KINGDOM OF SAUDI ARABIA

SAUDI STANDARDS, METROLOGY AND QUALITY ORGANIZATION

SASO

SAUDI STANDARD
SASO 2950:2021

FLAT PLASTIC PALLETS FOR PETROCHEMICAL INDUSTRIES

ICS 55.180.20

Introduction

The Saudi Standards, Metrology and Quality Organization (SASO) has prepared the Saudi Standards " FLAT PLASTIC PALLETS FOR PETROCHEMICAL INDUSTRIES" after reviewing the specifications of Arab ADMO, foreign and international standards and reviewing the related reference literature

FLAT PLASTIC PALLETS FOR PETROCHEMICAL INDUSTRIES

1. SCOPE AND FIELD OF APPLICATION

This Saudi Arabian Standard covers specifications and performance requirements for new single-deck and double-deck reversible and non-reversible flat plastic pallets, of all entry types used in the petrochemical industries. The requirements for features such as openings and clearances that are required for efficient handling are also included.

2. COMPLEMENTARY REFERENCES

2.1. SASO 1929 "Methods of Testing General Purpose Injection Moulded Flat Plastic Pallets".

2.2. SASO GSO ISO 6780 "Flat pallets for intercontinental materials handling — Principal dimensions and tolerances"

2.3. SASO GSO ISO 8611-1 "Pallets for materials handling — Flat pallets — Part 1: Test methods"

2.4. SASO GSO ISO 8611-2 "Pallets for materials handling — Flat pallets — Part 2: Performance requirements and selection of tests"

2.5. SASO GSO ISO 8611-3 "Pallets for materials handling — Flat pallets — Part 2: Maximum working loads"

2.6. SASO ASTM D1185 "Standard Test Methods for Pallets and Related Structures Employed in Materials Handling and Shipping"

3. TERMS AND DEFINITIONS

3.1. Pallet Size

Nominal plan view dimensions of pallet length and pallet width.

3.2. Pallet truck

Industrial truck, equipped with two fork arms extending over the structure of the frame containing trail wheels (single or tandem) located near the fork arm tips, which is designed to lift the pallet only sufficiently to permit horizontal movement.

3.3. Fork-lift truck

Industrial truck, equipped with two fork arms not extending over the frame structure when handling pallets, attached through the carriage to the mast of the truck, which is designed to lift the load permitting stacking and racking as well as horizontal movement.

3.4. Four-way pallet

Pallet permitting the entry of the fork arms of fork-lift trucks, pallet trucks and pallet stackers from all four directions.

3.5. Partial four-way pallet

Pallet permitting four-way entry of the fork arms of fork-lift trucks and two-way entry of the fork arms of pallet trucks and pallet stackers.

3.6. Two-way pallet

Pallet permitting the entry of the fork arms of fork-lift trucks, pallet trucks and pallet stackers from two opposite directions only.

3.7. Ultimate load (U)

Load at which compression, displacement or deflection is no longer contained, resulting in the destruction of the specimen or breaking of one component, or when displacement, deformation or deflection becomes excessive.

3.8. Nominal load (R)

Lowest safe load value for the specified support conditions, independent of the type of load (excluding concentrated loads).

3.9. Safety factor

Ratio of the ultimate load to the nominal load (this ratio is at least 2.0).

3.10. Payload (Q)

Load carried by the pallet in use.

3.11. Maximum working load

Greatest payload that a pallet is permitted to carry in a specific loading and support condition.

4. CLASSIFICATION

4.1. Chemical Pallets (CP)

A Chemical Pallet is one of the many kinds of plastic pallets. This pallet was originally intended to bring unity to pallets that are used for the chemical and plastic industry in Europe. They are often referred to as CP pallets. Chemical Pallets are available in nine different models. These are denoted by the names CP1 through CP9. The difference between the pallets is in the size and how they are constructed. There is also a difference in use between the various CP pallets.

4.2. Manufacturing

Plastic pallets can be manufactured using any standard manufacturing technique such as injection molding, blow molding and thermoforming process.

4.3. Design Principles

Pallets manufactured using an injection molding procedure can be divided into two categories. Monoblock pallets that are manufactured in a single piece. The second category comprises pallets manufactured from two or more parts. The parts that make up these pallets can be connected to one another by Snap-on connections, screws, glue or welding after the injection-molding process is finished.

