International Standard 4180/2

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Complete, filled transport packages — General rules for the compilation of performance test schedules — Part 2 : Quantitative data

Emballages d'expédition complets et pleins — Règles générales pour l'établissement des programmes d'essais d'aptitude à l'emploi — Partie 2 : Données quantitatives

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4180/2 was developed by Technical Committee ISO/TC 122, *Packaging*, and was circulated to the member bodies in March 1979.

It has been approved by the member bodies of the following countries :

Australia	France	New Zealand
Austria	Germany, F.R.	Poland
Belgium	Hungary	Romania
Brazil	India	South Africa, Rep. of
Bulgaria	Ireland	Spain
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Denmark	Malaysia	USSR
Egypt, Arab Rep. of	Netherlands	Yugoslavia

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Italy
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0 Introduction

This International Standard has been prepared in order to fulfil a need of organizations concerned with the compilation of test schedules for complete, filled transport packages.

Such test schedules can be as diverse as the journeys that packages undergo. Accordingly, this International Standard is intended to set guidelines for the compilation of appropriate test schedules, rather than to provide a rigid framework or to be specified by regulatory or other authorities.

It is expected that, once compiled, a particular test schedule, including the test methods and intensities to be applied, could be the subject of International Standards or would become a matter for agreement between the parties concerned, for example the package designer, the manufacturer of the contents, the transport authority, the customer, the statutory regulating body or any combination of them.

1 Scope and field of application

This International Standard establishes general rules to be used for the compilation of performance test schedules for complete, filled transport packages intended for use within any distribution system, whether transported by road, rail, sea, air or inland waterway, or by a combination of these modes of transport.

ISO 4180/1 states the general principles entailed in compiling test schedules.

It also gives the factors to be considered in assessing the criteria of acceptance of such packages after they have been subjected to a package performance test schedule.

This part incorporates all the quantitative data necessary to establish test intensities and other quantitative features of test schedules.

The two parts are intended to be read in conjunction with one another.

2 References

ISO 2206, *Packaging — Complete, filled transport packages — Part 1 : Identification of parts when testing.*

ISO 2233, *Packaging — Complete, filled transport packages — Part 2 : Conditioning for testing.*

ISO 2234, *Packaging — Complete, filled transport packages — Part 3 : Stacking test.*

ISO 2244, *Packaging — Complete, filled transport packages — Part 5 : Horizontal impact tests (inclined plane test; pendulum test).*

ISO 2247, *Packaging — Complete, filled transport packages — Part 6 : Vibration test.*

ISO 2248, *Packaging — Complete, filled transport packages — Part 4 : Vertical impact test by dropping.*

ISO 2872, *Packaging — Complete, filled transport packages — Part 7 : Compression test.*

ISO 2873, *Packaging — Complete, filled transport packages — Part 8 : Low pressure test.*

ISO 2874, *Packaging — Complete, filled transport packages — Part 9 : Stacking test using compression tester.*

ISO 2875, *Packaging — Complete, filled transport packages — Part 10 : Water spray test.*

ISO 2876, *Packaging — Complete, filled transport packages — Part 11 : Rolling test.*

ISO 4180/1, *Complete, filled transport packages — General rules for the compilation of performance test schedules — Part 1 : General principles.*

3 Factors requiring quantification in test methods

Relevant test methods, and the factors requiring quantification before each test can be used, are given in table 1.

4 Preferred values of test intensities

Basic test intensities, which are considered to be normal for a common distribution system and which are based upon a package of "average" mass and size (i.e. of mass 20 kg and dimensions 400 mm × 400 mm × 400 mm) are given in table 2, for the road, rail, water and air modes of transport and for storage.

Where a test intensity other than the basic value is appropriate (see clause 5) the value selected should be chosen, as far as is practicable, from the preferred values given in table 3.

For comparative investigations or research it may be necessary to select values of test intensity other than those given in table 3.

