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Road vehicles — Ergonomic requirements for the driver's workplace in line-service buses —

Part 4: Cabin environment

Véhicules routiers — Exigences ergonomiques du poste de conduite dans les bus de ville —

Partie 4: Environnement dans la cabine

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16121-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 13, *Ergonomics applicable to road vehicles*.

This second edition cancels and replaces the first edition (ISO 16121-4:2005), which has been editorially revised.

ISO 16121 consists of the following parts, under the general title *Road vehicles — Ergonomic requirements for the driver's workplace in line-service buses*:

— *Part 1: General description, basic requirements*

— *Part 2: Visibility*

— *Part 3: Information devices and controls*

— *Part 4: Cabin environment*

Introduction

Poor ergonomics in the driver's workplace in buses designed to provide scheduled urban and interurban services increase the already high physical and mental strains on the drivers.

It is the aim of this part of ISO 16121 to supply the designer of line-service buses with information about how to develop an overall ergonomic concept for the driver's workplace. The recommended requirements on the driver's workplace for line-service buses made in this part of ISO 16121 are based on the scientific conclusions of the research project “Driver's workplace in the line-service bus”. This was conducted in Germany and summarized in the recommendation VDV 234[1]. Further comprehensive ergonomic studies related to the design of an enhanced driver workplace conducted in the United States, Canada, the Netherlands, Sweden and the United Kingdom[2][3][4][5][6] have been considered and found to provide recommendations covering similar areas.

This part of ISO 16121 sets out to consider the practical implications for all ranges of drivers, but particularly those with statures from 1,55 m (small female) to 2,0 m (large male). These statures include shoes (~30 mm).

It is also essential that the designer refers to the specifications and requirements of all parts of ISO 16121 (1 to 4) before completing the design of a driver's workplace.

It should be noted that where there is also national legislation covering any of the subjects contained herein, then both should be complied with. However, if a contradiction between the two should arise in any specific area, then the legislation shall prevail for that specific point only.

Road vehicles — Ergonomic requirements for the driver's workplace in line-service buses —

Part 4: Cabin environment

1 Scope

This part of ISO 16121 specifies minimum requirements for the cabin environment.

It applies to the driver's workplace in low-floor line-service buses designed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum weight exceeding five metric tonnes and an overall width exceeding 2,30 m.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5128, *Acoustics — Measurement of noise inside motor vehicles*

ISO 6549, *Road vehicles — Procedure for H- and R-point determination*

ISO/TS 11155-1, *Road Vehicles — Air filters for passenger compartments — Part 1: Test for particulate filtration*

ISO 11155-2, *Road vehicles — Air filters for passenger compartments — Part 2: Test for gaseous filtration*

ISO 16121-2:2005, *Road vehicles — Ergonomic requirements for the driver's workplace in line-service buses — Part 2: Visibility*

SAE J381, *Windshield defrosting systems test procedure and performance requirements — Trucks, buses and multipurpose vehicles*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
low-floor
vehicle in which at least 35 % of the area available for standing passengers (or of its forward section in the case of an articulated vehicle) forms a single area without steps, reached through at least one service door by a single step from the ground

3.2
test air flow rate
average volume of air passing through the filter per unit time

NOTE Expressed in m^3/h.

3.3
efficiency or penetration
relative comparison of the amount of contaminant removed or reduced by the filter compared to the amount exposed to it, described by the following equation:

$$\% \text{ efficiency} = 100\ \% * (C_1 - C_2)/(C_1)$$

where

C_1 is influent concentration;

C_2 is effluent concentration;

% penetration is 100 % — % efficiency (for particles);

% breakthrough is 100 % — % efficiency (for gas and vapour)

3.4
time zero
t_0
calculated zero point based on the shape of the ramp-up curve of gas challenge breakthrough versus time

NOTE For further details, see ISO/TS 11155-2.

4 Climate, ventilation

4.1 Basic requirements

The design of the cab and the climate-control system shall together provide a climate inside the cab that is acceptable to the vast majority of drivers working in the normal conditions prevailing in the region throughout the year.

The basic system shall consist of conventional air heating and ventilation, with the option of additional heating or air conditioning as necessary for the particular operating environment.

The climate and ventilation in the driver's cab shall be controllable independently of that of the passenger compartment.

4.2 Climate of driver's cab

4.2.1 Heating

The level that is considered as a comfortable interior temperature and the time it takes to get to that temperature largely depend on the outside temperature and living conditions of the region the vehicle is operated in. The interior climate conditioning is therefore subject to agreement between the client and manufacturer.

Annex A provides a recommendation of heating performance.

4.2.2 Air conditioning (if fitted)

Consideration should be given to the fitness of air conditioning to maintain a comfortable climate in the driver's cab, subject to agreement between client and manufacturer, taking into account the environmental conditions of operation. If both saloon and cab air conditioning systems are required, and these systems are served by the same compressor and condenser unit, then the zone control would be maintained by independent air outlets.

