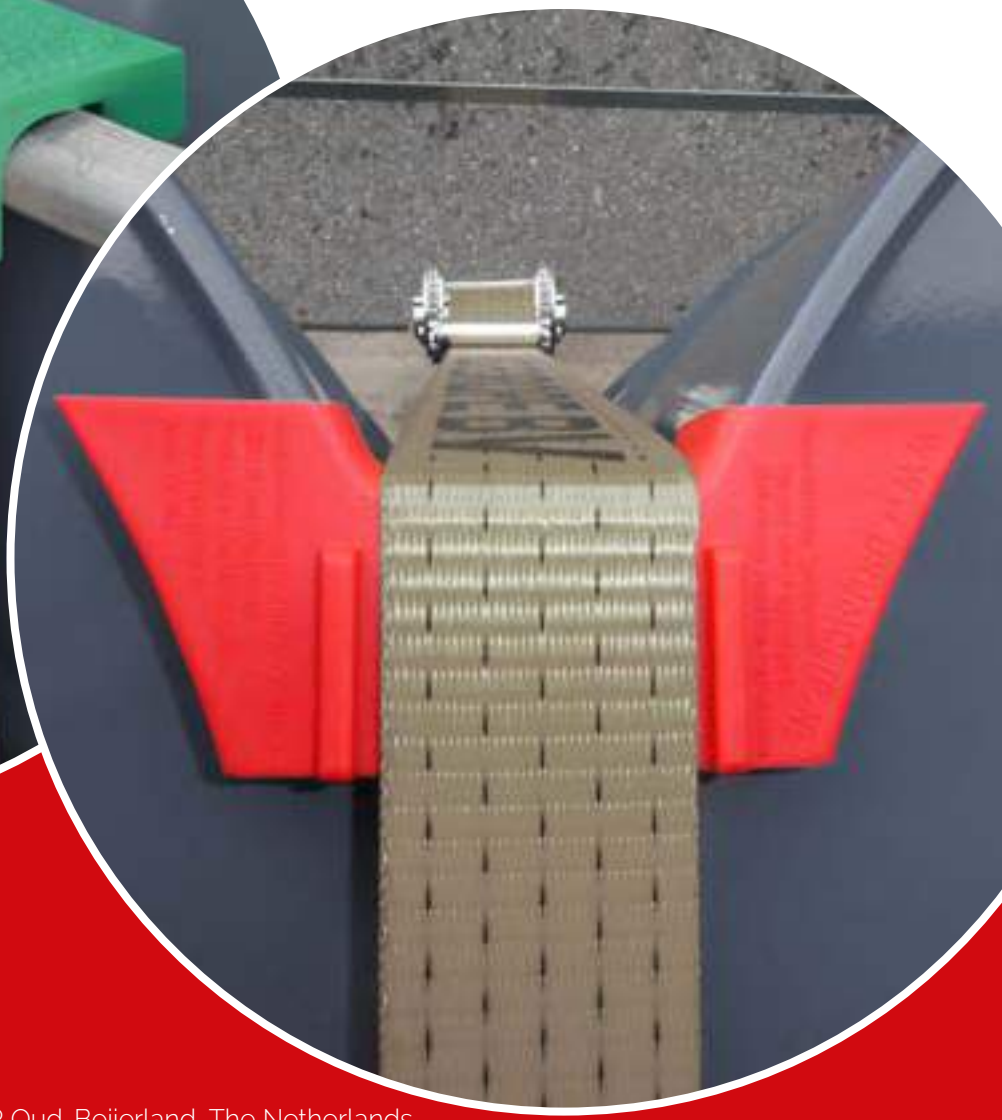
DRUM CLIP

Manual

Version EN 3.0 | October 2022

SIGNODE



Invago B.V. | www.drumclip.nl
Christiaan Huygensstraat 3, 3261 LR Oud-Beijerland, The Netherlands

Table of contents

1. Introduction

1.1 General introduction

This Manual has been written for everyone who has to deal with the Drumclip. The Drumclip is a patented, innovative plastic tool for securing drums on a pallet and in a trailer. There are two types of Drumclips. The Drumclips are both DIN EN 12195-1, ISTA 3E Pallet Stability and EUMOS 40509 certified, in combination with different strapping configurations.
Where considered necessary, a specific type of Drumclips is mentioned.

This Manual describes all relevant information regarding the Drumclip. How to work with the Drumclip is described in the various operating instructions. The certifications and associated reports are included in the manual, as are all the necessary requirements for using the Drumclip.

This Manual serves as a guide for the professional use of the Drumclip as a load securing product. The procedures described for the use of the Drumclip are binding and must be followed.

1.2 How is this manual structured?

After this introduction, Chapter 2 gives an overview of which type of Drumclip has been certified for which application (type of drum) and with what requirements. This Manual then provides the relevant Drumclip prescribed for each type of drum. This will be done in 3 separate chapters. Chapter 3 deals with the closed head edge UN200 litre drum, also called the Tight-Head Drum. Chapter 4 discusses the open head UN200 litre drum, also called the Open-Head Drum. And Chapter 5 discusses the plastic drum, also called Plastic Drum.

Each chapter includes descriptions, certifications, test methods related to these certifications, the operating instructions for the relevant Drumclip (these operating instructions are leading when the Drumclip is used) and the supplies needed to use the Drumclip. All test reports can be found in the appendices.

2. Applications

The Drumclip makes it easier to secure drums on a pallet, in a trailer or in a container. This means that the Drumclip can be used for transporting drums on land and at sea (not certified).

The use of the Drumclip for pallet stability of the pallet load with drums is certified according to ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe. The use of the Drumclip for the overland transport of drums is tested and certified by TÜV Rheinland according to DIN EN 12195-1 for sliding tarpaulin trailers among others. No additional products are required other than the tension strap with which the pallets with drums are secured on the trailer and an anti-slip mat in the trailer under the pallets. More information on the test and certification can be found in Chapters 3.6, 3.7, 3.8, 4.6, 4.7, 4.8, 5.6 and 5.7.
Table A schematically shows:
1) Which type of Drumclip is needed for the different types of drums;
2) With what requirements can the relevant Drumclip be secured to the drums and pallet; and
3) Which application is certified.