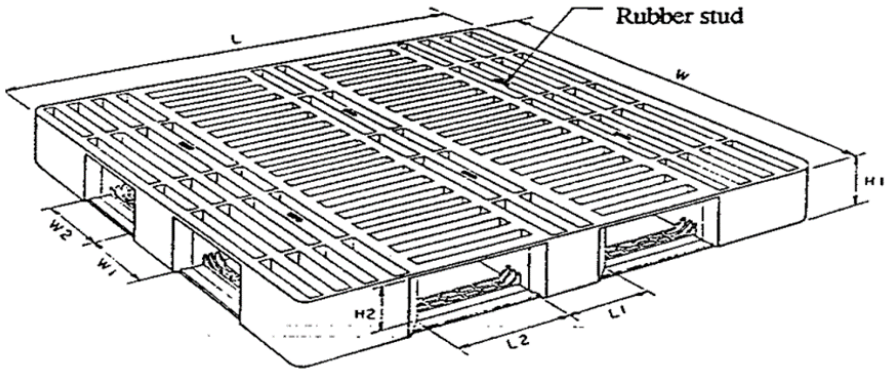

Figure 1: Monoblock Pallet

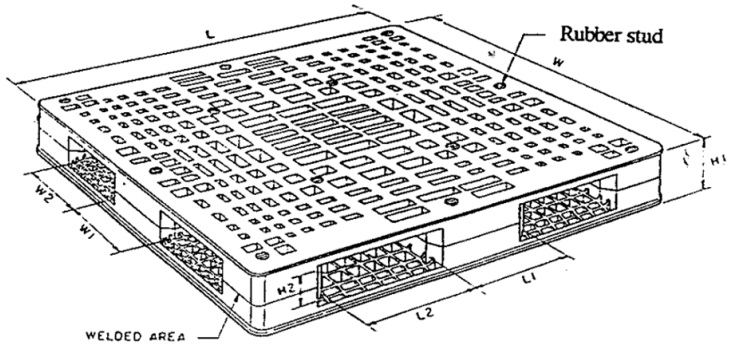

Figure 2: Two Piece Welded Pallet

4.4. Bottom Support

The term bottom support essentially determines the stability and field of application for plastic pallets. A difference is commonly made among pallets that are nestable, stackable or suitable for high-racking systems. More details in Annex B.

4.5. Stackable vs Rackable Pallets

Stackable pallets are designed to allow palletized product to be stacked, saving valuable floor space. These pallets are perfect for stack loading, static storage, and conveyance in manufacturing, warehousing, and processing environments. Stackable plastic pallet bases are usually provided with 3, 5 or 6 runners.

Rackable pallets are designed to be used in pallet racks. Whether the pallet rack is a fully-supported open-beam rack, a push-back rack, an edge rack, or a wire mesh rack. Rackable Plastic Pallets have bases with runners, a cruciform or 6 runner pallet is most common.

5. GENERAL REQUIREMENTS

5.1. Raw materials

The pallets shall be manufactured from plastic materials such as high density

polyethylene, polypropylene, or any other suitable polymeric material accepted by purchaser with the addition of:

5.1.1. Stabilizers against ultraviolet radiation in order to avoid deterioration of the physical properties of the pallets during continuous exposure.

5.1.2. Reinforcing and non-reinforcing fillers such as glass fibers, calcium carbonate and talc can be used.

5.1.3. Fire retarding agent can be added in order for the pallet to withstand direct fire exposure, if required by the customer.

5.1.4. Recycled polymeric materials can be used providing that the final product meets all the requirements of this standard

5.2. Visual Inspection

The pallets shall be free from any noticeable defects such as short shots, excessive flash, warpage, or any other similar defects.

5.3. Color

The pallets can be manufactured in any color according to mutual agreement between the manufacturer and the customer. The color must be homogenous and free from any noticeable variation.

6. DIMENSIONS AND TOLERANCES

6.1. Nominal Dimension

The nominal overall plan dimensions of chemical pallets (CP[a]) shall be according to Table (1):

CP#	Pallet Dimension (mm)	Example of Applied pallet loads
1	1000 x 1200	Sacks, cardboard boxes, Flexible Intermediate Bulk Containers
2	800 x 1200	Cardboard boxes, fibre drums, cans
3	1140 x 1140	Drums, Flexible Intermediate Bulk Containers, octabins
4	1100 x 1300	Sacks
5	760 x 1140	Cardboard boxes
6	1200 x 1000	Sacks
7	1300 x 1100	Sacks
8	1140 x 1140	Octabins with bottom discharge facility
9	1140 x 1140	Drums, Flexible Intermediate Bulk Containers, octabins
10	1200 x 1200	Sacks, drums

Table 1: Nominal dimension of CP pallets (Plastics Europe)

[a] The permitted length & width deviation is ±3 mm. The permitted height deviation is + 5 / - 2 mm.

6.2. Vertical dimensions for lifting devices

The vertical entry clearance H1 under the top deck for the entry of fork arms of pallet trucks and fork lift trucks is according to clause (2.4)

The entries for the forks of fork lift trucks and fingers of pallet trucks shall be according to Table (2):

Lifting Device	Minimum vertical entry clearance (H_1) (mm)
Pallet trucks	95±5
Fork-lift trucks	50
Automatic handling systems	100

Table 2: Vertical dimensions for lifting devices

The distance from the top of the opening to the bottom surface of the pallet (H2) shall not exceed 156mm.

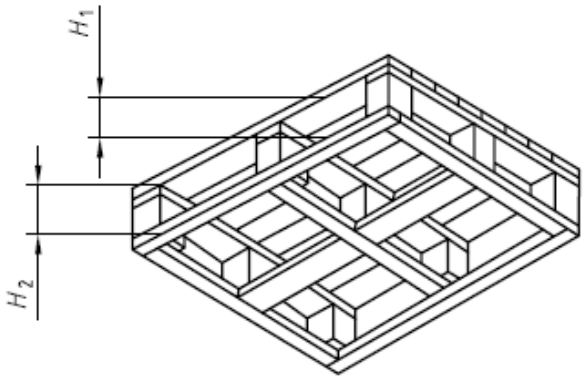

Figure 4: Vertical clearance

6.3. Horizontal dimensions for lifting devices

The horizontal entry clearance for the entry of fork arms of pallet trucks and fork lift trucks is according to item 4.3.