Annex A provides a recommendation of climate performance.

4.3 Ventilation

4.3.1 The ventilation fan shall have a minimum of three speed settings.

4.3.2 Additional adjustable air nozzles for direct air jets in the direction of the driver shall be provided. The airflow should be such that the nozzles can be closed if required.

4.4 Windscreen defrosting and demisting

4.4.1 The defrosting and demisting system shall ensure that the driving view (front and sides) is kept clear during operation. The specific measurement and performance requirements shall be in compliance with SAE J381.

It should be noted that requirements for demisting of the windscreen can be met by the defrosting system as described in SAE J381.

4.4.2 Attention shall be paid to maintain adequate demisting of the window used to provide lateral visibility according to 4.2 of ISO 16121-2:2005.

4.5 Air quality

The driver's workplace shall be capable of being ventilated from either external ambient air or re-circulated cabin air. The specific performance requirements are subject to agreement between client and manufacturer. Annex B gives an overview of typical performance criteria measured according to ISO/TS 11155-1 and ISO/TS 11155-2.

5 Noise inside the vehicle

5.1 In order to minimize the exposure of the driver to workplace noise, the following measurements should be taken.

5.1.1 The driving noise, expressed as an L_{eq} (taken over two minutes) at 50 km/h, shall not exceed 70 dB(A) at the driver's ear height (measuring method in accordance with ISO 5128). The noise level, when stationary and engine is idle, shall be <60 dB(A).

5.1.2 The noise level of the ventilation fan in the lowest position shall not exceed 55 dB(A) at the driver's ear height. The noise level in the middle position (de-misting, directed to the windscreen) shall not exceed 65 dB(A), with the engine off.

5.2 Noises with distinct and unpleasant tonal characteristics (clattering, grating, squeaking, etc.) shall be avoided.

Annex A
(informative)

Recommended heating performance

A.1 The set temperature should be attainable under typical operation for a region with mild climate (e.g. Western Europe) and average temperature between −10 °C and +25 °C.

A.2 The area around the driver, with the seat in the rearmost upper position, should be controllable in the range of at least 18 °C to 25 °C. This condition should be reached after 30 min from the start of the heating system with the engine at operating temperature, measured at the H-point as specified by ISO 6549.

A.3 The distribution of the temperature in the head area should be approximately 1 °C to 3 °C cooler than the footwell when measured at the V-point and the accelerator heel point.

A.4 Once the target temperature is reached, it should be possible to maintain it at an air velocity of 0,2 m/s near the body area. If required, special measures should be provided to prevent ingress of air from outside the bus, when the front door is open, for example by:

— high cabin door to protect the driver's thigh area, and/or

— a separation above the cabin door, and/or

— warm air curtain or special warm air nozzles in the door area.

A.5 Once the target temperatures have been reached, a surface temperature of >15 °C should be ensured at all adjacent surfaces (excluding all external windows).

Annex B
(informative)

Recommended performance of a typical cabin air filter

B.1 Particle efficiencies

Cabin air filters (if fitted) for line-service buses should have particle efficiencies as specified in Table B.1, at an air flow of 200 m^3/h when measured in compliance with ISO/TS 11155-1.

Table B.1 — Recommended particle efficiency

Particle size (µm)	Efficiency limits (%)
0,5 — 1,0	>30
1,0 — 2,0	>42
2,0 — 3,0	>66
3,0 — 5,0	>84
5,0 — 10,0	>90

B.2 Gas efficiencies

Cabin air filters (if fitted and if suitable for the removal of gas) for line-service buses should have gas efficiencies as specified in Table B.2, at an air flow of 200 m^3/h when measured in compliance with ISO/TS 11155-2.

Table B.2 — Recommended gas efficiency

Gas and times (min)	Limits for gas efficiency (%)
n-Butane, t_0	>75
n-Butane 5 min	>20
Toluene, t_0	>75
Toluene 5 min	>70
SO_2, t_0	>75
SO_2, 5 min	>60

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[1] VDV 234, *Driver's work place in the low-floor line-service bus*, Verband Deutscher Verkehrsbetriebe (VDV), Cologne, Germany

[2] TCRP Report 25, *Bus operator workstation evaluation and design guidelines — Summary*, sponsored by the Federal Transit Administration, USA, 1997

[3] STRP Report # 6, *Ergonomic study of the driver's workstation in urban buses*, Canadian Urban Transit Association

[4] NEN 5526, *Nederlandse Norm, Ergonomische criteria voor het ontwerpen de beoordeling van de buscabine*, Delft 1999

[5] Swedish Road and Transport Research Institute, *Driver's Cab in Buses, Phase 3: Field tests — Summary*

[6] *Bus Cab Ergonomics: Assessment of general layout and guidelines*, by ICE Ergonomics Ltd and Sammie CAD Ltd, UK, August 2000

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