Table 1 — Methods of test and factors requiring quantification

Method of test	Relevant International Standard	Factors requiring quantification
Conditioning	ISO 2233	Temperature, relative humidity, time, pre-drying conditions (if any).
Stacking test	ISO 2234	Load, duration of time under load, attitude(s) of the package(s)[1], atmospheric temperature and relative humidity, number of replicate packages.
Vertical impact test by dropping	ISO 2248	Drop height, attitude(s) of the package(s)[1], atmospheric temperature and relative humidity, number of replicate packages, number of impacts.
Horizontal impact tests (inclined plane test, pendulum test)	ISO 2244	Horizontal velocity, attitude(s) of the package(s)[1], atmospheric temperature and relative humidity, profiles of impacting surfaces and use (if any) of an interposed hazard, number of replicate packages.
Vibration test	ISO 2247	Duration of test, attitude(s) of the package(s)[1], atmospheric temperature and relative humidity, load (if any) superimposed on the package(s), number of replicate packages.
Compression test	ISO 2872	Maximum load (where applicable), attitude(s) of the package(s)[1], atmospheric temperature and relative humidity, upper platen rigidly mounted or free to tilt, number of replicate packages.
Low pressure test	ISO 2873	Pressure, duration of time at reduced pressure, temperature within test chamber, number of replicate packages.
Stacking test using compression tester	ISO 2874	Load applied, duration of time under load, attitude(s) of the package(s)[1], atmospheric temperature and relative humidity, number of replicate packages.
Water spray test	ISO 2875	Duration of time under spray, attitude(s) of the package(s)[1], number of replicate packages.
Rolling test	ISO 2876	Atmospheric temperature and relative humidity, number of replicate packages.

1) See ISO 2206.

Table 2 – Basic test intensities

Method of test	Variable	Units	Transport mode								Storage	
			Road		Rail		Water		Air			
			Basic value	Range	Basic value	Range	Basic value	Range	Basic value	Range	Basic value	Range
Tests imposed by equipment installation and environment												
Climatic[1]	Rain Temperature Relative humidity Low pressure		Under study									
Vibration	Duration	min	20	10 to 60	20	10 to 60	Short : 20 Long : 60	10 to 60	Under study	Under study		
	Height of stack, if loaded	m	2,50	1,50 to 3,50	2,50	1,50 to 2,50	3,50	3,50 to 7,00				
Stacking	Duration	As given	1 day	1 day to 1 week	1 day	1 day to 1 week	Short : 1 day Long : 1 week	1 day to 4 weeks	1 day	Nil	Short : 1 day Long : 1 week	1 day to 4 weeks
	Height	m	2,50	1,50 to 3,50	2,50	1,50 to 2,50	3,50	3,50 to 7,00	1,80	Nil	3,50	1,50 to 7,00
Horizontal impact	Velocity	m/s	1,5	1,5 to 2,7	1,8	1,3 to 5,0	–	–	–	–	–	–
Test imposed by manpower												
Vertical impact	Drop height	mm	500	100 to 1 200	500	100 to 1 200	300	100 to 1 200	500	100 to 1 200	–	–

1) Appropriate methods of test will be the subjects of future International Standards.

Table 3 — Preferred range of test intensities

Method of test	Relevant International Standard	Variable	Preferred range of test intensities	
			Applicable to normal hazards	Applicable to unusual or particular hazards
Stacking	ISO 2234	Load by a combination of :		
		a) height of stack;	1,50 — 1,80 — 2,50 — 3,50 — 5,00 — 7,00 m	Range commencing at 9,00 m and continuing at 2 m intervals.
		b) density of stack.	1) identical packages : the density of the package under test.	As for normal range of hazards.
			2) for assorted packages : 0,25 — 0,35 — 0,5 — 0,7 — 1,0 — 1,4 — 2,0 Mg/m^3	As for normal range of hazards.
		Duration under load	1 — 2 — 3 days; 1 — 2 — 3 — 4 weeks.	Range commencing at 8 weeks and continuing at 4 week intervals.
Horizontal impact	ISO 2244	Horizontal velocity	1,5 — 1,8 — 2,2 — 2,7 — 3,3 — 4,0 — 5,0 m/s	As for normal range of hazards.
Vertical impact	ISO 2248	Drop height	100 — 150 — 200 — 300 — 400 — 500 — 600 — 800 — 1 000 — 1 200 mm	Range commencing at 1 500 mm and continuing at 300 mm intervals.
Vibration	ISO 2247	Duration of test	10 — 20 — 40 — 60 min	Range commencing at 2 h and continuing at 1 h intervals.
		Height of stack from which superimposed loads are derived	1,50 — 1,80 — 2,50 — 3,50 m	As for normal range of hazards.