Horizontal clearances for the entry of pallet trucks into the ends of two-way and partial four-way pallets and into the ends and sides of four-way pallets shall conform to those dimensions specified in Table 3 and shown Figure 4:

Nominal Dimension of pallet (L or W) (mm)	Horizontal Clearance (mm)	
	L1/W1	L2/W2
800	160	580
≥ 1000	160	710

Table 3: Horizontal clearance for pallet trucks

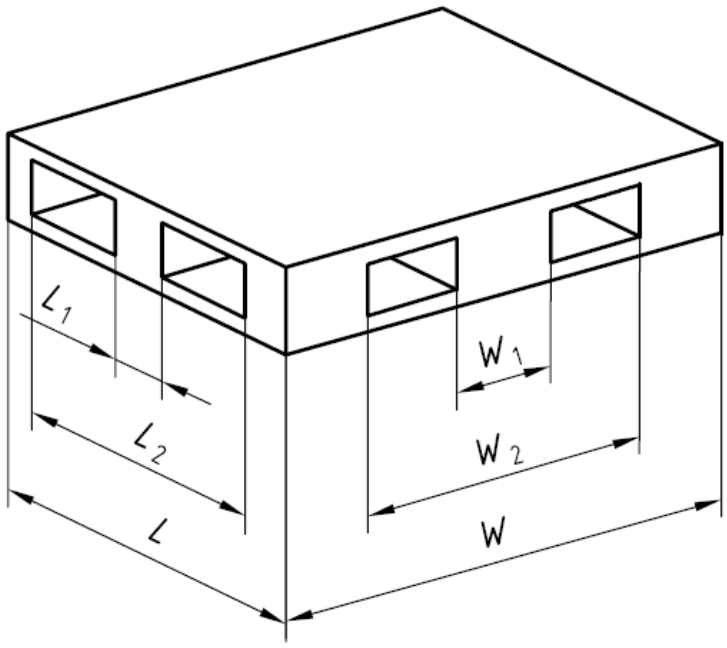

Figure 5: Horizontal Clearance for pallet trucks

Horizontal clearances for the entry of pallet trucks into the sides of partial four-way pallets shall conform to those dimensions specified in Table 4 and shown in Figure 5.

Pallet length (mm)	**Horizontal clearance (mm)**					
	L5		**L4**		**L3**	
	min	max	min	max	min	max
800	90	140	200	210	100	220
1000	90	155	200	255	180	420
1100	90	155	200	255	280	520
1140	90	155	200	255	320	560
1200	90	155	200	255	380	620
1300	90	155	200	255	480	720

Table 4: Horizontal clearance of partial four-way pallets

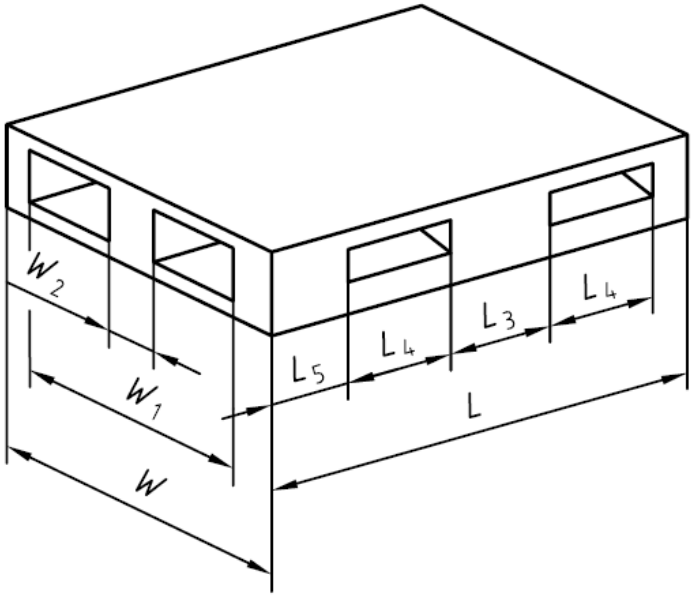

Figure 5: Horizontal clearance of entries and openings for side entry into partial four-way entry pallets

7. PERFORMANCE REQUIREMENTS AND SELECTION OF TESTS

7.1. Test Condition

The test conditions for ultimate load, maximum working load and durability tests for plastic pallets shall be the following:

Test load type	Temperature Condition (°C)
Ultimate load	23±2
Maximum working load*	50±2
Durability test	23±2 and -10±2

Table 5: Test Condition

* For maximum working loads test, wherever plastic pallets are used in controlled or more extreme conditions, the test conditions shall be agreed between the supplier and purchaser.

7.2. Number of replicates

For each test, at least three untested pallets shall be used.

7.3. Performance requirements

The load capacity of the pallet is determined by considering safety and functionality. It uses a deterministic design procedure using safety factor of 2.0 or higher.

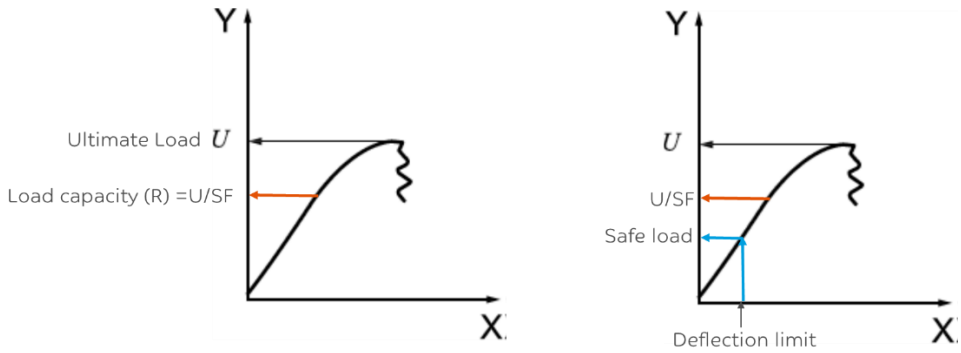

Figure 6: Load Capacity of the pallet

Safety	Functionality
1. Conduct a strength test. 2. Determine the ultimate load. 3. Divide the ultimate load by the safety factor. 4. Maximum is the safe load value	1. Conduct a stiffness test 2. Measure the deflection of the pallet under the test load at the end of the creep time 3. Compare the deflection to the performance limit 4. Adjust the test load to achieve deflection close to the performance limit. 5. Compare the test load to the maximum safe load 6. The smallest will be your safe load or load capacity

