



2.3 Approaches to, and departures and go-arounds from one runway pair have the potential to intersect or pass in close proximity to the flight paths of approaches, departures and go-arounds to and from the other pair.

2.4 Aircraft conducting a go around and following the published missed approach may pass over or close to another runway.

2.5 Aircraft taxiing to and from the runways or parked on the aprons have the potential to constitute close in obstacles for departing aircraft.

2.6 Aircraft overrunning runways 32L and 32R, and to a lesser extent 18L and 18R, have the potential to impact aircraft on the ground, airport buildings and structures, vehicles or personnel (not entirely unique to this runway configuration).

### **3. Operational Constraints**

3.1 LEMD is very noise sensitive and applies strict noise abatement procedures. For take-off these include specific speed, thrust, aircraft configuration and acceleration altitude constraints. For landing, the use of reverse thrust above idle is forbidden<sup>1</sup> between 2300-0700 local except for safety reasons, and for the most sensitive runway, 18R, the AIP recommends at the pilot's discretion the delayed selection of flaps and landing gear on approach. There are 27 noise monitoring sites surrounding LEMD.

3.2 LEMD typically operates in one of two arrival and departure runway combinations, described as 'North' and 'South' Configurations. The AIP excerpt below describes the 'preferential' runways for both day and night operations:

#### **PREFERENTIAL CONFIGURATIONS**

1. Except when one or more of the following conditions are present or forecasted:

- Bad runway surface conditions and/or braking action less than good,
- Clouds ceiling lower than 500 ft above aerodrome elevation,
- Visibility less than 1,9 Km (1 NM),
- Windshear notified or forecasted, or storms on approach or departure,
- Traffic conditions, operative needs, safety situations, or any other meteorological phenomena that may prevent it,

ATC will adhere to the preferential configurations described below, and to the indicated preferential runway use, up to wind components, gusts included, of 10 kt tailwind and/or 20 kt crosswind:

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<sup>1</sup> Many airlines already use idle reverse thrust on landing as standard operating procedure in order to save fuel.

Between 0700 and 2300 LT:

- Preferential: North Configuration  
Arrivals: 32L/32R  
Departures: 36L/36R
- Non preferential: South Configuration  
Arrivals: 18L/18R  
Departures: 14L/14R

Between 2300 and 0700 LT:

- Preferential: North Configuration  
Arrivals: 32R  
Departures: 36L
- Non preferential: South Configuration  
Arrivals: 18L  
Departures: 14L

3.3 North Configuration, with departures to the north and arrivals from the south is generally preferential at all times.

3.4 There are no published approaches for runways 36L, 36R, 14L and 14R and these runways are promulgated as 'not available for landing'.

3.5 There are no published standard instrument departures (SIDs) for runways 18L, 18R, 32L and 32R and these runways are promulgated as 'not available for take-off'.

3.6 Runways 36L, 36R, 14L and 14R each have two published sets of SIDs, defined as 'day' (0700-2300 local) and night (2300-0700 local).

3.7 Wake turbulence minimum separation is applicable for departing aircraft as follows:

AERONAVE PRECEDENTE PRECEDING AIRCRAFT	AERONAVE SUBSIGUIENTE FOLLOWING AIRCRAFT	SEPARACIÓN EN MINUTOS SEPARATION IN MINUTES
PESADA / HEAVY	B757	2
PESADA / HEAVY	MEDIA / MEDIUM	2
PESADA / HEAVY	LIGERA / LIGHT	2
B757	LIGERA / LIGHT	2
MEDIA / MEDIUM	LIGERA / LIGHT	2
B757	MEDIA / MEDIUM	2
LIGERA / LIGHT	LIGERA / LIGHT	–
LIGERA / LIGHT	PESADA / HEAVY	–
LIGERA / LIGHT	B757	–
LIGERA / LIGHT	MEDIA / MEDIUM	–
MEDIA / MEDIUM	MEDIA / MEDIUM	–
MEDIA / MEDIUM	B757	–
MEDIA / MEDIUM	PESADA / HEAVY	–
B757	PESADA / HEAVY	–
PESADA / HEAVY	PESADA / HEAVY	2

3.8 Between sunrise and sunset ATC is permitted to issue landing clearance to an arriving aircraft when the landing runway is occupied, if the controller is satisfied that at the time the landing aircraft crosses the threshold the 'prescribed separation from the preceding aircraft will exist'.

