

RA 3522 – Permanent Fixed Wing Aerodrome – Vertical Landing Pads

Rationale

Vertical Landing Pads (VLP) may be established for proficiency training or to enable Aircraft recovery where conventional landing is not available. Without adequate provision for the design and safeguarding of the VLP, and supporting infrastructure, there is a Risk of unsafe operations. The purpose of this Regulatory Article (RA) is to provide a compliance framework that enables safe VLP operations to be conducted.

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Scope

The purpose of this RA is to provide a baseline of requirements to enable the safe use of VLPs in support of F-35B operations at Main Operating Bases (MOBs). This initial issue will primarily support operations at RAF Marham, however it could be used to support installation of VLPs at other land-based locations. The requirements below have been derived from Design Specifications for the F-35B and combined, where applicable, with extant Regulatory requirements for airfield design and safeguarding.

Regulation

3522(1)

Physical Characteristics

3522(1) Heads of Establishments (HoEs), Aviation Duty Holder-Facing Organizations and Accountable Manager (Military Flying)– Facing Organizations (AA-Facing Organizations) **shall** ensure that VLPs enable the stabilised and safe use of the Aircraft for which they are intended.

Acceptable Means of Compliance

3522(1)

Physical Characteristics

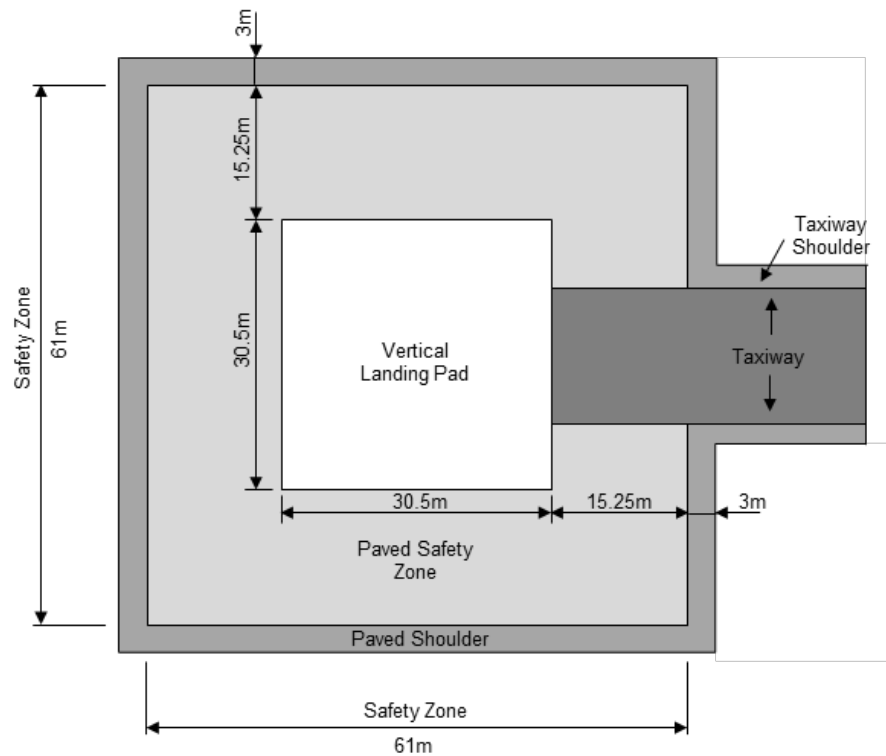
1. The minimum dimensions of the VLP, Safety Zone and shoulder, **should** be in accordance (iaw) with Figure 1.
2. The VLP pavements and ancillary elements **should** be designed and constructed by Suitably Qualified and Experienced Persons / organizations, using the appropriate materials and construction methods to achieve the functional and geometric properties to meet the requirements of the intended platforms¹.
3. Surfaces bordering the paved shoulders **should** be assessed for resilience to jet blast, and where necessary engineered to maintain resilience to Foreign Object Damage / Debris, particularly important at first build due to the potential for disturbed natural surfaces during construction.
4. The siting of a VLP in relation to other Manoeuvring Areas, may be dictated by the space available, but **should** consider the unique wake turbulence characteristics of Short Take-Off Vertical Landing Aircraft² and the impact of this to adjacent Manoeuvring Areas.