Table 6: Procedure for determining the load capacity of pallets

Example: Determining the nominal racking capacity of the pallet

- Conduct an ultimate bending strength test: load the pallet in bending condition until the pallet breaks or deformation exceed the limit (6% of span)
- Load reached in ultimate bending strength test U1 = 2,500 kg
- Allowable maximum bending load is 50% (Safety factor of 2) of U1 = 1,250 kg
- Conduct bending stiffness test = load the pallet until the maximum load limit (1,250 kg) or the deformation exceed the limit (2% of span)
- 2% of span (L1) deformation reached at 1,150 kg
- The maximum racking capacity of the pallet is = 1,150 kg

7.3.1. Duration of tests

Test	Test period (Hours)	Relaxation Time (Hours)
Stacking Test	48	2
All other tests	24	2

Table 7: Test Duration

7.3.2. Load Capacity Test

The following load capacity test need to be conducted:

Test#	Test Name	Handling Activity	Test load level	Performance Limits
1a	Bending test	Racking	Load until component breakage or load until 6% of L1 (L2) deflection (U1)	
1b			≤ 50% Ultimate load	2 % of L1 (L2) under load 0.7 % of L1 (L2) after relaxation period
2a	Forklifting Test	Lifting with forklift and pallet trucks	Load until component breakage U2	
2b			≤ 50% Ultimate load	20 mm or bend angle of less than 4.5[g], whichever is less deflection, under load7 mm deflection after relaxation period
3a	Compression tests for blocks or stringers	Any activity that compresses blocks or stringers, including stacking	Load until component breakage U3 or load causing 10% of y deflection.	
3b			≤ 50% Ultimate load	4 mm under load 1.5 mm after relaxation period
4a	Stacking tests	Stacking	Load until component breakage or load until 6% of L1 (L2) deflection U4	
4b			≤ 50% Ultimate load	2 % of L1 (L2) under load 0.7 % of L1 (L2) after relaxation period
5a	Bottom deck bending tests	Twin track conveyors	Load until component breakage or load until 6% of L1 (L2) deflection U5	
5b			≤ 50% Ultimate load	15 mm deflection under load and 7 mm deflection after relaxation period
6a	Wing pallet bending test	Lifting with slings	Load until component breakage or load until 6% of L1 (L2) deflection (U1)	

6b			≤ 50% Ultimate load	2 % of L1 (L2) under load 0.7 % of L1 (L2) after relaxation period
g The angle is measured between the line from the edge of the support beam in a horizontal plane to the edge of the pallet before loading and the line from the edge of the support beam to the same point after loading.				

Table 8: Load capacity tests cases

7.3.2.1. Bending tests

Purpose: The purpose of these tests is to determine the bending strength and stiffness of the pallet in racking situations

Procedure: Place a load on the load board until breakage of one of the components of the pallet or until reaching 6% deflection of L_1 or deformation. Record the ultimate load

Apply a load up to 50% of the ultimate load determined in previous step and measure deflection after required testing and relaxation periods.

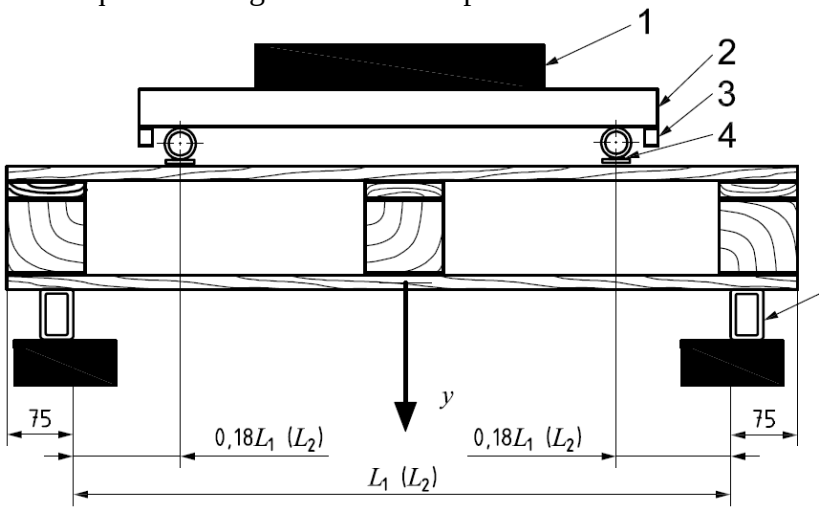

Figure 7: Ultimate bending test set-up

7.3.2.2. Forklifting Test

Purpose: The forklifting test is shown schematically in Figure 8. The test method permits simulation of the forklifting condition of use in each direction of pallet length and width.

Procedure: Apply the test load until breakage occurs in one of the components of the pallet or until reaching an excessive deflection or deformation. Record the ultimate load

Apply a load up to 50% of the ultimate load determined in previous step and measure deflection after required testing and relaxation periods.

