

## Aircraft Ground Service Connections Locations and Type

### RATIONALE

This revision was developed and agreed to bring ARP4084, originally published 1989, up to date versus more recent commercial transport aircraft types now in service.

### FOREWORD

In this document, the minimum essential criteria are identified by the use of the key word "shall". Other recommended criteria are identified by the key word "should" and, while not mandatory, are considered to be of primary importance in providing serviceable, economical and practical aircraft ground service connections layouts.

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## 1. SCOPE

### 1.1 Purpose

The purpose of this SAE Aerospace Recommended Practice (ARP) is to standardize locations of aircraft ground service connections to accommodate the trend toward fixed systems, which use the passenger loading bridge as a vehicle for a source of utilities. It must be recognized that, in standardizing the locations of the aircraft service connections, they must continue to be served efficiently in those instances where mobile ground support equipment is used. There is an ever increasing number of fixed installations for aircraft servicing. The objectives to be met by standardizing the locations of the aircraft service connections are the following:

- 1.1.1 Reduce ramp congestion and equipment interference around the aircraft, and minimize the chance of aircraft damage from ground support equipment.
- 1.1.2 Allow for optimization of ground services, both fixed and mobile, specifically 400 Hz electric power, preconditioned air for cabin conditioning, pneumatic power for jet engine start, potable water, lavatory service (draining, flushing), aircraft refueling, and interphone (headset) connections.
- 1.1.3 Standardize the locations of the service points around the aircraft to allow airport planners and facility engineers to design their fixed servicing systems to serve all aircraft easily and efficiently, as well as to provide additional standards and parameters for mobile equipment that connects to the aircraft.

### 1.2 Field of Application

- 1.2.1 This document limits itself to the seven different services mentioned in 1.1.2. It has focused on these aircraft services because:
  - a. These connections are those most frequently used during aircraft operation.
  - b. In terms of economic benefits, they have the greatest impact through improved efficiency.
- 1.2.2 This document is intended to apply to any new type of main line commercial transport aircraft designed or built after its original publication.
- 1.2.3 In addition, it is recommended that any substantially modified new derivative aircraft type in the same category (derived from a previously existing type) should, insofar as technically and economically practical, meet the requirements of this document, if specified in the aircraft type specification established between the airline(s) and the manufacturer.

## 2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AIR1589 Aircraft Damage Caused by Ground Support Equipment

AS90362 Connector, Receptacle, External Electric Power, Aircraft, 115/200 Volt, 400 Hz

## 2.2 ISO International Standards

ISO International Standards can be obtained:

In the U.S., from the American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, [www.ansi.org](http://www.ansi.org).

Abroad, from the national standardization institutions, or ISO, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, [www.iso.org](http://www.iso.org).

|           |                                                                                                                               |
|-----------|-------------------------------------------------------------------------------------------------------------------------------|
| ISO 45    | Aircraft - Pressure refueling connections                                                                                     |
| ISO 461-2 | Aircraft - Connectors for ground electrical supplies - Part 2: Dimensions                                                     |
| ISO 1034  | Aircraft - Ground air-conditioning connections                                                                                |
| ISO 2026  | Aircraft - Connections for starting engines by air                                                                            |
| ISO 7718  | Aircraft - Main deck passenger doors - Interface requirements for connection of passenger boarding bridge or transfer vehicle |
| ISO 10842 | Aircraft - Locations and type of ground service connections                                                                   |
| ISO 16004 | Ground equipment - Passenger boarding bridge or transfer vehicle - Interface requirements with aircraft doors                 |
| ISO 17775 | Aircraft - Ground service interfaces for potable water and toilet flush water tank and drain                                  |

## 2.3 ATA Publications

Available from Air Transport Association of America, Inc., 1301 Pennsylvania Avenue, NW, Suite 1100, Washington, DC 20004-1707, Tel: 202-626-4000, [www.airlines.org](http://www.airlines.org).

400 Hz Fixed Power Systems Design Guidebook - 1980

Aircraft Ground Support Air Systems Planning Guidebook - 1981

## 2.4 IATA Publications

Available from International Air Transport Association, Publications Assistant, 800 Place Victoria, P.O. Box 113, Montreal, Quebec H4Z 1M1, Canada, Tel: 1-514-874-0202, [www.iata.org](http://www.iata.org).

