International Civil Aviation Organization

STA/10-WP/5
13/10/09

**WORKING PAPER**

# TENTH SESSION OF THE STATISTICS DIVISION

**Montréal, 23 to 27 November 2009**

**Agenda Item 1: Civil aviation statistics — ICAO classification and definition**

## AVAILABLE CAPACITY AND AVERAGE PASSENGER MASS

(Presented by the Secretariat)

**SUMMARY**

This working paper discusses the importance of the ability of air carriers to calculate their production in terms of tonne-kilometres available. This is not only important for the air carriers in the context of their management but it is also useful for all other stakeholders involved who may wish to carry out comparative analyses among the various air carriers. One of the elements used in this calculation is the average passenger mass (including baggage). While air carriers are encouraged to make use of their own figures, they may wish to note that the internationally agreed recommended average passenger mass has stood at 90 kg for over seventy years. The Fourteenth Meeting of the Statistics Panel (STAP/14) has suggested that IATA may wish to conduct a survey among its members to verify if the recommended value was still relevant in today's environment. The results of this survey are included in this paper.

Action by the division is in paragraph 5.

## 1. INTRODUCTION

1.1 ICAO has, on the basis of traffic statistics received, observed that some air carriers do not know how to calculate total payload capacity available[1]. In the air transport industry, this is measured by tonne-kilometres available (TKA). It is important that air carriers know how to calculate this parameter since those that do not will not be able to calculate the proportion of sales in relation to their volume of production or their cost per unit of production, which are two important measures managers use to assess the commercial success of an enterprise. In addition, airlines that are publicly traded would not be in a position to provide shareholders and financial analysts with a true and fair account of their production costs and their efficiency with respect to the sale of their product in the marketplace. Finally, ICAO and its Contracting States would not be able to carry out valid comparative financial analyses among air carriers.

[1] Total payload capacity available (in metric tonnes), is the capacity available above and below deck, for the carriage of revenue load (passengers, baggage, freight and mail) taking into account payload restrictions, where applicable, and operational restrictions on the supply of capacity.

1.2 Another significant issue relates to the average passenger mass used to calculate both the passenger tonne-kilometres performed (PTKP) and the passenger component of the capacity in tonne-kilometres available. While air carriers are encouraged to make use of mass values per passenger (including checked baggage) that are appropriate for their route structure, ICAO, the International Air Transport Association (IATA) and the regional air carrier associations, recommend that if that mass is not known, air carriers can apply an average passenger mass value, including checked baggage, of 90 kilograms (198 pounds) for statistical purposes.

1.3 The purpose of this working paper is to invite the division to examine the appropriateness of these definitions, and suggest changes that could be made to the definitions and instructions as deemed necessary with a view to improving the reporting of these data by air carriers.

## 2. TONNE-KILOMETRES AVAILABLE (TKA)

2.1 One of the problems with TKA may be that its concept is poorly understood. The capacity offered is not the maximum design payload of an aircraft. As defined by ICAO (and IATA), TKA is the capacity available *for sale* after taking into account any payload limitations due to operational and/or commercial factors[2]. Unfortunately, it seems that the latter part of the definition is not always applied since data reported to ICAO suggest that in some cases air carriers are using available payload figures that are too high when compared with the load carried and the associated weight load factors.

2.2 Capacity restrictions required for operational reasons may involve restrictions on an aircraft's maximum take-off mass as a result of the airport's ambient air temperature or high elevation (a typical airport in this category would be Nairobi). Restrictions also arise in operations where range needs to be extended by sacrificing some of the payload for additional fuel, although such a need is becoming rare among the current generation of long haul aircraft, as a result of the amended Extended-range Twin-engine Operational Performance Standards **(**ETOPS) rules.

2.3 Commercial reasons may also reduce the capacity available for sale below the maximum design capacity. For example, many of the Low-Cost Carriers (LCCs) only carry passengers and do not make use of the freight capacity of the aircraft. A similar situation may occur with traditional air carriers which decide to partly or completely forgo the carriage of freight so as to reduce their flight turnaround times on short haul routes and thus maximize their daily aircraft utilization. Also, for short haul routes in Europe and North America, some air carriers prefer to carry air freight by truck as this is the cheaper option.

2.4 To calculate the tonne-kilometres available, an air carrier must first convert the seat-kilometres available into tonne-kilometres by multiplying the former by the average passenger mass which includes its checked baggage[3]. On routes where air carriers have opted not to carry cargo (see above), the TKA is equivalent to the seat-kilometres available (SKA), multiplied by the average passenger mass.