¹ For F35B, facility requirements are owned by the F35 Joint Project Office.

² For further information, refer to RA 3277 – Wake Turbulence, para 31.

**Acceptable
Means of
Compliance
3522(1)**

Figure 1 – Vertical Landing Pad Dimensions.



**Guidance
Material
3522(1)**

Physical Characteristics

5. The VLP and Safety Zones are established to prevent erosion of graded surfaces by jet blast from Aircraft transition to / from the pad and surface water runoff.
6. The use of F-35B VLPs by other Aircraft types is not prohibited, however, if the weight or performance characteristics of a different Aircraft type are likely to exceed the Design Specifications of the VLP, the unit may contact the Defence Infrastructure Organisation for advice.

**Regulation
3522(2)**

Obstacle Environment

- 3522(2) HoEs and AA-Facing Organizations **shall** establish VLP Obstacle Limitation Surfaces (OLS) for the following: primary zone, clear zone, Accident potential zone (APZ), transitional surface, approach surface and inner horizontal surface.

**Acceptable
Means of
Compliance
3522(2)**

Obstacle Environment

7. The OLS for VLPs **should** be a combination of surfaces and zones around the landing surface, as depicted at Figure 2.
8. **Primary Zone.** The primary zone **should** be:
 - a. A square measuring 300 x 300 ft (91.5 x 91.5 m) centred on, and at the same elevation as, the VLP.
 - b. Free of obstacles³.
 - c. Rough graded in the surface area beyond the paved surfaces, to the extent necessary to minimize damage to the Aircraft in the event of an emergency landing and to encourage drainage and avoid standing water.
9. **Clear zone.** The clear zone **should** be the same width as, and extend 400 ft (122 m) beyond, the primary zone and be centred on the primary approach path to the

³ Except where the obstacle is operationally essential – refer to RA 3590(12): Safeguarding – Operationally Essential Obstructions

Acceptable Means of Compliance 3522(2)

VLP. This area **should** be free of obstacles and graded to the extent necessary to prevent accumulation of water.

10. **APZ.** The APZ starts at the end of the clear zone, at the same width, and extend for 800 ft (244 m) in the direction of the approach path. This area **should** be kept free of obstacles as far as is practicable. Only frangible mounted obstacles, such as Aerodrome Ground Lighting (AGL) fittings, which are operationally essential, constructed and sited to reduce the Hazard to a minimum, **should** be used⁴.

11. **Transitional Surface.** The transitional surface is a complex surface that **should** originate from the four outer edges of the primary zone, extending uniformly upwards and outwards along slopes with a gradient of 2:1. The transitional surfaces end where they bisect the approach surfaces and / or inner horizontal surface.

