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AEROSPACE RECOMMENDED PRACTICE

SAE

ARP1836

REV.
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AIRCRAFT CARGO CONVEYOR - BATTERY POWERED

1. SCOPE:

This SAE Aerospace Recommended Practice (ARP) outlines the functional and design requirements for a battery powered, self-propelled belt conveyor for handling baggage and cargo at aircraft bulk cargo holds.

2. APPLICABLE DOCUMENTS:

The following documents shall become a part of this document.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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|---------|--|
| ARP1247 | General Requirements for Aerospace Powered Mobile Ground Support Equipment |
| ARP1328 | Aircraft Ground Support Equipment Vehicle Stability Analysis |
| AIR1375 | Minimum Safety Requirements for Special Purpose Airline Ground Support Equipment |
| AIR1558 | Interface Protective Devices - Ground Equipment to Aircraft. |
| ARP1816 | Charger for Battery Powered Ground Support Equipment |
| ARP1817 | Batteries for Battery Powered Ground Support Equipment |
| AIR1838 | Pictograms for Ground Support Equipment |
| ARP1892 | Electrical Connectors for Use In Battery Powered Ground Support Equipment |

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2.2 AHM Publications:

Available from AHM, 942 International Air Transport Association, 2000 Peel Street, Montreal, Quebec, Canada H3A 2R4.

IATA Airport Handling Manual, Section 9

3. DESIGN REQUIREMENTS:

Design, systems, hardware, and material used in the manufacture of the conveyor must meet automotive standards and good industry practices. The loader shall be designed for easy access to those areas that require frequent checks for servicing.

3.1 Physical Characteristics:

- 3.1.1 Overall dimensions of the aircraft cargo conveyor shall be within 347 in (8.81 m) long and 80 in (2.03 m) wide. The vehicle shall have a minimum front to rear wheelbase of 110 in (2.8 m).

Overall height should be kept as low as possible consistent with good operation, safety, and ground clearance.

- 3.1.2 The loader must be capable of servicing all commercial aircraft cargo compartments. This requires a range of travel of the forward end of the conveyor of a minimum of 38 in (0.97 m), from the ground in the conveyor full down position, to a minimum of 150 in (3.8 m) in the full up position. The rear end of the conveyor must maintain 20 in (0.51 m) to 24 in (0.58 m) through the entire height range of the forward end and extend to a minimum height of 50 in (1.27 m).
- 3.1.3 The turning radius as measured from the outside corner of the vehicle shall not be greater than 25 ft (7.6 m).
- 3.1.4 The following characteristics shall be met under normal operating conditions and loads:
- Approach angle: 16° (0.28 rad) minimum
 - Ramp breakover angle: 10° (0.18 rad) minimum
 - Departure angle: 10° (0.18 rad) minimum
- 3.1.5 The conveying belt shall be 24 in (0.61 m) wide. Usable conveyor bed width shall be a minimum of 32 in (0.81 m) with guides and a maximum of 40 in (1.02 m) overall.
- 3.1.6 The belt conveyor shall have tire tread suitable for outdoor use and all performance requirements as specified in this document.
- 3.1.7 The minimum ground clearance shall be at least 5 in (0.13 m).
- 3.1.8 The loader chassis shall have rub rails on both sides for protection against damage.

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- 3.1.9 To minimize aircraft damage the forward end of the conveyor support structure shall be protected with a type of rubber bumper.
- 3.1.9.1 First Bumper Alternative: Bumper does not extend across the front of the conveyor bed, but is mounted to the support structure on either side of the conveyor bed, reducing finger pinching hazard.
- 3.1.9.2 Second Bumper Alternative: Bumper is full width, 5 in (0.13 m) ID x 7 in (0.18 m) OD.
- CAUTION: The gap width between the bumper support and belt at the front of the conveyor should be chosen with great care. If too small, the risk of getting fingers caught exists. If too large, packages can get stuck or fall through the gap.
- 3.1.10 The operator's control area shall have adequate room to safely and efficiently operate the loader. Recommended dimensions to accomplish this are shown in Figure 1 and Table 1.

