LINEAR GUIDE SYSTEM STREAMLINES AIRCRAFT SEAT ASSEMBLY, OPERATION

RAILS ON PLANES

Linear guide rails are an important component within aircraft interiors. Following are some of the places where they are used:

- For seat adjustments — forward and back seat movements, footrests, sliding armrests and tables
- Rails enable 180° positioning for super first class seats that flatten for sleeping
- Sliding privacy screens between passengers
- Kitchen slide-outs, such as garbage compactors
- Sliding lavatory doors

When airline passengers travel in coach class, expectations are fairly low with regard to comfort. For example, most seats only offer two positions, straight for takeoff and landing, and a slight recline for the journey. Coach seats are relatively simple and lightweight structures compared to their more sophisticated counterparts in business class, first class, and super first class. Whereas a coach seat weighs approximately 100 lb, seats in higher classes weigh 200 to 300 lb each, depending on their features.

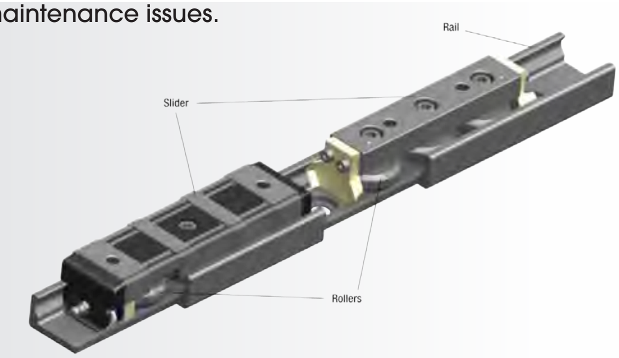
Super first class seats are the most complex, folding flat to 180° for sleeping and featuring infinitely adjustable headrests, footrests, and seatbacks. At a cost of $250,000 to $300,000 per seat — and a spec sheet of 5,000 parts — designers must carefully consider how each component contributes to the overall design. To facilitate smooth and quiet operation, engineers incorporate various linear motion components into their seat designs.

Among these components are the linear rails and bearings that allow seats to move forward and back, and armrests and footrests to slide smoothly into a range of positions. Because weight and reliability are the most important design constraints in aerospace applications, each component must be as lightweight and robust as possible. To achieve this, design engineers have traditionally relied on titanium as the material of choice for certain components, due to its blend of lightweight, high strength properties. However, titanium has become more difficult to source over the past few years, leading to a corresponding increase in both price and delivery schedules. Steel is increasingly being used in place of titanium, as it is widely available and offers comparable strength at roughly one-fourth the cost.

The design tradeoff is that steel is approximately twice as heavy as titanium. However, with regard to the linear rails and bearings used in seat construction, this is not much of an issue: Of the 300 lb weight of a super first class seat, a mere 2 lb comes from the steel rails and bearings. Using titanium would save another pound of weight, but at a significant cost and time disadvantage. To compensate for the weight of steel versus titanium, aircraft designers have shaved bulk from other areas with lighter weight seat materials and stronger engines, reduced meal service, and other strategies.

In addition to meeting weight constraints, the linear motion components used in aircraft seats must be rigid, straight, and feature a sufficient load capacity to support passengers. Seats must also withstand extremely severe tests, including 16 g of acceleration in both vertical drops and side impact testing. To conduct the trials, seats are placed on a track within a testing chamber and subjected to g forces to determine how they hold up. In addition to in-house manufacturer testing, seats must also be verified by FAA-authorized labs in order to gain approval for use in commercial aircraft. Seat rails may deform and bend up to 3 inches, but cannot break apart and create flying debris.

Straightness is the major design and assembly issue when it comes to specifying and installing linear rails in aircraft seats. If the framing is not straight enough, misalignment will occur, resulting in friction, stuck bearings, and seats that are difficult to operate. Traditionally, designers have specified linear rails and bearings separately, leaving alignment tasks up to assembly technicians. However, this approach can result in time-consuming assembly processes. Even worse, improper alignment can occur, leading to maintenance issues and significantly reduced seat lives. Seats are expected to last for five to seven years with little if any maintenance issues.

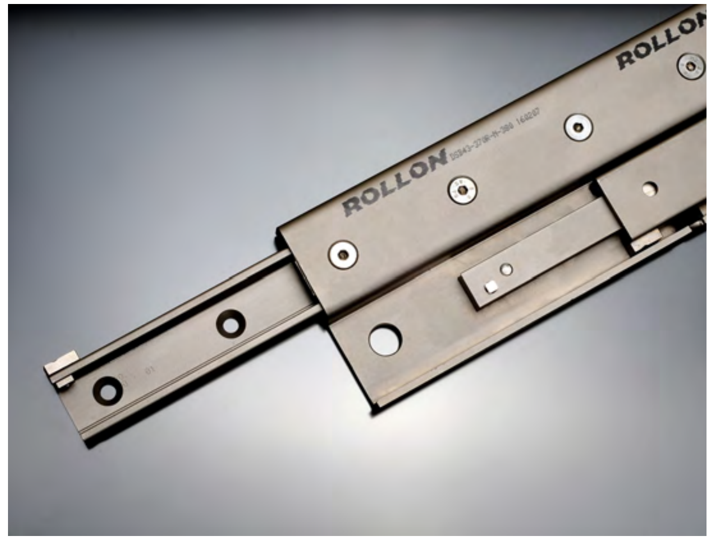


COMPACT RAIL: SPECS AND STATS

- The Compact Rail linear guide system absorbs rotational positioning errors, misalignments between lateral planes, and longitudinal parallelism errors — while maintaining the original preload setting
- Internal raceways resist corrosion and dirt, and allow mounting in space-constrained areas
- Sliders are equipped with rollers that are in alternating contact with both sides of the raceway
- Individual sliders can carry up to 3,300 lb dynamically
- Spring-loaded, lubed-for-life wipers continuously deposit a thin film of oil on raceways
- Maximum radial load capacity: 15,000 N per slider dynamically
- Operating temperature range: -22° to 248° F
- Rail lengths from 6.3 to 142 in.
- Induction hardened and ground rail raceways
- Rails and slider bodies zinc plated according to ISO 2081

Another option is to use a self-aligning, preloaded linear guide system. One such multi-component system, the Compact Rail family from Rollon Corp., offers guide rails that include pre-installed rolling sliders with radial bearings that slide on internal raceways. This flexible system features three types of rails, including a fixed bearing rail, floating bearing rail, and a compensation rail that can be combined in different ways. For example, a fixed bearing rail and floating bearing rail can be supplied as a system to allow for deviations in parallelism of up to 1/8 of an inch. Fixed bearing rails act as the main load-bearing surface for radial and axial forces, while floating bearing rails are used for load bearing of radial forces and as a support bearing for any occurring moments. Because the rails are supplied together — with sliders already mounted and preloaded inside — there is no chance of misalignment. The self-aligning system guarantees that straightness is not an issue during seat assembly and operation, saving time and costs.

Compact Rails are made of readily available carbon bearing steel with induction-hardened raceways and zinc-plated surfaces for corrosion resistance. The system is lubricated for life and insensitive to dirt, due to sliders that run on internal tracks inside the guide rails. Noise-free and very smooth operation is another advantage. Because Compact Rails employ radial bearings, they are significantly quieter than traditional recirculating ball systems, an important design feature in first-class aircraft cabins.



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