Airport Handling Manual AHM 922 - Basic Requirements for Passenger Loading Bridge or Transfer Vehicle Interface with Aircraft

Guidelines for Airport Consultative Committees (ACCs) - Section 15

Airport Development Reference Manual (ADRM) - Section 5.4, Aircraft Servicing Installations

### 3. GENERAL REQUIREMENTS

- 3.1 The majority of domestic and international airports now have nose-in parking and passenger loading bridges. The passenger loading bridges are being used more and more as a location point or vehicle for some of the services mentioned above. Typically, prior to this document, the location of the service connections on aircraft have been located with consideration for mobile ground support equipment servicing. This has created situations where certain aircraft cannot be serviced or are very inefficient to service with fixed utilities from the passenger loading bridge. Because we are discussing all types of aircraft to be serviced from fixed systems, as well as ground support equipment in open ramp situations, a common reference point must be identified for location of some of these services.
- 3.2 Since the passenger loading bridge is the primary means to convey certain utilities to the aircraft, the aircraft passenger door shall be used as a reference point for the location of connections appropriate for these utilities. As a result, it is necessary to consider separately the case of:
- 3.2.1 Aircraft with a single door, capable of being used for passenger access, located forward of the wing,
- 3.2.2 Aircraft with two doors, capable of being used (separately or simultaneously) for passenger access, located forward of the wing. Such aircraft can, depending on airport gate layout, be serviced either with two passenger bridges, or with one located at the most forward door (number 1L) or with one located at the most aft door (number 2L).
- 3.3 The standardized ground service connections locations shall provide efficient servicing configurations in either of the possible airport gate layouts (see Figure 3):
- 3.3.1 Open ramp parking, where all services are rendered by mobile equipment/vehicles. The objectives shall be to minimize ramp congestion and the possibilities of servicing vehicles interference with each other or with the aircraft structure.
- 3.3.2 Passenger loading bridge parking, where services can be rendered either by mobile equipment/vehicles, or by fixed facilities conveyed by the bridge. The objectives shall be to minimize the length of the various cables/hoses concerned and the possibilities of their interference with each other or with mobile equipment/vehicles still required.
- 3.4 In addition, the standardized ground service connections shall be selected in order to minimize the resulting design, weight, and space occupancy penalties on board the aircraft itself.
- 3.5 Access to ground service connections shall meet the following requirements:
- 3.5.1 Access doors and openings should be sufficiently sized to allow easy access for connection and removal of the applicable service. Access to the connection should be possible with a gloved hand.
- 3.5.2 Hinged doors shall not be susceptible to damage from the service device or present a potential hazard to the operator.

### 4. CONNECTIONS HEIGHT

- 4.1 With reference to the ground, the connections for all services covered by this document shall be located, whenever the aircraft structure's height allows, at a point where ground personnel can easily make connection from a standing position on the ground, without the use of ancillary access equipment.
- 4.2 The above requirement should at least apply, regardless of the aircraft structure's height, to interphone connections.
- 4.3 The above requirement should not apply to fueling connections.

## 5. CONNECTIONS LOCATIONS - INDEPENDENT OF AIRCRAFT TYPE

### 5.1 Electrical Power

5.1.1 Regarding the location of the 400 Hz electrical power connection, the most critical case is considered to be aircraft towing with 400 Hz power being provided from the tractor. Accordingly, the reference point used shall be the aircraft's nose landing gear.

5.1.2 (A) 90 kVA nominal capacity connection receptacle(s) meeting the requirements of international standard ISO 461-2 (6 pin connector configured to AS90362) shall be provided for 400 Hz electrical power. The connection(s) should preferably be vertical so as to avoid the possibility of pins misalignment under the weight of the cable.

NOTE: Where two or more electrical power connection receptacles are provided, it shall remain possible to perform aircraft towing using only one of the connections.

5.1.3 This (these) connection(s) should be located on or left of the lower center line of the fuselage, at a distance not exceeding 1.5 m (5 ft) from the nose landing gear.