TABLE 1 - Operator Station Interior Dimensions

TABLE 1A - Dimensions A through N

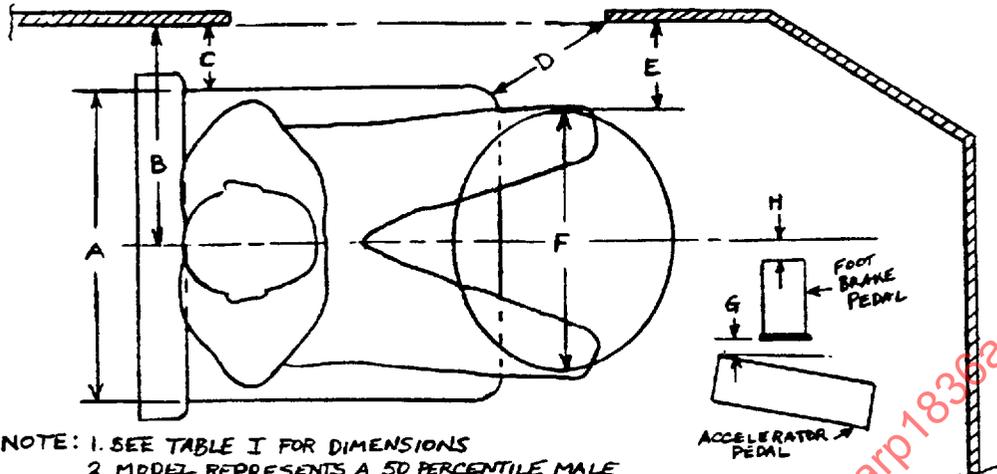
Dimension	Inches	Centimeters	Description
A	18.0 min 22.0 max	45.72 min 55.88 max	Seat width
B	15.0 min	38.1 min	Seat position-lateral
C	5.0 min	12.7 min	Elbow room
D	14.5 min	36.83 min	Knee room
E	6.5 min	16.51 min	Side room
F	16 min 18 max	40.64 min 45.72 max	Steering wheel diameter
G	2.5 max	6.35 max	Brake-accel. separation
H	2.5 max	6.35 max	Steering Column - Brake Separation
I			Not used
J	27.0	68.58	Small man eye level
K			Not used
L	31.5	80	Average man eye level
M	18 min 20 max	45.72 min 50.8 max	Seat backrest height
N	29 min	73.66 min	Knee room

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TABLE 1B - Dimensions O through Z

Dimension	Inches	Centimeters	Description
O			Not used
P	18 min (± 3)	45.72 min (± 7.62)	Seat position fore-aft
Q	13 min 17 max	33.02 min 43.18 max	Seat length
R	10 min 17 max	25.4 min 43.18 max	Seat cushion height
S	25 min	63.5 min	Steer height
T			Not used
U	3.0 max	7.62 max	Shift lever
V	26 min	66.04 min	Leg room
W	11 min 14 max	27.94 min 35.56 max	Braking
X	14.5 min	36.83 min	Foot room
Y	4.0 max	10.16 max	Brake pedal travel
Z	8.0 max	20.32 max	Brake pedal height
Angle	Degrees	Description	
β	15.0 min	Downward visibility	
γ	28.0 min	Accelerator pedal down angle	

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NOTE: 1. SEE TABLE I FOR DIMENSIONS
 2. MODEL REPRESENTS A 50 PERCENTILE MALE
 REFERENCE: DREYFUS, THE MEASURE OF MAN.