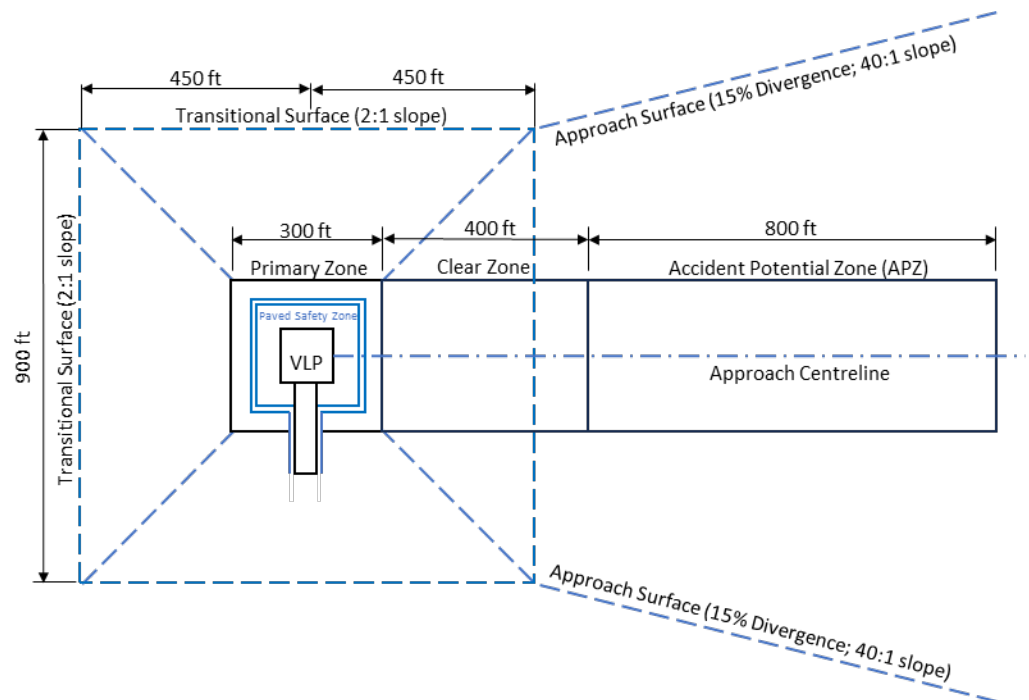
12. **Approach Surface.** The approach surfaces **should**:

- a. Commence from the top of the Transitional Surface in the direction of approach, with continuing uniform divergence from the approach path centreline, at a rate of 15 degrees.
- b. Follow an incline slope with a gradient of 40:1.
- c. Be of sufficient length required to extend from the top of the Transitional Surface (150 ft) to 500 ft AGL.

13. **Inner Horizontal Surface.** The inner horizontal surface **should** be constructed by scribing a 180-degree (or more for multiple approaches) arc with a radius of 6,000 ft and with an elevation of 45 m from, the centre of the VLP. This imaginary surface covers the VFR landing pattern obstacle clearance requirements.

14. Where VLP OLS and Aerodrome OLS requirements overlap, the more stringent or lower surface **should** be used for assessment of obstacles.

Figure 2 – VLP Obstacle Limitation Surfaces



Note

The orientation presented here for the OLS, clear zone and APZ is for illustration only and will be otherwise determined by the actual direction of approach / departure. To support multiple directions of approach and departure and for

⁴ Refer to RA 3590 – Maintenance and Safeguarding, for further information on operationally essential obstructions.

**Acceptable
Means of
Compliance
3522(2)**

Aerodrome planning purposes, units may wish to consider zones based on a 360-degree area, or portion thereof, around the VLP.

**Guidance
Material
3522(2)**

Obstacle Environment

15. In the context of this Regulation, 'zones' refer to ground level, and 'surfaces' extend away from the VLP, upwards and outwards as depicted.

16. The VLP OLS requirements may be omitted in part or full where existing Aerodrome OLS meet or exceed the obstacle clearance requirements defined by the VLP OLS presented in this Regulation.

17. The VLP OLS requirements and supporting diagrams are based on a single direction of approach to the VLP. OLS may therefore be extended accordingly where more than one approach direction is used.

18. When the VLP is on or adjacent to an Aerodrome, the inner horizontal surface may be established to match the Aerodrome's inner horizontal surface.

19. When the VLP is located within the boundaries of an existing Aerodrome and the OLS of the two facilities overlap, the VLP transitional surface elevation will extend to meet the existing inner horizontal surface elevation of the Aerodrome.

20. When the VLP is located within the Runway Strip of an existing Runway, use of the Runway approach / departure surface may suffice for the VLP approach surface provided a visual transition between the path and the VLP can be conducted while under Visual Meteorological Conditions.

