

PALLET CONTAINER

The present invention relates to a pallet container with a thin-walled inner liner of thermoplastic polymer for the storage and transport of liquid or free-flowing bulk materials, with a trellis tube frame closely surrounding the plastic liner as a supporting jacket and with a baseplate on which the plastic liner rests and to which the supporting jacket is firmly connected, wherein the trellis tube frame comprises vertical and horizontal, tubular rods welded together at the intersection points.

Prior Art

Pallet containers are used for the transport and storage of liquid or free-flowing bulk materials. During the transport of filled pallet containers - in particular with bulk materials with a high specific weight (e.g. over 1,6 g/cm³) - on poor roads on trucks with hard suspension and during rail or sea transport, the trellis tube frame is subjected to considerable loads by the surge forces of the bulk material. These dynamic transport loads create considerable constantly changing bending and torsional stresses in the trellis tube frame that with correspondingly long exposure times inevitably lead to fatigue cracking followed by rod breakage.

Such pallet containers with supporting jacket of trellis tube frame are generally known in a variety of forms; all supporting jacket forms to date, however, exhibit considerable disadvantages.

On exposure to the transport-related reversed bending strains caused by the oscillating surge pressure of the liquid bulk material, the versions of trellis tube frame with a uniform and continuous trellis tube profile, for example known from EP 0 755 863-A (Fu), DE 297 19 830-A (VL) or US 62244453 B1 (Mam), suffer a rod breakage comparatively quickly that always starts

or is initiated in the tensile area of the trellis tube rods. The rod breakage occurs predominantly near the welded intersection points of the trellis tube rods.

5 Those trellis tube frames with welded round tubes, e.g. known from EP 0 734 967 B1 (Sch), and with intentional significantly reduced tube cross-sectional heights (no continuous tube profile, recesses of uniform depth at all points or reduced tube cross-sectional height) in
10 the area of the intersection points, have the serious disadvantage that in these areas of the reduced tube cross-section, considerable load peaks occur and therefore design fracture or bending points are formed, e.g. for drop tests, for reversed bending strains due
15 to transport loads and during the hydrostatic internal pressure test. The rod areas between the intersection points are far too stiff and rigid for all the dynamic loads, they absorb no deformations; these occur only in the intersection area with the reduced tube cross-
20 sections. In addition, further cross-section reductions and/or relief areas are prescribed here in all the horizontal and vertical trellis tubes at all the welding points, e.g. EP 0 734 967 B1 (Sch) in order to protect these against breaking/separation under the
25 reversed bending strains of the transport loads. It is considered to be very disadvantageous, however, that the weakest tube cross-sections are arranged in the direct proximity of the welding points of the intersecting trellis rods, and that consequently a constant
30 cyclic deformation takes place immediately alongside the welding points. The consequence of this is that the welding points are overloaded and tend to be torn off. It is a known design principle for welding specialists that parts subject to dynamic loads should not be
35 welded where the greatest dynamic deformation occurs.

A pallet container is also known from WO 01/89954-A and from WO 01/89955-A with a trapezoidal tubular profile of the trellis rods in which the vertical and/or

horizontal tubular rods each have a formed recess alongside an intersection point. These partial formed recesses are intended to act as "bending hinges" and to reduce the bending resistance moment of the tubular rods. It has been discovered that these limited recesses lead to noticeably longer service lives, but cannot completely rule out rod breakage with the strain peaks concentrated at one point with long-term exposure.

10

The trellis tube frames known to date with uniform and continuous trellis tube profile, on the other hand, all have the disadvantage that the horizontal and vertical trellis tube rods are generally and over their entire length too torsionally rigid and resistant to bending with reversed bending strains; as a result, fatigue cracks and rod breakages occur here even after a comparatively short period of exposure, particularly in the vicinity of the welded intersection points of the trellis tube rods.

By comparison, the known trellis tube frames of welded round tube (Sch) with reduced tube cross-section at the intersection points and additional partial relief areas to their sides have the following disadvantages:

- The height of the reduced tube cross-section has to be the same at all welded intersection points, and cannot be adapted to different reversed bending loads.

30

- The round tubes with circular cross-section alongside the intersection points welded in recesses are very resistant to bending and are not deformed on exposure to reversed bending strains.