5 Test intensity modifying factors

5.1 General

Guidelines for modifying basic values of test intensity, due to known features of the distribution system or of the package, are given in table 4.

The special circumstances introduced by palletization and by the use of freight containers are outlined in 5.2.

Table 4 — Test intensity modifying factors

Test variable	Transport mode	Modification of test intensity
Stacking height	Road	a) **Vehicle height :** For road transport the basic stacking height of 2,50 m may be increased to 3,50 m when it is known that vehicles permitting such stacking heights may be used. b) **Mass and size of package :** The size and mass of the packages constituting the stack may introduce a limiting factor to the stack height and lead to a stack height of less than 2,50 m due to the floor loading and axle loading capabilities of the vehicles.
	Rail	a) **Vehicle height :** For rail transport the basic stacking height of 2,50 m will also be the maximum. b) **Mass and size of package :** The size and mass of the packages constituting the stack may introduce a limiting factor to the stack height and lead to a stack height of less than 2,50 m due to the floor loading capabilities of the vehicles.
	Water	a) **Vehicle height :** For water transport the basic stacking height of 3,50 m may be increased to 5,00 m or 7,00 m when it is known that vessels permitting such stacking heights may be used. b) **Mass and size of package :** The size and mass of the packages constituting the stack may introduce a limiting factor to the stack height and lead to a stack height of less than 3,50 m due to the floor loading capabilities of the decks.
	Air	Not applicable.
	Storage	**Warehouses :** Greater stacking heights (5,00 m, 7,00 m, or higher) may be applied when it is known that such heights may be used.
	Freight containers and pallets	(See 5.2.)
Stacking duration	Road Rail Water Air Storage	**Known conditions :** Variation from the times given in table 2 may be made against known facts relating to the distribution system.
Vibration duration	NOTE — The effects of vibration testing will usually be manifest within the normal duration. It is desirable to extend the duration of the vibration test whilst significant changes in the package or contents can be detected.	
	Road	a) **Journey length :** For road journeys between 1 000 and 1 500 km in length, the vibration duration should be 40 min and for journeys longer than 1 500 km the duration should be 60 min. For journeys of less than 1 h a duration of 10 min should be used. b) **Rough journeys :** For known journeys over bad roads, where poor vehicles are used or where the journey is known to be severe in some other way, the distances quoted in a) should be halved before a decision is made concerning the duration of vibration.

Table 4 (*continued*)

Test variable	Transport mode	Modification of test intensity
Vibration duration	Rail	a) **Journey length** : For rail journeys between 3 000 and 4 500 km in length the vibration duration should be 40 min and for journeys longer than 4 500 km the duration should be 60 min. For journeys of less than 3 h a duration of 10 min should be used. b) **Rough journeys** : For known journeys over poor track or where poor vehicles are used, the distances quoted in a) should be halved before deciding whether the basic duration of vibration should be modified.
	Water	(Under study)
	Air	(Under study)
Vibration stack height corresponding to superimposed load	Road Rail Water	As for "stacking height".
Horizontal impact velocity	Road	**Stowage** : In known instances of bad stowage a velocity of 2,7 m/s should be used.
	Rail	**Known conditions** : The values of horizontal impact velocity in rail transport may be selected from the range 1,5 to 5,0 m/s against conditions known to obtain within a given network of railways.
	Water	Not applicable.
	Air	Not applicable.
Horizontal impact, number of impacts	Road Rail	The number of impacts carried out at the appropriate stages in the test schedule should be related to the likely incidence of the horizontal impact hazard in the distribution system.
	Water	Not applicable.
	Air	Not applicable.
Vertical impact, drop height	Road Rail Air	a) **Mass of package** : The drop height should be modified according to the package mass and mode of transport as follows : **Package mass** (kg) / **Drop height** (mm) < 10 — 800 10 to 20 — 600 20 to 30 — 500 30 to 40 — 400 40 to 50 — 300 50 to 100 — 200 > 100 — 100
	Water	< 15 — 1 000 15 to 30 — 800 30 to 40 — 600 40 to 45 — 500 45 to 50 — 400 > 50 — 300
	Road Rail Water Air	b) **Handling equipment** : The equipment used to handle a package has to be taken into account. If it is known that handling equipment is well suited to the package, a decrease in intensity will be in order; if the handling equipment is ill-suited to the package, an increase in intensity will be appropriate. Any increase or decrease in intensity should be limited to one step in the preferred range of values of drop height (see table 3).