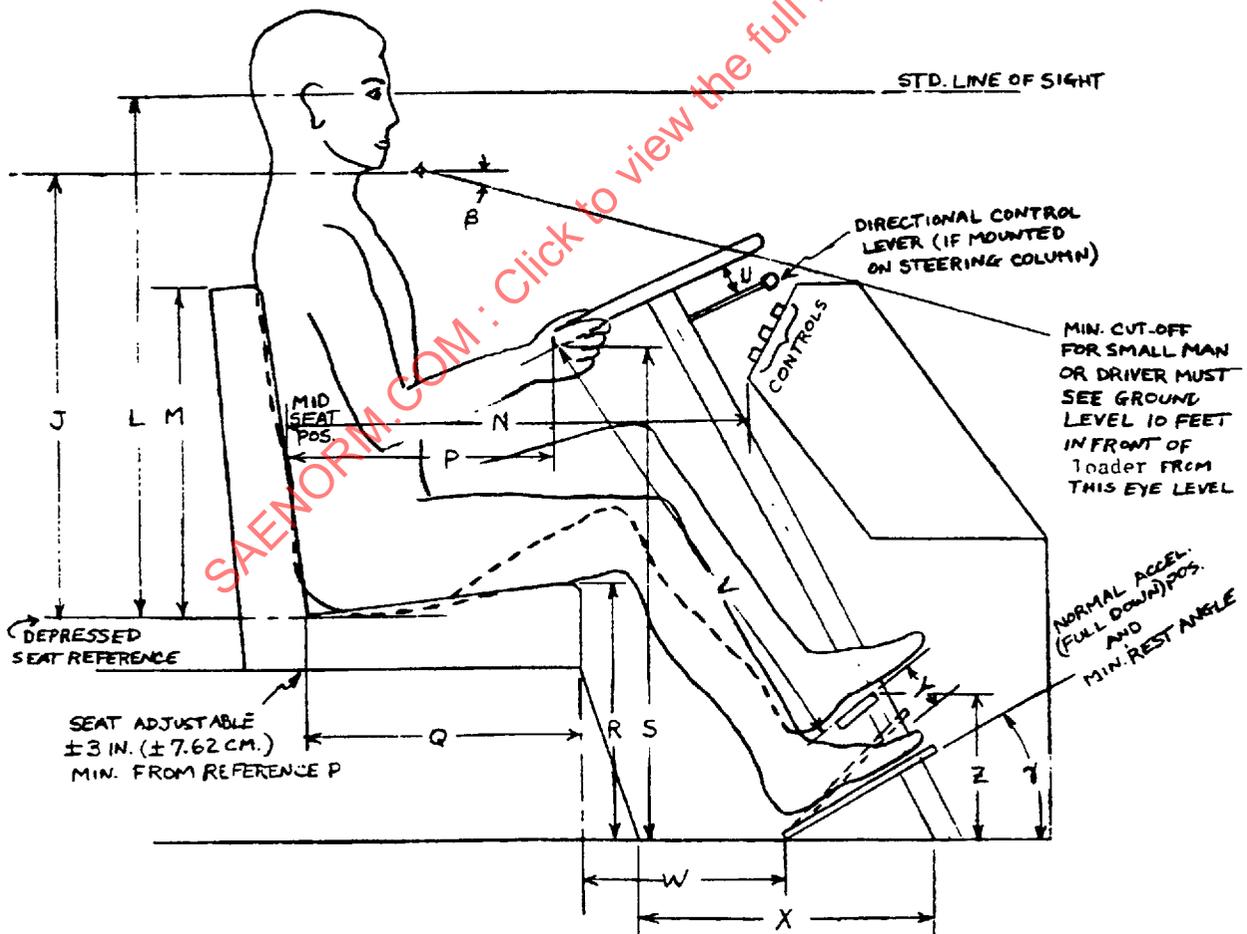


FIGURE 1 - Operator Station Dimensions

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3.2 Mechanical and Hydraulic Systems:

Design requirements as delineated in 3.13.1.1 and 3.13.1.3 of ARP1247 in particular shall be followed.

- 3.2.1 The loader shall be a four wheel vehicle with front wheel steering.
- 3.2.2 Steering effort shall not require more than 20 lb-ft (27.1 n-m) torque as measured from the circumference of the steering wheel.
- 3.2.3 Service brakes shall be of a dual system hydraulic design with split master cylinder and indicator light on dash to warn the operator if one system fails. Drum brakes, disc brakes, or combinations of both are acceptable.
- The maximum permissible stopping distance from full speed on level ground shall not be greater than 25 ft (7.6 m). A brake pedal force required to meet this distance shall not be more than 100 lb (444 n).
- 3.2.4 The suspension system shall be adequate to prevent chassis bottoming under normal operating condition with a full rated load.
- 3.2.5 Drive wheels shall have at least 2.0 in (5.1 cm) of clearance to permit installation of tire chains.
- 3.2.6 The operator's seat shall be adjustable fore and aft with a minimum range of 6 in (0.15 m). See Figure 1.
- 3.2.7 The loader shall be equipped with an adjustable overcenter manual type hand brake with a pulling motion toward the operator engaging the brake.
- 3.2.8 The directional control switch for traction drive shall have three positions:
- Forward
 - Neutral
 - Reverse

The reverse position shall be to the front, neutral in the middle, and forward to the rear.

NOTE: For international operators, these positions may have to be reversed.

The neutral position must have a detent. Operation shall be for a right-handed person.

- 3.2.9 Provisions for adjusting belt tension and alignment shall be made.