35

- The round tubes alongside the welded intersection points are also very torsionally rigid and are not deformed on exposure to torsional loads. The horizontal trellis profile rods are twisted on exposure to

reversed bending strains by radial movements of the vertical rods to which they are welded. This results in additional tensile and compressive loads on the welding points.

5

- All the loads and stresses caused by the transport strains, such as e.g. compressive, tensile and torsional loads can be absorbed exclusively by the locally limited partial recesses (design bending or breaking points) directly alongside the intersection points.

Object

The object of the present invention is to provide a pallet container with a trellis tube frame of welded tubular rods that no longer has the disadvantages of the prior art and in which - allowing for the stacking load of a filled, stacked pallet container (double stacking) - in addition to the normal transport loads of the sloshing liquid bulk material - in particular the vertical tubular rods are more durably resistant to fatigue cracking and rod breakage.

This object is achieved with the generic pallet container whose trellis tube rods have a continuous closed profile according to the present invention in that at least the vertical trellis rods have a higher bending resistance moment only in the area of their intersection points to be welded and a comparatively lower bending resistance moment in all the remaining areas between two intersection points. The tubular rods welded together have a greater tubular profile height at the intersection points and thus represent limited areas with a high resistance to bending and torsional rigidity, while the trellis rods outside an intersection point have a lower tubular profile height and represent the areas with a lower resistance to bending and torsional rigidity. It is furthermore intended that the trellis tube rods should have two different cross-

sections arranged alternately over their entire length, one with a reduced tubular profile height and reduced bending resistance moment over a comparatively large rod length, and one cross-section with a partially larger tubular profile height with higher bending resistance moment that extends over a comparatively short rod length over the area of the welded intersection points. With the embodiment according to the invention in which the areas with reduced tubular profile height and lower bending resistance moment are all arranged centrally between two intersection points, the area of the welded intersection points is effectively protected against fatigue cracks and rod breakage, i.e. not by a local design bending point directly alongside the welding points with rigid areas between the intersection points, but by the whole area between the welded intersection points that is designed as an elastic, flexible section.

As the pallet containers have a longer and a shorter side (dimensions 1200 x 1000 mm), the largest dynamic deformations logically occur in the longer side walls of the trellis tube supporting jacket where normally the most breakages of the tubular rods occur. With the configuration of the tubular rods according to the invention in which the areas with the reduced tubular profile height - when seen in longitudinal direction of the tubular rod - are considerably longer than the areas with larger tubular profile height and higher bending resistance moment (at least twice as long), the longer side wall of the trellis tube supporting jacket in particular is created so elastically as a vibration unit while maintaining an adequate rigidity against stacking loads that tubular rod breakages no longer occur even with long-term loading from transport vibrations.

The damaging reversed bending and torsional strains occurring with the normal transport loads and addition-

ally from double stacking (superimposed additive compressive load) are absorbed by all the elastic areas between the rigid intersection points so that elevated localised strain peaks no longer occur at or alongside
5 the welded intersection points.

Furthermore, the tubular trellis rod according to the invention is less torsionally rigid in the long areas with lower tubular profile height outside the inter-
10 section points, i.e. it permits more twisting or it creates less compressive and tensile stresses at the welded intersection points with the same torsional angle.

15 The invention is explained and described in greater detail below by reference to the illustrative embodiments shown schematically in the drawings.

Figure 1 shows a pallet container according to the
20 invention in front view,

Figure 2 shows the pallet container according to the invention in a side view with a stacked second pallet container (double stacking),
25

Figure 3 a shows the hydrostatic pressure distribution in the plastic liner,

Figure 3 b shows the bulging of the side walls of the
30 plastic liner,

Figure 4 shows the deformations of the pallet container due to surge forces with superimposed stacking load (in side view),
35

Figure 5 shows the deformations of the pallet container due to surge and stacking load (aerial view),

Figure 6 shows the lateral deformations of a vertical trellis rod in a sectional view:

a) normal, b) with deformation outwards and c) inwards,

- 5 Figure 7 a shows a consideration of the forces at a welded trellis rod intersection point,

Figure 7 b shows cracking due to bending loads at an intersection point,

10

Figure 7 c shows tearing of a welding point at an intersection point,

- 15 Figure 8 a, b shows a T-girder model with corresponding stress distribution during bending,