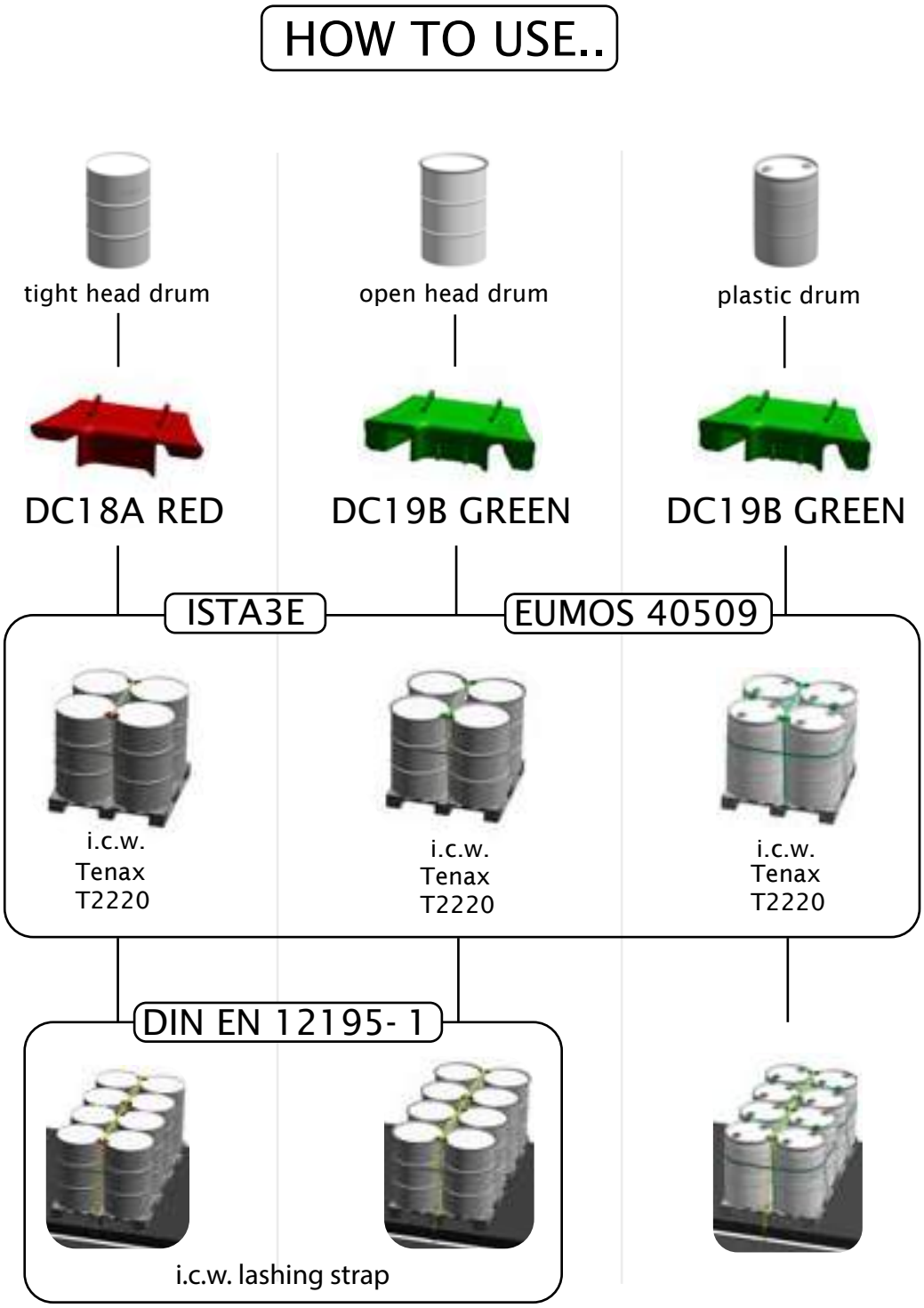


Table A: Overview of Drumclip Applications

3. Tight head UN200 litre drum

Drums with a closed head (UN200 litre drums) can be recognised by their closed top side (see Figure 1). The DRUMCLIP DC18A RED was designed for these drums.

Figure 1: UN200 litre tight head drum

3.1 DRUMCLIP DC18A RED

The DRUMCLIP DC18A RED is a plastic tool which should be used exclusively for tight head UN200 litre drums and not for other drums.
Figures 2, 3, 4 and 5 below show the application of the DRUMCLIP DC18A RED on a tight head UN200 litre drum.

Figure 2: DRUMCLIP DC18A RED between 2 tight head UN200 litre drums

3. Tight head UN200 litre drum

Figure 3: DRUMCLIP DC18A RED secured with Signode Tenax T2220 Polyester strap

Figure 4: DRUMCLIP DC18A RED secured with universal lashing strap (front view).

Figure 5: DRUMCLIP DC18A RED secured with universal lashing strap (top view).

3.2 Technical information DRUMCLIP DC18A RED

The DRUMCLIP DC18A RED is made of a glass-fibre reinforced plastic. The base material is mixed with a red dye. The ambient temperature at which the Drumclip may be used lies between -10°C and + 50°C. The dimensions are shown in Figures 6a and 6b.

Each Drumclip shows the following text:

Geba Innovations BV
Chr. Huygenstraat 3
3261 LR Oud-Beijerland
Produced in The Netherlands
Product: DRUMCLIP A
Art. No.: DC18 A

Each Drumclip has a unique article number that can be found under the text. The Drumclip can be used for a maximum of two years after production. Therefore there is a production date on every Drumclip. The Drumclip is certified for 2 years after the production date. Once these 2 years have passed, the Drumclip can no longer be used. The date stamp can be found in the following location in Figure 7.

