commercial pilot license
CPL(A)	Commercial pilot license (aircraft)
CVR	Cockpit voice recorder
EDDH	ICAO code for Hamburg Airport
EGGP	ICAO code for Liverpool Airport
FDR	Flight data recorder
ft	Feet
GMC	Ground movement control endorsement
GMS	Ground movement surveillance endorsement
GND	Ground control
GS	Ground speed
h	Hours
hPa	Hectopascals
IAA	Irish Aviation Authority
IFR	Instrument flight rules
km	Kilometres

kt	Knots
LCL	Local air traffic control position
LEMG	ICAO code for Málaga-Costa del Sol Airport
m	Metres
METAR	Aviation routine weather report
MHz	Megahertz
NM	Nautical mile
ICAO	International Civil Aviation Organisation
QAR	Quick access recorder
QNH	Atmospheric pressure adjusted to mean sea level in the airport area
RAD	Aerodrome radar control endorsement
RWY	Runway
s	Seconds
SACTA	Automated air traffic control system
SERA	Standardised European rules of the air
SNS	Event notification system
t	time
TCL	Terminal control endorsement
TMA	Traffic management area
TWR	Aerodrome control tower or aerodrome control
EU	European Union
UTC	Coordinated universal time
VFR	Visual flight rules

Technical Report IN-044/2020

	AIRCRAFT 1	AIRCRAFT 2
Operator:	Ryanair	Eliance Aviation
Aircraft:	Boeing 737-8AS registration EI-EBC (Ireland)	Beechcraft B200 registration EC-MUP (Spain)
Persons on board:	114, unharmed	5, unharmed
Type of flight:	Commercial air transport – Scheduled – International – With passengers	Commercial air transport – Other – Emergency medical services
Phase of flight	Take-off, take-off run	Landing
Flight rules	IFR	VFR

Date and time of incident: 23 October 2020, 16:15 UTC[1]

Site of accident: Málaga-Costa del Sol Airport (LEMG)

Date of approval: 27 July 2022

Synopsis

Summary of the investigation:

On 23 October 2020, the Boeing 737-800 aircraft, registration EI-EBC, was departing from Málaga-Costa del Sol Airport (LEMG) while the Beechcraft B200 aircraft, registration EC-MUP, was approaching the same airport to land.

Both were in radio contact with the local control position (LCL) in the LEMG control tower. At approximately 16:15 UTC, the EI-EBC aircraft began rotation on take-off run from runway 13, while, at the same time, the EC-MUP aircraft overflew the threshold of runway 13 on landing. As a result, both aircraft occupied the same runway simultaneously, and the horizontal separation between them was reduced to approximately 0.9 NM.

There were no injuries, and neither aircraft sustained any damage.

The investigation has concluded that the incident occurred due to poor landing and take-off planning, which led to an aircraft being cleared to land on a runway already occupied by another on take-off without respecting the minimum separation requirements.

1 All times used in this report are UTC. Local time can be calculated by adding 2 hours to UTC

Given the history of events involving losses of separation at Málaga-Costa del Sol Airport (LEMG), the two investigations recently opened by the CIAIAC (IN-049-2019 and IN-044-2020), and the uptick in regulatory separation breaches between July 2021 and April 2022, the issue of three safety recommendations has been deemed appropriate: two addressed to ENAIRE, and one to AESA.

1. FACTUAL INFORMATION

1.1. Description of the incident

At 16:15 UTC on 23 October 2020, an incident involving a loss of separation between two aircraft on runway 13 at Málaga-Costa del Sol Airport occurred. One was on the take-off run and the other on short final.

The first aircraft was a Boeing 737-8AS, registration EI-EBC and callsign RYR7YM, departing from Málaga-Costa del Sol Airport (LEMG). The second aircraft was a Beechcraft B200, registration EC-MUP and callsign UGC113B, bound for Málaga-Costa del Sol Airport (LEMG).

Málaga-Costa del Sol Airport was using the preferential single-runway configuration, with take-offs and landings via the runway 13. The air traffic controller at the LCL position cleared aircraft RYR7YM for take-off when the approaching UGC113B aircraft was on final at 2.2 NM, without informing the departing traffic of the position of the arriving traffic and using different languages for the communications. Subsequently, the LCL controller cleared aircraft UGC113B to land when it was over the runway threshold and aircraft RYR7YM was on the take-off run, resulting in a horizontal separation of 0.9 NM.

The sequence of events outlined above led to a loss of separation and, given that both aircraft were occupying the runway at the same time, a runway incursion.

No damage occurred as a result of the incident.

1.2. Injuries to persons

1.2.1. Aircraft EI-EBC

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
Unharmed	6	108	114	
TOTAL	6	108	114	

1.2.2. Aircraft EC-MUP

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
Unharmed	2	3	5	
TOTAL	2	3	5	

1.3. Damage to the aircraft

Neither aircraft sustained damage.

1.4. Other damage

There was no other damage

1.5. Information about the personnel

This section outlines the most relevant information about the crew of both aircraft and the personnel involved at the different control tower positions.

1.5.1. Information about the crew of the EI-EBC aircraft

The 28-year-old commander held an ATPL (A) airline transport pilot licence issued by the Irish Aviation Authority (IAA) on 06/12/2013 with a B737 300-900 type rating valid until 31/08/2021.

He also had a class 1 medical certificate, valid until 02/07/2021.

He had a total flight experience of 7,370 hours, of which 7,160 hours were in type.

The 25-year-old co-pilot held a commercial pilot license CPL(A) issued by the Irish Aviation Authority (IAA) on 28/11/2017 with a B737 300--900 type rating valid until 31/01/2021.

He also had a class 1 medical certificate, valid until 10/01/2021.

He had a total flight experience of 1,605 hours, of which 1,435 hours were in type.

1.5.2. Information about the crew of the EC-MUP aircraft

The 42-year-old commander held a CPL(A) commercial airline pilot licence issued by the Spanish Aviation Authority (AESA) on 17/11/2008 with a Beech 90/99/100/200 type rating valid until 30/09/2021.

He also had a class 1 medical certificate, valid until 14/03/2021.

He had a total flight experience of 3,716 hours, of which 718 hours were in type.

The 32-year-old co-pilot held a CPL(A) commercial airline pilot licence issued by the Spanish Aviation Authority (AESA) on 27/03/2018 with a Beech 90/99/100/200 type rating valid until 31/08/2021.

He also had a class 1 medical certificate, valid until 07/10/2021.

He had a total flight experience of 900 hours, of which 700 hours were in type.

1.5.3. General information about the LCL position air traffic controller

The 45-year-old local position air traffic controller (LCL) had an air traffic controller license issued by Spain's National Aviation Safety Agency (AESA) on 05/12/2006 with the following ratings: ADV, ADI (with the endorsements: AIR, GMC, TWR, GMS, RAD), APP, APS (with the TCL endorsement), ACP and ACS (with the TCL endorsement). For the unit, the controller had the ADI rating with TWR and RAD endorsements valid until 18/10/2021 and the APS rating valid until 18/10/2021.

In addition, he had a valid medical certificate and 13 years of experience in air traffic control.

He passed the training for the TWR LEMG unit in June 2014.

1.6. Information about the aircraft

1.6.1. General information about the EI-EBC aircraft

The BOEING 737-8AS aircraft with registration EI-EBC and serial number 37520 was manufactured in 2009. It is equipped with two CFMI CFM56-7B26 engines.

It has a certificate of airworthiness issued by the Irish Aviation Authority and an airworthiness review certificate valid until 24 October 2021. On the day of the incident, the aircraft had flown a total of 37,423 flight hours and 21,587 cycles.

The aircraft was being maintained according to its approved maintenance programme, and its most recent airworthiness overhaul had been carried out on 28 August 2020, when it had 37,091 hours.

The aircraft has a wingspan of 35.8 metres, making it a category C aircraft according to ICAO's airport reference code set out in Chapter 1 of Annexe 14. The airport reference code is used to determine the operations of a specific airport complex.

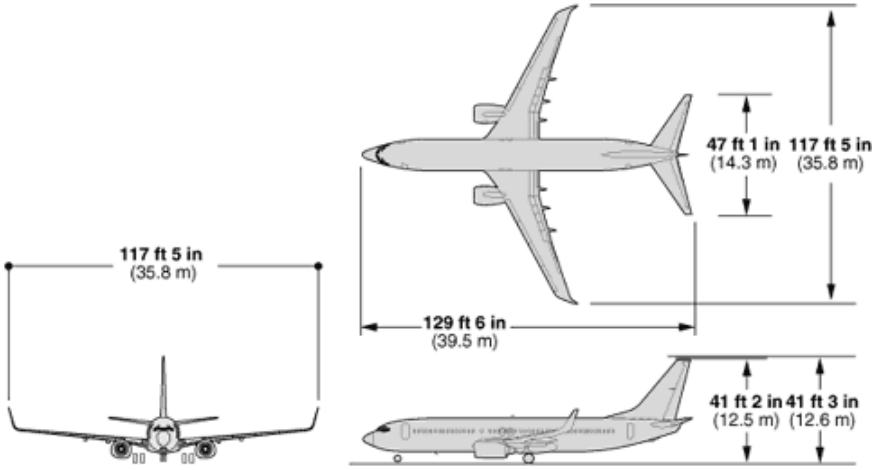


Illustration 1 Dimensions of the B737-800 aircraft

1.6.2. General information about the EC-MUP aircraft

The Beechcraft B200 aircraft with registration number EC-MUP and serial number BB-2014 was manufactured in 2009. It was equipped with two Pratt Whitney PT6A-42 engines.

It had an airworthiness certificate issued by AESA and an airworthiness review certificate valid until 07 August 2021. On the day of the incident, the aircraft had accumulated approximately 5,200 flight hours.

The aircraft was being maintained according to its approved maintenance programme, and its last overhaul was carried out on 24 July 2020, when it had 5,147 flight hours.

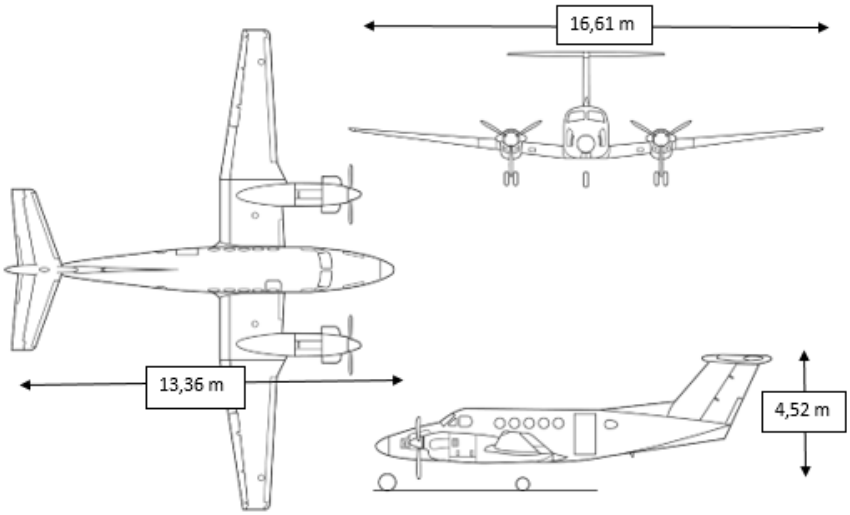


Illustration 2 Dimensions of the Beechcraft B200 aircraft

1.7. Meteorological information

The METAR for Málaga-Costa del Sol Airport (LEMG) at the time of the incident was as follows:

METAR LEMG 231600Z 19007KT 150V240 9999 FEW020 SCT060 22/13 Q1023 NOSIG

Wind direction 190º, variable between 150º and 240º, speed 7 kt. Visibility of 10 km or more, limited clouds at 2,000 ft and scattered clouds at 6,000 ft. Temperature 22ºC, dew point 13ºC and QNH 1,023 hPa. No significant changes in climatic phenomena expected.

On the day of the incident in the Málaga-Costa del Sol region, sunset was at 17:31 UTC. Therefore, the event, which took place at approximately 16:15 UTC (1 hour and 16 minutes before sunset), occurred in daylight conditions.

1.8. Aids to navigation

The Málaga control unit has a SACTA system (Automated Air Traffic Control System) for processing flight data and radar coverage in the area where the aircraft were flying. In addition, the data extracted from the flight recorders has been incorporated to add specificity to the information collected from the SACTA system. The most significant data relative to the aircraft involved in the incident is included below.

1.8.1. Information extracted from the SACTA system

The aircraft involved in the incident have the following identifiers:

- [RYR7YM]: Boeing B737-800 aircraft, registration EI-EBC, taking off.
- [UGC113B]: Beechcraft B200 aircraft, registration EC-MUP, on visual approach.

At 16:11:03 UTC, the radar trace shows the following sequence of aircraft on runway 13:

- 1st aircraft [ANE8269] lands - not involved in the incident.
- 2nd aircraft [RYR7YM] taxis
- 3rd aircraft [UGC113B] lands

The aircraft preparing to land are making a visual approach to Málaga-Costa del Sol Airport. The RYR7YM aircraft taking off is taxiing on taxiway A, on its way to the A3 intermediate holding point.

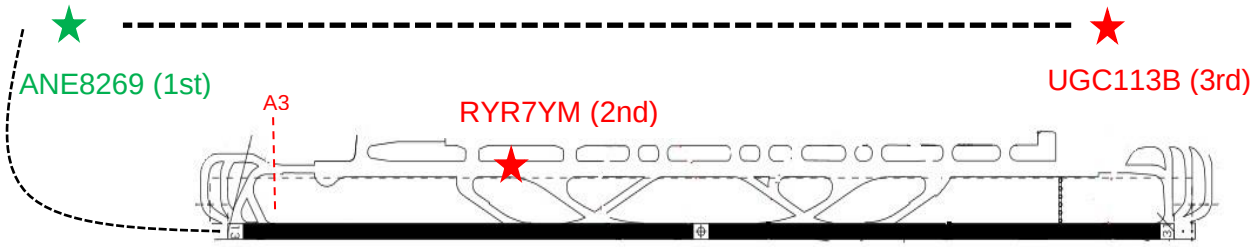


Illustration 3 Position of aircraft at 16:11:03 UTC

At 16:12:49 UTC, the trace shows aircraft RYR7YM at the A3 intermediate holding point and aircraft ANE8269, not involved in the incident, established on final at 7.8 NM from the threshold of runway 13.