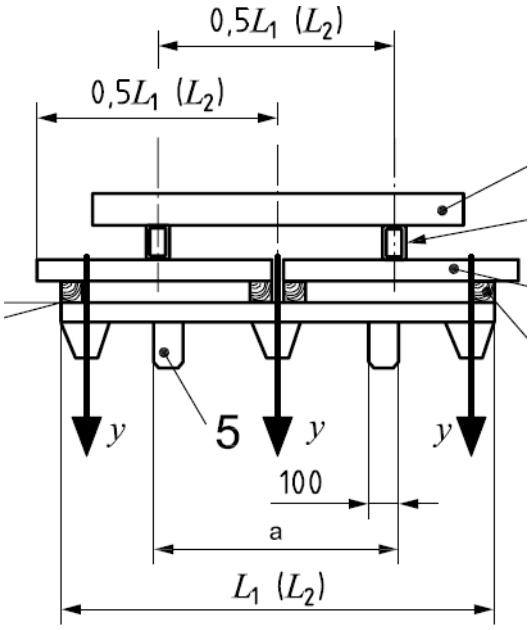

Figure 8: Fork-lifting test set-up

7.3.2.3. Compression tests for blocks or stringers

Purpose: The purpose of this test is to determine the compression strength of the blocks stringers or columns of the pallet.

Procedure: Apply the load until breakage occurs in one of the blocks or stringers of the pallet or upon reaching 10% of y deflection or deformation. Record the ultimate load.

Apply a load up to 50% of the ultimate load determined in previous step and measure deflection after required testing and relaxation periods.

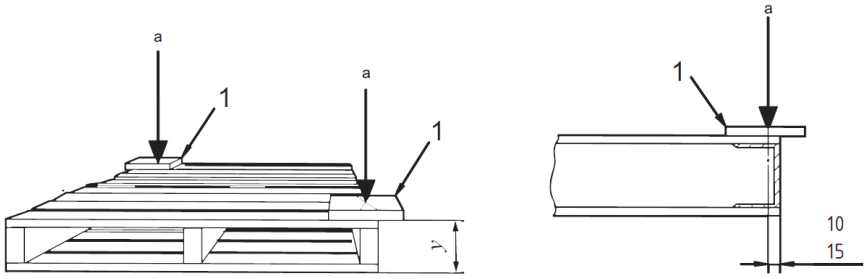

Figure 9: Blocks compression test set-up

7.3.2.4. Stacking tests

Purpose: The purpose of this test is to determine the ability of the pallet top and bottom decks to withstand the local effects of widely varying payloads on subspans of decks between blocks or stringers in a block-stacking situation.

Procedure: Place a load on the load board until breakage of one of the components of the pallet or upon reaching 6% of $L_1(L_2)$ deflection or deformation. Record the ultimate load

Apply a load up to 50% of the ultimate load determined in previous step and measure deflection after required testing and relaxation periods.

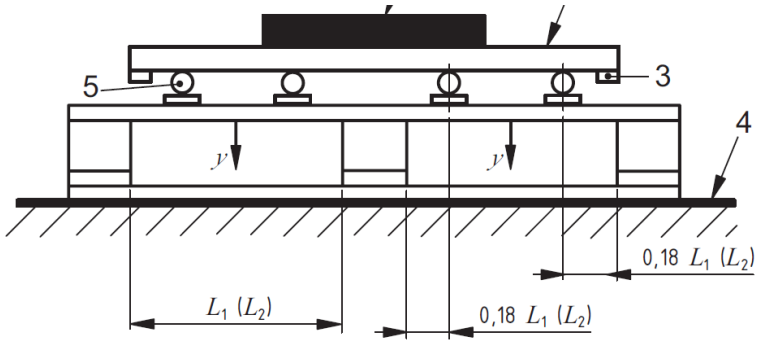

Figure 10: Stacking test set-up

7.3.2.5. Bottom deck bending tests

Purpose: The purpose of these tests is to determine the strength and stiffness of the bottom deck between blocks or stringers when handling on twin track conveyors or narrow span beam rack supports.

Procedure: Place a load on the load board until breakage of one of the components of the pallet or until reaching 6% of $L_1(L_2)$ deflection or deformation. Record the ultimate load

Apply a load up to 50% of the ultimate load determined in previous step and measure deflection after required testing and relaxation periods.

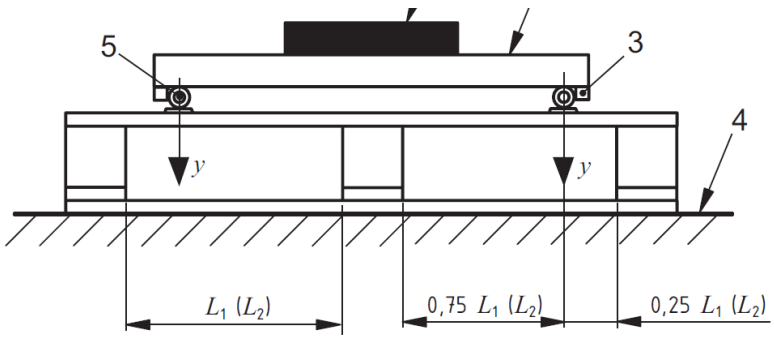

Figure 11: Bottom deck bending test set-up

7.3.2.6. Wing Pallet Bending tests

Purpose: The purpose of these tests is to determine the bending strength and stiffness of the winged pallet during lifting with slings.

Procedure: Place a load on the load board until breakage of one of the components of the pallet or until reaching 6% deflection of L_1 or deformation. Record the ultimate load

Apply a load up to 50% of the ultimate load determined in previous step and measure deflection after required testing and relaxation periods.