**Regulation
3522(3)**

Markings

3522(3) HoEs and AA-Facing Organizations **shall** ensure that clearly defined markings are provided to allow safe movement on and in the vicinity of the VLP by vehicles and Aircraft.

**Acceptable
Means of
Compliance
3522(3)**

Markings

21. VLP markings **should** be a combination of white and yellow iaw the scheme and dimensions shown at Figure 3.

22. Adjoining taxiways and roads **should** be marked iaw RA 3514⁵.

23. VLP holding position markings **should** follow the conventions for a Runway holding position type A, as provided in RA 3514⁵. The distance of the holding position from the VLP **should** be not less than the outer edge of the primary zone (91.5 m) but **should** be extended if jet downwash is likely to endanger a waiting Aircraft or vehicle.

24. The use of VLP ahead markings **should** be considered as shown in Figures 3 and 4.

25. Where a Mechanical Transport route joins a VLP, vehicle holding positions **should** be located outside the Primary Zone (91.5m) or at a suitable distance to ensure waiting vehicles are not endangered by jet downwash.

26. Markings **should** be made with materials having similar wet friction qualities to those of the surrounding paved surfaces.

⁵ Refer to RA 3514 – Permanent Fixed Wing Aerodromes – Markings.

**Guidance
Material
3522(3)**

Markings

27. Full size VLP designators are not mandated, however where multiple VLPs are available they may be added if the unit assesses there is a risk of confusion.
28. The VLP Ahead markings depicted at Figure 3 and 4, will be legible to both vehicles and Aircraft.
29. Black outlining (at least 0.15 m in width) may be provided where there is insufficient background contrast.
30. Colour specifications for paints can be found in BS 381C and colour specifications for signs and surface markings are for reflective materials are prescribed in BS EN 12899-1:2007.

**Regulation
3522(4)**

Lighting

- 3522(4) HoEs and AA-Facing Organizations **shall** ensure that the VLPs lights are provided to support Aircraft movements during low visibility and night operations.

**Acceptable
Means of
Compliance
3522(4)**

Lighting

31. VLP AGL **should**:
- Provide adequate guidance to indicate the layout and corners of the VLP Safety Zone.
 - Be of a different colour to the adjoining taxiway (orange is advocated) to ensure clear delineation of the surfaces.
 - Have intensity and distribution characteristics consistent with surrounding AGL and compatible with Night Vision Operations if required.
 - Be controlled by Air Traffic Control (ATC), with individual control of each VLP available.
32. Adjoining taxiways **should** be lit iaw RA 3515⁶.
33. **Parallax Markers.** Where parallax markers are provided to assist the pilot when executing a vertical landing, they **should** be:
- Arranged and optimized to provide sufficient guidance to enable a pilot to carry out a safe and accurate vertical landing.
 - Uni-directional.
 - Visible throughout the hovering height band of 0-200 ft AGL.
 - Robustly constructed to withstand transitional jet downwash from an Aircraft approaching the VLP at 150-200 ft AGL.
 - The minimum height required to function as intended.
34. When used to support night flying, parallax markers **should** be illuminated and, if required, compatible with applicable Night Vision Operations.