3.9 Between sunrise and sunset LEMD applies 'Minimum Reduced Separation on the Same Runway' by which a landing aircraft will not be permitted to cross the landing threshold until a preceding departing aircraft is airborne and at least 2,000 metres from the threshold.

3.10 LEMD applies 'Minimum Runway Occupancy Time' constraints to 'minimise the occurrence of go round' and 'get the maximum runway utilisation', requiring landing aircraft to vacate the runway by specified rapid exit taxiways, and departing aircraft to initiate their take-off run immediately when cleared.

3.11 Runways 18L, 18R, 32L and 32 R (the 'landing' runways) have significantly displaced landing thresholds between 500 and 924 metres from the end of the paved surface, possibly to provide obstacle clearance on approach, to improve noise abatement or both.

#### 4. Flow Rate and Passenger Traffic

4.1 At peak capacity LEMD claims to be able to handle 120 movements (take-offs or landings) per hour. In 2004 the airport had 400,000 aircraft movements and this increased to a peak of 470,000 in 2008.

4.2 Passenger traffic for the past 20 years was recorded as:

 DEVELOPMENT OF PASSENGER TRAFFIC			
Year	Passengers	Year	Passengers
1994	18,416,510	2004	38,718,614
1995	19,964,997	2005	42,146,84
1996	21,865,051	2006	45,799,983
1997	23,634,113	2007	52,110,787
1998	25,506,395	2008	50,846,494
1999	27,545,020	2009	48,437,147
2000	32,829,182	2010	49,866,113
2001	34,002,411	2011	49,671,270
2002	33,915,302	2012	45,190,528
2003	35,855,861	2013	39,729,027

Passenger numbers had stabilised in the mid-30M range in 2000-2003 but following the airport and runway expansion this had increased to over 50M. The subsequent downturn is attributable to the severe and protracted effects of recession in Spain since 2008.

## **5. Accidents and Incidents**

Since the inauguration of the additional runways in 2006 there have been two significant aircraft accidents:

5.1 On 15 July 2006 the wingtip of a taxiing Boeing 747-400 impacted the tail of a stationary Embraer ERJ-135, completely detaching the tail section of the Embraer. No injuries were recorded. The crew of the Boeing had inadvertently deviated from the cleared taxi route.

5.2 On 20 August 2008 a McDonnell Douglas MD-82 taking off from runway 36L veered to the right after lift-off and crashed into the ground immediately to the east of the upwind end of the runway. Only 18 of the 172 on board survived. The crew had omitted to select the appropriate slat/flap configuration for take-off and the take-off configuration warning system failed to alert them. The aircraft stalled.

Neither of these accidents can be attributed to the configuration or management of the airport.

## **6. Mitigations**

6.1 All runways have a runway end safety area (RESA) that significantly exceeds the ICAO Annex 14 standard of 90 metres length from the runway end and with the exception of 18R (205 metres) meets the ICAO recommendation of 240 metres. All RESAs are at least twice the associated runway width.

6.2 Runways 32L and 32R, which terminate within aircraft manoeuvring areas and close to passenger terminals have installed within the RESA an 'engineered materials arrestor system' (EMAS). EMAS consists of a bed of frangible material designed to safely absorb the kinetic energy of an aircraft overrunning the runway and to stop it within the length of the RESA. EMAS has been successfully demonstrated to work in a number of overruns elsewhere in the world.

6.3 All published SIDs from the take-off runways 14L/R and 36L/R guide departing aircraft away from the published missed approaches for the landing runways 18L/R and 32L/R, providing separation laterally, vertically or both.

6.4 All published SIDs include a specified requirement for departing aircraft not to change track prior to the departure end of the runway (DER).

6.5 In order to reduce the risk of aircraft overshooting the runway extended centreline on approach, pilots receiving a radar vector converging with the inbound course to the assigned runway at less than 70° should intercept the ILS localiser (or alternative lateral guidance) without further instructions.