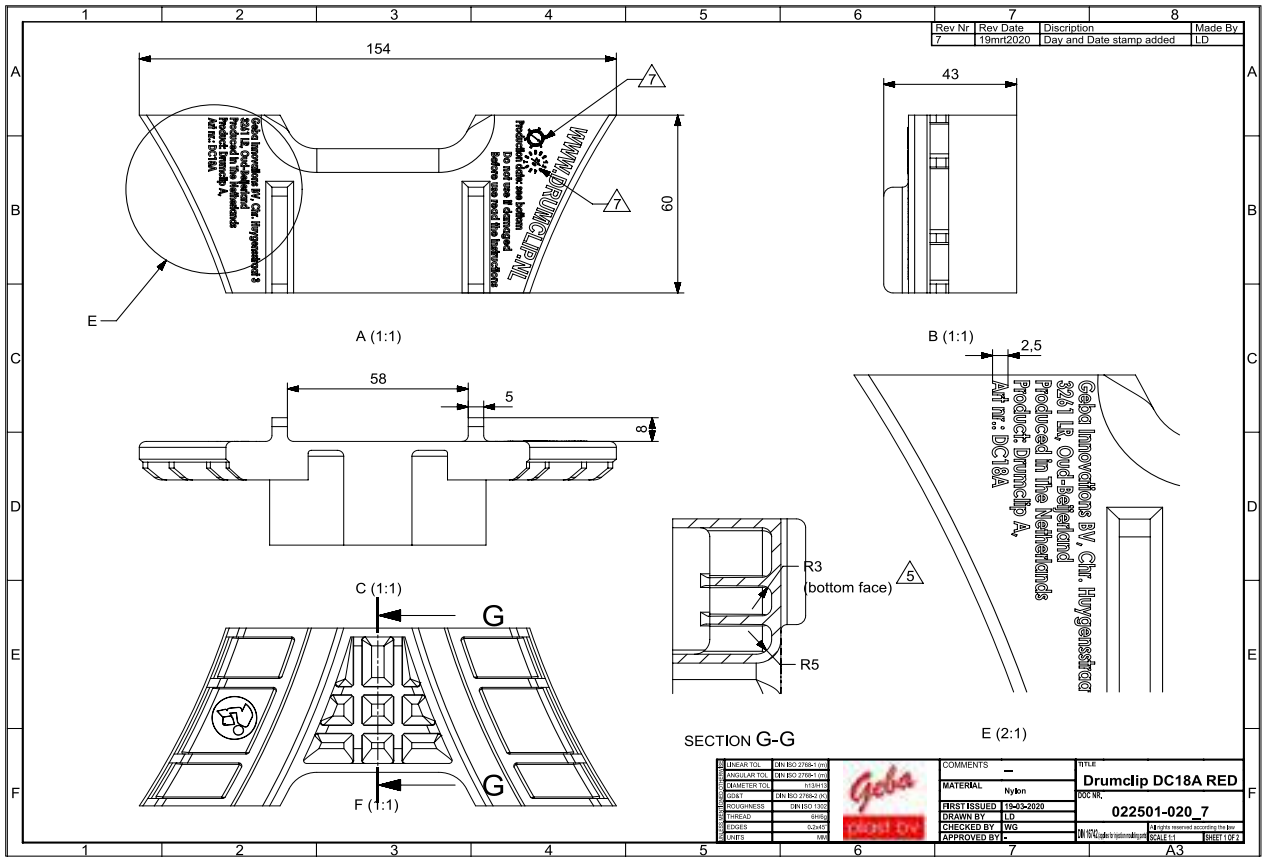


Figure 6a: 2D drawing DRUMCLIP DC18A RED

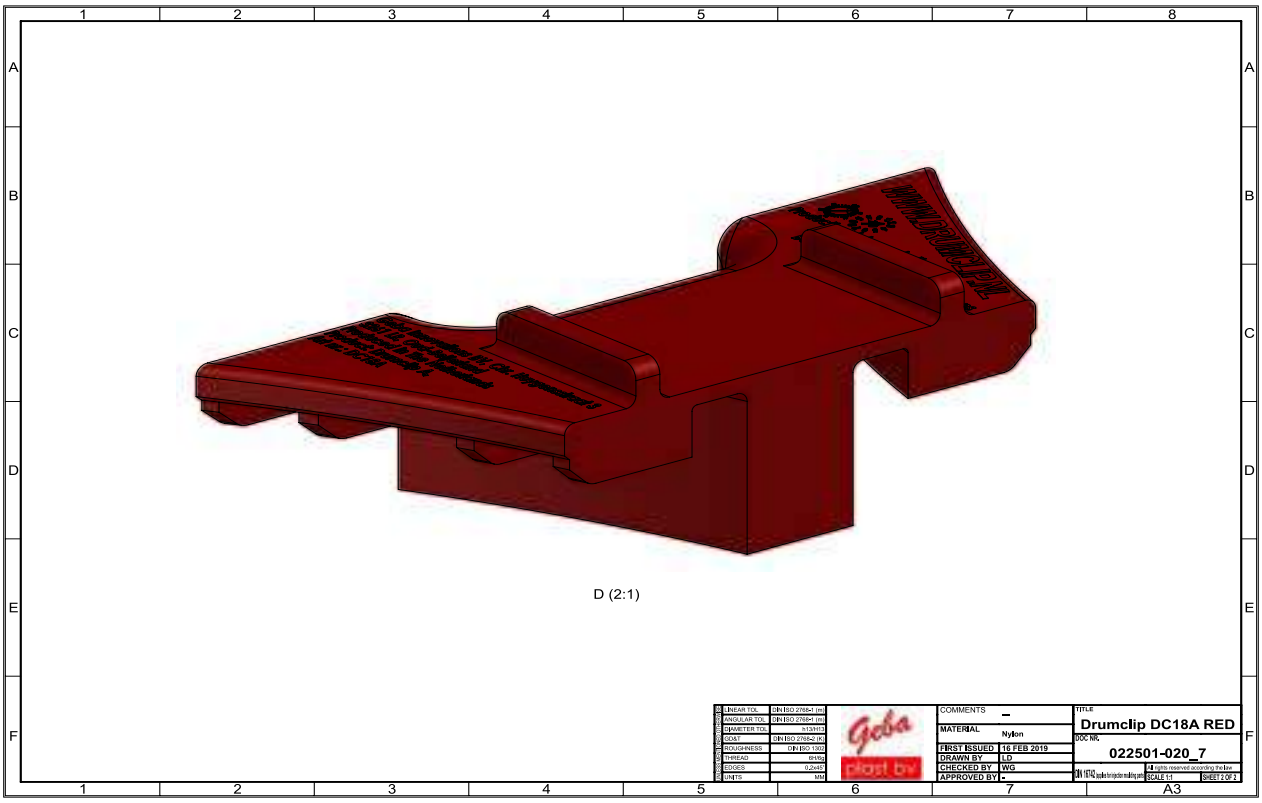


Figure 6b: Isometric view DRUMCLIP DC18A RED

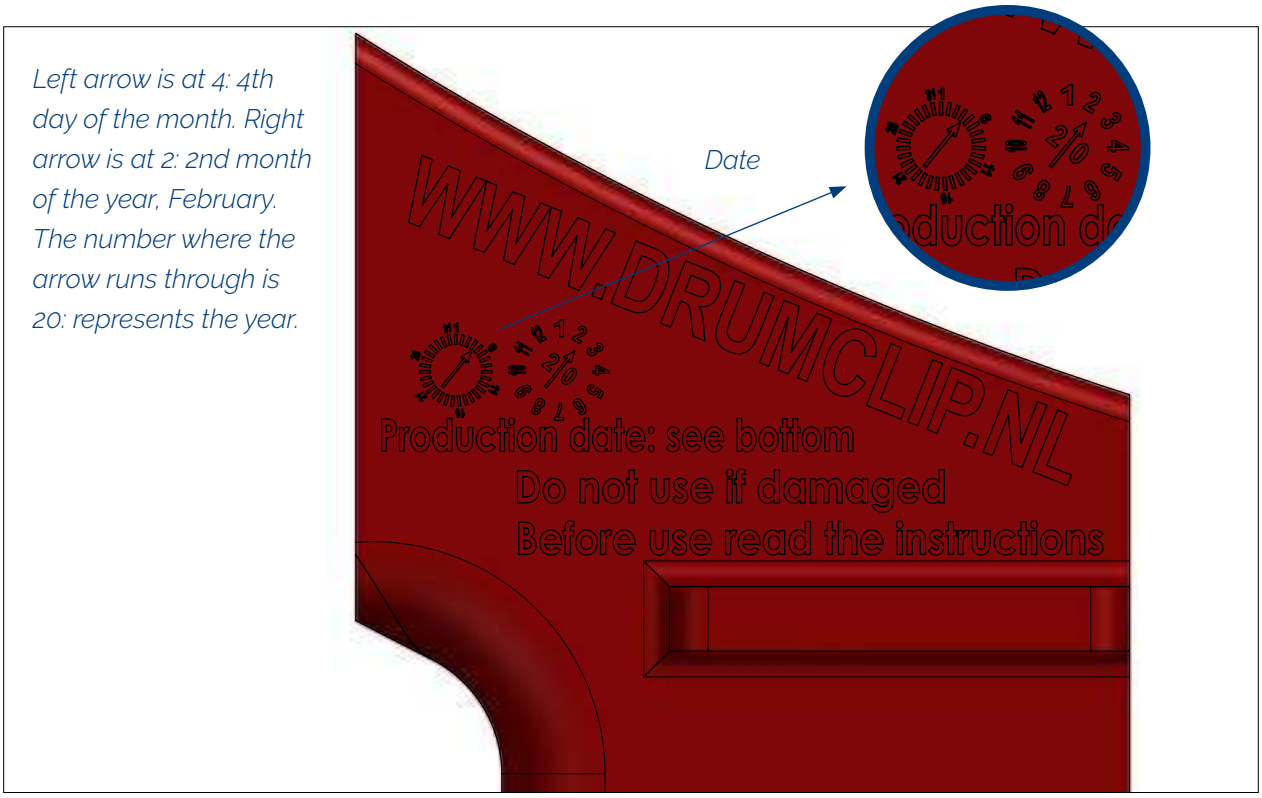


Figure 7: Stamp of production date DC18A RED

3.3 Certification DRUMCLIP DC18A RED

3.3.1 DIN EN 12195-1 | Load Securing

The Drumclip has been tested by TÜV Rheinland, in accordance with DIN EN 12642 Annex B for the guidelines according to Load Securing DIN EN 12195-1. The certificate can be found in Figures 8a, b and c. The complete test report can be found in Chapter 3.6 Test report TÜV Rheinland. | DRUMCLIP DC18A RED.

3. Tight head UN200 litre drum

TÜVRheinland®
Genau. Richtig.

Certificate

10TVS9350029-03

TÜVRheinland TESTED

Cargo Securing Equipment

www.tuv.com
ID 0000067649

Herewith we certify / *Hiermit bescheinigen wir*

Geba Innovations B.V.
Christiaan Huygensstraat 3
NL-3261 LR Oud-Beijerland

for the utility for securing tight head drums /
für das Hilfsmittel zur Spundfassssicherung

DRUMCLIP (Type: DC18A RED)

the effective securing of cargo according to the procedures of DIN EN 12642 annex B and requirements of DIN EN 12195-1 /
die wirksame Ladungssicherung gemäß den Ausführungen der DIN EN 12642 Anhang B und den Anforderungen der DIN EN 12195-1.