Figure 9 a, b shows a trapezoidal profile with the corresponding stress distribution during bending,

- 20 Figure 10 shows trellis tube rods according to the invention with increased tubular profile height in the intersection area (square-rectangular profile),

- 25 Figure 11 shows a preferred embodiment of trellis tube rods according to the invention with increased tubular profile height in the intersection area,

- 30 Figure 12 shows a cross-section through a profiled trellis tube rod according to the invention at a welded intersection point (large tubular profile height),

- Figure 13 shows a cross-section through a profiled trellis tube rod outside the welded intersection points (low tubular profile height),

35

- Figure 14 shows a further cross-section through a profiled trellis tube rod outside the welded intersection points (low tubular profile height),

Figure 15 shows a further cross-section through a profiled trellis tube rod outside the welded intersection points (low tubular profile height),

- 5 Figure 16 shows a further cross-section through a profiled trellis tube rod outside the welded intersection points (low tubular profile height),

10 Figure 17 a shows a longitudinal section of the tubular trellis rods at a welded intersection point (large tubular profile height),

Figure 17 b shows a cross-section in the vertical tubular trellis rod (large tubular profile height),

15 Figure 17 c shows a cross-section in the vertical tubular trellis rod (small tubular profile height),

20 Figure 18 shows an outside view of welded intersection areas of the trellis tube frame with profiled trellis tube rods according to the invention,

Figure 19 shows an inside view of welded intersection areas of the trellis tube frame with profiled trellis tube rods according to the invention, and

30 Figure 20 shows elastic deformations of a preferred vertical trellis rod due to surge forces and stacking load a) normal, b) deformation outwards and c) deformation inwards,

Figure 1 shows a pallet container 10 according to the invention with plastic inner liner 12, trellis tube supporting jacket 14 and baseplate 16 in a front view
35 with lower tapping valve (pallet width 1000 mm).

The pallet container 10 is shown in a side view in Figure 2 (pallet length 1200 mm) with a similar second pallet container stacked on top. During transport, e.g.

on a truck, the lower pallet container is subjected -
in addition to the alternating surge pressure loads of
the liquid bulk material - in a considerable and
mutually superimposed manner to the stacking load of
5 the stacked pallet container swinging back and forth
and up and down (double stacking).

Filling of a plastic inner liner 12 with a liquid bulk
material 18 results in a curve of the hydrostatic
10 internal pressure P_i shown in Figure 3 a that increases
linearly from top to bottom, with the centre of gravity
S of the liquid bulk material being located at roughly
one-third of the height of the inner liner. Under the
dynamic transport loads, this causes an alternating
15 lateral bulging of the inner liner 12 shown clearly in
Figure 3 b with the maximum lateral bulging exactly at
the height of the centre of gravity S. With the dynamic
oscillations of the system, the inner liner "pumps"
causing the filling level of the liquid bulk material
20 to change by the height L (Level), while the side wall
is deformed elastically inwards and outwards by the
amount "O" (Outside) and "I" (Inner side) about the
normal position and the base (up and down movements)
correspondingly in the middle by an amount "O" and "I"
25 (in exaggerated form in the lower of the stacked pallet
containers).

Figure 4 shows this oscillation situation with an
additional stacking load "StP" for a long side wall of
30 the pallet container, wherein the tubular rods of the
trellis cage automatically have to follow these elastic
deformations inwards and outwards.

Figure 5 shows the long side wall of the pallet
35 container in a top view. It can be clearly seen that
the deformation of the side wall outwards is roughly
twice as large as the movement of the side wall
inwards.

When considering load situations, the weakest point or the area subject to the highest load always has to be taken into consideration. The two vertical rods in the middle of the long side walls of the trellis cage in the area of the largest bulging are also subject to the highest loads, as these vertical rods are additionally affected in a disadvantageous manner by the effect of the stacking load "StP" of the further stacked pallet container. The most frequently incurred damage at these vertical rods can be buckling or breakage below the lower horizontal rod and tearing of the welded joints with the uppermost continuous horizontal rod. With transport vibrations, the stacked pallet container (Fig. 2) also represents a self-contained, independent oscillation system. The baseplate rests around the outside continuously on the trellis frame or on the uppermost horizontal trellis rod of the lower pallet container and thereby oscillates - also in the middle of the long side wall - mostly downwards and imposes a considerable additional load (like hammer blows) on the middle vertical rods of the pallet container stacked underneath.