2.5 Having established this figure, the carrier has to estimate the volume of the cargo holds which remains available for sale after having taken into account the volume taken up by the passengers' checked baggage. In this context, the carrier's knowledge of its cargo routes and load composition becomes important because, in order to calculate the mass, the air carrier has to apply the average cargo

[2] An identical definition is used in relation to seat-kilometres available (SKA), where they represent the capacity available *for sale* for the carriage of passengers after taking into account any payload limitations due to operational and/or commercial factors.

[3] For consistency, this has to be the same mass which is used to calculate the passenger TKP.

density appropriate to its routes to the volume available for the carriage of cargo. However, in so doing, it must also take into account the fact that not all the remaining cargo volume may be used (dead spaces). Also important is the type of unit load device (ULD) used (pallets or containers), if any. In addition, it must ensure that the overall calculated payload falls within the established operational limits for each route and that it should not exceed the maximum design payload of the aircraft under any circumstances.

2.6 An important fact with regard to cargo is that while the aircraft may reach its maximum allowable payload in terms of weight, the volume of the cargo allowed is limited by the size of the cargo holds. The effect of not using the appropriate cargo density to estimate TKA where low density shipments are involved is that the air carrier may erroneously show a low cargo load factor, while from a volumetric point of view; the aircraft may well be operating at its limit. On the other hand, TKA computed with the correct cargo density may well show cargo load factors akin to those achieved for the carriage of passengers. However, one problem with showing TKAs and load factors which are more appropriate to the type of operation of an air carrier is that it may result in a higher unit cost per TKA, which is something that some managers may be reluctant to do.

2.7 The definitions and instructions included in the cost and revenue questionnaire of the IATA Airline Economic Task Force suggest that carriers which do not know the cargo densities of their loads may use an average cargo density of 161 kg per cubic meter (10.05 pounds per cubic foot). ICAO has no recommendation with regard to cargo density.

2.8 *Recommendation of the Fourteenth Meeting of the Statistics Panel (STAP/14)*. The Panel agreed with the suggestion made by some observers that current practices of the air transport industry stakeholders be looked at before a decision is taken.

2.9 The IATA survey discussed below did include questions on cargo density (see paragraph 4 b). In addition, the Secretariat also approached Boeing and Airbus on this issue. In response, Boeing sent the results of a voluntary survey carried out over the period 1985-2002 as well as a rigorous ramp data-gathering study conducted to cover a four-year period (2003-2007) involving 500 Boeing 747F and 16 000 pallet positions. The results from both of these activities reveal an average cargo density of 160 kg per cubic metre.

## 3. AVERAGE PASSENGER MASS (INCLUDING CHECKED BAGGAGE)

3.1 As indicated above, and in order to convert the number of passengers carried into a load expressed in metric tonnes, the former are multiplied by a factor representing the average mass of the passenger plus checked baggage (which covers the free baggage allowance plus excess baggage). The current instructions used by ICAO (and IATA) leave this conversion factor at the discretion of the operator. However, if no conversion factor is available, it is recommended that 90 kg be used.

3.2 The average mass of 90 kg was established some 70 years ago and the question must be raised as to whether such a value is still pertinent at present, given the changes in the load carrying capacity of aircraft, in the mass profiles of individuals, and in the amount (kg) of checked baggage which passengers are allowed to carry. Also, the issue as to whether a single average passenger mass fits all routes or whether some distinction should be made by differentiating, say, between domestic and international services, becomes relevant.

3.3 Appendix A contains an analysis presented to the panel of the distribution of the average passenger mass used in submitting the air carriers for Form A — Traffic — Commercial Air Carriers. The

charts show that for scheduled services, most carriers appear to be using the recommended average passenger mass of 90 kg. Consequently this did not assist the panel in reaching a judgement on the validity of this value.

3.4 *Recommendation of the Fourteenth Meeting of the Statistics Panel (STAP/14)*. The panel agreed that IATA, with the support of ICAO, should inquire from its member airlines if an amendment of the average value for passenger mass from 90 kg to 100 kg as discussed by the Panel would be advisable and report back to ICAO by June 2009. IATA would also investigate the commonly value used for cargo density.

## 4. RESULTS OF THE IATA SURVEY

4.1 IATA received replies to its survey from 28 air carriers, 82 per cent of which agree that, for statistical purposes, an average mass of 100 kg for a passenger plus its checked baggage better reflects today's actual values. This overall mass would generally include an average mass of 20 kg for checked baggage. The division may wish to note that the same passenger plus checked baggage mass is being recommended by the European Union (EU) as a default value if actual values are not available to be used for the statistical data air carriers will have to submit for the EU Emissions Trading Scheme (ETS).

4.2 With regard to air cargo, some 75 per cent of the air carriers sampled also agreed that, for statistical purposes, an average cargo density of 161 kg per cubic meter is representative of their international and domestic routes, be it all cargo or mixed operations. This density is practically identical to the results obtained by Boeing for all-cargo services (see paragraph 2.9 above).