The "Drumclip", a support utility for the safe transport of tight head drums on road vehicles, requires the availability of stable load units (strapping of the barrels and palette with stretch foil or by strapping with a horizontal and vertical strap), load restraint assembling with web lashings and loading application with anti slip mats. Details can be found in the manufacturer's operating instructions. The manufacturer's instructions must be observed. /
Der „Drumclip", ein Hilfsmittel zur Transportsicherung von Spundfässern auf Straßenfahrzeugen, erfordert das Vorhandensein von stabilen Ladeeinheiten (durch Umreifung der Fässer und Palette mit Stretchfolie oder durch Zurren mit einem horizontalen und vertikalen Band), die Abspannung durch textile Spanngurte und einer Verladung unter Verwendung von Antirutschmatten. Details dazu sind der Bedienungsanleitung des Herstellers zu entnehmen. Die Anweisungen des Herstellers sind zu beachten.

Technologiezentrum Verkehrssicherheit
TÜV Rheinland Kraftfahrt GmbH
Am Grauen Stein, 51105 Köln, Deutschland

Seite 1 von 3 Seiten

Figure 8a


TÜVRheinland®
Genau. Richtig.
Certificate
10TVS9350029-03
TÜVRheinland
TESTED
Cargo
Securing
Equipment
www.tuv.com
ID 0000057649
HOW TO USE..
DC 18A RED
ISTA 3E
tight head drum
tight head drum
tight head drum
DIN EN 12195-1
transport
customer
Technologiezentrum Verkehrssicherheit
TÜV Rheinland Kraftfahrt GmbH
Am Grauen Stein, 51105 Köln, Deutschland
Seite 2 von 3 Seiten

Figure 8b

TÜVRheinland®
Genau. Richtig.

Certificate

10TVS9350029-03

TÜVRheinland TESTED

Cargo Securing Equipment

www.tuv.com
ID 0000067649

The product has been tested by TÜV Rheinland Kraftfahrt GmbH for its suitability as a load securing aid. In addition to the basically required driving dynamics tests, tests were also carried out on mechanical safety, ageing resistance, pollutant content and completeness and comprehensibility of the instructions for use.
Furthermore, the manufacture of the product is subject to annual monitoring by TÜV Rheinland LGA Product GmbH /
Das Produkt wurde durch die TÜV Rheinland Kraftfahrt GmbH auf seine Eignung als Ladungssicherungshilfsmittel getestet. Dazu wurden neben den grundsätzlich erforderlichen fahrdynamischen Prüfungen zusätzlich Prüfungen zu mechanischer Sicherheit, Alterungsbeständigkeit, Schadstoffinhalt und Vollständigkeit & Verständlichkeit der Gebrauchsanleitung durchgeführt.
Weiterhin unterliegt die Fertigung des Produktes einer jährlichen Überwachung durch die TÜV Rheinland LGA Produkte GmbH.

The test results are documented in the following reports / *Die Prüfergebnisse sind in folgenden Berichten dokumentiert*: 195XS0017-03 (TRK), 60224650-001 (TRLP), 60223641-002 (FI TRLP) / 40-2021-02-000563-G001 (FUI TRLP).

This certificate is valid until / *Dieses Zertifikat ist gültig bis*: 18.03.2025

Cologne, March 22nd, 2022 / Köln, 22. März 2022

Uwe Ziegler
Head of Department
EG/ECE FMVSS
Mobility

Thomas Husemann
Head of Department
Vehicle and Component Testing
Mobility

Technologiezentrum Verkehrssicherheit
TÜV Rheinland Kraftfahrt GmbH
Am Grauen Stein, 51105 Köln, Deutschland

Seite 3 von 3 Seiten

Figure 8c

3.3.2 ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe

The Drumclip is certified for pallet stability according to ISTA 3E Pallet Stability and EUMOS 40509 Transport Safe. According to these certifications, the right pallet stability can be created in combination with the right strap and Drumclip. The Drumclip is certified ISTA 3 E Pallet Stability, DIN EN 12195-1 and EUMOS 40509. The complete test reports can be found in Chapter 3.7 Test report ISTA | DRUMCLIP DC18A RED and 3.8 Test report EUMOS | DRUMCLIP DC18A RED.

ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe	Signode	(Figure 9)
Item	**Description**	**Specifications**
Pallet type	CP-9	Chemicals Pallet,1140x1140x156mm.
Drums	Tight head UN200	4 pieces
Straps	Signode Tenax 2220 Strapping	Polyester | width: 19mm, thickness: 0,89mm | 1x horizontal, 1x vertical (2 in total)
Machine setting	Signode BXT3-19	2500 N
Type of Drumclip	DC18A	2 Pieces

Figure 9

3.4 Requirements DRUMCLIP DC18A RED

The certification DIN EN 12195-1 Load Securing, ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safety of the DRUMCLIP DC18A RED was obtained in combination with supplies from Signode.
See also Chapter 2 Applications.

3.4.1 Signode

Signode's requirements for meeting the above certifications are:

- Signode Tenax T2220 Polyester straps (Figure 10a)
- Signode BXT3 – 19 strapping machine (Figure 10b)

SIGNODE

Tenax 2220 (19*0,89)

PRODUCT DATA SHEET

This is to certify that the product supplied by us is manufactured according to quality procedures in compliance with ISO 9001, ISO14001, EN 13891 and EN 13394.
Made of 100% of recycled PET

Produced in Netherlands

Product description	Product designation:	Tenax 2220 (19*0,89)
	Item code:	670273
	Material type:	Polyester
	Production technology:	Strand
	Surface:	Flat
	Colour:	Green

Strap properties		Minimum	Nominal	Maximum
	Width (mm):	18.4	19	19.6
	Thickness (mm):	0.84	0.89	0.94
	Elongation (%):	10		15
	Break Strength (daN):	675	750	

Coils details	Coil Type:	standard
	Coil Inside Diameter (mm):	408
	Coil Outside Diameter (mm):	610
	Coil Width (mm):	153
	Net Coil Weight (kg):	24.684
	Meters per coil:	1100

Pallet details	Package Dimensions (LxWxH):	1200 x 1200 x 1100
	Number of Coils per Pallet:	24
	Approx. Gross Weight per Pallet (kg):	646

Date of issue: 19/02/2020

Figure 10a

Technical Data Sheet BXT3-19

SIGNODE
TRANSIT PACKAGING SOLUTIONS

Strapping tool	BXT3-19
Operation mode	auto / semi / manual
Tension force range Standard	1300 – 4500N (290 – 1000 lbf)
Soft	400 – 1600 (90 – 340 lbf)
Variable tension speed range	0 – 120 mm/s (4,7 in/s)
Weight (incl. battery)	4,3 kg (9,5 lb)
Dimensions (L x W x H)	370 x 143 x 135 mm
	15.5" x 5.6" x 5.3"
Working temperature	-10°C to +40°C (14-104 °F)
Relative humidity	up to 90%

Battery / Charger	
Charger type	Bosch
Battery charger voltage	100 or 110 or 230 V
Charging time	25-35 min.
Battery type	Bosch Li-ion 18V, 4.0 Ah
Cycles per battery charge	
- Low tension	800
- Medium tension	500
- High tension	300

Strap	
Strap	PET (Polyester)
	PP (Polypropylene)
Width	15-16, 18-19 mm (5/8", 3/4")
Thickness	0,8-1,3 mm (.031"-0.51")

Features	
Real time indication of applied tension force	√
Variable tension speed	√
Favorite strapping function	√
Display color indication for tool status information	√
Strap alignment indication	√
Strap dust blow out vent	√
Battery protection	√
0-Tension welding	√

Figure 10b

3.5 Operating Instructions DRUMCLIP DC18A RED

Main steps to be taken before using the Drumclip.