**Guidance
Material
3522(4)**

Lighting

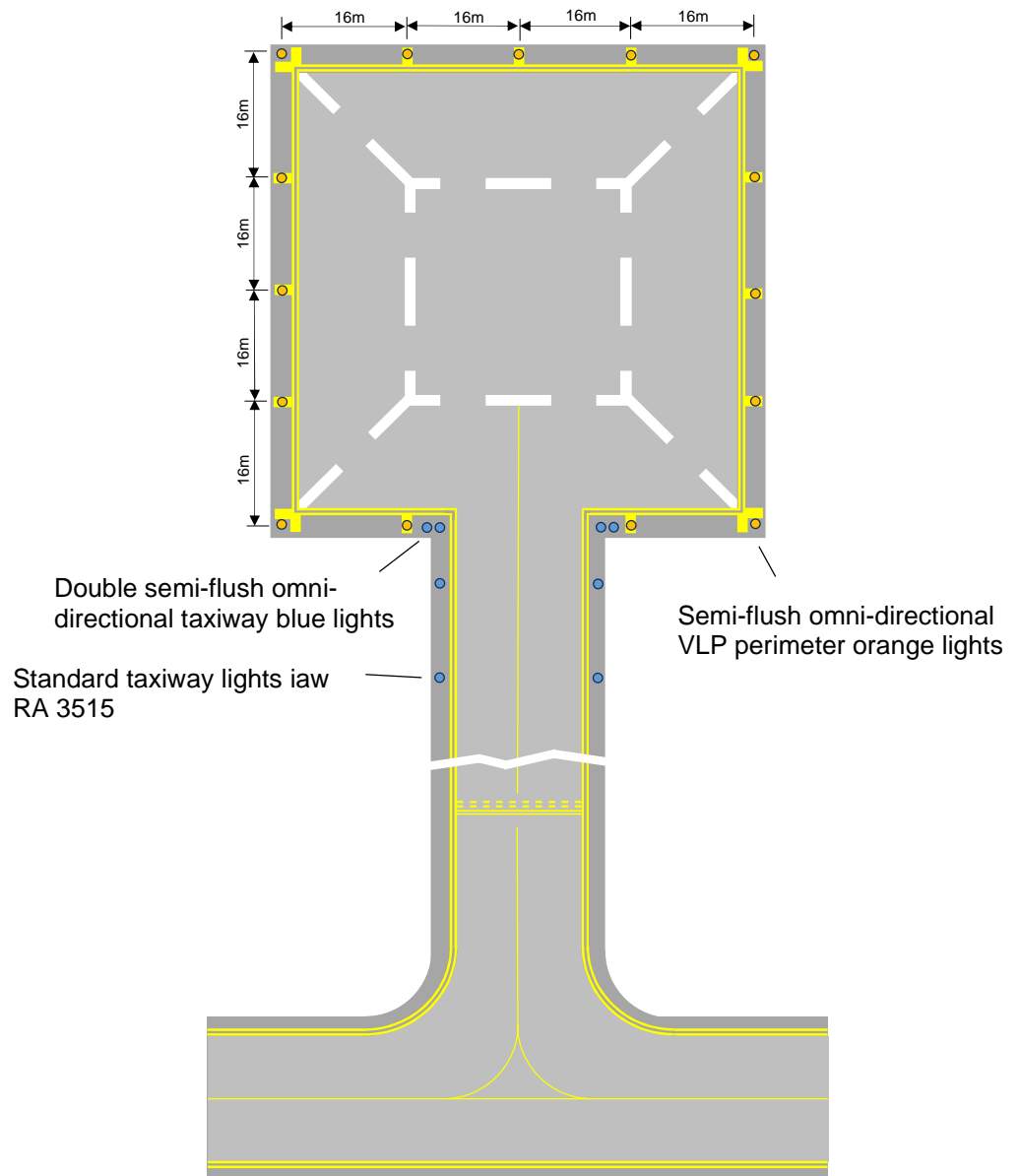
35. The recommended layout for VLP AGL is at Figure 5.
36. The requirement for individual control of each VLP enables visual reinforcement of the active VLP and, particularly at night, avoids unnecessary use of AGL and reduces the likelihood of confusion.
37. The recommended layout for parallax markers, to support F-35B, is at Figure 6 and as follows:

⁶ Refer to RA 3515 – Permanent Fixed Wing Aerodrome – Lighting, sub-regulation 17.