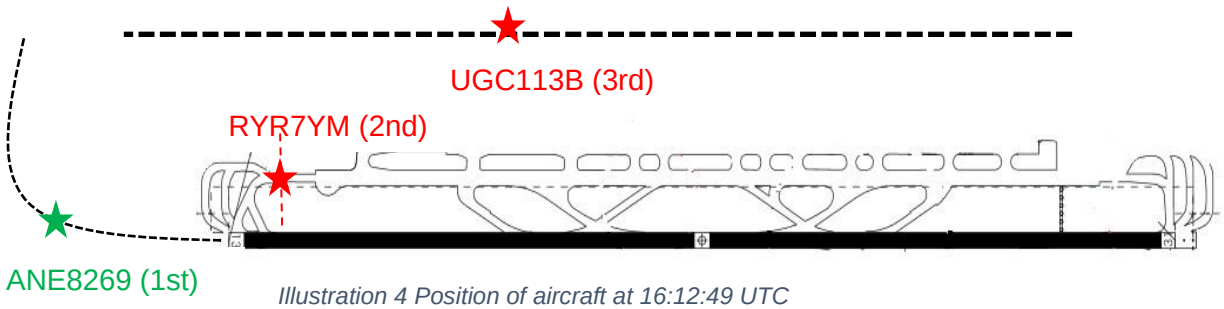


Illustration 4 Position of aircraft at 16:12:49 UTC

At 16:14:18 UTC, the trace shows aircraft RYR7YM at the HN-1R holding point. The first aircraft in the sequence, ANE8269, is established on final at 3 NM from the head of RWY 13.

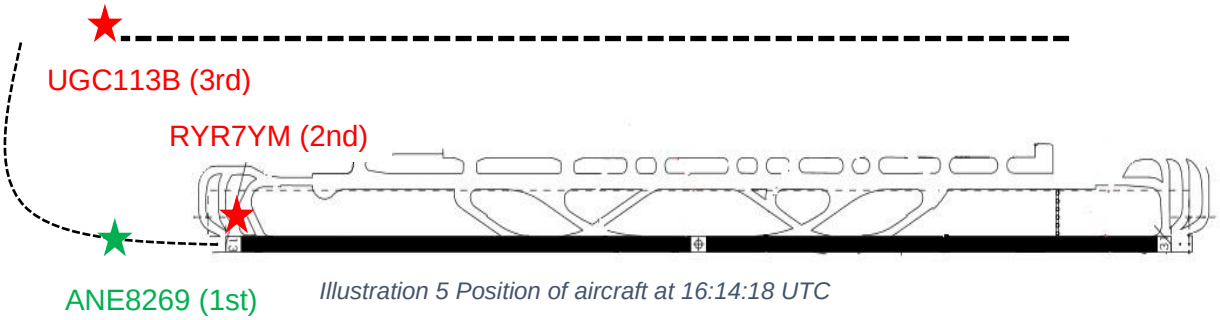


Illustration 5 Position of aircraft at 16:14:18 UTC

At 16:14:34 UTC, the trace shows aircraft RYR7YM at the HN-1R holding point. The first aircraft in the sequence, ANE8269, is established on final at 2.4 NM from the head of RWY 13, and the third aircraft in the sequence, UGC113B, is making a visual approach at 4.6 NM from the threshold of runway 13.

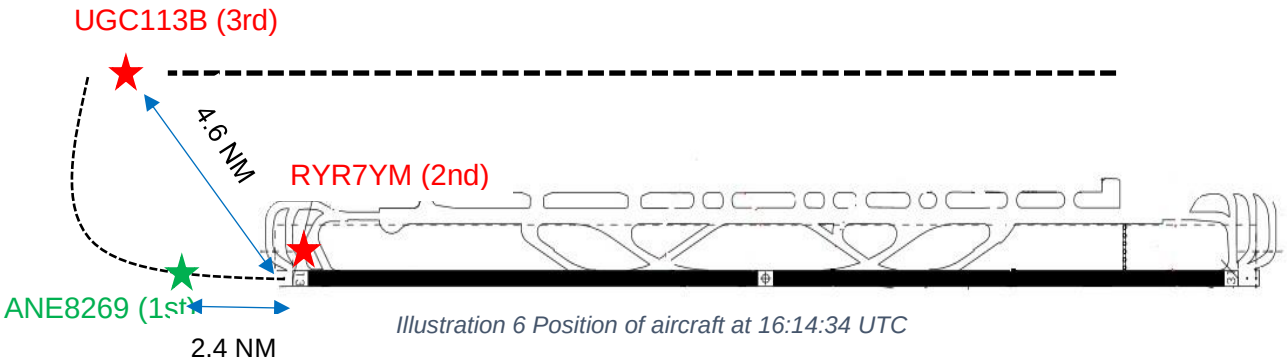


Illustration 6 Position of aircraft at 16:14:34 UTC

At 16:15:40 UTC, the trace shows aircraft RYR7YM at the HN-1R holding point. The first aircraft in the sequence, ANE8269, is overflying the threshold of RWY 13. The third aircraft in the sequence, UGC113B, is on the base leg of the aerodrome circuit, making a visual approach.

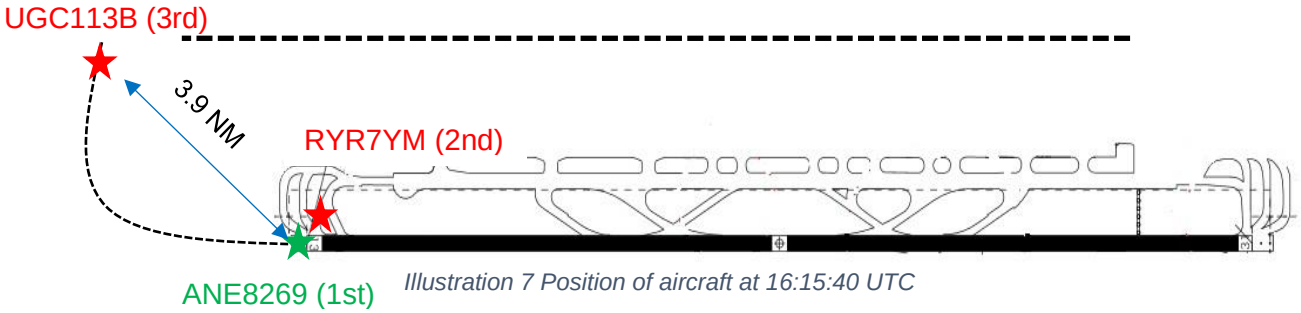


Illustration 7 Position of aircraft at 16:15:40 UTC

At 16:16:00 UTC, the trace shows aircraft RYR7YM moving beyond holding point HN-1R to line up at the head of runway 13. The first aircraft in the sequence, ANE8269, is landing on the first third of the runway. The third aircraft in the sequence, UGC113B, is on visual approach midway along the base leg of the aerodrome circuit.

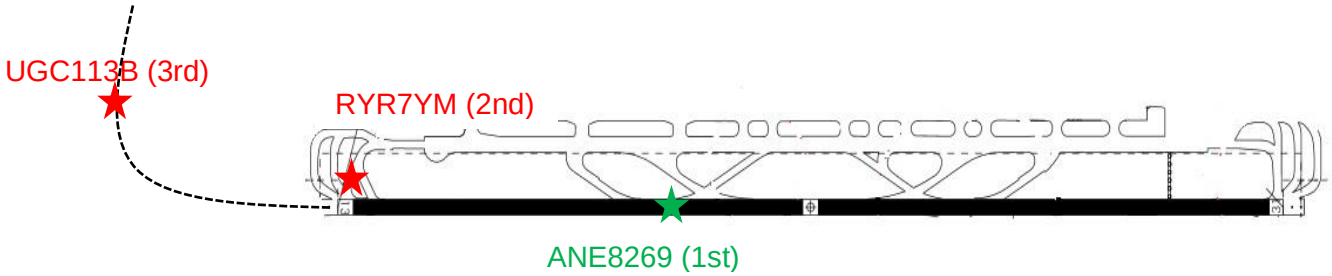


Illustration 8 Position of aircraft at 16:16:00

At 16:16:32 UTC, the trace shows aircraft RYR7YM aligned at the head of runway 13. The first aircraft in the sequence, ANE8269, is leaving the runway via the exit taxiway. The third aircraft in the sequence, UGC113B, is on short final at 2.2 NM from the threshold of the runway.

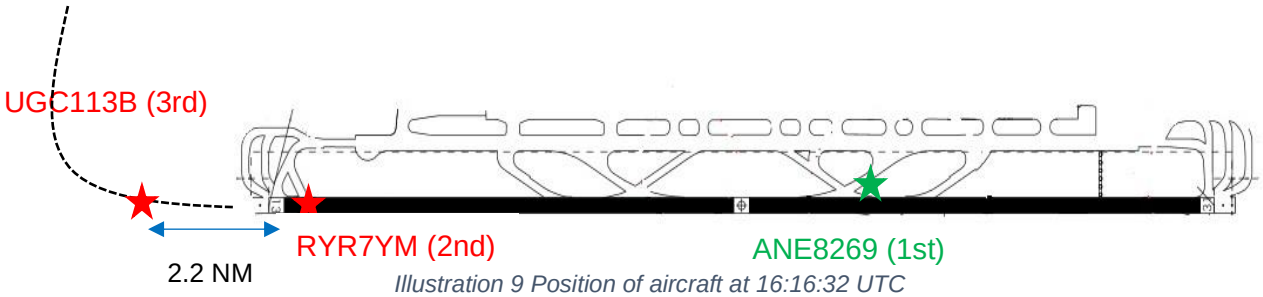


Illustration 9 Position of aircraft at 16:16:32 UTC

At 16:17:03 UTC, the trace shows aircraft RYR7YM initiating its take-off run at a speed of 20 kt. Aircraft UGC113B is on short final at 1 NM from the threshold of the runway, flying at a speed of 130 kt.

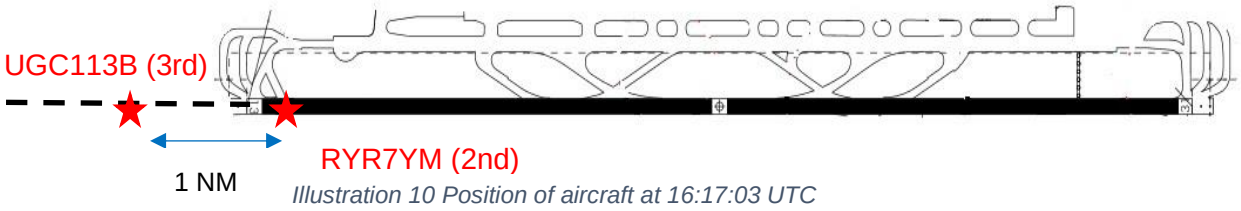


Illustration 10 Position of aircraft at 16:17:03 UTC

At 16:17:17 UTC, the trace shows aircraft RYR7YM on take-off run at a speed of 90 kt and aircraft UGC113B on short final proceeding at a speed of 130 kt. This was the point of minimum separation between the aircraft, it being 0.8 NM.

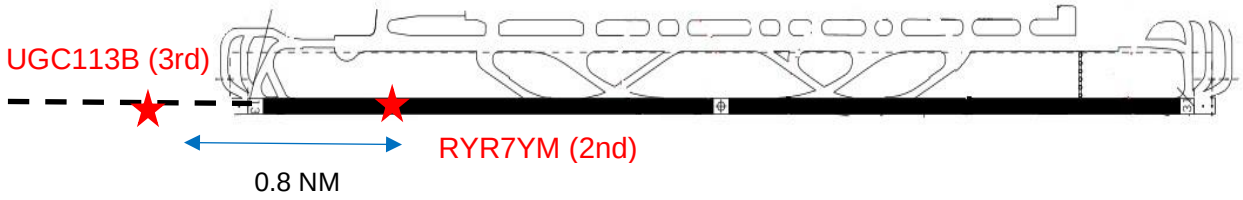


Illustration 11 Position of aircraft at 16:17:17 UTC

At 16:17:33 UTC, the trace shows aircraft RYR7YM on take-off run at a speed of 140 kt and aircraft UGC113B overflying the threshold of runway 13 at 300 ft AMSL and at a speed of 120 kt. At this point, the horizontal separation between the aircraft was 0.9 NM.

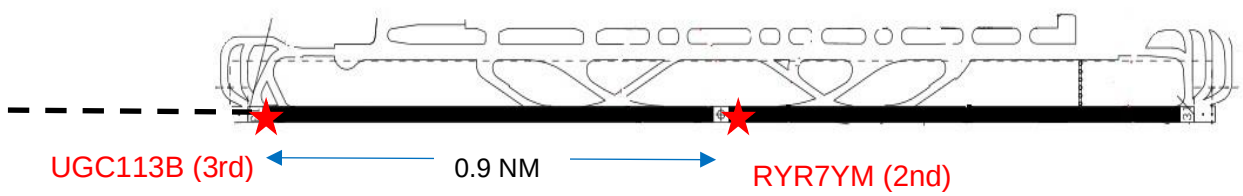


Illustration 12 Position of aircraft at 16:17:33 UTC

At 16:17:49 UTC, the trace shows aircraft RYR7YM climbing on take-off to 500 ft AMSL and aircraft UGC113B landing on the first third of the runway. At this point, the horizontal separation between the aircraft was 1.1 NM.

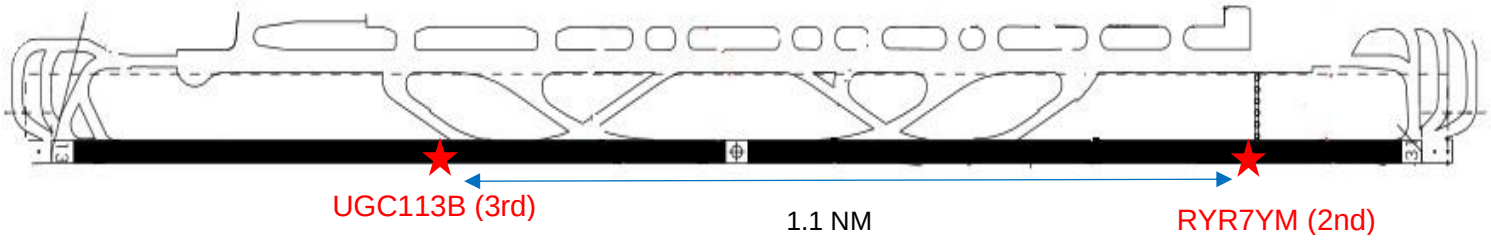


Illustration 13 Position of aircraft at 16:17:49 UTC

1.9. Communications

The investigation was able to access the communications between the aircraft and the local control frequency (LCL) during the event.

According to the communications records for the LCL control position on frequency 118.150 MHz, the air traffic controller used English to address the departing RYR7YM traffic and Spanish to address the approaching UGC113B traffic.

At 16:11:03 UTC, the LCL TWR LEMG controller instructed the aircraft with call sign RYR7YM to continue taxiing to the holding point on runway 13 and informed it that there was traffic on approach.

At 16:14:34 UTC, the LCL TWR LEMG controller contacted aircraft RYR7YM at holding point HN-1R and instructed it to line up and wait on runway 13 behind the traffic on short final.