- Check the Drumclip for any damages.
- Check the production date on the upper side of the Drumclip. The Drumclip must not be used for more than 2 years after the production date.
- The Drumclip may be cleaned with water and soap.
- If the Drumclip has been in contact with chemicals, it may no longer be used.
- The Drumclip may only be used on trucks with a gross weight of 3,500 kg or more.
- Drumclips must be stored in dry, moderately heated conditions and protected from sunlight and mechanical damage.
- The Drumclip may not be dried or stored near fire or in places with elevated temperatures.
- The maximum temperature at which the Drumclip can be used is -10C Degrees Celsius + 50 Degrees Celsius.

The operation instructions must always be followed.

DRUM CLIP

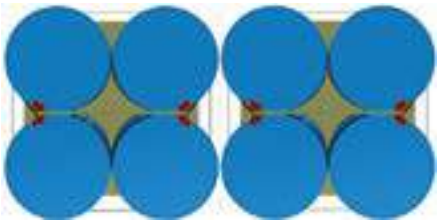
Operating Instructions DC18A RED
for tight head drums in combination with Signode

Operating Instructions DRUMCLIP DC18A RED
in combination with two Signode Tenax T2220 (19x0.89mm) straps.
The DRUMCLIP DC18A RED is an innovative tool, that makes it **safer** and **easier** to secure 200-litre tight head drums on a pallet and/or trailer, without the use of additional pallets or other equipment. The DC18A has been tested with a 0.8g brake delay in combination with straps (Signode Tenax 2220). This solution is DIN EN 12195-1, ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe certified. This combination is suitable for transport and pallet stabilisation of UN 200 litre tight head drums on pallets.

Important information
- Check the Drumclip before use. A damaged Drumclip may not be used again.
- Check the production date on the upperside of the Drumclip. The Drumclip must not be used for longer than 2 years after the production date.
- The Drumclip can be cleaned with water and soap.
- If the Drumclip has been in contact with chemicals, it may no longer be used.
- The Drumclip may only be used on trucks of 3.500 kg or more.
- Drumclips must be kept in dry, moderately heated conditions and protected from sunlight and mechanical damage.
- The Drumclip may not be dried or stored near fire or in places with elevated temperatures.

Step 1
Place four drums on a wooden pallet. Place two Drumclips opposite each other between two drums, with the wide side facing outwards. Use two Signode Tenax T2220 straps. One strap is stretched horizontally in the middle of the drums. The other strap is stretched vertically across the two drum clips and under the pallet. Both straps should be tensioned with a force of 2,500 N. Do this with each pallet of drums to be transported.

Step 2
Place the pallets with drums (with a forklift truck) on the trailer (in single or double rows) in such a way that the Drumclips are visible at the side of the trailer (the tension strap will be put on these later). Place the pallets on anti-slip mats that have a minimum friction resistance of 0.6u.



Double row

Figure 11 - page 1

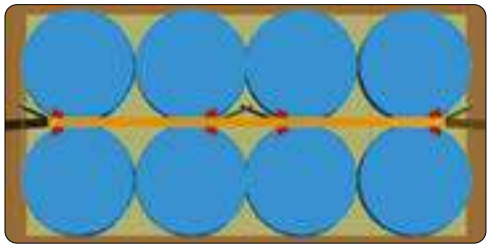
DRUM CLIP

Operating Instructions DC18A RED
for tight head drums in combination with Signode

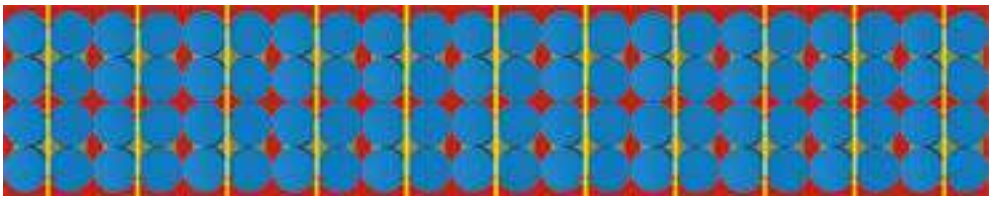
Step 3
Use a securing strap with a minimum StF value of 350 DaN for a double row of drums. This way drums can be secured as shown in the
illustration. Consult the guidelines of the lashing strap here.

Place the strap across the drums and the Drumclips, so that the strap is between the strap guides of the Drumclip. Make sure the strap is not twisted.
The strap should be placed on both sides of the vehicle under the horizontal strap that goes around the drums.

Then attach the strap hooks to the anchor points on the vehicle. Use an ergo ratchet and a lashing strap (50mm LC=2,500 daN) to secure the drumpallets to the vehicle.
Lead the strap into the ergo ratchet and hand-tension with a force of SHF daN (50 kilograms).
The strap should be at a 90-degree angle to the direction of travel and attached to the vehicle in line with the Drumclips.



A fully loaded trailer looks like this:



Double row

Figure 11 - page 2

3.6 Test Report TÜV Rheinland | DRUMCLIP DC18A RED

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Technischer Bericht: 195XS0017-03
/ Technical Report

„Beurteilung der Eignung eines Ladungssicherungskonzepts für den Transport von Stahlfässern – fahrdynamische Untersuchungen“
/ Assessment of the suitability of a load securing concept for the transport of steel drums - vehicle dynamics investigations

September / *September* **2020**

Auftraggeber / *Client*:
Fa. InVaGo BVBA,
NL-3261 PB Oud Beijerland

Bearbeitung / *Handling*:
TÜV Rheinland Kraftfahrt GmbH
Technologiezentrum
Verkehrssicherheit (TVS)
Typprüfstelle Fahrzeuge/Fahrzeugteile
Am Grauen Stein
51105 Köln

Dieser Technische Bericht dient ausschließlich der Dokumentation von Prüfergebnissen
/ This technical report is intended exclusively for the documentation of test results.

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ *Technical Report*

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

1. Allgemeine Angaben / *General information*

1.1.	Technischer Bericht / *Technical report*	: 195XS0017-03
1.2.	Bauteil / *Component*	: Drumclip
1.3.	Typ / *Type*	: DC18A RED
1.4.	Prüfgrundlage / *Test basis*	: in Anlehnung an DIN EN 12195-1 (Stand: 11/2010) Beurteilung der Eignung eines Beladungssicherungs-konzepts für den Transport von Stahlfässern – fahrdynamische Untersuchung / *following DIN EN 12195-1 (2010-11) Assessment of the suitability of a load securing concept for the transport of steel drums - a vehicle dynamics study*
1.5.	Auftraggeber / *Client*	: InVaGo BV Poortlaan 6 NL-3261 PB Oud Beijerland
1.6.	Prüflabor / *Testing laboratory*	: TÜV Rheinland Kraftfahrt GmbH Technologiezentrum Verkehrssicherheit Typprüfstelle Fahrzeuge/Fahrzeugteile Am Grauen Stein D - 51105 Köln
1.7.	Antrag vom / *Application from*	: Oktober 2018, Oktober 2019, Juni 2020
1.8.	Prüfmuster eingegangen am / *Test sample received on*	: entfällt / *not applicable*
1.9.	Art der Prüfmuster / *Type of test sample*	: Drumclip, Typ DC18A RED
1.10.	Kennzeichnung / *Marking*	: www.drumclip.nl
1.11.	Prüfdatum / *Test date*	: 03. November 2018, Rotterdam 09. November 2018, Köln / *Cologne* 26. Oktober 2019, Rotterdam 13. Juni 2020, Rotterdam

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

1.12. Prüforte / *Test locations*	: C. Steinweg-Handelsveem BV Theemsweg 26 NL-3197 KM Botlek Rotterdam Haven 5111 TÜV Rheinland Kraftfahrt GmbH Technologiezentrum Verkehrssicherheit Typprüfstelle Fahrzeuge/Fahrzeugteile Am Grauen Stein D - 51105 Köln

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

2. Prüfungen / *Tests*

Die Prüfungen gliedern sich auf in Versuche aus dem Jahr 2018, die in Abschnitt 2.1. näher beschrieben sind (in Prüfbericht 195XS0017-01 bereits dokumentiert) und die Versuche aus dem Jahr 2019, die in Abschnitt 2.2. näher beschrieben sind (in Prüfbericht 195XS0017-02 bereits dokumentiert) sowie neue Versuche aus dem Jahr 2020, die in Abschnitt 2.3. dokumentiert sind. Allen Tests gemein ist, dass die gleiche Art der Fasssicherung eingesetzt wurde /
The tests are divided into tests from 2018, which are described in detail in section 2.1. (already documented in test report 195XS0017-01) and the tests from 2019, described in detail in section 2.2. (already documented in test report 195XS0017-02) and new tests from 2020, which are documented in section 2.3.. Common to all tests is that the same type of drum securing was used.