**Guidance
Material
3522(4)**

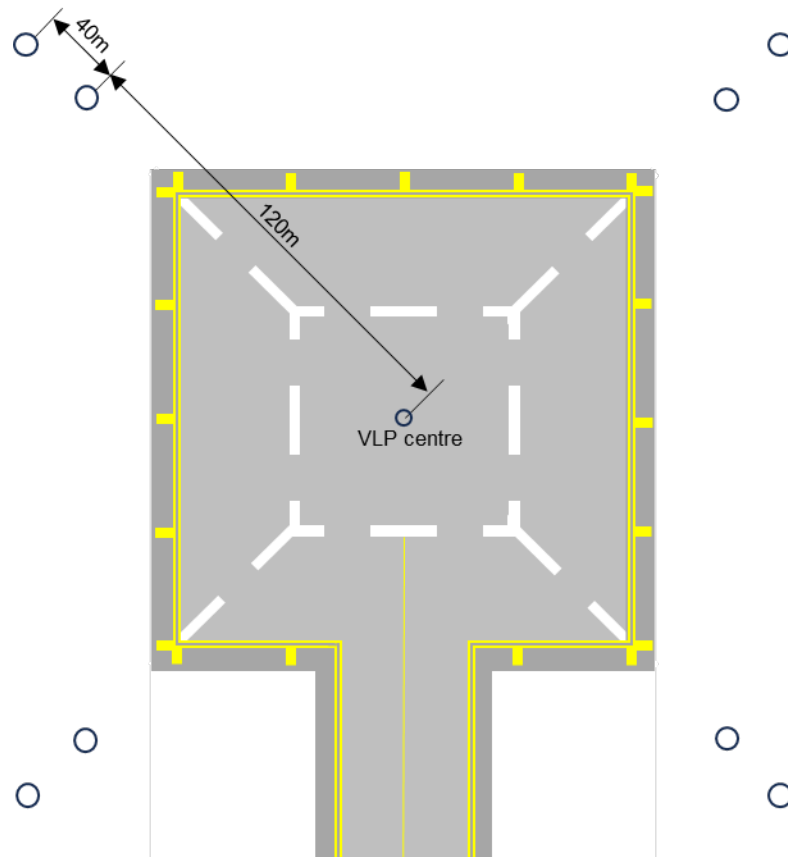
- a. An inner marker positioned 120 m from the centre of the VLP on a line extending through each corner.
 - b. An outer marker positioned at 160 m from the centre of the VLP on a line extending through each corner.
 - c. The colour to be used for parallax marker is not specified and may be determined by local requirements, provided that the lights are not dangerous or confusing to users of adjacent surfaces.
38. Where the recommended parallax marker configuration cannot be achieved due to space constraints the pattern may be adjusted, provided that the required visual references are still achieved to enable a safe approach.

Figure 5 – VLP AGL Layout



**Guidance
Material
3522(4)**

Figure 6 – Parallax Marker Layout (not to scale)



**Regulation
3522(5)**

Signs

- 3255(5) HoEs and AA-Facing Organizations **shall** ensure that mandatory instruction signs are provided to identify the location beyond which an Aircraft or vehicle is not to proceed unless authorized by ATC.

**Acceptable
Means of
Compliance
3522(5)**

Signs

39. VLP mandatory instruction signs **should** be installed iaw RA 3516(1)(2)⁷.
40. As a minimum, the following signs **should** be installed at MOBs where VLPs are in operation:
- VLP designation signs.
 - Holding position signs.
 - Road holding position signs.
41. VLP signs **should** be illuminated and / or retro-reflective iaw the provisions of International Civil Aviation Organization (ICAO) Annex 14 Vol I Appendix 4, when intended for use at night.

**Guidance
Material
3522(5)**

Signs

42. VLP naming and numbering conventions may be determined at unit discretion.
43. The decision to install either illuminated signs or retro-reflective signs will be determined by operational requirements, however it is recommended that VLP signage is consistent with the provisions on surrounding surfaces.

⁷ Refer to RA 3516(1): General and RA 3516(2): Mandatory Instruction Signs.