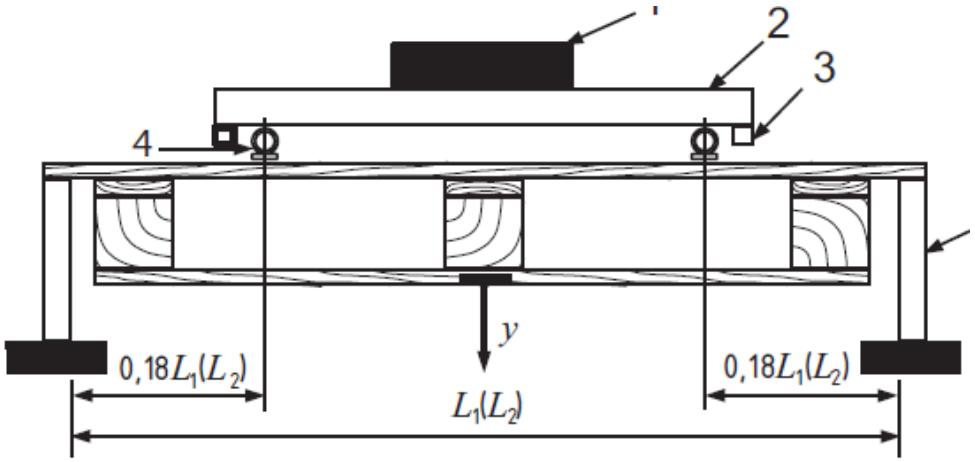

Figure 12: Wing pallet bending test

7.3.3. Durability Test

Test#	Test Name	Handling Activity	Test load level	Performance Limits
1	Corner drop test	Resistance to impacts	Empty pallet	$\Delta y \leq 4$ % h = 0.5 m
2	Slip angle test	Slip resistance of loads	Self-weight	Comparative testing
3	Static coefficient of friction test	Slip resistance on fork arms	Self-weight	Comparative testing

Table 10: Durability test cases

7.3.4. Corner Drop Test

Purpose: The purpose of this test is to determine the diagonal rigidity of the top deck of the pallet and its resistance to impact.

Procedure: Mark the two measuring points, A and B, as shown in Figure 16 at approximately 50 mm from the corners of the pallet. While suspending the pallet as shown in Figure 13, drop the pallet freely on to its top deck corner edge from a height, h, on to a hard horizontal impact surface. Whenever possible, carry out the drop three times, always on the same corner and from the same height.

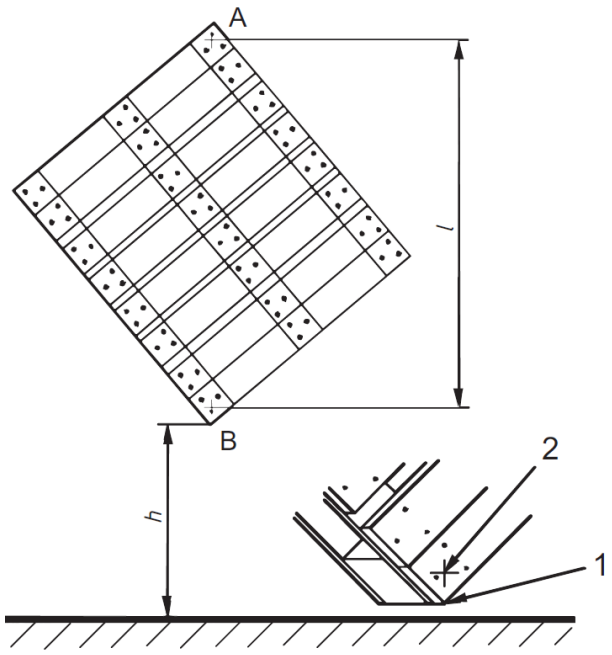

Figure 13: Corner drop test set-up

The length of diagonal, l, shall be measured before the first and after the third drop. Any damage shall be noted.

7.3.5. Slip angle test

Purpose: The purpose of this test is to determine the angle at which the test box commences to slip.The surface structure of the pallet's top decks must be designed in such a way to provide anti skidding properties in order to avoid slippage of the payload.

Procedure: Load a box 600 mm × 400 mm, having a bottom contact surface faced with a grease-free, dry, steel surface, to 30 kg and tilt the pallet from the horizontal at a rate of (45°± 4,5°)/min as shown in Figure 14. Repeat on the length and width of the pallet. Record the angle, β, at which the load commences to slip down the deck.

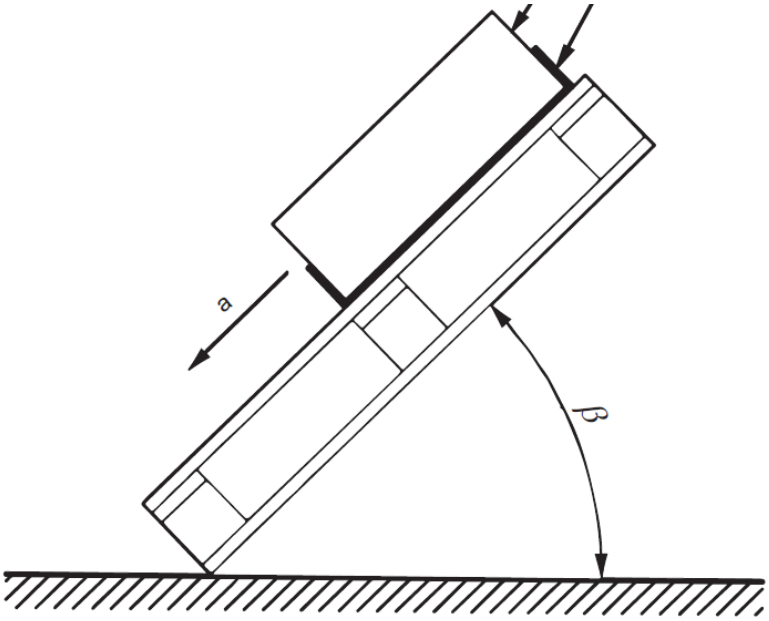

Figure 14: Slip angle test set-up

7.3.6. Static coefficient of friction test

Purpose: The purpose of this test is to determine the friction between the underside of the top deck and the forks of forklift trucks.