Figures 6 a, 6 b and 6 c show a vertical tubular rod in the area of a lower intersection point "X" with a lower welded horizontal tubular rod 22. Figure 6 a shows the standard position (normal condition), while in Figure 6 b the condition of the largest deflection (amount "O") outwards, and in Figure 6 c the condition of the largest deflection (amount "I") inwards can be clearly seen.

When the vertical tubular rod is deflected outwards (Fig. 6 b), the outside of the rod is subjected to high tensile stresses and the inside of the rod to correspondingly high compressive stresses. When the vertical tubular rod is deflected inwards (Fig. 6 c), on the other hand, the outside of the rod is subjected to lower compressive stresses and the inside of the rod to

corresponding tensile stresses. Under dynamic transport loads, these deformation states occur in the rapid succession of roughly 3 Hz (oscillations/sec = roughly 180 hits/minute).

5

When considering Figure 4 it becomes clear that the vertical tubular rod is bent more sharply below the intersection point "X" than above this intersection point. The reason for this is that the lower end of the vertical tubular rod is fixed rigidly to the baseplate 16 and the distance between the intersection point "X" and baseplate 16 is comparatively short. This in turn leads to special load situations that are illustrated in Figures 7 a, 7 b and 7 c. Due to the different level of bending of the vertical rods (top, middle and bottom; and outside and middle in the long side wall of the trellis frame), the horizontal tubular rods are twisted within themselves resulting in a torsional stress that acts in the lower welding points of the considered intersection point "X" as an additional, in its effect additive tensile stress "Z" (Fig. 7 a). This can lead on the one hand to a fatigue crack or rod breakage (Fig. 7 b) or with circular tubular profiles, for example, to a tearing/separation of the welding points (Fig. 7 c).

In order to explain tensile and compressive stresses occurring, a T-girder with its corresponding stress state under bending load is shown as a model in Figures 8 a and 8 b. The neutral fibre layer (elastic line) passes through the centre of gravity of the surface S_F of a bending beam (T-girder). With a symmetrical cross-section (e.g. round tube, square cross-section or rectangular cross-section), the neutral fibre layer lies in the deer middle of the bending beam because that is where the centre of gravity of the surface lies. As can be seen from Figure 8 a, the centre of gravity of the surface S_F of the T-girder has been shifted down to the broad side of

the T-girder. As a result, the resistance moment of the T-girder for the lower edge fibres on the broad side is larger than for the upper edge fibres on the narrow side, and hence the stresses are lower at the bottom than at the top. Normally practically any material can be subjected to far higher compressive loads than to tensile loads, i.e. they can withstand higher compressive stresses than hazardous tensile stresses. This is important for the correct installation position of a part subject to dynamic loads.

A tubular rod with trapezoidal profile (with broad side and narrow side) behaves in a similar, i.e. approximated manner to a T-girder, as shown in Figures 9 a and 9 b. If we consider the least favourable load case on a long side of the trellis frame with the largest deflection outwards of a vertical tubular rod in the area of the trapezoidal profile, lower tensile stresses occur on the outer broad side of the tubular rod, there where the welding points are located in the intersection areas, than compressive stresses on the narrow inward-facing side of the vertical tubular rod (cf. Fig. 9 b): $\sigma_z < \sigma_D$.

This shows clearly that the vertical tubular rod in the area of the favourable trapezoidal profile is subject to less hazardous tensile stresses during the critical deflection outwards (T-girder model) than would be the case with a symmetrical tube cross-section such as, for example, with a round tube.

Figure 10 shows one embodiment according to the present invention. The basic profile of the trellis tube rods is designed here as a square profile (edge length e.g. 16 mm = high rectangular profile). In the intersection areas the horizontal and vertical tubular rods 20, 22 have a large tubular profile height "H" of e.g. 16 mm, while in the free areas if the tubular rods outside the intersection points a low rectangular profile with a

reduced, lower tubular profile height "h" of e.g. 12 mm is provided. The reduction in the tubular profile height from "H" to "h" is effected here in each case from the side on which the horizontal and vertical
5 tubular rods are welded together.