4.3 A brief report with key results of the survey is in Appendix B.

## 5. ACTION BY THE DIVISION

5.1 For statistical purposes, the division is invited to recommend that:

a) where an air carrier does not have a factor representing the average mass of the passenger plus both normal baggage allowance and excess baggage to convert them into a mass, it is recommended that 100 kg. should be used;

b) where an air carrier does not have a cargo density to convert the volume of air cargo or checked baggage into a mass, the density of 161 kg per cubic meter should be used. Such a density can be used for all-cargo and mixed operations.

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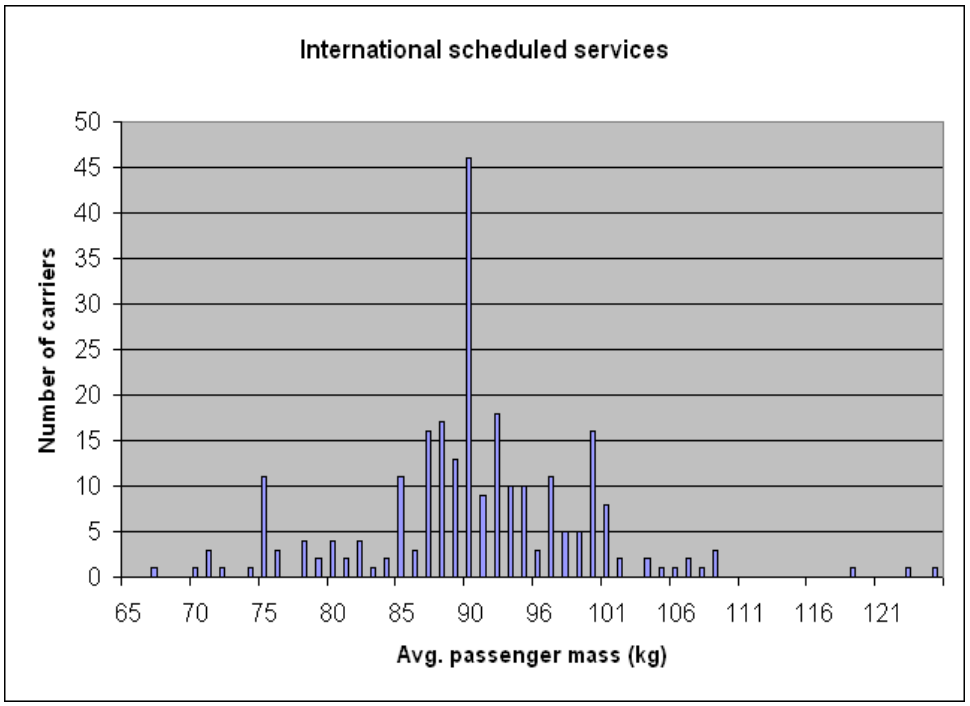
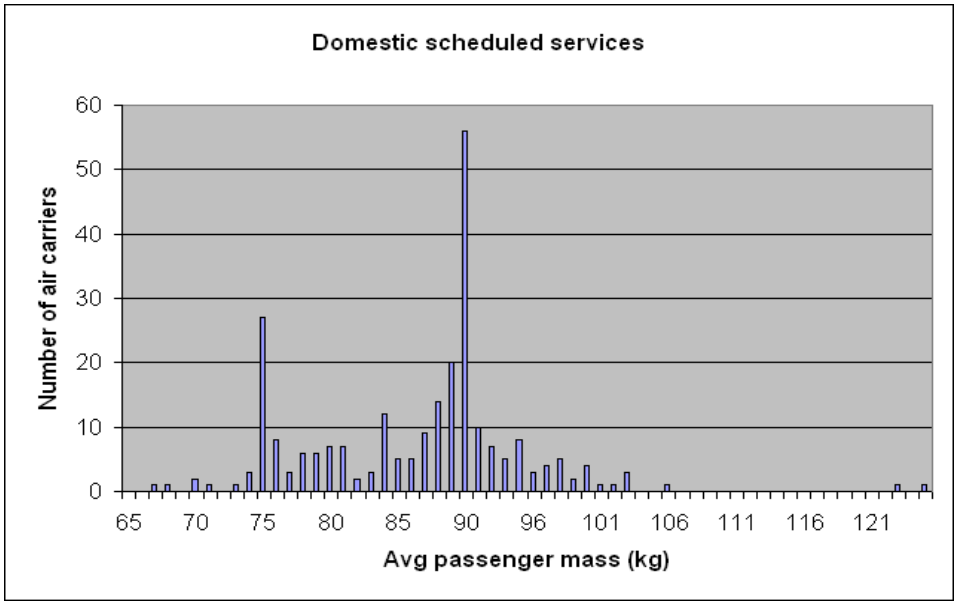
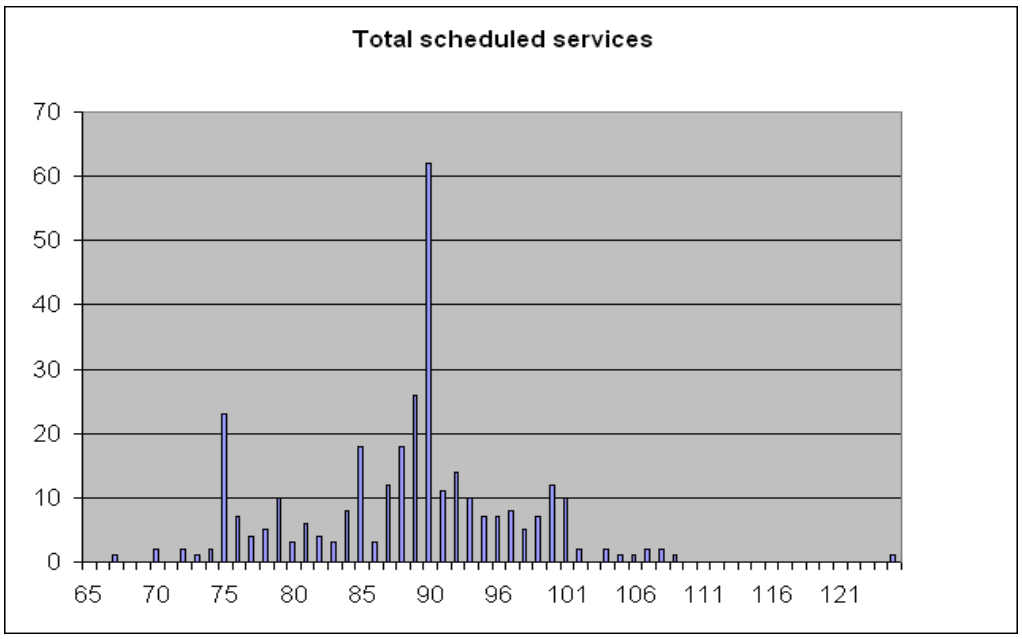
# APPENDIX A