Table 4 (*concluded*)

Test variable	Transport mode	Modification of test intensity
	Road Rail Water Air	c) **Handleability (size, shape, handling aids) of packages :** The handleability of a package (comprised of size, shape, presence of handling aids, etc.) may influence the degree of hazard. Packages that are difficult to handle may be subject to an increased hazard; conversely, packages that are easily handled may be subject to a reduced hazard. d) **Appearance (including markings), materials, or construction of package or fragility of contents :** These may require a reduction or an increase to be made in intensity. The reduction or increase should be limited to one step in the preferred range of values of drop height (see table 3). e) **Dangerous, aggressive, or valuable contents :** Packages containing dangerous goods must frequently comply with various mandatory and/or statutory regulations, performance requirements or special carrier requirements and give additional assurance of the integrity of the contents. The test intensities to be used are commonly included in such requirements. Additional assurance of the integrity of the contents of the package may also be required if the contents are aggressive (for example liable to contaminate other packages), or of high value. The test intensity should be raised accordingly.
	Freight containers and pallets	See 5.2.
Vertical impact, number of drops	Road Rail Water Air	The number of drop tests carried out at the appropriate stages in the test schedule should be related to the likely incidence of the vertical impact hazard in the distribution system.
Attitude of package (applies to all tests)	Road Rail Water Air Storage	The attitude in which the package is tested is determined primarily by the normal or most likely attitude of the package when exposed to the hazard concerned. If no one attitude is more common or likely, the attitude used should be that judged most likely to test the weakest parts of the package.

5.2 Modification of test intensity by palletization or by the use of freight containers

5.2.1 Palletization

Packages may be grouped into a unit load on a pallet or similar device for the whole or part of their life.

The subsequent handling of the unit load by mechanical means can change the magnitude of the hazards to which the packages are exposed, primarily vertical impact and stacking hazards.

5.2.1.1 Vertical impact

Manual palletization subjects the individual packages to vertical impacts of intensity similar to those sustained in loading the packages on to a road vehicle. Mechanical palletization, however, subjects the packages to a very small, if any, vertical impact hazard.

Mechanical handling of the resultant unit loads, into and out of storage and in the loading and unloading of vehicles, results in the packages being subjected to a smaller vertical impact than that normally associated with the comparable manual operation (see tables 2 and 4).

Palletization, coupled with a suitable distribution system for handling pallets may therefore justify a reduction in intensity of more than one step in the preferred range of values of drop height (see tables 2, 3 and 4).

5.2.1.2 Storage

The ability of mechanical equipment to lift unit loads to a greater height than is normal using manual methods can result in packages being stacked to greater heights. In addition, certain designs of pallet and some stacking patterns may impose local stresses on packages, which then require special consideration when the stacking test is performed.

Increased heights of stacking may not necessarily occur, however, as in modern tall-warehousing techniques the unit loads are placed in pallet racks. In such circumstances the packages are only stacked to the height of the unit load. The use of post-pallets or box-pallets also avoids placing high stacks on to packages.

Palletization, coupled with a suitable system for handling pallets, may therefore justify the selection of either a greater or a smaller stacking height than that given in table 2 (see also tables 3 and 4).