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Brakes, Wheels & Tyres Cost not to be overlooked

In this issue . .

Brakes, wheels and tyres should not be overlooked as they constitute major safety critical components and impact on the total cost of aircraft operation. Landing gears, wheels, tyres and brakes - which together form ATA Chapter 32 - represent one of the largest maintenance cost centres after power plants. The cost of wheels and brakes includes tyre retreading, tyre replacement, wheel inspection, brake repair and overhaul, and brake replacement.

Brakes & Tyres Pricing & Costs

The actual price paid for brakes maintenance and overhaul will depend upon the negotiating operator's power and discounts of up to 40% can be achieved by large airlines with large fleets. For wheels and tyres, whilst some tyre manufacturers publish price catalogues, these are not representative to airline operators in practical terms, since the vast majority of operators will negotiate prices which take account of commercial clout and the cost and frequency of tyre retreading. There are two favoured methods of paying for aircraft tyres. The first is called "cost-per-landing", which transfers all inventory and supply responsibilities to the tyre OEM. Once the total cost of tyres per cycle has been agreed, the airline will advise the tyre OEM of the number of cycles flown each month and a corresponding invoice will be issued to the operator. Cost-per-landing contracts are becoming more popular, particularly among the larger airlines, although small operations and start-ups may still prefer basic time-and-material arrangement. The second method of paying for aircraft tyre is called "single unit price" and is based upon averaging the cost of a new tyre in relation to the cost and number of retreads that can be accomplished.

Tyres: Radial 'versus' Bias

There are two major types of tyres, namely radials and bias, which show different maintenance patterns both in terms of costs and intervals. Bias aircraft tyres feature a casing which is constructed of alternate layers of

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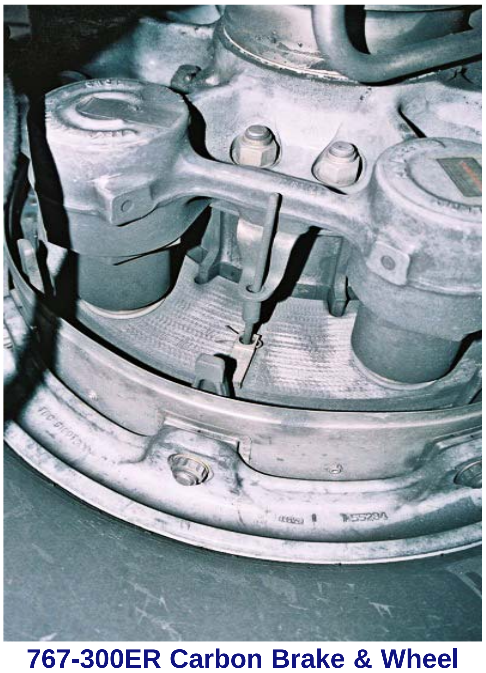
rubber-coated nylon ply cords which extend under the beads at alternate angles. On the other side, radial aircraft tires feature a flexible rubber casing coated with polyester ply cords extending to the beads, at 90 degrees to the centre line of the tread. This casing is stabilized by a stiff circumferential belt. Looking at the tyre manufacture market, 84% are of bias construction and 16% are of radial construction. This dominancy of the bias-ply tyre can be explained by the fact that once a bias-ply tyre is approved for a given aircraft, it stays with that aircraft until the end of its service life, since retrofits from bias to radial are expensive to obtain as well as involving a long administrative procedure. Also most aircraft manufacturers, with the exception of Airbus, use wheel rims designed for bias-ply tyres and rarely have specific radial rims. Radials are today fitted as original equipment on all Airbus aircraft. Radials are more suited to large heavy aircraft as the tyre walls can bend freely under the full weight of the aircraft. Bias-ply tyres are widespread for regional aircraft.



767-300ER Carbon Brake & Wheel Unit

The weight advantage of radials is significant for larger tyres, though there is generally more stress on the wheels with a radial. Radial tyres typically weigh 10-15% less and last up to 30% longer. But on the negative side, they can cost up to 20% more to purchase and retread. The manufacturing cost of radials is significantly higher than bias tyres. For the purpose of this article, we will look at a tyre size 49"x19"-22", 32 PR as on-board the 747-400 as bias and 777-200/-300 as radial. The bias tyre costs $3,888 with Goodyear and Goodyear offers retread service for $1,069. Michelin offers a 49"x19"-22", 32 PR radial tyre for $5,444. On average, the bias tyre is retread every 250 FC and can be retread up to four times compared to 280 FC for the radial tyre, which can be retread up to five times. Despite the cost of retreading being very close between the two tyres (a resulting factor of negotiation), replacement costs for the 777 radial tyres can be significantly more than the 747 bias-ply. In reality, many of the 777 and 747 operators receive large discounts for their tyre purchases primarily due to the concentrated nature and relatively large sizes of the fleets.