2.1. Erste Prüfungen in 2018 / *First tests in 2018*

Auf Wunsch des Auftraggebers wurde 2018 eine neuartige Fasssicherung (Drumclip, Typ DC18A RED) im Fahrversuch auf ihre Eignung als Hilfsmittel zur Ladungssicherung untersucht /
At the customer's request in 2018 a new type of drum securing device (Drumclip, type DC18A RED) was tested in a driving test to determine its suitability as a load securing aid.

2.1.1. Anforderungen an die einzusetzenden Ladungssicherungsmittel / *Requirements for the load securing equipment to be used*

Für die Prüfung wurden Spundfässer mit der UN Zulassung 1A1/X1.6/250 mit einem Fassungsvermögen von ca. 216 l verwendet. Jeweils vier Fässer wurden auf einer Holzpalette 1.200 x 1.200 mm² abgestellt. Die Fässer wurden dann entweder händisch bis 4/5 der Höhe oder maschinell über die komplette Höhe 8-fach mit Folie umwickelt. Die Palette wurde bei der Wicklung mit einbezogen. Dadurch entstand eine Ladeeinheit mit Palette. Die Spezifikation der Folie ist Anlage 1 zu entnehmen. Die Fässer waren gleichmäßig mit Wasser befüllt. Das Gesamtgewicht je Ladeeinheit betrug 800 kg. Zwischen Trailerboden und Palette wurde Antirutschmaterial (μ ≥ 0,6) eingesetzt /
For the test, bung drums with UN approval 1A1/X1.6/250 and a capacity of approx. 216 l were used. Four drums each were placed on a wooden pallet 1,200 x 1,200 mm². The drums were then wrapped with foil either manually up to 4/5 of the height or mechanically over the entire height 8 times. The pallet was included in the wrapping. This resulted in a loading unit with pallet. The specification of the foil can be found in Appendix 1. The drums were evenly filled with water. The total weight per loading unit was 800 kg. Anti-slip material (μ ≥ 0.6) was used between the trailer floor and the pallet.

Die Fasssicherung wurde bei den jeweils äußeren beiden Fässern der Ladeeinheiten aufgesetzt und über einen Spanngurt (LC = 2.500 daN) niedergezurrt. Der Gurt verlief mittig über die Fasssicherung und senkrecht nach unten /
The drum safety device was attached to the outer two drums of the load units and lashed down using a lashing belt (LC = 2,500 daN). The lashing belt ran centrally over the drum safety device and vertically downwards.

Drumclip (verschiedene Ansichten) / *Drumclip (different views)*

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**



Sicherung der Fässer / *drum securing*

2.1.2. Prüfkräfte / *Test forces*

Als Prüfgrundlage wurde die DIN EN 12195-1 „Berechnung von Sicherungskräften“ herangezogen. In Kapitel 4.2 der Norm sind als Beschleunigungsbeiwerte für nicht kippgefährdete Transportmittel für Fahrzeuge ab 3.500 kg die folgenden Werte zu finden /
DIN EN 12195-1 "Calculation of securing forces" was used as the test basis. In Chapter 4.2 of the standard, the following values can be found as acceleration coefficients for non-tilt-endangered means of transport for vehicles from 3,500 kg upwards:

Sichern in *Securing for*	Beschleunigungsbeiwerte / *Acceleration coefficients*			
	a_x		a_y	a_z
	Nach vorne *To the front*	Nach hinten *To the rear*	Nur Rutschen *Sliding only*	Nach unten *Downwards*
Längsrichtung *Longitudinal direction*	0,8	0,5	./.	./.
Querrichtung *Transverse direction*	./.	./.	0,5	./.
Vertikal	./.	./.	./.	1,0

Übersicht zu den Beschleunigungsbeiwerten / *Overview of the acceleration coefficients*

Diese europäische Norm gilt nicht für Fahrzeuge mit einem Gesamtgewicht bis einschließlich 3.500 kg, da bei diesen höhere Beschleunigungen auftreten können /
This European standard does not apply to vehicles with a total weight of up to and including 3,500 kg, as these vehicles may have higher accelerations.

2.1.3. Beladungen / *Loads*

Insgesamt wurden 3 verschiedene Sicherungsvarianten untersucht, die nachfolgend beschrieben sind / *A total of 3 different securing variants were tested, which are described in the following.*

Variante 1 / *Variant 1:*

- 4 Fässer, **händisch** mit Folie umwickelt (Folie geht auch um die Palette), auf einer Palette / *4 drums, **manually** wrapped with foil (foil was also wrapped around the pallet), on a pallet*
- 2 Paletten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander / *2 pallets side by side with anti-slip material beneath (μ ≥ 0.6)*
- die jeweils äußeren beiden Fässer wurden durch jeweils ein Drumclip verbunden / *the two outer drums were connected by a drum clip each*

- die Fassreihe wurde mit einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief über die Drumclips / *the row of drums was lashed down with a lashing belt (LC = 2,500 daN), the strap ran over the drum clips*

Variante 2 / *Variant 2:*

- 4 Fässer, **maschinell** mit Folie umwickelt (Folie geht auch um die Palette), auf einer Palette / *4 drums, **machine-wrapped** with foil (foil was also wrapped around the pallet), on a pallet*
- 2 Paletten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander / *2 pallets side by side with anti-slip material beneath (μ ≥ 0.6)*
- auf die Fässer wurden zwei Paletten gelegt / *two pallets were placed on the drums*
- die Fassreihe wurde mit einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief über die Paletten / *the row of drums was lashed down with a lashing belt (LC = 2,500 daN), the strap ran over the pallets*

Variante 3 / *Variant 3*:

- 4 Fässer, **maschinell** mit Folie umwickelt (Folie geht auch um die Palette), auf einer Palette / *4 drums, **machine-wrapped** with foil (foil was also wrapped around the pallet), on a pallet*
- 2 Paletten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander / *2 pallets side by side with anti-slip material beneath (μ ≥ 0.6)*
- die jeweils äußeren beiden Fässer wurden durch jeweils ein Drumclip verbunden / *the two outer drums were connected by a drum clip each*
- die Fassreihe wurde mit einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief über die Drumclips / *the drum row was lashed down with a lashing strap (LC = 2,500 daN), the strap ran over the drum clips*

Variante 1 mit Drumclip, handgewickelt / *Variant 1 with Drumclip, manually wrapped*

Variante 2 mit Paletten, maschinell gewickelt / *Variant 2 with pallets, machine-wrapped*

Variante 3 mit Drumclip, maschinell gewickelt / *Variant 3 with Drumclip, machine-wrapped*

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Variante 2 mit Paletten /
Variant 2 with pallets

Variante 3 mit Drumclip /
Variant 3 with Drumclips

Für die Versuche in Rotterdam wurde ein Sattelzug mit den Sicherungsvarianten 1, 2 und 3 beladen. Bei den Versuchen in Köln war das Fahrzeug nur mit der Sicherungsvariante 3 beladen /
For the tests in Rotterdam, a semi-trailer truck was loaded with the securing variants 1, 2 and 3. During the tests in Cologne, the vehicle was loaded with securing variant 3 only.