### 5.2 Interphone (Headset)

5.2.1 Also as regards the location of the ground interphone (headset) connection, the most critical case is considered to be aircraft towing with an interphone link established with the tractor. Accordingly, the reference point used shall be aircraft's nose landing gear.

5.2.2 Two headset female connections shall be provided for interphone connection.

5.2.3 These connections should be located on or left of the lower center line of the fuselage, at a distance not exceeding 1.5 m (5 ft) from the nose landing gear.

### 5.3 Fueling

5.3.1 (A) pressure fueling connection(s) meeting the requirements of international standard ISO 45 (63 mm/2.5 in diameter) shall be provided.

5.3.2 One or two pressure fueling connection(s) should be provided on each wing.

5.3.3 The fueling connection(s) location on the wing should be determined in order to minimize access height and the possibilities of interference with mobile ramp equipment/vehicles performing other services on the aircraft, in the course of normal cargo or passenger operations. As a general rule, the most effective location for these connections is on the forward edge of the wing box (fuel tank), as far from the fuselage center line (outboard) as made allowable by maximum access height.

### 5.4 Lavatory

5.4.1 (A) lavatory servicing (draining and flushing) connection(s) meeting the requirements of international standard ISO 17775 shall be provided. The connection shall be complemented by an additional internal flapper valve to avoid the risks of either fluid leakage leading to in flight icing, or waste dumping over the ramp when connecting the servicing vehicle.

5.4.2 A single lavatory servicing connection should be provided, whenever allowed by aircraft's systems design.

5.4.3 The lavatory service connection should be located in the aft part of the aircraft. Its location should be determined in order to minimize access height and the possibilities of interference with mobile ramp equipment/vehicles performing other services on the aircraft, in the course of normal cargo or passenger operations.

## 6. CONNECTIONS LOCATIONS - AIRCRAFT WITH A SINGLE PASSENGER DOOR FORWARD OF THE WING

- 6.1 For aircraft with a single door, capable of being used for passenger access, located forward of the wing, the center line of the number 1L passenger loading door shall be used as a reference point. The location on the aircraft for the service connection points for water servicing, pneumatic power, and preconditioned air should be located at a point accessible from the center line of the number 1L passenger loading door, on or left of the lower center line of the fuselage.
- 6.2 For aircraft with a single door, capable of being used for passenger access, located forward of the wing, access shall be defined as any point within 1.5 m (5 ft) forward and 7.5 m (25 ft) aft of the center line of the number 1L passenger loading door (see Figure 1).
- 6.3 Potable Water
- 6.3.1 A single potable water servicing connection meeting the requirements of international standard ISO 17775 (19 mm/0.75 in diameter) shall be provided.
- 6.3.2 The potable water connection should be located at any point within the envelope defined in 6.1 and 6.2. As an alternate solution, the potable water connection may be located in the aft part of the aircraft. Its location should be determined in order to minimize access height and the possibilities of interference with mobile ramp equipment/vehicles performing other services on the aircraft, in the course of normal cargo or passenger operations.
- 6.3.3 If this alternate aft location is selected, the potable water servicing connection should be separated by at least 1.5 m (5 ft) from, and not located aft of, the lavatory service connection (see 5.4.3).
- 6.4 Pneumatic Power
- 6.4.1 No more than two pneumatic power connections, meeting the requirements of international standard ISO 2026 (76 mm/3.0 in diameter), shall be provided. In the event of two connections being provided, they should not be located more than 1.5 m (5 ft) apart from each other. Where there are two connections, minimum clearance requirements should be considered.
- 6.4.2 The pneumatic power connection(s) should be located at any point within the envelope defined in 6.1 and 6.2.
- 6.4.3 In addition, in the event of wing mounted engines, the pneumatic power connection(s) location should be determined in order to allow an entirely safe path for the operator, away from the aircraft inboard engines air intakes hazard areas, after disconnection with engines running.
- 6.5 Preconditioned Air
- 6.5.1 No more than two preconditioned air supply connections, meeting the requirements of international standard ISO 1034 (203 mm/8.0 in diameter), shall be provided. In the event of two connections being provided, they should not be located more than 1.5 m (5 ft) apart from each other. Where there are two connections, minimum clearance requirements should be considered.
- 6.5.2 The preconditioned air connection(s) should be located at any point within the envelope defined in 6.1 and 6.2.