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3.3 Electrical System:

- 3.3.1 The cargo conveyor is to operate on a common industrial battery pack powering the vehicle, conveyor lift, and belt drive. The preferred method for electric drive utilizes an SCR (silicon controlled rectifier) or equivalent electronic controller to produce smooth acceleration and operation. Battery voltage shall reflect the best design for duty cycle, vehicle speed, hydraulic system, and minimum current losses.
- 3.3.2 The electrical system shall use a two wire system; i.e., the battery negative shall use a separate wire isolated from vehicle chassis by at least 500 000 Ω resistance. Battery cleanliness to prevent acid leakage paths is of utmost importance and every attempt to facilitate same should be taken into consideration in the design.
- 3.3.3 A separate 12 V DC accessory system using chassis ground to accommodate standard automotive equipment shall be provided. The preferred method to provide the 12 V system is through an electronic DC to DC converter with or without a cycling type 12 V storage battery.
- 3.3.4 The loader shall be equipped with two headlights, two brake/taillights, and a backup light(s). The backup light(s) shall be activated through the reverse position of the directional control switch.
- 3.3.5 Two adjustable floodlights, one forward and one rear, shall be installed with switch on dash panel.
- 3.3.6 The controller, DC-DC converter and associated equipment shall be enclosed in a sealed compartment with Type NEMA 4 standards or better. All peripheral electrical or electronic components that cannot be contained in this compartment must be of waterproof and heavy duty construction, or adequately protected from wind, ramp splash, snow and ice accumulation, blown rain, dust, and sand.
- 3.3.7 The electrical/electronic systems shall incorporate proper shielding, filtering, etc., if necessary, to assure electromagnetic compatibility with any and all communication and navigation frequencies in and around the airport ramp areas.
- 3.3.8 Power connectors must comply with ARP1892.
- 3.3.9 Battery and chargers must comply with ARP1817 and ARP1816.
- 3.3.10 The vehicle charging connector shall be interlocked to prevent the loader moving with the battery charging cable attached.

4. PERFORMANCE REQUIREMENTS:

The following performance requirements apply to the loader on dry, level concrete of good quality and an outdoor ambient temperature range of 5 °F (-15 °C) to +95 °F (35 °C), unless otherwise specified. Note that this is not the operating temperature range of the equipment, which is as specified in ARP1247.

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- 4.1 The maximum speed of the vehicle with no load shall be approximately 15 mph (24.1 km/h).
- 4.2 Total distributed load capacity of at least 2000 lb (907 kg) for conveyor angles up to 15° (0.26 rad), and at least 1000 lb (453.6 kg) at the maximum conveyor angle of the loader, is required.
- 4.3 The conveyor shall have a load density rating of at least 200 lb/ft² (976.4 kg/m²).
- 4.4 Conveyor belt speed shall be manually controllable within a range of 40 to 100 ft/min (12.2 to 30.5 m/min) with any loads up to those specified in the duty cycle requirement (see 4.7).
- 4.5 The belt drive system shall not permit a load to move more than 0 in/min in the unpowered (belt motor off) state. This condition applies to any loads up to those specified in 4.2 and 4.3 and in any weather conditions.
- 4.6 Conveyor lift speed with no load shall be at least 25 ft/min (7.62 m/min). Conveyor lowering speed at no load shall be within 50% of lift speed; i.e., within a range of 12.5 to 37.5 ft/min (3.81 to 11.43 m/min).
- 4.7 As a minimum requirement, the battery pack and electrical system shall be designed to meet a duty cycle of 1.5 h actual vehicle travel time and 4.5 h of conveyor belt operating time before recharging or changing batteries.

For purposes of testing and specification, the following conditions shall be used:

a. Vehicle Operation:

- (1) Vehicle traveling with no load (except operator) at various speeds
- (2) 15 full stops and starts
- (3) 45 full turns per mile at various speeds
- (4) Rest periods of 20 min for every hour of driving

b. Conveyor/Belt Operation:

- (1) Belt operating with 750 lb (340 kg) load
- (2) 15° conveyor angle (with respect to horizontal)
- (3) 75 ft/min (22.9 m/min) constant belt speed
- (4) 6 full stops and starts per each simulated 20 min aircraft loading, demonstrating the service capabilities established in 3.1.2

5. INSTRUMENTS AND CONTROLS:

The requirements of 3.13.1.8 and 3.13.12 in ARP1247 shall be met for instruments and controls.

- 5.1 Instrumentation shall include as a minimum a battery discharge indicator and an hourmeter. The hourmeter shall register the operating time of the vehicle during travel and belt conveyor function (either event shall activate the hourmeter). An indicator light for the brake system as per 3.2.3 is required on the dash.