At 16:15:40 UTC, the UGC113B aircraft established initial contact with the LCL TWR LEMG controller, reporting that it was on the left base leg of the aerodrome circuit.

At 16:15:47 UTC, the LCL TWR LEMG controller instructed aircraft UGC113B to continue the visual approach and informed it that an aircraft would depart prior to their landing.

At 16:16:32 UTC, the LCL TWR LEMG controller cleared aircraft RYR7YM for take-off when the UGC113B aircraft on approach was 2.2 NM from the threshold of runway 13.

At 16:17:09 UTC, the LCL TWR LEMG controller informed the approaching UGC113B traffic that the preceding traffic was on take-off run.

At 16:17:34 UTC, the LCL TWR LEMG controller cleared the UGC113B aircraft to land when it was over the threshold of runway 13 and aircraft RYR7YM was on take-off run, with 0.9 NM between them.

1.10. Information about the aerodrome

Málaga-Costa del Sol Airport is located 7 km to the southwest of the city of Málaga. General information about the runway access taxiways and the control positions is provided below.

1.10.1. General information about Málaga-Costa del Sol Airport

Málaga-Costa del Sol Airport (LEMG) is located at an elevation of 16 metres and has 2 runways, one designated 12-30 and the other 13-31. At the time of the event, the airport was operating with a single runway, with runway threshold 13 being used for both take-offs and landings. This is the airport's preferred configuration with a single runway in operation.

Runway 13-31 is 3.200 m long and 45 m wide.

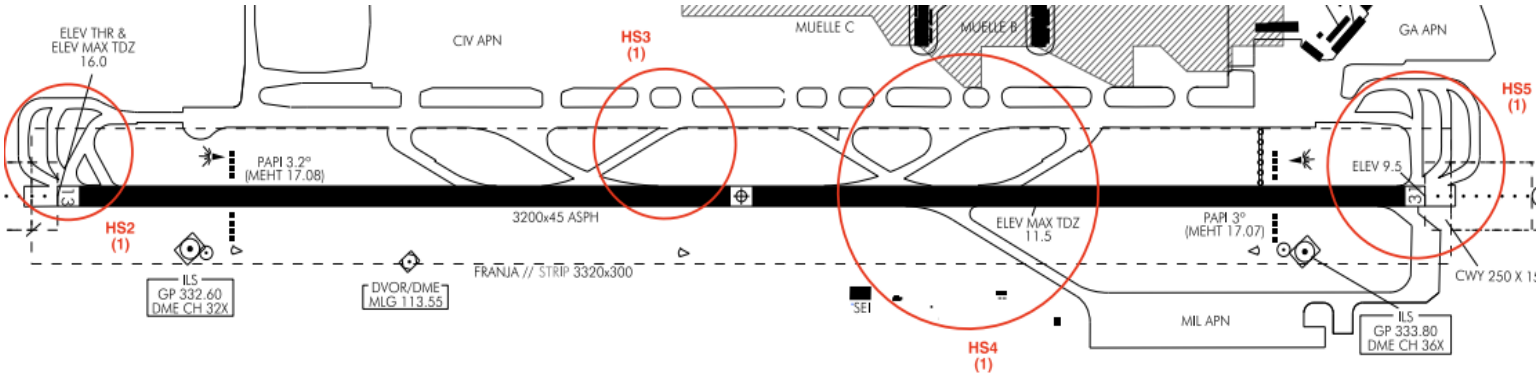


Illustration 14 Diagram RWY 13/31

The access taxiways to runway 13 are shown in the following diagram:

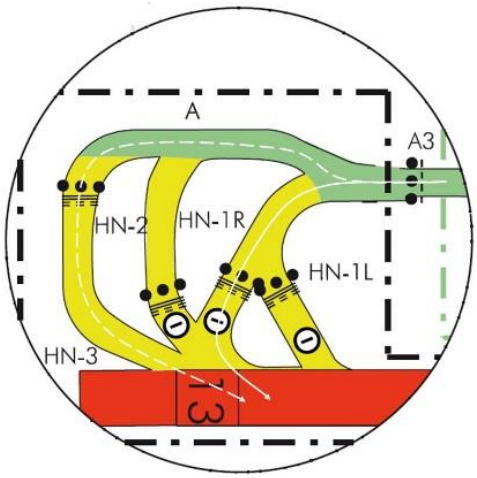


Illustration 15 Access taxiways to the head of runway 13

According to the information published in the AIP, the following precautions are established for taxiing aircraft:

"Bearing in mind the incompatibilities of the holding bay of RWY 13, all aircraft proceeding to RWY 13 shall initially taxi up to the corresponding intermediate holding position A3."

"Unless otherwise advised by ATC, access to RWY 13/31 shall be carried out preferably via HN-3 or HS-3, whenever only one aircraft is operating."

"HN-1R shall not be used except when so indicated by ATC."

The information published in the AIP also includes a procedure for the minimum runway occupation time for aircraft departures:

"Pilots should be ready for departure when reaching the runway-holding position.

On receipt of line-up clearance, pilots should ensure that they are able to taxi and line-up on the runway as soon as the preceding aircraft has commenced either its take-off run or landing roll.

Pilots should be able to commence the take-off run immediately when take-off clearance is issued.

Pilots unable to comply with this requirement shall notify ATC as soon as possible and await instructions. When appropriate, ATC could cancel the clearance and instruct the aircraft to vacate the runway."

1.10.2. Information about the control tower at Málaga-Costa del Sol Airport

At Málaga-Costa del Sol Airport, the control tower positions are distributed as follows:

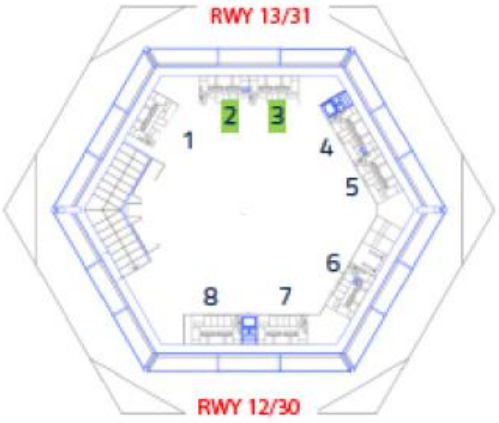


Illustration 16 Distribution of positions in the LEMG control tower

At the time of the event, the control tower cab was configured with two open positions. The LCL controller was in position 3 as of 15:05 UTC. The GMC-CLD controller was in position 2 from 15:09 UTC, handling taxiing and clearance.

1.10.3. Information on runway use configurations at Málaga-Costa del Sol Airport

According to the provisions published in the AIP, at Málaga-Costa del Sol Airport the number of runways in use will depend on traffic demand.

The South configuration is the preferred configuration, with one or two runways in use depending on traffic and capacity:

- Two Runway South Configuration: Arrivals RWY 12 and Departures RWY 13
- One Runway South Configuration: Arrivals and Departures RWY 13

At the time of the incident, the airport was operating in the One Runway South Configuration.

1.11. Flight recorders

The time synchronisation of the EI-EBC aircraft's Quick Access Data Recorder (QAR) was achieved using the aircraft's communications with the airport Control Tower.

1.11.1. Data recorder in the EI-EBC Aircraft

The EI-EBC aircraft with callsign RYR7YM was equipped with flight data recorders (FDR) and cockpit voice recorders (CVR). Due to the time that elapsed between the date of the incident and the date it was reported to the CIAIAC, we were unable to retrieve the information from either the CVR or the FDR. However, we were able to retrieve the information recorded by the Quick Access Recorder (QAR).

The most relevant data obtained from the QAR is detailed below:

- At 16:12:49 UTC, the aircraft is taxiing towards runway threshold 13, being at intermediate holding point A3.

- At 16.13:30 UTC, the aircraft is waiting at the HN-1R holding point of runway 13.

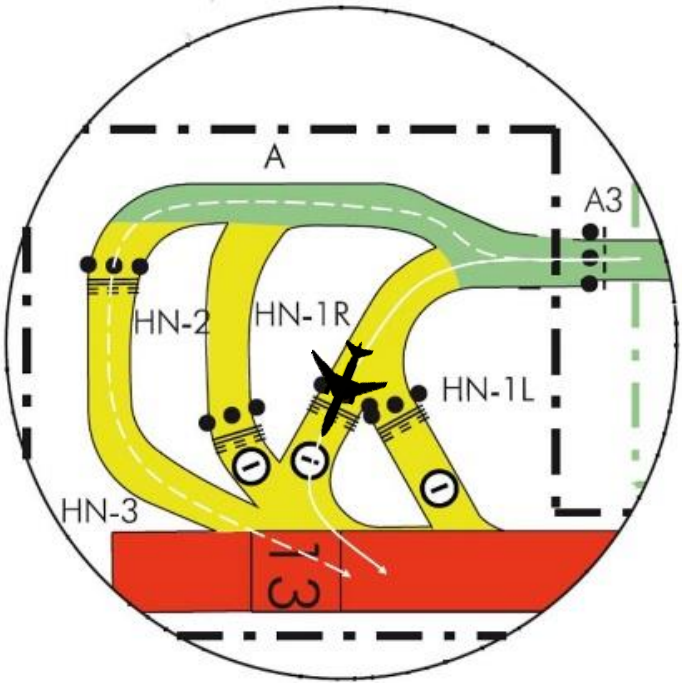


Illustration 17 Position of aircraft on take-off 16:13:30 UTC

- At 16:15:57 UTC, the aircraft is moving beyond holding point HN-1R, proceeding at a speed of 10 kt to line up at the threshold of runway 13.

- At 16:16:32 UTC, the aircraft lines up at the threshold of runway 13 and remains on standby.

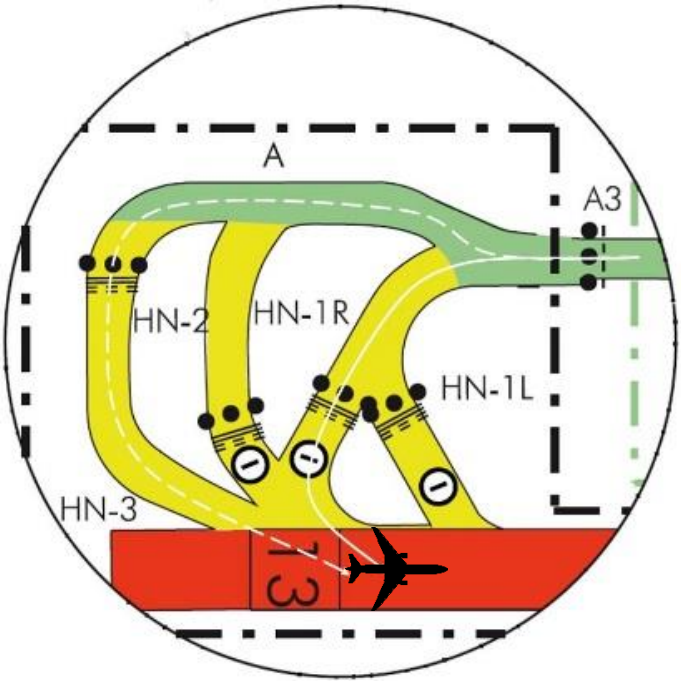


Illustration 18 Position of aircraft on take-off at 16:16:32 UTC

- At 16:17:01 UTC, the aircraft is lined up at the threshold of runway 13 and commencing the take-off run at 20 kt.

- At 16:17:29 UTC, the aircraft begins the rotation manoeuvre.

- At 16:17:49 UTC, the aircraft is in take-off climb proceeding to 500 ft AMSL.

1.12. Aircraft wreckage and impact information

N/A.

1.13. Medical and pathological information

N/A.

1.14. Fire

N/A.

1.15. Survival aspects

N/A.

1.16. Tests and research

1.16.1. Information provided by crews

The crew of the landing EC-MUP aircraft reported to the CIAIAC that as they were about to make the turn from base to final during their visual approach, the air traffic controller instructed a traffic to enter and hold on runway 13. The air traffic controller then cleared this traffic for take-off.

The crew of the landing EC-MUP aircraft stated that they reduced speed as much as possible to accommodate the departing traffic, and that as they passed over the threshold of runway 13, the air traffic controller cleared them to land. The crew also stated that they had the preceding taxiing traffic in sight at all times and were ready to perform an evasive manoeuvre if necessary.

For their part, the crew of the EI-EBC aircraft taking off stated that they were unaware of the incident, as they did not receive any information about it from the air traffic controller, nor did they have visual contact with the approaching aircraft behind them.

1.17. Organisational and management information

1.17.1. LEMG operating manual - single-runway operations

Unit-specific procedures are described in Annexe B of the LEMG operating manual. Chapter 6 establishes the local LEMG TWR procedures and, in particular, single-runway operations:

6.4.5 Operaciones en pista única: separación entre arribadas y salidas autorizadas a despegue inmediato

Con carácter general, se tendrá en consideración que:

- En su caso, la autorización de despegue se expedirá cuando la aeronave esté lista y próxima a la pista, evitando autorizaciones de despegue excesivamente tempranas.
- Puede concederse la autorización de aterrizar a una aeronave sólo si se tiene un grado razonable de seguridad de que la separación reglamentaria existirá cuando dicha aeronave cruce el umbral de la pista en uso.
- Salvo que aplique lo indicado en RCA 4.5.11 o RCA 4.5.15, no se permitirá cruzar el umbral de la pista, en su aproximación final, a ninguna aeronave que vaya a aterrizar hasta que la aeronave precedente en despegue haya cruzado el extremo de la pista en uso o haya iniciado un viraje.
- Se concederá la autorización de aterrizaje con la mayor antelación posible, normalmente antes de que la arribada alcance la posición de 1 NM en final.
- Tan pronto se prevea que la autorización vaya a concederse más tarde, se dará información de tránsito y se instruirá a la aeronave a que continúe aproximación.

Con la mayor antelación posible, una vez valorados los factores anteriores y determinada la viabilidad de la secuencia salida-arribada, el CTA realizará la siguiente secuencia de actuaciones:

1. Informar a la arribada de que se va a producir un despegue, o en su caso, de la secuencia en el uso de la pista que puede esperar.
2. Si procede, preguntar si tiene al tráfico en salida a la vista y solicitar que se ajuste.
3. Informar a la aeronave de salida de la posición que ocupa la arribada y de su velocidad si se considera necesario, y preguntar si se encuentra lista para despegue inmediato (antes de entrar en pista).
4. En caso de que responda afirmativamente, y si se considera que existe un tiempo suficiente para realizar el ajuste, autorizar a despegue inmediato.
5. Vigilar la evolución de ambas aeronaves con los medios disponibles incluido el sistema de vigilancia ATS de modo que, si se prevé que pueda perderse la separación reglamentaria entre ambas aeronaves, se cancele preferentemente la autorización de despegue, evitando en lo posible detener el despegue una vez haya iniciado la carrera de despegue.
6. En caso de que, después de dar una autorización de despegue o una autorización de aterrizaje, el CTA advierta que pudiera infringirse la separación reglamentaria indicada, actuar con la mayor celeridad aplicando las siguientes medidas según sea procedente:
    1. **Cancelar o detener el despegue, según proceda** (ver fraseología en RCA 4.10.3.4.12).
    2. **Motor y al aire** (ver fraseología en RCA 4.10.3.4.19).