Brakes & Tyres Pricing & Costs

There are two types of brakes: carbon and steel. Carbon brakes are the result of recent technological advances and carbon's high specific heat and thermal conductivity make it highly desirable as a heat absorber. The first production carbon brakes were provided by Dunlop Aerospace Braking Systems for the Concorde in the early 1970s. The majority of the Airbus fleet uses carbon brakes exclusively, while Boeing typically uses a mixture of both. Approximately 90% of brake repair is accounted for by materials and less than 10% by labour. Carbon brake stacks have to be repaired so that their original weight and thickness are maintained. Steel brakes have to be reassembled so that the stack has a minimum width and weight, which provides sufficient braking power. Nowadays, the majority of brake work is carried out on carbon heat stacks rather than the more traditional steel.

Carbon brakes have the advantage of being lighter and having longer removal


737 Steel Brake Units

intervals compared with steel brakes, however, the cost of the repair and replacement is higher. Carbon brakes have higher repair costs because of the higher replacement rate of stators, which are more expensive than steel units. In comparison, repairing steel brakes is more labour intensive, as it is more time consuming to rebuild the heat stack in the workshop. Despite their high cost compared with steel units, carbon brakes compensate by sharply increasing brake life. Removal intervals for steel brakes are about 600-1,500 cycles for most types. Intervals may vary because of weight. Removal intervals for carbon brakes are in the region of 1,600-3,000 cycles. Despite having longer removal intervals for repairs, carbon brakes have higher costs per FC because their repair or shop visit costs are more than twice the cost for steel units. Steel brakes have average repair/overhaul cost of $5,000-13,000. Comparatively, carbon brakes have average repair/overhaul cost of $20,000-55,000. Consequently, cost of brake repair per FC average $7-18 for steel brakes while carbon brakes average a repair cost of $10-21 per FC.

Wear Rate 'versus' Landing Weight

IBA analyzed the key costs associated with brakes and tyres to determine what correlation may exist between landing costs and landing weight. As brake wear is directly related to the magnitude of the force that is exerted upon them, the weight of the aircraft coupled with its speed will relate directly to the wear rate of the brakes and tyres alike.

As can be seen from the graph on the following page, a clear correlation exists for maintenance costs and landing weight for a series of narrow-body aircraft. Although not confirmed, 737NG carbon brakes will be more expensive than the steel brakes per landing, however, the economic benefits on fuel burn are likely to effect operating costs as a whole in a beneficial way.

As for the narrow-body aircraft, a strong correlation exists for the wide-body aircraft as shown in the following graph. The 757 has been included in this analysis due to similarities with the 767 family in general and because it has eight brake units, twice the number of any other narrow-body aircraft under investigation. From this graph it can be deduced that the A330 family of aircraft have a lower cost per landing with respect to landing weight than any other wide-body. This is unsurprising when you consider that the 767 is of an older generation, whilst the 777 has four more brakes units to maintain.

To conclude, IBA feels that operators need to gain a better understanding of their maintenance costs for brakes and tyres so as to be able to optimise their spending throughout their fleets. Costs of maintenance of such items do weigh on the company operating costs and should be kept in mind while deciding on aircraft purchase and operation. Operators need to look carefully at their operations to decide how best to address the maintenance of their brakes and tyres, and whether a cost per landing approach is suitable to their operations.