## DISTRIBUTION OF THE AVERAGE PASSENGER MASS




Total scheduled services
70
60
50
40
30
20
10
0
65
70
75
80
85
90
96
101
106
111
116
121

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# APPENDIX B

# IATA SURVEY ON AVERAGE PASSENGER WEIGHT AND CARGO DENSITY

## 1. AIRLINE SURVEY FINDINGS

1.1 Eighty two per cent of the respondent to the International Air Transport Association (IATA) survey agree that, for statistical purposes, an average passenger mass (plus checked baggage) better reflects the actual average mass. Based on historical data submissions stored within IATA, the World Air Transport Statistics (WATS) member datasets show similar trends to those depicted by ICAO in Appendix A.

1.2 For cargo operations, 75 per cent of carriers agreed that, for statistical purposes, 161 kg per cubic meter is a representative average cargo density in their international and domestic cargo and mixed operations.

1.3 These results were obtained from a sample of 28 member airlines distributed as follows: 4 Africa; 2 Americas; 9 Asia/Pacific; 8 Europe; and 5 Middle East.

## 2. KEY RESULTS

2.1 On the issue of an average passenger mass (passenger including checked baggage) of 90 kg, opinions were split. For international scheduled operations, 57 per cent of the airlines considered that 90 kg value as a fair representation, while 43 per cent consider it to be under representative; whereas opinions where uniform for domestic scheduled and charter operations, where 80 per cent considered 90 kg as a fair representation.

2.2 About 80 per cent of the air carriers agreed they have used an average passenger mass between 70 and 80 kg across all domestic and international scheduled operations. In addition, about 70 per cent of carriers agreed the average checked baggage weight used varies between 10-20 kg for domestic and international short haul operations, whereas 46 per cent indicated that a value of 25-30 kg is the average used in international long haul operations.

2.3 When asked directly their opinion if, for statistical purposes, the value of 100 kg for average passenger mass (plus both normal baggage allowance and excess baggage) better reflects current values, 82 per cent of the airlines agreed. However a few airlines suggested 95-105 as alternative values.

2.4 With regard to cargo, about 85 per cent of air carriers agreed that, for statistical purposes, 161 kg per cubic meter is a fair average cargo density across their international and domestic all-cargo and mixed operations. Overall, 75 per cent of carriers agreed it was a representative number and 14 per cent suggested different values ranging from 125-195 kg per cubic meter. Finally, 68 per cent of airlines indicated that they use a density of 161 kg to estimate the volume required to store passenger checked baggage in the aircraft cargo hold. 29 per cent of these respondents suggested values ranging 145-170 kg per cubic meter.

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