1.17.2. LEMG operating manual - north holding bay use (runway head 13)

Unit-specific procedures are described in Annexe B of the LEMG operating manual. Chapter 6 establishes the local LEMG TWR procedures and, in particular, the use of the holding bay at the head of runway 13:

6.6.3.1 Uso del apartadero norte (cabecera 13)

El apartadero norte (cabecera 13) presenta las siguientes particularidades:

- La barra de parada HN-3 está a una distancia de eje de pista mayor de lo habitual con el fin de garantizar que no se vulneren ni la zona despejada de obstáculos de la superficie de aproximación; ni la superficie de ascenso en el despegue; ni el área crítica/sensible del ILS.
- El acceso a pista para alinear desde HN-3 tiene una pendiente en ascenso que reduce la velocidad de rodaje hasta la pista.

Por ello, cuando dicha cabecera 13 esté en uso y se tengan que hacer ajustes entre arribadas y despegues, LCL tendrá en cuenta:

- Extremar la precaución a la hora de realizar ajustes entre arribadas y salidas desde HN-3.
- Consultar al tráfico de salida si está listo para inmediato, en caso afirmativo, informar de la posición del tráfico de arribada.
- En caso de despegue entre dos arribadas, utilizar siempre la fraseología:

  TINAIR 1234, DETRÁS DEL BOEING 737 DE IBERIA EN FINAL, ENTRE Y MANTENGA PISTA 13 Y ESPERE. DETRÁS.
  TINAIR 1234, BEHIND THE BOEING 737 IBERIA ON SHORT FINAL, LINE UP RUNWAY 25 AND WAIT. BEHIND.

- En caso de que con alta demanda de tráfico haya que ajustar tráficos de salidas y arribadas, sería recomendable utilizar principalmente los apartaderos (HN-2 y HN-1 R/1 L) teniendo en cuenta las incompatibilidades de aeronaves en apartaderos publicadas en AIP-España AD2-LEMG Ítem 20.

1.17.3. LEMG operating manual - holding bay management

Unit-specific procedures are described in Annexe B of the LEMG operating manual. Chapter 6 establishes the local LEMG TWR procedures and, in particular, the airfield configurations.

As indicated in the SOUTH ONE-RUNWAY configuration, the holding bay and the management and assignment of the runway access taxiway is the responsibility of the LCL controller. The GMC controller transfers the aircraft to LCL when they arrive at A3 so that LCL can organise the take-off sequence.

1.17.4. LEMG operating manual - Use of a single language in ground-to-air communications

Unit-specific procedures are described in Annexe B of the LEMG operating manual. Chapter 6 establishes the local LEMG TWR procedures and, in particular, the use of a single language for communications:

6.20 Uso del idioma único en las comunicaciones tierra-aire

Siempre que en la/s frecuencia/s bajo la/s que se encuentra el área de maniobras exista un piloto que no sea de habla castellana, será obligatorio el uso del inglés en las comunicaciones tierra-aire entre aeronave y dependencia ATS; sin perjuicio de la aplicación de lo establecido en SERA.2010 'Responsabilidades del piloto al mando' y de las decisiones que adopte el piloto al mando en tales circunstancias, así como ante las situaciones de emergencia que puedan surgir a bordo de la aeronave, y de la adopción por el CTA de las medidas que estime necesarias para mantener la seguridad.

Esto es de aplicación, cuando corresponda, en los escenarios operativos descritos en el Anexo IV del RD. 1180/2018:

1. Las siguientes operaciones de aterrizaje y despegue:
   a. Autorizaciones de aterrizaje con tráfico en el punto de espera.
   b. Autorizaciones de despegue con tráfico en final.
   c. Autorizaciones para entrar y alinear desde puntos de espera congestionados.
2. Las operaciones en que haya aeronaves que transiten por la pista activa, pero que no vayan ni a aterrizar o a despegar. Típicamente estas operaciones son de rodaje por la pista activa o cruce de la pista activa.
3. Las operaciones con Procedimientos de Baja Visibilidad (LVP), VIS3, activados.

En los escenarios operativos anteriores podrá utilizarse el castellano en las comunicaciones tierra–aire entre las dependencias de control de tránsito de aeródromo y los vuelos que operan conforme a las reglas de vuelo visual (VFR), siempre que los pilotos no dispongan de competencia lingüística en inglés.

1.17.5. Capacity control procedure at LEMG

The ATC (TWR) Capacity refers to the number of operations per unit of time that the control tower can manage, taking into account the control positions, infrastructures and the associated technical means.

The ATC (APP) Capacity refers to the number of aircraft that can be safely accepted in the airspace during a set unit of time.

Airport capacity refers to the number of operations (arrivals, departures and totals) associated with the airport infrastructure, i.e., the airfield and runway system. This capacity is determined by AENA, as the airport manager.

Declared Capacity is the maximum permitted traffic flow within a specific unit of time that can be maintained over time in accordance with the safety requirements.

Maximum Capacity is the maximum permitted traffic flow within a specific unit of time (usually one hour) that cannot be sustained over a long period of time. It is calculated by increasing the declared capacity by 10% for a period not exceeding 1 hour.

The Declared Capacity is the lowest of the following three values for any given period:

- ATC (TWR) capacity
- ATC (APP) capacity
- Airport capacity

The ATC (APP) capacity, defined by ENAIRE for the different sectors that make up Málaga Approach, is as follows:

REGIÓN SUR			
MÁLAGA APROXIMACIÓN			
SECTOR	**VOL**	**CAP**	**OBSERVACIONES**
LEMGANM SFC - FL145	MGSUR	30	Sector Elemental. Se reduce la capacidad a 25, por Área de Bloqueo con dos pistas. Se reduce la capacidad a 25 con pista única.
	MGW		
LEMGAPM SFC - FL145	MGCEN	25	
	MGE		
	MGSUR		
	MGW		
LEMGASM SFC - FL145	MGCEN	30	Sector Elemental. Se reduce la capacidad a 25 con pista única.
	MGW		
LEMGDNM SFC - FL145	MGCEN	30	Sector Elemental. Se reduce la capacidad a 25 con pista única.
	MGE		
LEMGDSM SFC - FL145	MGE	30	Sector Elemental. Se reduce la capacidad a 25 con pista única.
	MGSUR		

As can be seen from the previous table, for a single-runway configuration, the ATC (APP) capacity is 25 operations per hour

The ATC (TWR) capacity, defined by ENAIRE for Málaga-Costa del Sol, is as follows:

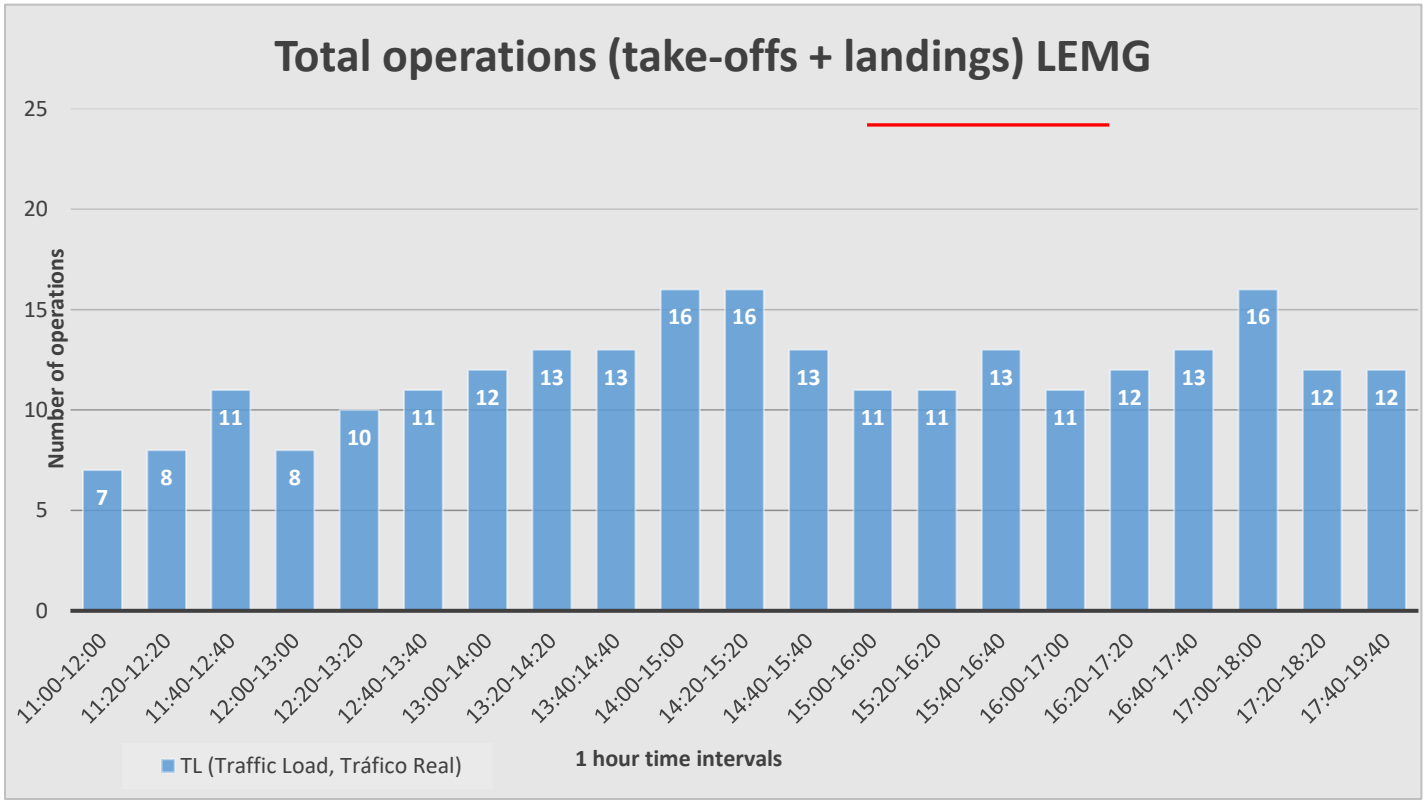
Servicio de control de tránsito aéreo prestado	Número de pistas	Número de posiciones de control abiertas	Número de movimientos IFR por hora		
			Totales	Llegadas	Salidas
Aeródromo	2	5	60	35	35
		4	50	28	28
		3	35	19	19
		2	23	14	14
	1	3	37	24	24
		2	24	16	16
		1	12	8	8

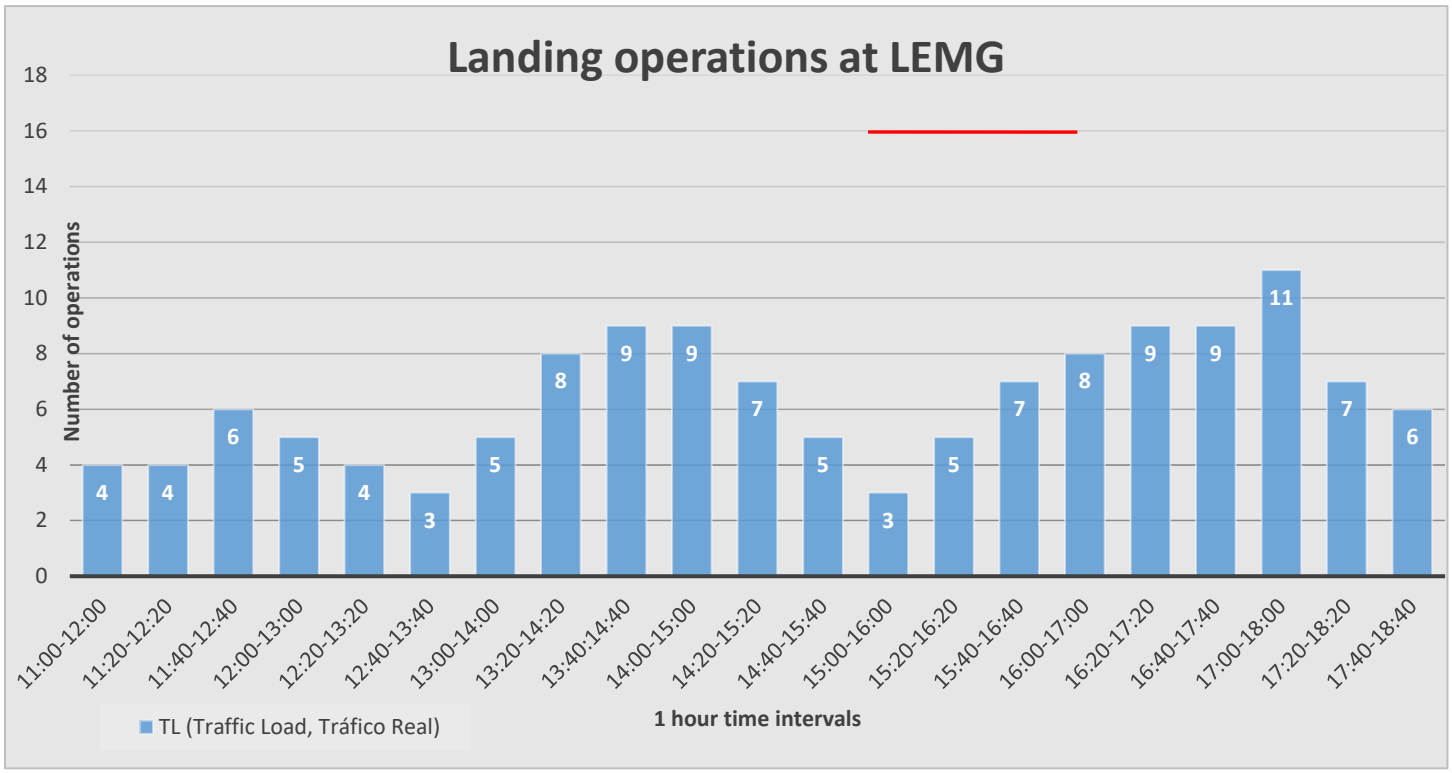
According to the above table, when operating with a single runway and 2 open control positions, the ATC capacity is 24 total operations per hour, 16 departures per hour and 16 arrivals per hour.