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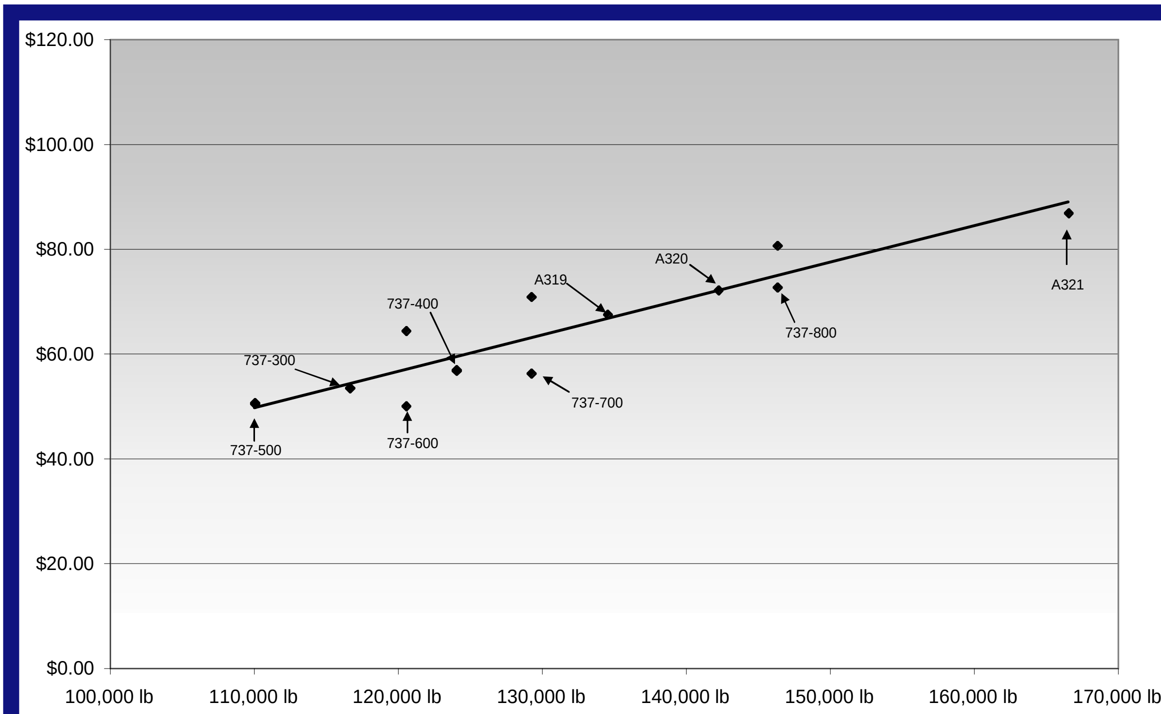
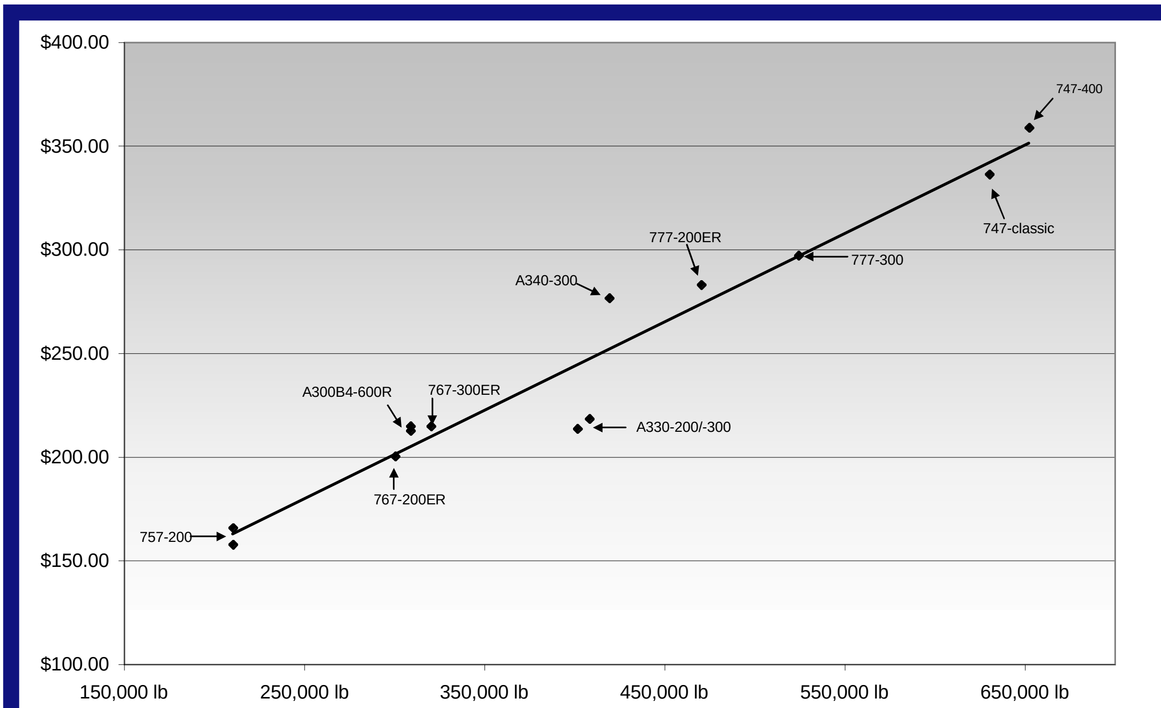


Total Cost Per Landing for a Series of Narrow-body Aircraft



Total Cost Per Landing for a Series of Wide-body Aircraft

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