## 7. CONNECTIONS LOCATIONS - AIRCRAFT WITH TWO PASSENGER DOORS FORWARD OF THE WING

- 7.1 For aircraft with two doors, capable of being used for passenger access, located forward of the wing, the center line of the number 2L passenger loading door shall be used as a reference point. The location on the aircraft for the service connection points for water servicing, pneumatic power, and preconditioned air should be located at a point accessible from the center line of the number 2L passenger loading door, on or left of the lower center line of the fuselage.

7.2 For aircraft with two doors, capable of being used for passenger access, located forward of the wing, access shall be defined as any point within 7.5 m (25 ft) of the center line of the number 2L passenger loading door (see Figure 2).

### 7.3 Potable Water

7.3.1 A single potable water servicing connection meeting the requirements of international standard ISO 17775 (19 mm/0.75 in diameter) shall be provided.

7.3.2 The potable water connection should be located at any point within the envelope defined in 6.1 and 6.2. As an alternate solution, the potable water connection may be located in the aft part of the aircraft. Its location should be determined in order to minimize access height and the possibilities of interference with mobile ramp equipment/vehicles performing other services on the aircraft, in the course of normal cargo or passenger operations.

7.3.3 If this alternate aft location is selected, the potable water servicing connection should be separated by at least 1.5 m (5 ft) from, and not located aft of, the lavatory service connection (see 5.4.3).

### 7.4 Pneumatic Power

7.4.1 No more than three pneumatic power connections, meeting the requirements of international standard ISO 2026 (76 mm/3.0 in diameter), shall be provided. In the event of two connections being provided, they shall not be located more than 1.5 m (5 ft) apart from each other. In the event that three connections are provided, no two connections shall be more than 2.4 m (8 ft) apart from each other. When there are multiple connections, minimum clearance requirements should be considered.

NOTE: Where three pneumatic connections are provided, it will not be feasible or economical to install three hoses on passenger loading bridges at airports. Accordingly, it shall remain possible to start the aircraft's engines using at most two of the three pneumatic connections, with appropriate input air flow capability.

7.4.2 The pneumatic power connection(s) should be located at any point within the envelope defined in 7.1 and 7.2.

7.4.3 In addition, in the event of wing mounted engines, the pneumatic power connection(s) location should be determined in order to allow an entirely safe path for the operator, away from the aircraft inboard engines air intakes hazard areas, after disconnection with engines running.

### 7.5 Preconditioned Air

7.5.1 (A) preconditioned air supply connection(s), meeting the requirements of international standard ISO 1034 (203 mm/8.0 in diameter), shall be provided. In the event of two or more connections being provided, they should not be located more than 1.5 m (5 ft) apart from each other. Where there are two or more connections, minimum clearance requirements should be considered.

NOTE: Where more than two air-conditioning connections are provided, it will not be feasible or economical to install three or more hoses on passenger loading bridges at airports. Accordingly, ground air-conditioning of aircraft, when serviced from an airport fixed facility, will remain limited to the performance level achievable with at most two connections under appropriate input air flow.

7.5.2 The preconditioned air connection(s) should be located at any point within the envelope defined in 7.1 and 7.2.

## 8. PREVENTION OF MOBILE G.S.E. INTERFERENCE

8.1 The service locations should be located in the above defined areas so that they are accessible to mobile ground support equipment under the following conditions:

8.1.1 When passenger loading bridges or fixed utilities are not available, or

8.1.2 When passenger access stairs are used in an open ramp situation.

8.2 Accommodations for service vehicles of 2.5 m (8 ft) width are required for a service vehicle within accessible distance of each connection point, and 0.6 m (2 ft) of clearance must be allowed for between positioned vehicles or from any part of the aircraft.

### 8.3 Safety

Before determining the locations of the connection points, the dangerous areas in front and in the rear of the aircraft engines have to be taken into consideration. It should be possible to connect/disconnect the couplings and to handle the aircraft without entering these dangerous areas while the engines are running on idle.

## 9. NOTES

9.1 The change bar ( | ) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document.

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