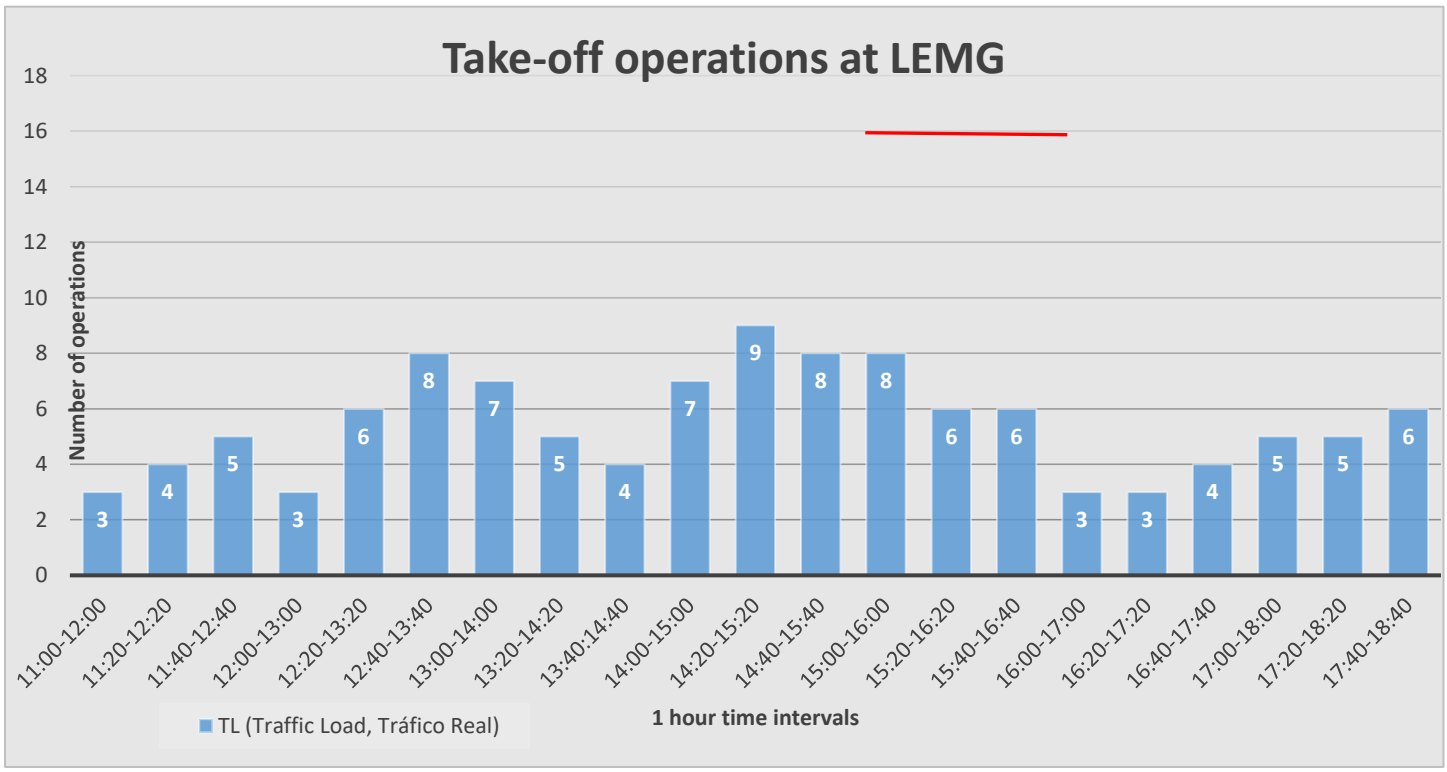
Thus, for 1 open runway and 2 control positions, the most restrictive capacity is the ATC (TWR) capacity and, therefore, it is also the Declared Capacity.

The capacity information provided by ENAIRE with respect to the traffic data (arrivals and departures) in Málaga-Costa del Sol on the day of the incident (23 October 2020) is analysed in the graphs below, which show the following parameters:

- Real traffic
- Limit in red: Declared capacity at 16:15 UTC (24 total operations/hour, 16 departures/hour and 16 arrivals/hour)




Landing operations at LEMG
Number of operations
18
16
14
12
10
8
6
4
2
0
4
4
6
5
4
3
5
8
9
9
7
5
3
5
7
8
9
9
11
7
6
11:00-12:00
11:20-12:20
11:40-12:40
12:00-13:00
12:20-13:20
12:40-13:40
13:00-14:00
13:20-14:20
13:40:14:40
14:00-15:00
14:20-15:20
14:40-15:40
15:00-16:00
15:20-16:20
15:40-16:40
16:00-17:00
16:20-17:20
16:40-17:40
17:00-18:00
17:20-18:20
17:40-18:40
TL (Traffic Load, Tráfico Real)
1 hour time intervals


Take-off operations at LEMG
Number of operations
18
16
14
12
10
8
6
4
2
0
3
4
5
3
6
8
7
5
4
7
9
8
8
6
6
3
3
4
5
5
6
11:00-12:00
11:20-12:20
11:40-12:40
12:00-13:00
12:20-13:20
12:40-13:40
13:00-14:00
13:20-14:20
13:40:14:40
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14:20-15:20
14:40-15:40
15:00-16:00
15:20-16:20
15:40-16:40
16:00-17:00
16:20-17:20
16:40-17:40
17:00-18:00
17:20-18:20
17:40-18:40
TL (Traffic Load, Tráfico Real)
1 hour time intervals

1.18. Additional information

1.18.1. Similar incidents at Málaga-Costa del Sol Airport

The following is a list of the loss-of-separation incidents (either between arrivals and take-offs or between arrivals only) that have taken place with the single-runway configuration in force at Málaga-Costa del Sol, since 2019. A distinction can be made between insufficient separation (where the minimum regulatory separation is not violated) and loss of regulatory separation (where both aircraft are simultaneously flying over the same runway)

They are classified into two groups:

The first group catalogues events in which, due to a loss of separation between aircraft, ATC had to intervene to prevent two aircraft from coinciding on the runway simultaneously.

Date	Distance	Severity	Comments
01/01/2019	-	-	Go-around A/C due to insufficient separation (ATC INITIATIVE)
04/02/2019	-	-	Go-around A/C due to insufficient separation (ATC INITIATIVE)
17/03/2019	-	-	Go-around A/C due to insufficient separation (ATC INITIATIVE)
08/08/2019	-	-	Go-around A/C due to insufficient separation (ATC INITIATIVE)
07/10/2019	-	-	Go-around A/C due to insufficient separation (ATC INITIATIVE)
26/12/2019	2 NM	-	Go-around A/C due to insufficient separation (ATC INITIATIVE)
28/02/2020	-	ENAIRE severity level C (Significant Incident)	Go-around A/C due to insufficient separation (ATC INITIATIVE)
12/09/2020	1.1 NM	ENAIRE severity level E (Significant Incident)	Go-around A/C due to insufficient separation (ATC INITIATIVE)
22/12/2020	-	ENAIRE severity level E (Significant Incident)	Go-around A/C due to insufficient separation (ATC INITIATIVE)

The second group catalogues events in which, due to a loss of separation between aircraft, the crew decided to execute a go-around, or an incursion took place due to two aircraft coinciding on the runway simultaneously. The severity designated either by CEANITA (Commission for the study and analysis of air traffic incident reports) or by ENAIRE (air navigation service provider) has been included. In both cases, it is the overall severity associated with each event, using RAT (Risk Analysis Tool) methodology designed to classify air safety-related events in the field of air traffic.

Date	Distance	Severity	Comments
23/01/2019	-	-	Go-around A/C due to insufficient separation (A/C INITIATIVE)
26/04/2019	0.6 NM & 400 ft	CEANITA severity level A4 (Major Incident)	Go-around A/C due to insufficient separation (A/C INITIATIVE)
17/07/2019	-	-	Go-around A/C due to insufficient separation (A/C INITIATIVE)
11/09/2019	519 m	CEANITA severity level A3 (Major Incident)	Loss of separation between arrival and take-off
15/09/2019	0.8 NM	CEANITA severity level B3 (Major Incident)	Loss of separation between arrival and take-off
24/09/2019	0.4 NM	CEANITA severity level B3 (Major Incident)	Loss of separation between arrival and take-off

27/09/2019	0.87 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation detected by ENAIRE's automated tools
11/10/2019	0.5 NM & 1000 ft	ENAIRE severity level C4 (Significant Incident)	Go-around A/C due to insufficient separation (A/C INITIATIVE)
22/10/2019	1.3 NM	ENAIRE severity level C3 (Significant Incident)	Loss of separation detected by ENAIRE's automated tools
25/10/2019	0.79 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation detected by ENAIRE's automated tools
26/10/2019	1.3 NM	ENAIRE severity level C3 (Significant Incident)	Loss of separation detected by ENAIRE's automated tools
30/10/2019	1.24 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation detected by ENAIRE's automated tools
07/11/2019	1.23 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation detected by ENAIRE's automated tools
03/01/2020	-	ENAIRE severity level C (Significant Incident)	Loss of separation detected by ENAIRE's automated tools
23/01/2020	-	ENAIRE severity level C (Significant Incident)	Loss of separation detected by ENAIRE's automated tools
14/02/2020	-	ENAIRE severity level C (Significant Incident)	Loss of separation detected by ENAIRE's automated tools
21/02/2020	1.1 NM	ENAIRE severity level E (Significant Incident)	Runway incursion due to the simultaneous presence of 2 arrivals
12/03/2020	0.9 NM	ENAIRE severity level C (Significant Incident)	Loss of separation detected by ENAIRE's automated tools
19/07/2020	0.9 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation between arrival and take-off
15/08/2020	1.3 NM	ENAIRE severity level C3 (Significant Incident)	Loss of separation between arrival and take-off
15/08/2020	1.2 NM	ENAIRE severity level C3 (Significant Incident)	Loss of separation between arrival and take-off
18/09/2020	1.3 NM & 500 ft	ENAIRE severity level C (Significant Incident)	Loss of separation between arrival and take-off
23/10/2020	0.9 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation between arrival and take-off
31/10/2020	1.5 NM	ENAIRE severity level C1 (Significant Incident)	Loss of separation between arrival and take-off
17/07/2021	0.6 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation between arrival and take-off
17/07/2021	0.8 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation between arrival and take-off
20/07/2021	1 NM	ENAIRE severity level C3 (Significant Incident)	Loss of separation between arrival and take-off
15/08/2021	1.3 NM	ENAIRE severity level C (Significant Incident)	Loss of separation between arrival and take-off
06/09/2021	1.1 NM	ENAIRE severity level C (Significant Incident)	Loss of separation between arrival and take-off
26/10/2021	0.8 NM	ENAIRE severity level B1 (Major Incident)	Loss of separation between arrival and take-off
29/12/2021	< 1.7 NM	ENAIRE severity level C4 (Significant Incident)	Loss of separation between arrival and take-off
01/01/2022	0.8 NM	ENAIRE severity level B3 (Major Incident)	Loss of separation between arrival and take-off
21/01/2022	1.3 NM	ENAIRE severity level C (Significant Incident)	Loss of separation between arrival and take-off
22/04/2022	0.9 NM	ENAIRE severity level B4 (Major Incident)	Loss of separation between arrival and take-off

Since 2019, a total of 43 events involving a loss of separation between aircraft in the single-runway configuration have been reported to the National Incident System.

Of these, in the 4 events indicated in yellow, the approaching aircraft performed a go-around manoeuvre at the initiative of the flight crew itself.

The 13 events indicated in red involved a situation where the distance between the aircraft landing and the aircraft taking off was less than 1NM.

In addition to this report (IN-044-2020) on the 23 October 2020 incident, the CIAIAC has finalised and published report number IN-049-2019 on the incident that took place on 11 September 2019.

Due to the recurrence of these events, ENAIRE implemented a "second LEMG Action Plan", finalising the measures in February 2021. The table above shows that between November 2020 and July 2021, there were no loss of separation events reported. However, between July 2021 and April 2022, there were 10 new incidents involving a loss of separation between aircraft, 5 of which involved a distance of less than 1 NM between traffic.

1.18.2. Contributing factors detected by ENAIRE

According to ENAIRE, their internal investigations identified both individual and systemic factors in the cases analysed. The organisation also detected a relatively well-extended unit sub-culture of using work modes associated with traffic adjustments.

The systemic aspects detected by ENAIRE are summarised below:

- Historical factors: reduced runway separation procedures applied until 2017 in the Málaga unit that led to inertia in work modes

- Organisational factors: The ATC unit training plan does not reflect specific training scenarios for changes of plan or strategies for mitigating cognitive biases. The regulations do not explicitly require this. Furthermore, the operating manual contains general guidelines for separation between departures and arrivals but does not include specific criteria for whether or not these adjustments are allowed.

- Proximal factors: Operational pressures when handling departures, self-induced pressure to take advantage of gaps in arrivals and a tendency to use nominal gaps of 7NM for 2 departures.

- Human factors: Expectation bias on the crew’s response to immediate take-off clearance, plan continuity bias, aversion to cancelling take-off clearances and poor risk perception as separations of less than one runway are not deemed significant enough to be reported.

1.18.3. Corrective measures applied by ENAIRE

On 24 October 2019, the first “LEMG Action Plan” prepared by ENAIRE came into force. After having recorded high severity incidents involving a loss of separation between traffics operating on the same runway, ENAIRE proposed the action plan to monitor operations at LEMG and identify any systemic factors that may have contributed to the events.

In a preliminary analysis, ENAIRE detected unreported incidents involving significant violations of the safety margins. For this reason, the organisation decided to install an automated detection tool to ensure that any losses of separation between aircraft would be identified.

ENAIRE implemented 11 corrective measures, with the last being finalised in February 2020. The implementation of the corrective measures is shown in the following table:

Code	Action	Date
AC1	Communication with actors involved	
AC2	Meeting with the head of ATS LEMG	November 2019
AC3	Semi-automated monitoring of operations	December 2019
AC4	Opening of investigations	December 2019
AC5	Real-time operation observation	December 2019
AC6	Meeting with supervisors	November 2019
AC7	Meeting with instructors	November 2019
AC8	Dissemination DSEGU criteria	November 2019
AC9	Culture reinforcement	February 2020
AC10	Standardised notification request	November 2019
AC11	Feedback in the unit	February 2020

As a result of a series of incidents in July 2020 involving safety margin violations between arrivals and a previous departure, ENAIRE implemented a second package of actions that came into effect on 08 October 2020. The actions were structured in 3 large blocks:

- Dissemination and awareness
- Operational support
- Operational reinforcement in the control tower cab

Dissemination and Awareness Actions		
Code	**Action**	**Date**
DIV1	Follow-up meetings	December 2020
DIV2	EAPPRI / RAT presentations	January 2021
DIV3	Cognitive bias and risk perception presentations	February 2021
DIV4	Reference material	January 2021

Operational support actions		
Code	**Action**	**Date**
OPS1	Recommendations based on timings and distance	October 2020
OPS2	General recommendations guide	October 2020
OPS3	Specific LEMG recommendations guide	November 2020
OPS4	Criteria to support single runway decision-making	November 2020
OPS5	Dissemination / training on the recommendation guides	February 2021
OPS6	Dissemination to airlines	December 2020

Operational reinforcement actions in the control tower cab		
Code	**Action**	**Date**
REF1	Communications to supervisors	November 2020
REF2	ATC technician	September 2020
REF3	Briefings	December 2020
REF4	Printing of the guides	December 2020

Between November 2020 (and after the completion of the "second LEMG action plan" in February 2021) and July 2021, no loss of separation events were reported. However, despite the second LEMG action plan being completed, between July 2021 and April 2022, there were 10 new incidents involving a loss of separation between aircraft, 5 of which involved a distance of less than 1 NM between traffic.