A preferred embodiment according to the present invention is shown in Figure 11. The basic profile of the trellis tube rods here is a trapezoidal profile. The
10 horizontal and vertical tubular rods 20, 22 in the intersection areas also have a large tubular profile height "H" of 16 mm and in the free areas of the tubular rods outside the intersection points a reduced, lower tubular profile height "h" of roughly 12 mm with
15 a roughly rectangular cross-section (flat rectangular cross-section). In this case, however, the reduction in the tubular profile height from "H" to "h" was effected from the side opposite the welding points. This has the advantage that the sides on which the horizontal and
20 vertical tubular rods are welded together form a continuous line and are not deformed. This results in no significant changes or steps in the level of the maximum tensile stresses during deflection outwards (amount "O") of a vertical tubular rod.

25 A further advantageous variant embodiment can be seen here in the lower part of the vertical tubular rod 20, where the reduction in the tubular profile height from "H" to "h" was effected from both sides (welded side
30 and the side opposite the welding points), resulting in advantages for manufacturing and avoiding one-sided forming stresses. Furthermore, with two-sided reduction of the tubular rod height per side, only a smaller difference, i.e. half the difference in height ($H - h$) / 2 (per side e.g. 2-3 mm) has to be formed into the
35 high basic profile.

Figure 12 shows a preferred trapezoidal tubular profile as a high basic profile in cross-section through a

profiled trellis tube rod according to the invention at a welded intersection point (large tubular profile height) The height "H" here is 16 mm and the width approx. 18 mm. Figure 13 shows a cross-section through the profiled trellis tube rod according to Fig. 12 outside the welded intersection point with low tubular profile height "h". The height "h" here is 12 mm and the width approx. 20 mm. The reduction in the tubular profile height from "H" to "h" has been effected here from the broad side of the trapezoidal basic profile. Figure 14 shows a different cross-section version of a profiled trellis tube rod outside the welded intersection point with low tubular profile height "h". The height "h" here is 12 mm and the width approx. 19 mm. The reduction in the tubular profile height from "H" to "h" has been effected here from the narrow side of the trapezoidal basic profile; the profile is roughly rectangular. Another version of a height-reduced tubular cross-section is shown in Figure 15. Here the narrow side was also formed inwards into the tube cross-section in order to reduce the tubular profile height H of the trapezoidal basic profile; again, a roughly rectangular profile is produced.

A further version of a height-reduced tubular cross-section can be seen in Figure 16. The reduction in the tubular profile height H was effected here by forming the two opposite inclined side walls of the trapezoidal basic profile inwards into the tube cross-section.

Figure 17 shows the preferred embodiment with trapezoidal basic profile H over the intersection point and height-reduced rectangular tubular rod profile h between the intersection points. The reduction in the tubular profile height from "H" to "h" was effected on the horizontal and vertical tubular rods 20, 22 in each case from the side opposite the welding points.

Figure 18 shows the detail of a trellis frame in top view from the outside with four intersection points. The horizontal and vertical trellis tube rods are welded together with four welding points per intersection point (by intersecting outer ribs of the trellis tube rods lying on top of one another).

The whole tubular rod length L_h between two intersection points with low tubular profile height h was flattened from the large tubular profile height H = basic profile (or rolled down, pressed flat, formed) and lies between 100 mm and 260 mm, preferably approx. 130 mm.

The comparatively short tubular rod length L with high tubular profile height L_H extending over an intersection point lies between 40 mm and 120 mm, preferably approx. 60 mm (= 3 x tubular rod width of 20 mm).

Correspondingly, Figure 19 shows the view from the inside (onto the elevation H of the vertical tubular rods 20).

Various advantageous measures can be employed in order to achieve a high resistance to bending in the area of the welded intersection points with a low resistance to bending or higher elasticity in the whole area of the trellis rods outside the intersection points. On the one hand, it is possible for the horizontal trellis tube rods 22 outside the intersection points to have an equal or smaller tubular profile height than the vertical trellis tube rods 20 outside the intersection points. On the other hand, it is possible for the vertical trellis tube rods 20 within the intersection areas to have an equally large or larger tubular profile height than the horizontal trellis tube rods 22.