Sattelzug in Rotterdam, hier mit Sicherungsvariante 1 & 2 beladen /
Semitrailer truck in Rotterdam, here loaded with safety variant 1 & 2

Sattelzug in Köln, nur mit Sicherungsvariante 3 beladen /
Semitrailer truck in Cologne, loaded with securing variant 3 only

2.1.4. Prüfergebnisse / *Test results*

Im Folgenden sind die einzelnen Ergebnisse und Auffälligkeiten der Versuche dargestellt. Die unter 2.1.4.1. bis 2.1.4.3. beschriebenen Versuche wurden in Rotterdam durchgeführt, die unter 2.1.4.4. beschriebenen in Köln. Weitere Bilder sowie Filme zu den einzelnen Versuchen sind in Anlage 5 (USB-Datenträger) zu finden /
The individual results and peculiarities of the tests are presented below. The tests described under 2.1.4.1. to 2.1.4.3. were carried out in Rotterdam, the tests described under 2.1.4.4. in Cologne. Further pictures and films of the individual tests can be found in Appendix 5 (USB-stick).

2.1.4.1. Versuch 1 (Fahrversuch Bremsen) / *Test 1 (Driving test braking)*

Das Fahrzeug war mit den Varianten 1 & 2 beladen. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Im ersten Versuch konnte nur eine Längsverzögerung von maximal 0,77 g erreicht werden. Damit wurde die gewünschte Längsbeschleunigung von 0,8 g nicht erreicht. Der Fahrversuch konnte dennoch zur Beurteilung der Ladungssicherung verwendet werden, da es zu einem Versagen der Folie der Variante 1 kam. Die Ladung wurde frei und war nicht mehr gesichert. Das Ergebnis führte dazu, dass zwei neue Ladeeinheiten zusammengestellt und maschinell gewickelt wurden (Variante 3) /
The vehicle was loaded with the variants 1 & 2. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to standstill. In the first attempt, only a maximum longitudinal deceleration of 0.77 g could be achieved. Thus, the desired longitudinal acceleration of 0.8 g was not achieved. Nevertheless, the driving test could be used to assess the load securing, as the foil of variant 1 failed. The load became free and was no longer secured. The result was that two new loading units were assembled and machine-wrapped (variant 3).

2.1.4.2. Versuch 2 & 3 (Fahrversuch Kreisfahrt) / *Test 2 & 3 (Driving test circular drive)*

Das Fahrzeug wurde mit den Varianten 2 & 3 beladen. Als Versuch war eine Kreisfahrt mit steigender Geschwindigkeit bis zum Erreichen einer Querbeschleunigung von 0,5 g geplant. Mit dem eingesetzten Testfahrer konnte in zwei Durchläufen nur eine Querbeschleunigung von maximal 0,33 g erreicht werden. Damit wurde die gewünschte Querbeschleunigung nicht erreicht. Der Fahrversuch konnte somit zur Beurteilung der Ladungssicherung nicht verwendet werden. Das Ladungsverhalten war über die gesamte Versuchsdauer neutral. Es kam zu keiner Verschiebung der Ladung /
The vehicle was loaded with the variants 2 & 3. The attempt was a circular drive with increasing speed until a lateral acceleration of 0.5 g was reached. The test driver could only achieve a maximum lateral acceleration of 0.33 g in two runs. This meant that the desired lateral acceleration was not achieved. The driving test could therefore not be used to assess load securing. The load behaviour was neutral over the entire duration of the test. There was no displacement of the load.

2.1.4.3. Versuch 4 bis 6 (Fortsetzung Fahrversuch Bremsen) */ Test 4 to 6 (Continuation of driving test braking)*

Das Fahrzeug war mit den Varianten 2 & 3 beladen. In Versuch 4 wurde eine Längsverzögerung von maximal 0,53 g erreicht. Die Ladung verhielt sich neutral. Es kam zu keiner Verschiebung der Ladung.
In Versuch 5 wurde eine Längsverzögerung von maximal 0,82 g erreicht. Der Fahrversuch konnte somit zur Beurteilung der Ladungssicherung verwendet werden. Die Ladung verhielt sich neutral. Es kam zu keiner Verschiebung der Ladung.
In Versuch 6 wurde eine Längsverzögerung von maximal 0,85 g erreicht. Der Fahrversuch konnte somit zur Beurteilung der Ladungssicherung verwendet werden. Bei der Ladung der Variante 2 kam es zu einem Versagen der Folie. Die Ladung wurde frei und war nicht mehr gesichert. Die Ladung der

Variante 3 verhielt sich neutral. Durch Anstoß der dahinter angeordneten frei werdenden Ladung der Variante 2 kam es zu einer leichten Verschiebung /
The vehicle was loaded with variants 2 & 3. In test 4 a maximum longitudinal deceleration of 0.53 g was achieved. The load behaved neutrally. There was no displacement of the load.
In test 5 a maximum longitudinal deceleration of 0.82 g was achieved. The driving test could therefore be used to assess the load securing. The load behaved neutrally. There was no displacement of the load.
In test 6 a maximum longitudinal deceleration of 0.85 g was achieved. The driving test could therefore be used to assess the load securing. In the case of load variant 2, the foil failed. The load became free and was no longer secured. The load of variant 3 behaved neutrally. A slight displacement was caused by the impact of the released load of variant 2 that was located behind.

2.1.4.4. Versuch 7 & 8 (Fortsetzung Fahrversuch Kreisfahrt) / *Test 7 & 8 (Continuation of driving test circular drive)*

Das Fahrzeug war nur mit Variante 3 beladen. Sowohl Fahrer wie auch Testfahrzeug waren getauscht worden. Als einziger Versuch war eine Kreisfahrt mit steigender Geschwindigkeit bis zum Erreichen einer Querbeschleunigung von 0,5 g geplant. Mit dem eingesetzten Testfahrer konnte in zwei Durchläufen eine Querbeschleunigung von maximal 0,52 g erreicht werden. Der Fahrversuch konnte somit zur Beurteilung der Ladungssicherung verwendet werden. Das Ladungsverhalten war über die gesamte Versuchsdauer neutral. Es kam zu keiner Verschiebung der Ladung /
The vehicle was loaded with variant 3 only. Both driver and test vehicle had been exchanged. The only test planned was a circular drive with increasing speed until a lateral acceleration of 0.5 g was reached. The test driver could achieve a maximum lateral acceleration of 0.52 g in two runs. The driving test could thus be used to assess the load securing. The load behaviour was neutral over the entire duration of the test. There was no displacement of the load.

Nachfolgend sind die im Fahrversuch gemessenen Werte zusammengefasst dargestellt:

Fahrmanöver	Sicherungs-varianten	Anforderung nach DIN EN 12642	v_{max} [km/h]	Max. Beschleunigung [m/s²] / [g]	Ergebnis	Bemerkung
Versuch 01 Bremsung	1 & 2	0,8 g über 50 ms bei v > 35 km/h	39	7,55 / 0,77	Nicht erfüllt	Ladung Var. 1 frei
Versuch 02 Kreisfahrt	2 & 3	0,5 g bei v > 30 km/h	25	2,9 / 0,30	Nicht erfüllt	./.
Versuch 03 Kreisfahrt	2 & 3	0,5 g bei v > 30 km/h	28	3,2 / 0,33	Nicht erfüllt	./.
Versuch 04 Bremsung	2 & 3	0,8 g über 50 ms bei v > 35 km/h	35	5,20 / 0,53	Nicht erfüllt	./.
Versuch 05 Bremsung	2 & 3	0,8 g über 50 ms bei v > 35 km/h	38	8,04 / 0,82	Erfüllt	./.
Versuch 06 Bremsung	2 3	0,8 g über 50 ms bei v > 35 km/h	39	8,34 / 0,85	Nicht erfüllt Erfüllt	Ladung frei
Versuch 07 Kreisfahrt	3	0,5 g bei v > 30 km/h	27	4,71 / 0,48	Nicht erfüllt	./.
Versuch 08 Kreisfahrt	3	0,5 g bei v > 30 km/h	28	5,10 / 0,52	Erfüllt	./.