1.18.4. Air Traffic Regulation provisions regarding the separation of aircraft using the same runway

The consolidated text of the Air Traffic Regulations (Royal Decree 57/2002 of 18 January) establishes the procedures for air navigation services in its Fourth Book. Specifically, chapter 5 (aerodrome control service) sets out the provisions for the separation of aircraft using the same runway.

Provision 4.5.10.1.1:

"as a general rule, no aircraft on its final approach to land will be allowed to cross the runway threshold until the preceding aircraft taking off has passed over the end of the runway in use (B), initiated a turn (C) or until any recently landed aircraft (D) have cleared the runway."

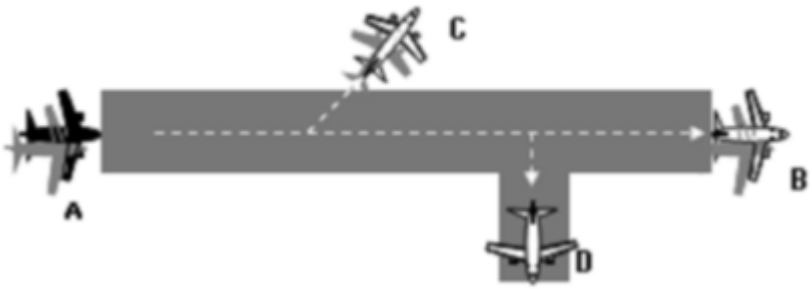


Illustration 19 Definition of free runway in the Air Traffic Regulations

1.18.5. ICAO runway incursion prevention manual

In appendix C, "Best practices in air traffic control", of the ICAO runway incursion prevention manual (Doc 9870), the following practices to avoid runway incursions are recommended:

- **Taxi Instructions:**

"Taxi instructions issued by a controller must always include a clearance limit, which is the point where the aircraft must stop until it receives an instruction to proceed."

1.18.6. Recommendations and best practices to mitigate possible inadequate separations between instrument or visual departures and missed approaches

Spain's National Aviation Safety Agency, AESA, publishes document RECS-2015/003/2.0 with recommendations and best practices to minimise the occurrence of inappropriate separations in those cases where they cannot guarantee compliance with the regulatory level of separation between outbound and inbound traffic.

Among the recommendations and best practices included, the following are aimed at ATC service providers:

"IT IS RECOMMENDED that should the aerodrome control service realise that the distance between the approaching aircraft and the one cleared for take-off is considerably reduced, potentially resulting in a violation of the regulatory runway separation provision, it should cancel the take-off and instruct the approaching aircraft to perform a missed approach, avoiding, as far as possible, cancellations during the take-off run."

"IT IS RECOMMENDED that if the aerodrome control service intends to authorise a departure when the approaching traffic could lead to a situation whereby the separation between the two aircraft will not be much more than the established minimum, check with the departing aircraft before clearing it to enter the runway. Doing so will increase certainty when organising the runway sequence and improve safety."

"IT IS RECOMMENDED that Aerodrome Control Air Navigation Providers prepare and include procedures, performance criteria and best practices for the management of separations between arrivals and departures cleared for immediate take-off during single-runway operations, in the unit's control tower operating manuals."

1.18.7. Regulations applicable to the use of ground-to-air communications

The European Commission Implementing Regulation (EU) 2016/1185 amending Implementing Regulation (EU) No 923/2012 as regards the update and completion of the common rules of the air and operational provisions regarding services and procedures in air navigation, sets out the following provision:

"SERA.14015 Language to be used in ground-to-air communication

b) The English language shall be available, on request of any aircraft, at all stations on the ground serving designated aerodromes and routes used by international air services. ***Unless otherwise prescribed by the competent authority for specific cases, the English language shall be used for communications between the ATS unit and aircraft, at aerodromes with more than 50 000 international IFR movements per year.*** *Member States, where at the date of entry into force of this Regulation, the English language is not the only language used for communications between the ATS unit and aircraft at such aerodromes, may decide not to apply the requirement to use the English language and inform the Commission accordingly. In that case, those Member States shall, by 31 December 2017 at the latest, conduct a study on the possibility to require the use of the English language for communications between the ATS unit and aircraft at those aerodromes for reasons of safety, so as to avoid incursions of aircraft on an occupied runway or other safety risks, while taking into account the applicable provisions of Union and national law on the use of languages. They shall make that study public and communicate its conclusions to the Agency and the Commission.*

In order to introduce the relevant amendments to national regulations and bring them into line with the amendments introduced by the Community regulations, Royal Decree 1180/2018, of 21 September, which implements the common rules of the air and operational provisions regarding services and procedures in air navigation, sets out, in Article 42, the following provisions on the use of communications:

"In application of SERA.14015 (b), ground-to-air communications between aircraft and the aerodrome control units at Adolfo Suárez Madrid-Barajas, Alicante-Elche, Barcelona-El Prat, Gran Canaria, Málaga-Costa del Sol, Palma de Mallorca and Tenerife Sur-Reina Sofía airports shall use a single language on the same frequency, Spanish or English, in the operational scenarios identified in Annexe IV. ***In the aforementioned operational scenarios, English shall be mandatory whenever there is a pilot on the communication frequency who is not a Spanish speaker."***

"The use of a single language, in accordance with the provisions of this paragraph, shall be without prejudice to the application of the provisions of SERA.2010 and the decisions taken by the pilot-in-command in such circumstances, as well as in the event of an emergency on board the aircraft, and the adoption, by the air traffic controller, of the measures he/she deems necessary to maintain safety."

Annexe IV of the aforementioned Royal Decree 1180/2018 describes the four operational scenarios referred to in Article 42, the second of which is as follows:

"The following landing and take-off operations:

a) ***Landing clearances with traffic at the holding point.***
b) ***Take-off clearances with traffic on final.***
c) Clearances to enter and line up from congested waiting points. "

1.18.8. Similar incident IN-049-2019 investigated by the CIAIAC

In incident IN-049-2019, which occurred on 11 September 2019 and was subsequently investigated by the CIAIAC, there was a loss of separation between two aircraft on runway 13 at Málaga-Costa del Sol Airport, the first being on the take-off run and the second on short final.

The investigation determined that the incident occurred because an aircraft was given clearance to land on a runway that was occupied by another aircraft in the process of taking off, without respecting the regulatory distances. Deficient planning by the air traffic controller, who took advantage of a gap between two landings to authorise a take-off, was identified as a contributing factor in the incident. Furthermore, given the immediate danger posed by the loss of regulatory separation, the air traffic controller's failure to make decisions, such as cancelling the take-off, was also deemed to have been a factor.

As a result of the repeated incidents involving a loss of separation at Málaga-Costa del Sol Airport, during the course of investigation IN-049-2019 and before concluding it, the CIAIAC decided to approve and issue two urgent safety recommendations prior to the approval and publication of the final report.

The first safety recommendation, addressed to ENAIRE, was issued on 04 November 2020:

REC 18/20: *It is recommended that ENAIRE, as the provider of air navigation services, should initiate a hazard identification and risk assessment process for the recent loss-of-separation events at Málaga-Costa del Sol Airport (LEMG) and coordinate with AESA to propose mitigation measures.*

On 11 November 2020, ENAIRE issued a response to REC 18/20, the content of which was assessed as UNSATISFACTORY by the CIAIAC. On 24 February 2021, ENAIRE issued a second response to REC 18/20, the content of which was assessed CLOSED, SATISFACTORY RESPONSE.

The second safety recommendation, addressed to AESA, was issued on 04 November 2020:

REC 19/20: *It is recommended that AESA should review the hazard identification and risk assessment process for the recent loss-of-separation events at Málaga-Costa del Sol Airport (LEMG), as well as the proposal for mitigation measures recommended to ENAIRE in recommendation REC 18/20*

On 24 February 2021, AESA issued a response to REC 19/20, the content of which was assessed as CLOSED, SATISFACTORY RESPONSE.

1.19. Special investigation techniques

Not applicable.

2. ANALYSIS

Analysis of the following aspects is deemed relevant:

- Meteorological situation
- Operation
- Capacity
- Repetitiveness of events

2.1. Analysis of the meteorological conditions

The meteorological conditions at Málaga-Costa del Sol Airport around the time of the event (16:15 UTC) were natural daylight conditions.

The crew of the approaching aircraft, EC-MUP, maintained visual contact with the preceding aircraft on take-off at all times.

2.2. Operational analysis

The section below contains a detailed analysis of the different stages of the flights: taxi, alignment and take-off of the aircraft with registration EI-EBC, and landing of the aircraft with registration EC-MUP.

2.2.1. Analysis of the taxi

As indicated in the LEMG Operating Manual, the air traffic controller at the GMC position must transfer aircraft to the LCL position when they reach intermediate holding point A3 so that the air traffic controller at the LCL position can organise the take-off sequence.

Similarly, the LEMG Operating Manual ("Holding bay management") establishes that, in the SOUTH ONE-RUNWAY configuration, the management and assignment of the runway access taxiway is the responsibility of the LCL controller.

At 16:11:03 UTC, the LCL controller instructed aircraft RYR7YM to continue taxiing to the holding point on runway 13, without specifying which holding point (HN-1R, HN-1L, HN-2 or HN-3). The air traffic controller also informed the aircraft on take-off that there was traffic on approach.

Having not received specific instructions as to which holding point they should go to, the crew chose to taxi to holding point HN-1R, which is the holding point closest to the runway head.
The crew's decision to do this is not in line with the information provided in the AIP, which says the following: *"Unless otherwise advised by ATC, access to RWY 13/31 shall be carried out preferably via HN-3 or HS-3, whenever only one aircraft is operating."* Despite this, the crew of the aircraft on take-off elected to taxi to the HN-1R holding point.

Holding point HN-3 is the furthest from the runway head and has an uphill slope, significantly increasing runway access time compared to other holding points.

The radar trace shows the aircraft with callsign RYR7YM arriving at the HN-1R holding point signal at 16:13:30 UTC.

As established in the ICAO runway incursion prevention manual, DOC 9870:

"Taxi instructions issued by a controller must always include a clearance limit, which is the point where the aircraft must stop until it receives an instruction to proceed."

In this incident, the LCL controller did not specify the holding point in his taxi instruction, leaving the choice of holding point to the discretion of the flight crew.

2.2.2. Analysis of the line-up and take-off

The LCL position controller planned to take advantage of the gap between two visual approaches to clear the take-off of the EI-EBC aircraft with callsign RYR7YM. The following figure shows the relative positions of the aircraft at 16:14:34 UTC, when the air traffic controller instructed the second aircraft in the sequence, RYR7YM, to line up and hold on runway 13 behind the traffic on final. At that moment, the first aircraft in the sequence was 2.4 NM from the threshold of runway 13 on final, and the third aircraft in the sequence was completing the downwind leg of the visual approach.

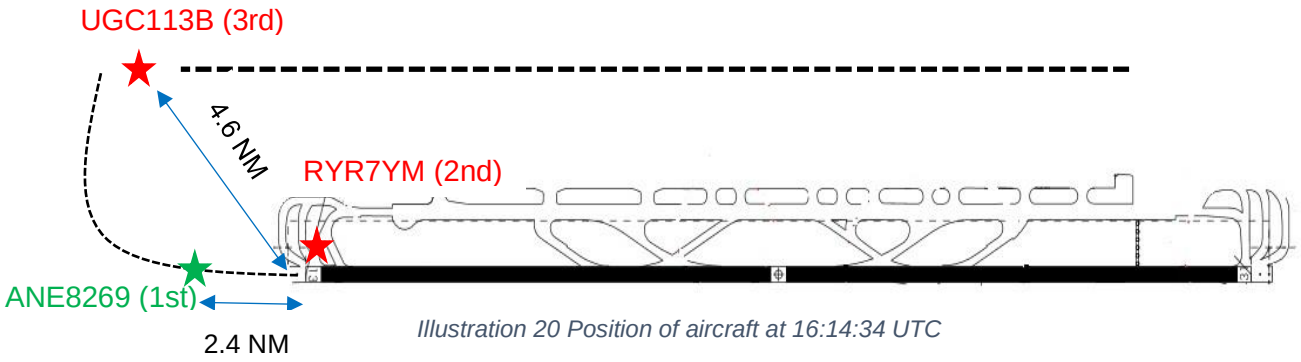


Illustration 20 Position of aircraft at 16:14:34 UTC

At 16:15:57 UTC, aircraft RYR7YM is moving beyond holding point HN-1R, proceeding at a speed of 10 kt to line up at the head of runway 13. At that moment, the first aircraft in the sequence, ANE8269, is landing on the first third of the runway, and the third aircraft in the sequence, UGC113B, is on the base leg of the visual approach.

The crew of the RYR7YM aircraft on take-off started to line up on runway 13 immediately after the first aircraft in the sequence, ANE8269, had flown over the runway threshold. The aircraft took 30 seconds to travel from holding point HN-1R and line up on the runway without stopping at any time. Therefore, we have concluded that there was no excessive delay in the actions taken by the crew of the aircraft on take-off.

At 16:16:32 UTC, the air traffic controller cleared aircraft RYR7YM for take-off when aircraft UGC113B was on final, 2.2 NM from the runway threshold. The departing aircraft started the take-off run (at a speed of 20 kt) 23 seconds after acknowledging the clearance. Given the time required to select take-off power and the time it takes for the aircraft to begin to move, we have concluded that the crew did not take an excessive amount of time to begin the take-off run.