6.6 The declared landing distance available (LDA) for each of the landing runways 18L/R and 32L/R is equal to or in excess of 3,000 metres.

6.7 Standard taxi routes between each runway and every parking stand are clearly specified for both arrivals and departures in all runway configurations.

## **7. Analysis**

The hazardous conditions identified in 2. above are addressed as follows:

*7.1 Aircraft approaching, departing or executing a go-around on the extended centrelines of either runway pair may have limited lateral separation.*

No precautions or procedures are identified to manage the risk of airborne collision or undue proximity due to aircraft operating to or from close parallel runways deviating from the prescribed course. Other airports with limited lateral spacing between parallel runways, like Sydney Kingsford Smith, have adopted additional monitoring and operational requirements. However, ICAO Document 9157 Aerodrome Design Manual Part 1 specifies the minimum lateral separation for independent parallel approaches as 1,035 metres and both parallel runway pairs at LEMD are separated by greater than this distance.

*7.2 Aircraft approaching, departing or executing a go-around on the same runway may have limited longitudinal separation (not unique to this runway configuration).*

The AIP addresses the possibility of aircraft simultaneously approaching and departing from the same runway, and applies specific longitudinal separation minima but does not make clear what action is to be taken if the separation is breached. This concern is common to runways worldwide, especially at single runway airports like London Gatwick. At LEMD it is difficult to envisage when this would occur in normal operations because runways authorised for take-off are promulgated as not available for landing and *vice versa*. The permitted use within certain conditions of clearance to land with preceding landing traffic still on the runway is commonplace and not unique to any runway configuration. The minimum runway occupancy time constraints are also commonplace elsewhere and do not constitute an undue safety hazard.

*7.3 Approaches to, and departures and go-arounds from one runway pair have the potential to intersect or pass in close proximity to the flight paths of approaches, departures and go-arounds to and from the other pair.*

In the standard North and South Configurations, approaches and SIDs do not intersect. The published SIDs from runways available for take-off are separated from the published missed approaches of the associated runways available for landing, either laterally, vertically or both, in each configuration.

*7.4 Aircraft conducting a go around and following the published missed approach may pass over or close to another runway.*

This is the case but the prescribed take-off and landing runway configurations ensure that the missed approach courses only pass over or close to the end of the take-off runway from which departing aircraft will commence their take-off roll and will hence be separated vertically.

*7.5 Aircraft taxiing to and from the runways or parked on the aprons have the potential to constitute close in obstacles for departing aircraft.*

Again this is the case but the rigorously specified taxi routes are able to manage the risk of a taxiing aircraft entering the obstacle splay of the departure runways.

*7.6 Aircraft overrunning runways 32L and 32R, and to a lesser extent 18L and 18R, have the potential to impact aircraft on the ground, airport buildings and structures, vehicles or personnel (not entirely unique to this runway configuration).*

Runway 18R has a RESA of 205 metres length, significantly greater than the ICAO standard of 90 metres. 18L, 32L and 32R each have a RESA of 240 metres length, equivalent to the ICAO recommended practice. Within the RESA of both 32L and 32R is installed EMAS, demonstrably capable of arresting an overrunning aircraft within the RESA.

Other identified potential concerns are addressed as follows:

7.7 The landing distance on runways 18L, 18R, 32L and 32R is adequate for all modern transport category aircraft in spite of the significantly displaced thresholds.

7.8 The constraint upon use of reverse thrust above idle when landing at night does not unduly impact standards of safety as this is common practice for many airlines at all times of the day. However, it should be noted that for some operators using aircraft types without brake fans, full reverse is standard procedure to minimise brake heating. The take-off noise abatement constraints are commonplace worldwide.

7.9 Individual operators promulgate lateral flight tracks for their pilots to follow in the case of an engine failure at speeds at or above  $V_1$  (take-off decision speed), in order to assure obstacle clearance with the associated reduced climb performance. These may not take account of aircraft using other runways and could potentially constitute a collision or proximity risk.

7.10 There are no recent recorded accidents or serious incidents that are attributable to the runway configuration or procedural design.

7.11 Following inauguration of the additional two runways both passenger numbers and aircraft movements increased significantly, although both have since declined due to economic factors associated with recession.

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