Procedure: Weigh the unloaded pallet, then place it on horizontally positioned, grease-free, dry, steel forks shall be
horizontal and level to the nearest 1° as shown in Figure 15. The width of the arms shall be 100 mm.
The test shall be carried out at the openings parallel to the length and parallel to the width of the unloaded pallet. If rubber or high friction inserts are set into the bottom of the top deck, note whether these engage on the steel forks during the test. Gradually increase force until motion commences and record this maximum value, $F_{s.}$
$U_s = F_{s.}/W_s$, where U_s is the static coefficient of friction, $F_{s.}$ is the force required to commence movement, and W_s is the pallet mass.

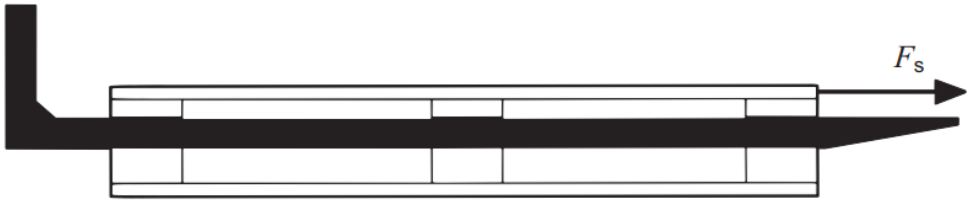

Figure 15: Static coefficient frictions set-up

8. PACKAGING, HANDLING AND STORAGE

Pallets shall be stacked ten pieces high and securely strapped together

9. MARKING

Each package shall be legibly and indelibly marked in Arabic or both Arabic and English in a clear place with the following information:

9.1 Name and/or trademark of the manufacturer.
9.2 Classification of the pallet (CP?)
9.3 Designated load capacity in Kg
9.4 Nominal dimensions in millimeters
9.5 Date of manufacture (day, month, year)
9.6 Batch number.
9.7 Reference to this standard.
9.8 The country of origin

Annex A: Horizontal Clearance

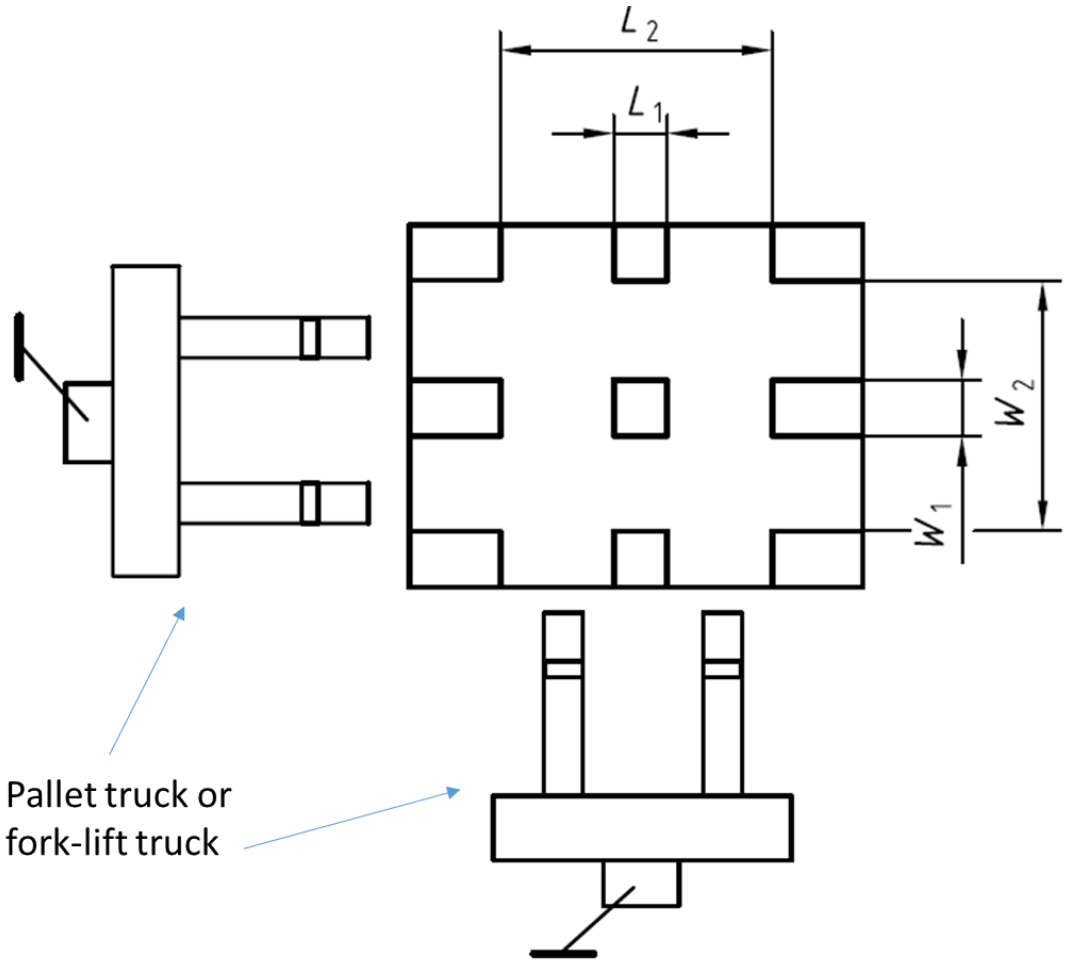

Figure A.1: Horizontal clearance for pallet trucks and fork-lift trucks — Four-way pallet designs