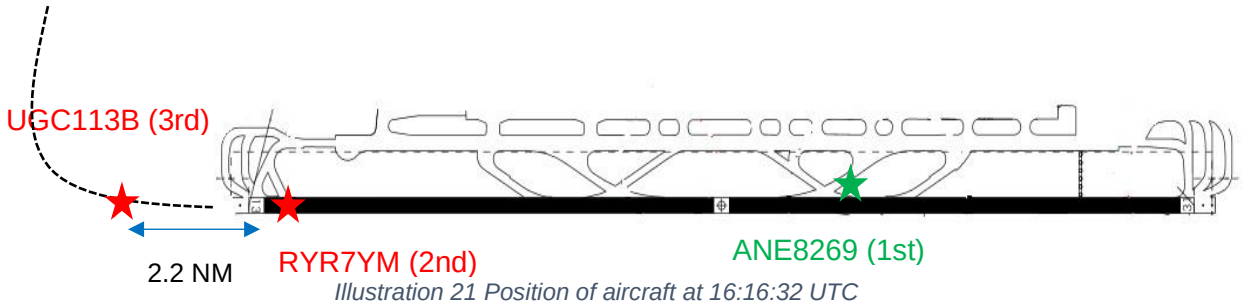


Illustration 21 Position of aircraft at 16:16:32 UTC

The following factors are considered to have played a decisive role in reducing the separation between the aircraft:

- The air traffic controller's plan to take advantage of a gap between two aircraft on visual approach to clear the take-off of another aircraft, while the last approaching aircraft was 4.6 NM from the threshold, completing the downwind leg.
- The air traffic controller's conditional instruction to align the aircraft on take-off when the first approaching aircraft was 2.4 NM from the runway threshold.
- The air traffic controller's decision to take-off an aircraft lined up on the runway when the aircraft on approach was 2.2 NM away.

Annexe B of the LEMG Operating Manual, on specific unit procedures, establishes the following indications for the use of the north holding bay (runway head 13):

- Exercise extreme caution when making adjustments between arrivals
- Inform the departing aircraft of the arriving aircraft's position and speed if deemed necessary
- If there is an expectation that regulatory separation between the two aircraft may be compromised, the take-off clearance should preferably be cancelled.
- Whenever there is a non-Spanish speaking pilot on the frequency, the use of English in ground-to-air communications is mandatory, particularly in the scenario of take-off clearances with traffic on final.

For its part, Spain's National Aviation Safety Agency, AESA, publishes document RECS-2015/003/2.0 with recommendations and best practices for minimising the occurrence of inappropriate separations between outbound and inbound traffic. Specifically, it makes the following recommendation:

"IT IS RECOMMENDED that if the aerodrome control service intends to authorise a departure when the approaching traffic could lead to a situation whereby the separation

between the two aircraft will not be much more than the established minimum, check with the departing aircraft before clearing it to enter the runway. Doing so will increase certainty when organising the runway sequence and improve safety."

In the incident analysed, the planned take-off window for the RYR7YM traffic was insufficient. Furthermore, the air traffic controller did not take into account the instructions in the LEMG Operating Manual or the aforementioned AESA recommendations. The TWR communicated with ANE8269 and UGC113B in Spanish and RYR7YM in English, which did not help the situational awareness of the crew on take-off. While it's true that the approaching traffic could see the preceding traffic on take-off, RYR7YM was given no information about the arriving traffic. Considering that the distance between the aircraft was reducing, the air traffic controller had several opportunities to change the initial plan:

- Cancel the clearance given to RYR7YM to line up and hold.
- Cancel the take-off of aircraft RYR7YM and instruct traffic UGC113B to go around.

Despite this, the air traffic controller decided to continue with the initial plan, knowing that the approaching traffic was informed of the take-off and had it in sight, and cleared the RYR7YM aircraft for take-off when the approaching aircraft was 2.2 NM from the runway threshold.

2.2.3. Analysis of the landing

At 16:17:34 UTC, the air traffic controller cleared aircraft EC- MUP with callsign UGC113B to land as it passed over the threshold of runway 13 at 300 ft AMSL. The RYR7YM aircraft on take-off was completing its rotation manoeuvre. The horizontal separation between the two aircraft was 0.9 NM.

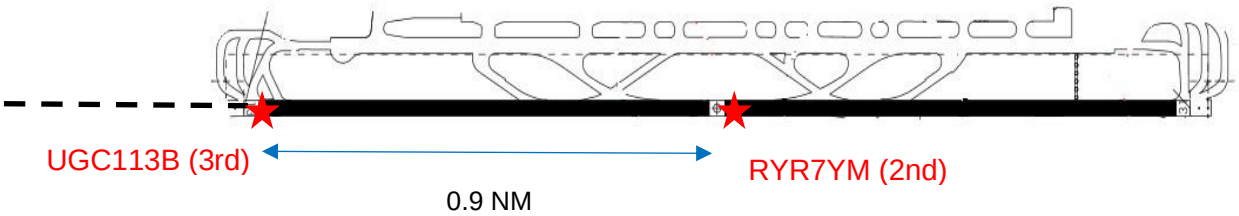


Illustration 22 Position of aircraft at 16:17:34 UTC

Seconds before receiving the clearance to land, aircraft UGC113B was informed that the preceding traffic was on take-off run. However, the traffic taking off was not informed of the position of the traffic arriving.

Annexe B of the LEMG Operating Manual, on unit-specific procedures, states that, in single-runway operations, the following must be taken into consideration in order to separate arrivals and take-offs with immediate departure:

- Clearance to land: only if there is a reasonable degree of assurance that the regulatory separation will exist when said aircraft crosses the threshold of the runway in use.

- No aircraft will be allowed to cross the runway threshold on its final approach to land until the preceding aircraft taking off has passed over the end of the runway in use.
- Landing clearance should be granted as far in advance as possible, generally before the arrival reaches 1NM on final.

In the incident being analysed, the air traffic controller did not heed any of the three aforementioned instructions or provision 4.5.10.1.1 of the Air Traffic Regulations, which establishes the following:

"as a general rule, no aircraft on its final approach to land will be allowed to cross the runway threshold until the preceding aircraft taking off has passed over the end of the runway in use (B), initiated a turn (C) or until any recently landed aircraft (D) have cleared the runway."

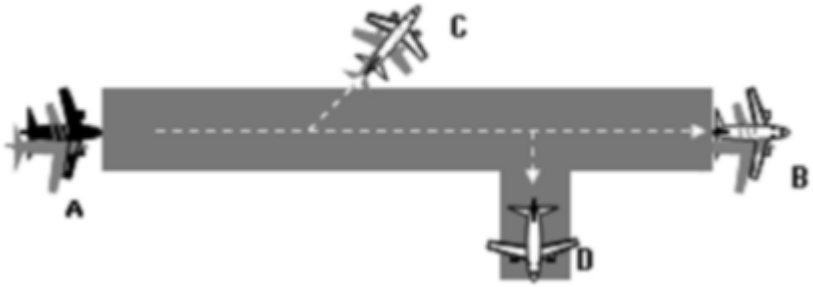


Illustration 23 Definition of free runway in the Air Traffic Regulations

The air traffic controller authorised the approaching aircraft to land when it was over the runway threshold, thereby allowing it to cross the threshold when the aircraft taking off was still on the runway initiating rotation, with no degree of assurance that regulatory separation could be maintained. The air traffic controller failed to anticipate the required separation between the aircraft.

2.2.4. Analysis of the minimum separation between aircraft

The moment of minimum separation between the aircraft occurred at 16:17:17 UTC when aircraft RYR7YM was on take-off run at a speed of 90 kt, and aircraft UGC113B was on short final at 130 kt. The horizontal separation between the aircraft was 0.8 NM.

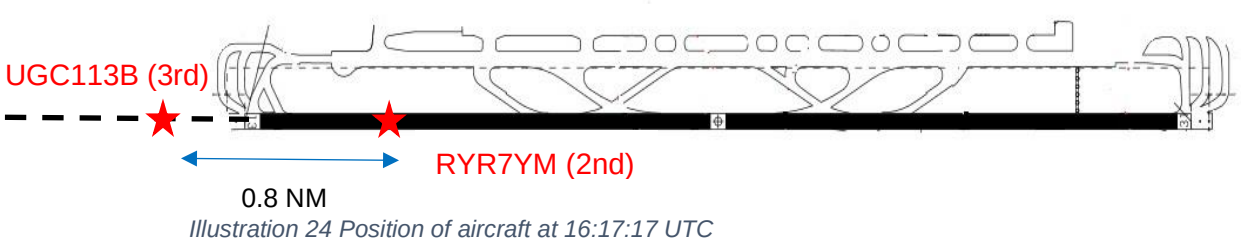


Illustration 24 Position of aircraft at 16:17:17 UTC

Subsequently, when both aircraft were on the runway, the horizontal separation between them was 0.9 NM.

According to provision 4.5.10.1.1 of the Air Traffic Regulations, the minimum separation should have been at least the length of the runway in use, i.e., 3,200 m (1.7 NM). Therefore,

the separation between the aircraft on the runway was approximately 53% short of the statutory minimum.

2.3. Analysis of the language used in the ground-to-air communications

In the operational scenario that occurred in this incident, the radar trace shows three traffics in the sequence for runway 13:

- 1st aircraft [ANE8269] lands - not involved in the incident.
- 2nd aircraft [RYR7YM] taxis
- 3rd aircraft [UGC113B] lands

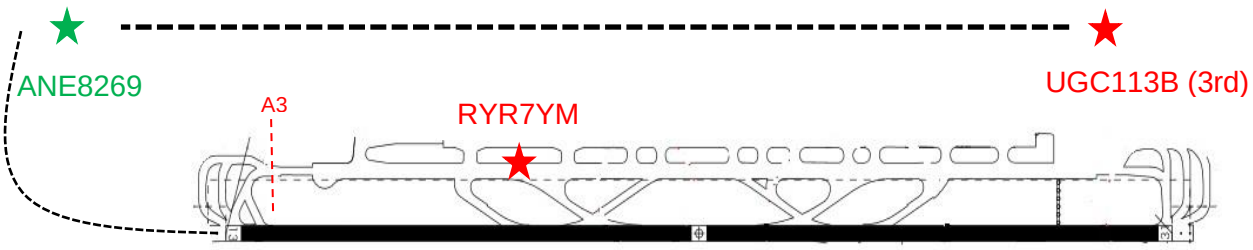


Illustration 25 Operational scenario of the incident

The LCL controller used the Spanish language in communications with the approaching aircraft ([ANE8269] and [UGC113B], first and third in the sequence respectively), and the English language in communications with the taxiing and take-off aircraft [RYR7YM].

The following communications are particularly relevant:

- Landing clearance given to the first aircraft in the sequence [ANE8269] in Spanish, while aircraft [RYR7YM] was established at the HN-1R holding point and with which the English language was used for communications.
- Instruction to continue the approach given to the third aircraft in the sequence [UGC113B] in Spanish, while aircraft [RYR7YM] was established at the HN-1R holding point and with which the English language was used for communications.
- Landing clearance given to the third aircraft in the sequence [UGC113B] in Spanish, while aircraft [RYR7YM] was on take-off run and with which the English language was used for communications.

As established in Royal Decree 1180/2018, which implements the common rules of the air and operational provisions regarding services and procedures in air navigation, in the operational scenario in this incident, which involves aircraft landing with traffic at the holding point and aircraft on take-off with traffic on final, a single language must be used. In this particular case, English was mandatory because there was a non-Spanish-speaking pilot on the frequency.

Therefore, the LCL controller failed to comply with the provisions of Royal Decree 1180/2018 by using the Spanish language with the aircraft on approach and the English

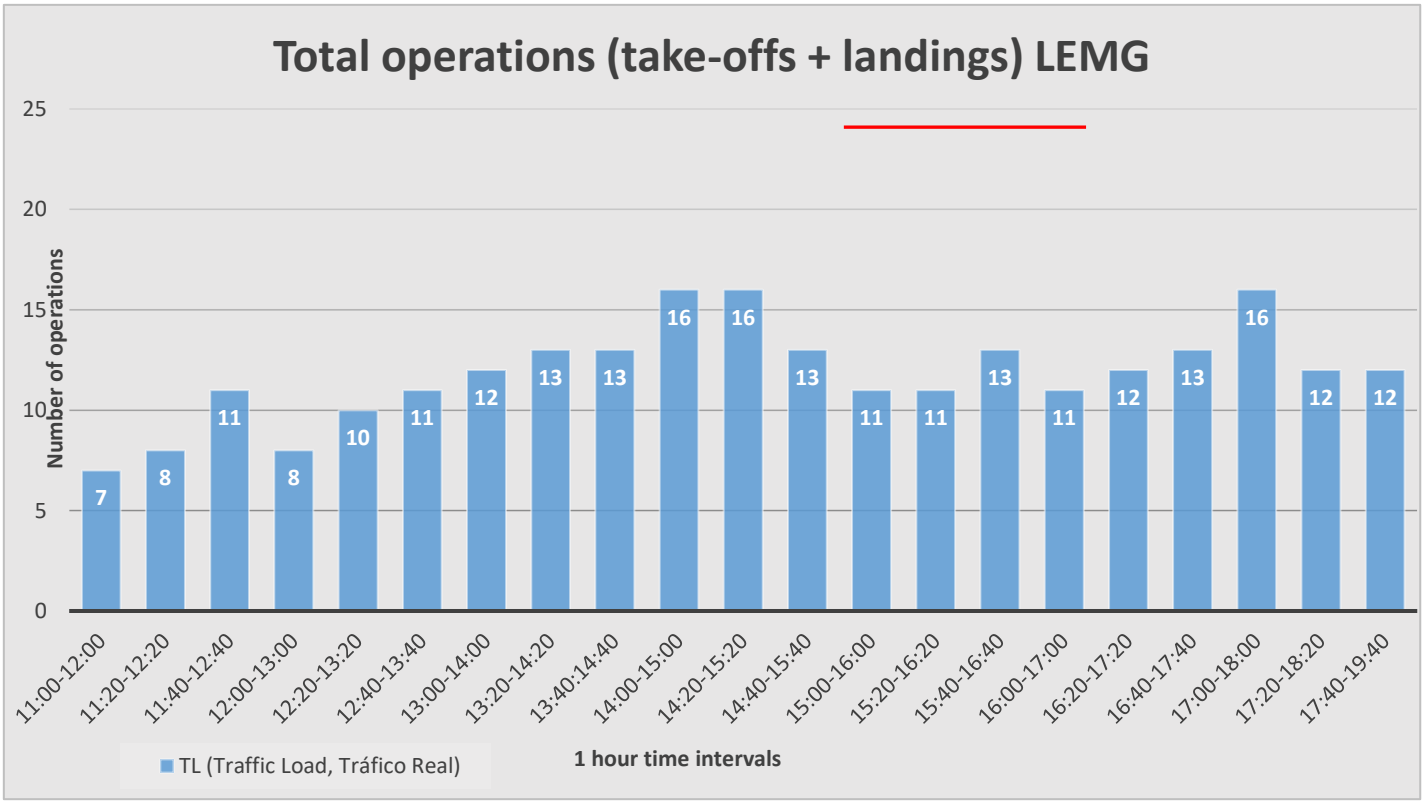
language with the aircraft on take-off, which did not favour the situational awareness of the traffic on take-off.