Furthermore, the vertical and/or the horizontal trellis tube rods 20, 22 within the intersection areas may

- extend over a length L_H of the respective tubular rod 20, 22 in the longitudinal direction of the tubular rod of at least twice the tubular rod width (2 x 20 mm) up to six times the tubular rod width, preferably roughly three times the tubular rod width. For the low rod profile (low tubular profile height) of the vertical and/or the horizontal trellis tube rods 20, 22 outside the intersection areas, a length L_h of the respective tubular rod 20, 22 - in the longitudinal direction of the tubular rod - of at least three times the tubular rod width (3 x 20 mm) up to eight times the tubular rod width, preferably roughly three times the tubular rod width, is recommended.
- 15 It is advantageous for manufacturing here if the lower tubular profile height h is produced by lateral forming from both sides (rolling in) of the starting profile rod with a continuous high tubular profile height H .
- 20 Another possibility for reducing the tubular profile height H is by section-wide single-sided and/or two-sided forming (rolling in) of two opposing sides of the starting profile rod (basic profile).
- 25 These measures result individually or in advantageous combination in a significant improvement in the overall elasticity behaviour of a trellis wall plane and relief of the welded intersection point areas, and lead to a noticeable reduction in susceptibility to rod breakage (= fatigue fractures) with prolonged and severe reversed bending strains, such as e.g. during extraordinary transport loads of filled pallet containers on trucks on poor roads.
- 30
- 35 The differences in the tubular profile height of the vertical and/or horizontal trellis tube rods can consist in the following variants:
1. Different over the tubular trellis rod length,

2. Only on vertical trellis tube rods,
 3. On vertical and horizontal trellis tube rods, and/or
 4. Only in sections of the trellis tube rods where
- 5 required to meet the occurring load.

Figure 20 a shows a vertical tubular rod 20 in preferred embodiment according to the invention in normal position. Under dynamic load, the tubular rod 20 oscillates about the normal position and bends outwards - in accordance with Figure 20 b - and inwards - in accordance with Figure 20 c.

With this embodiment of the tubular rods according to the invention, a larger amount "O" of the largest elastic deflection outwards and a larger amount "I" of the largest elastic deformation inwards is permitted, in particular for the long side walls of the trellis frame, by comparison with the known pallet containers, without the resulting stress peaks reaching such high values that fatigue cracks and brittle fractures occur in the vertical trellis rods subject to the highest loads within a very short time.

25 The trellis cage with its many "long" sections of low profile rod height therefore proves to be a far more elastic suspension system by comparison with the known trellis cages of conventional pallet containers.

List of Reference Numbers

10	Pallet container
12	Inner liner HD-PE
14	Trellis tube supporting jacket
16	Baseplate
18	Liquid bulk material
20	Vertical tubular rod
22	Horizontal tubular rod
"Z"	Tensile stress
M	Centre point
S_F	Surface centre of gravity
A_1	Flat rectangle 1
A_2	Flat rectangle 2
L_H	Length of high tubular rod height
L_h	Length of reduced tubular rod height
P_i	Internal hydrostatic pressure
S	Centre of gravity
O	Deflection outwards
I	Deflection inwards
O'	Deflection outwards
I'	Deflection inwards
"X"	Lower intersection point
H	High tubular rod height
h	Reduced tubular rod height
σ_Z	Tensile stress
σ_D	Compressive stress
e_1	Distance $S_F - A_1$
e_2	Distance $S_F - A_2$

Patent Claims

1. Pallet container (10) with a thin-walled inner
5 liner (12) of thermoplastic polymer for the storage and
transport of liquid or free-flowing bulk materials,
with a trellis tube frame (14) closely surrounding the
plastic liner (12) as a supporting jacket and with a
baseplate (16) on which the plastic liner (12) rests
10 and to which the trellis tube frame (14) is firmly
connected, wherein the trellis tube frame (14)
comprises vertical and horizontal, tubular rods (20,
22) welded together at the intersection points,
characterized in that at least the vertical tubular
15 rods (20) comprise areas with different tubular profile
height, with the areas with lower tubular profile
height (h) having a continuous linear form between and
outside the intersection points and the areas with
larger tubular profile height (H) being provided at or
20 inside the intersection points.