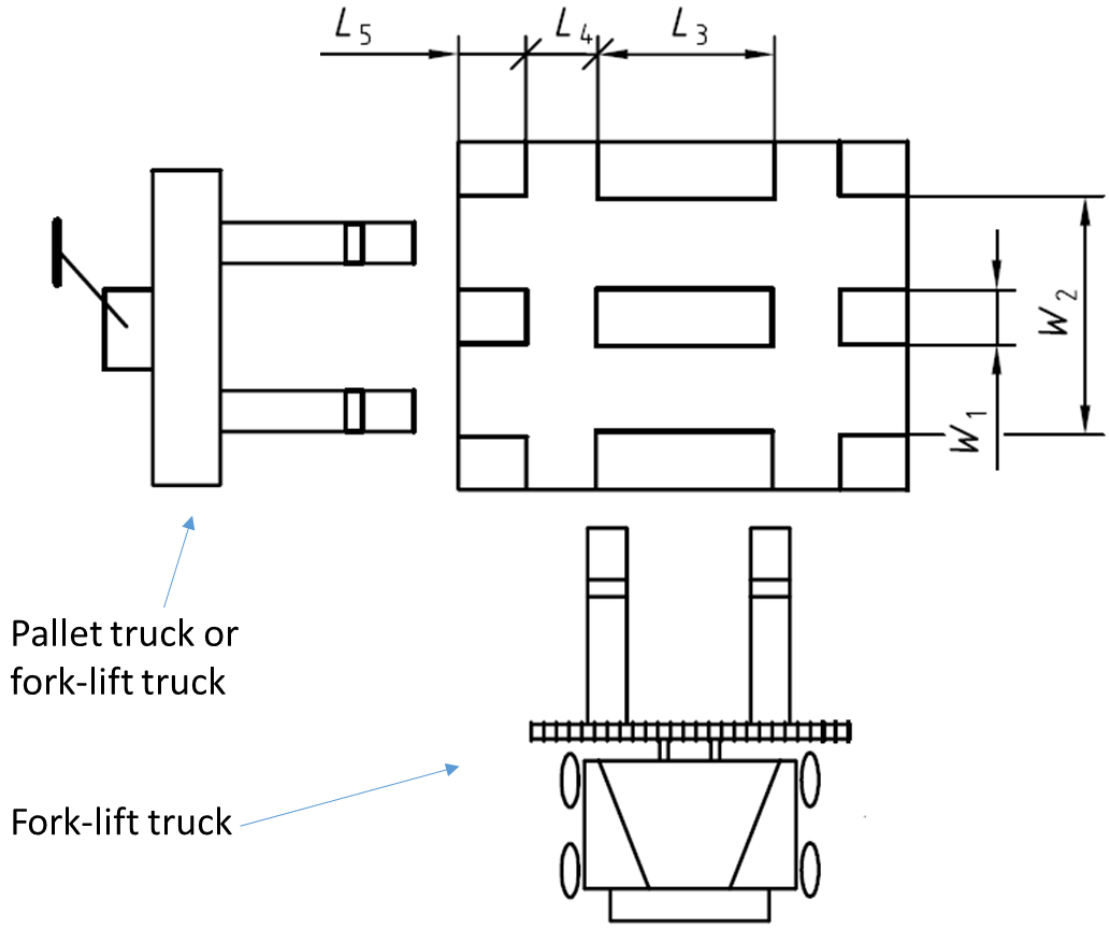

Figure A.2: Horizontal clearance for pallet trucks and fork-lift trucks — Partial four-way pallet designs

ANNEX B: Bottom Support

B 1: 9 Feet

Pallets equipped with tapered feet allow the nesting of pallets in a stack, achieving a volume reduction up to 75 % during storage and transportation. Without runners, these pallets cannot generally be used on roller tracks or in high-racks.

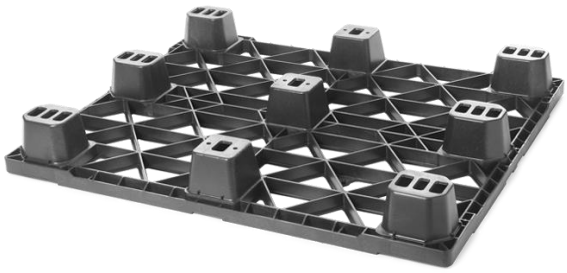

Figure B.1: Pallets with 9 Feet

B 2: 3 Runners

Pallets with three lengthwise runners are stackable and compatible with automated conveyor and high-racking systems.

Figure B.2: Pallets with 3 runners

B 3: 5 Runners

The perimetric bottom decks without a central transverse runner (5 runners) allow for better four-way entry and offer excellent block stackability.

Figure B.3: 5 Runners

B 4: 6 Runners

Plastic pallets with a fully perimetric bottom support (6 runners, cruciform perimeter-base) meet the highest demands in terms of block stacking. Their large supporting surface protects and avoids pressure marks on the cargo stored below and also ensures long-term stability for the plastic pallet.

Figure B.4: Pallet with 6 runners

References

CP Chemical Industry Pallet Edition:7, 2017: Plastics Europe

of this standard has been developed by the work team composed of :

Name	**Organization**
1. Dr. Abdul Rahim Arafath	SABIC
2. Eng. Abdulaziz Aldubayyan	Sadara Chemical Company
3. Eng. Saad Al-Hussain	SABIC