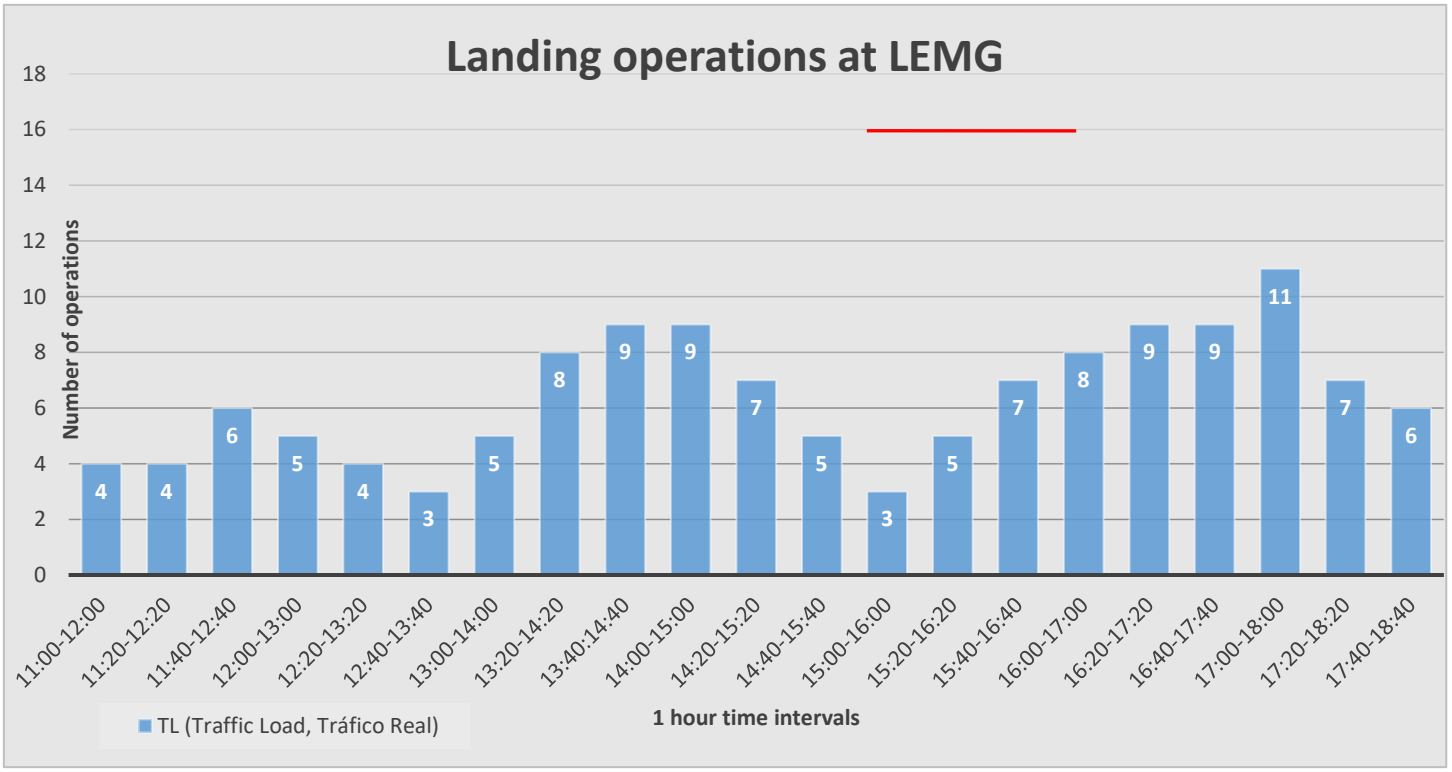
2.4. Analysis of the capacity

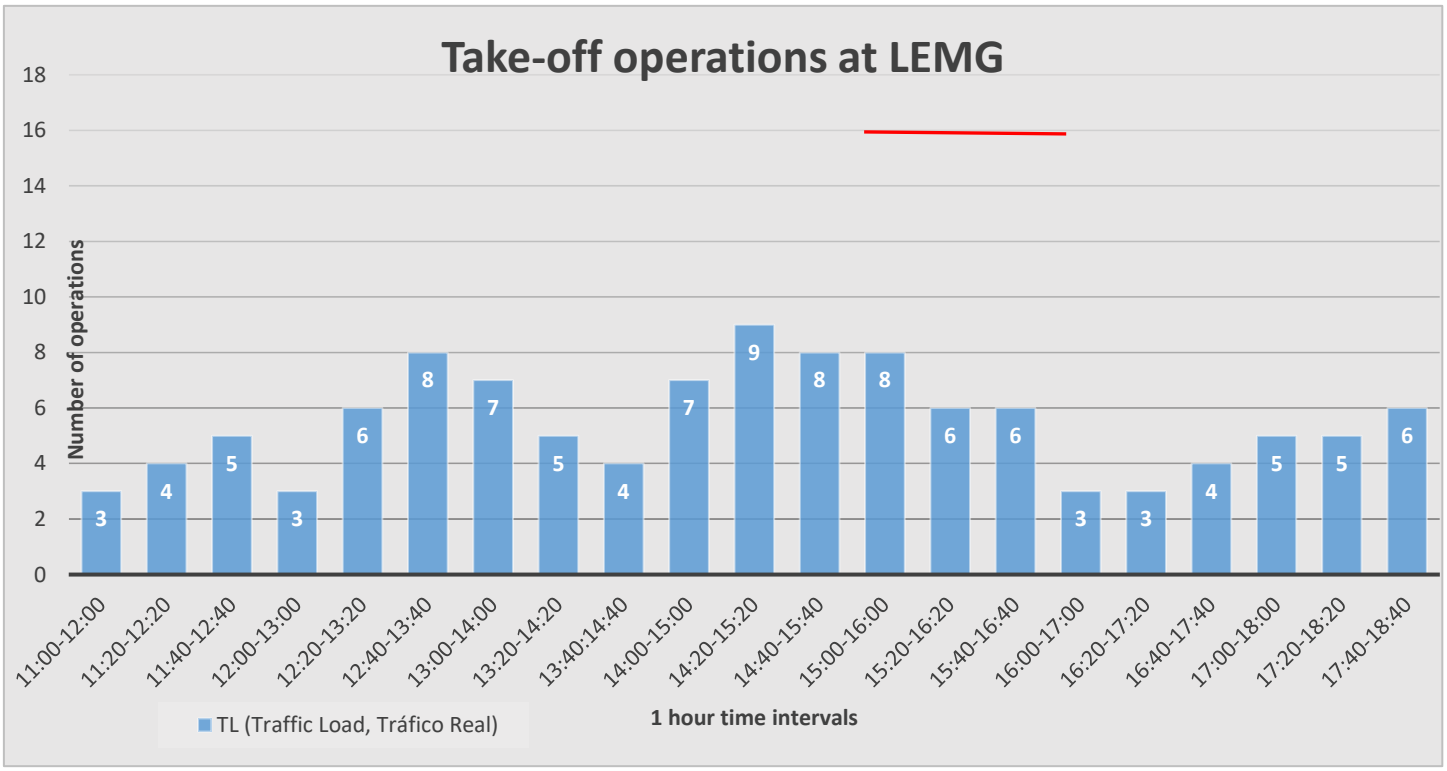
Declared Capacity is the maximum permitted traffic flow within a specific unit of time that can be maintained over time in accordance with the safety requirements.

As described in section 1.17.5, “Capacity control procedures at Málaga-Costa del Sol Airport”, at the time of the incident (16:15 UTC), the airport was operating with 1 open runway and 2 control positions, with the ATC Capacity (TWR) being the most restrictive and, therefore, the Declared Capacity. This capacity was 24 total operations per hour, 16 departures per hour and 16 arrivals per hour.

The following graphs show the actual traffic on 23 October 2020. The number of total operations, take-offs and landings are shown in time intervals of 1 hour, each separated by 20 minutes.







In the graphs, the red horizontal line represents the capacity limit in the time slots in which only 2 control positions were open. The following can be observed:

- At the time of the incident (16:15 UTC), the actual traffic, both in terms of take-offs, landings and total operations, did not exceed the capacity limit for two open tower control positions.

Therefore, it is considered that, at the time of the incident, the workload was appropriate for the control positions that were open in the control tower. The volume of traffic at the time of the incident is not deemed to have been a factor in the decisions made by the air traffic controller when adjusting the arrival and take-off traffic.

2.5. Analysis of the repetitiveness of loss-of-separation events at Málaga-Costa del Sol Airport

Section 1.18.1, "*Similar incidents at Málaga-Costa del Sol Airport*", details the incidents that have involved a loss of separation at the airport while in a single-runway configuration.

A total of 43 events have been reported to the National Incident System since 2019. Among them, the following are considered to be highly relevant:

- 4 events in which the landing aircraft executed a go-around manoeuvre at the initiative of the flight crew itself
- 13 events in which the distance between the aircraft landing and taking off was less than 1 NM

Given the repetitiveness of these events, ENAIRE identified historical, organisational and human factors that have contributed to particular ways of working in the unit, associated with adjustments between traffics. The most important factors detected by ENAIRE were as follows:

- Historical factors: reduced runway separation procedures applied until 2017 in the Málaga unit that led to inertia in work modes.
- Organisational factors: The ATC unit training plan does not reflect specific training scenarios for changes of plan or strategies for mitigating cognitive biases. The regulations do not explicitly require this. Furthermore, the operating manual contains general guidelines for separation between departures and arrivals but does not include specific adjust/don't adjust criteria.
- Proximal factors: Operational pressures when handling departures, self-induced pressure to take advantage of gaps in arrivals and a tendency to use nominal gaps of 7 NM for 2 departures.
- Human factors: Expectation bias in regard to the crew's response to immediate take-off clearance, plan continuity bias and aversion to cancelling take-off clearances.

Given the factors identified, on 24 October 2019, ENAIRE drafted the "*first LEMG Action Plan*", with 11 corrective measures that were completed by February 2020.

Despite this first action plan, in February 2020, the loss-of-separation events continued to occur. Moreover, although there were fewer of them, some were classified as severe even

after the first action plan had been fully implemented. The measures adopted in the first action plan included:

- Dissemination measures
- Culture reinforcement

While these measures are deemed to have been necessary, they were not sufficient to avoid recurring losses of separation at the unit. In addition, the historical factor detected by ENAIRE in its internal analysis is not considered to be directly related to the working methods acquired in the unit. The reduced separation procedures set out in section 4.5.11 of the Air Traffic Regulations are only applicable during the day and not at night, as in the case of incident IN-049-2019.

Consequently, on 08 October 2020, ENAIRE implemented the "*second LEMG Action Plan*". The new action plan contained dissemination actions, operational support measures and reinforcement measures in the control tower cab.

The implementation of the second action plan was completed in February 2021. From November 2020 to July 2021, no events involving a loss of separation between arrivals and departures at Málaga-Costa del Sol Airport were reported.

However, despite the second LEMG action plan being completed, between July 2021 and April 2022, there were 10 new incidents involving a loss of separation between aircraft, 5 of which involved a distance of less than 1 NM between the traffic. This represents an uptick in notifications of breaches of the minimum regulatory separation at Málaga-Costa del Sol Airport since July 2021.

Therefore, it is considered that the safety issues detected in IN-044-2020, IN-049-2019 and the other recorded cases of loss of separation have not been sufficiently remedied by the measures already adopted.

3. CONCLUSIONS

3.1. Findings

- When issuing taxiing instructions to the aircraft preparing to take off, the air traffic controller at the LCL position did not specify which holding point it should go to.
- Having not received specific instructions as to which holding point they should go to, the crew chose to taxi to holding point HN-1R, which is the holding point closest to the threshold of runway 13.
- The air traffic controller at the LCL position instructed aircraft EI-EBC to line up on the runway and hold behind the traffic that was on final, 2.4 NM from the threshold of the runway.
- The air traffic controller at the LCL position cleared aircraft EI-EBC for take-off when the aircraft on approach was established on final at a 2.2 NM from the runway threshold.
- The air traffic controller at the LCL position did not consult the departure traffic to see if it was ready for immediate take-off, nor did he inform it of the position of the arrival traffic.
- The aircraft on take-off, registration EI-EBC, took 30 seconds to travel from the holding point and line up on the runway, without stopping at any time and without any significant hold-up or delay.
- The air traffic controller used English to communicate with the aircraft on take-off and Spanish to communicate with the aircraft on approach, in breach of the provisions of Royal Decree 1180/2018.
- The air traffic controller at the LCL position cleared the EC-MUP aircraft to land with the preceding traffic in sight when it was flying over the runway threshold and the separation with the aircraft on take-off was 0.9 NM; the runway, therefore, being occupied.
- The minimum separation between the two aircraft was 0.8 NM.
- The actual traffic at the time of the incident did not exceed the ATC capacity.
- Since 2019, a total of 43 events involving a loss of separation between arrivals and take-offs at Málaga-Costa del Sol Airport have been reported to the National Incident System.
- ENAIRE, as the air traffic service provider, has implemented two action plans to mitigate the recurring loss-of-separation incidents at Málaga-Costa del Sol Airport.
- Between July 2021 and April 2022, after ENAIRE'S second action plan had been implemented, there were 10 new incidents involving a loss of separation between aircraft, 5 of which involved a distance of less than 1 NM.
- The incident did not involve any type of damage to persons or property.

3.2. Causes/contributing factors

The investigation has concluded that the incident occurred due to poor landing and take-off planning, which led to an aircraft being cleared to land on a runway already occupied by another on take-off without respecting the minimum separation requirements.

4. OPERATIONAL SAFETY RECOMMENDATIONS

CIAIAC has recently opened two investigations related to loss of separation incidents at Málaga-Costa del Sol Airport (IN-049-2019 and IN-044-2020). As a result of the repeated incidents involving losses of separation during the course of the investigation IN-049-2019 and before concluding it, the CIAIAC decided to approve and issue two urgent safety recommendations prior to the approval and publication of the final report, which led ENAIRE to the draw up two action plans containing mitigating measures.

After the implementation of ENAIRE's second action plan was completed in February 2021, the period between July 2021 and April 2022 saw an uptick in the number of notifications of breaches of the minimum separation distance at Málaga-Costa del Sol Airport.

Therefore, the safety issues detected in the CIAIAC's investigations and the other recorded cases of loss of separation have not been sufficiently remedied by the measures already adopted.

For this reason, the following safety recommendations are issued:

REC 15/22: It is recommended that ENAIRE, as air navigation service provider, draw up a proposal for additional mitigating measures to those already included in its second action plan, in coordination with AESA, in order to reduce the risks associated with the loss-of-separation events occurring at Málaga-Costa del Sol Airport (LEMG).

REC 16/22: It is recommended that EASA review the proposal for additional mitigating measures recommended by ENAIRE in the previous REC to assess their appropriateness.

REC 17/22: It is recommended that ENAIRE, as air navigation service provider, review the degree of compliance with the use of the English language in the air traffic control unit at Málaga-Costa del Sol Airport as required by EU regulations and in the operational scenarios described in Royal Decree 1180/2018.