2. Pallet container according to Claim 1,
characterized in that the tubular rods (20, 22) have
two different cross-sections arranged alternately over
25 their entire length, one cross-section with a reduced
tubular profile height (h) and reduced bending resist-
ance moment over a comparatively large rod length (L_h),
and one cross-section with a partially larger tubular
profile height (H) with a higher bending resistance
30 moment that extends over a comparatively short rod
length (L_H) over the area of the welded intersection
points.

3. Pallet container according to Claim 1 or 2,
35 characterized in that the areas with lower tubular
profile height (h) are formed extending in the middle
between two intersection points and the areas with
large tubular profile height (H) in the middle
extending over each intersection point.

4. Pallet container according to Claim 1, 2 or 3, characterized in that the areas with lower tubular profile height (h) between two intersection points - as
5 seen in the longitudinal direction of the tubular rod - are at least twice as long ($L_h \geq 2 \times L_H$) as the areas with large tubular profile height (H) extending over each intersection point.

10 5. Pallet container according to Claim 1, 2, 3 or 4, characterized in that the trellis tube rods (20, 22) are formed with respect to their tubular profile height outside the intersection points as a flat rectangular profile and in the area of the intersection points as a
15 high rectangular profile.

6. Pallet container according to Claim 1, 2, 3 or 4, characterized in that the trellis tube rods (20, 22) are formed with respect to their tubular profile height
20 outside the intersection points as a flat rectangular profile and in the area of the intersection points as a high trapezoidal profile.

7. Pallet container according to at least one of
25 the Claims 1 to 6, characterized in that the horizontal trellis tube rods (22) outside the intersection points have the same or a lower rod profile (tubular profile height) as the vertical trellis tube rods (20) outside the intersection points.

30 8. Pallet container according to at least one of the Claims 1 to 7, characterized in that the vertical trellis tube rods (20) within the intersection areas have the same or a higher rod profile (tubular profile
35 height) as the horizontal trellis tube rods (22).

9. Pallet container according to at least one of the Claims 1 to 8, characterized in that the high rod profile (tubular profile height) of the vertical and/or

horizontal trellis tube rods (20, 22) within the intersection areas extends over a length (L_H) of the respective tubular rod (20, 22) in the longitudinal direction of the tubular rod of at least twice the
5 tubular rod width up to six times the tubular rod width, preferably roughly three times the tubular rod width.

10. Pallet container according to at least one of
10 the Claims 1 to 9, characterized in that the low rod profile (low tubular profile height) of the vertical and/or horizontal trellis tube rods (20, 22) outside the intersection areas extends over a length (L_h) of the
15 respective tubular rod (20, 22) in the longitudinal direction of the tubular rod of at least three times the tubular rod width up to eight times the tubular rod width, preferably roughly six times the tubular rod width.

20 11. Pallet container according to one of the preceding Claims 1 to 10, characterized in that the lower tubular profile height (h) is formed by section-wise lateral forming (rolling in) from both sides of the starting profile rod with continuous high tubular
25 profile height (H).

12. Pallet container according to one of the preceding Claims 1 to 11, characterized in that the lower tubular profile height (h) is formed by section-
30 wise lateral forming (rolling in) from one and/or both sides from two opposing sides of the starting profile rod with continuous high tubular profile height (H = basic profile).

ABSTRACT

The invention relates to a pallet container (10) comprising a thin-walled inner container (12) made of thermoplastic material for storing and transporting liquid or free-flowing goods; a lattice tube frame (14), which closely surrounds the plastic container (12) in the form of a support jacket and which includes vertical and horizontal tubular rods (20, 22) that are welded to one another, and a bottom pallet (16) upon which the plastic container (12) rests and to which the lattice tube frame (14) is joined in a fixed manner. Known pallet containers have shortcomings with regard to strength (tubular rod fatigue failure) that are considerable in the event of longer lasting shaking during transport that involves fluctuating vibration stress. In order to improve the lattice tube frame durability while maintaining sufficient stacking load-bearing capacity, the invention achieves an adapted optimal elasticity for fluctuating dynamic loads by virtue of the fact that the tubular rods (20, 22) with a closed tubular profile have a varying tubular profile height, with alternating high tubular profile height in the intersections and continuously low tubular profile height between the intersections.