Übersicht der fahrdynamischen Anforderungen und Ergebnisse

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The values measured in the driving test are summarized below:

Driving manoeuvres	*Variants of securing*	*Requirements acc. to DIN EN 12642*	*v_{max} [km/h]*	*Max. acceleration [m/s²] / [g]*	*Result*	*Remark*
Test 01 Braking	*1 & 2*	*0,8 g for 50 ms at v > 35 km/h*	*39*	*7,55 / 0,77*	*Not fulfilled*	*Load Var. 1 free*
Test 02 Circle drive	*2 & 3*	*0,5 g at v > 30 km/h*	*25*	*2,9 / 0,30*	*Not fulfilled*	*./.*
Test 03 Circle drive	*2 & 3*	*0,5 g at v > 30 km/h*	*28*	*3,2 / 0,33*	*Not fulfilled*	*./.*
Test 04 Braking	*2 & 3*	*0,8 g for 50 ms at v > 35 km/h*	*35*	*5,20 / 0,53*	*Not fulfilled*	*./.*
Test 05 Braking	*2 & 3*	*0,8 g for 50 ms at v > 35 km/h*	*38*	*8,04 / 0,82*	*Passed*	*./.*
Test 06 Braking	*2*	*0,8 g for 50 ms at v > 35 km/h*	*39*	*8,34 / 0,85*	*Not fulfilled*	*Load free*
	3				*Passed*	
Test 07 Circle drivep	*3*	*0,5 g at v > 30 km/h*	*27*	*4,71 / 0,48*	*Not fulfilled*	*./.*
Test 08 Circle drive	*3*	*0,5 g at v > 30 km/h*	*28*	*5,10 / 0,52*	*Passed*	*./.*

Overview of the driving dynamics requirements and results

2.2. Weitere Prüfungen in 2019 / *Further tests in 2019*

Auf Wunsch des Auftraggebers wurden am 26.10.2019 Zwecks Erweiterung des Verwendungsbereichs weitere Sicherungsvarianten der Fasssicherung Drumclip des Typs DC18A RED mit Hilfe von Fahrversuchen untersucht /
At the customer's request further securing variants of the drum securing device Drumclip type DC18A RED were investigated on 26th of October 2019 by means of further road tests in order to extend the range of application.

2.2.1. Anforderungen an die einzusetzenden Ladungssicherungsmittel / *Requirements for the load securing equipment to be used*

Folgende Anforderungen entsprechen den Bedingungen unter Absatz 2.1.1.: die Fasssicherung (Drumclip), die Fassart (Spundfässer), die Anzahl der Fässer pro Palette, die Palettenausführung, die Fassfüllung, die generellen Gewichte sowie die Reibwerte zwischen Palette und Fässern /
The following requirements meet the requirements under 2.1.1.: the drum safety device (Drumclip), the drum type (bung drums), the number of drums per pallet, the pallet version, the drum filling, the general weights and the values of friction between pallet and drums.

Die Fasssicherung erfolgte in zwei weiteren Varianten, bei denen im Gegensatz zu den vorherigen Versuchen von 2018 die Fässer statt mit Folie mit Straps gesichert waren. Für eine einfachere Gesamtübersicht wurden diese auf Basis der vorherigen Varianten (1 bis 3) weiter hochgezählt / *The drums were secured in two further variants, in which, in contrast to the previous tests from 2018, the drums were secured with straps instead of foil. For a simpler overall view, these were further counted up on the basis of the previous variants (1 to 3).*

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Variante 4 / *Variant 4:*

- 4 Fässer, mit einem horizontalen und einem vertikalen Strap umspannt (Spannkraft jeweils 2.500 N), auf einer Palette. Durch den vertikalen Strap bilden die Fässer und die Palette eine Ladeeinheit / *4 drums, spanned with a horizontal and a vertical strap (tension force 2,500 N each), on a pallet. Due to the vertical strap, the drums and the pallet form one load unit.*
- jeweils zwei Fässer einer Ladeeinheit sind durch einen Drumclip verbunden (zwei Drumclips pro Ladeeinheit - diese sind notwendig, um den vertikalen Strap um die Ladeeinheit zu spannen) / *two drums of each load unit are connected by a Drumclip (two drum clips per load unit - these are necessary to tighten the vertical strap around the load unit).*
- 2 Ladeeinheiten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander / *2 load units with anti-slip material beneath (μ ≥ 0.6) side by side*
- die Fassreihe wurde mit einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief mittig über die äußeren Drumclips und hinter dem horizontalen Strap (kontaktlos) vertikal nach unten / *The row of drums was lashed down with a lashing belt (LC = 2,500 daN), the belt ran centrally over the outer Drumclips and vertically downwards behind the horizontal strap (contactless).*

Horizontaler und vertikaler Strap, Spanngurt hinter dem horizontalen Strap / *Horizontal and vertical strap, lashing belt behind the horizontal strap*

Spanngurt mittig auf äußerem Drumclip, Spanngurt hinter dem horizontalen Strap / *Lashing belt centered on outer drum clip, lashing belt behind the horizontal strap*

Zwei Drumclips pro Ladeeinheit / *Two Drumclips per load unit*

Detailansicht zwei Drumclips pro Ladeeinheit / *Detailed view of two Drumclips per load unit*

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Variante 5 / *Variant 5:*

- 4 Fässer, mit einem horizontalen Strap umspannt (Spannkraft jeweils 2.500 N), auf einer Palette. Durch Fehlen des vertikalen Straps ist die Palette nicht in die Ladeeinheit eingebunden */ 4 drums, strapped with a horizontal strap (tension force 2,500 N each), on a pallet. Due to the absence of the vertical strap, the pallet is not tied to the load unit.*
- 2 Paletten, beladen mit Fässern, mit unterlegtem Anti-Rutschmaterial (µ ≥ 0,6) nebeneinander / *2 pallets, loaded with drums, with anti-slip material beneath (µ ≥ 0.6), side by side.*
- die jeweils äußeren beiden Fässer der Fassreihe sind durch einen Drumclip verbunden (ein Drumclip pro Ladeeinheit) / *The two outermost drums of the drum row are connected by a Drumclip (one Drumclip per load unit).*

Fässer mit horizontalem Strap /
Drums with horizontal strap

Ein Drumclip pro Ladeeinheit /
One Drumclip per load unit

Detailansicht ein Drumclip pro Ladeeinheit /
Detail view one Drumclip per load unit

Bei Untersuchung der Variante 5 wurden die Fassreihen unterschiedlich niedergezurrt, deshalb wurde diese nochmals in Variante 5a und Variante 5b aufgeteilt /
When variant 5 was examined, the rows of drums were lashed down differently, so it was devided again into variant 5a and variant 5b.

Variante 5a / *Variant 5a:*

- die Fassreihe wurde mit einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief mittig über die äußeren Drumclips und **hinter** dem horizontalen Strap (kontaktlos) / *The row of drums was lashed down with a lashing belt (LC = 2,500 daN), the belt ran centrally over the outer Drumclips and **behind** the horizontal strap (contactless).*

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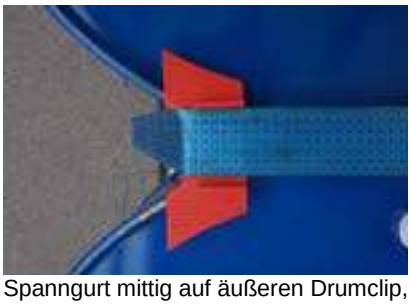
Variante 5a: Spanngurt **hinter** dem Strap /
*Variant 5a: Lashing belt **behind** the strap*

Spanngurt mittig auf äußeren Drumclip;
Spanngurt **hinter** dem horizontalen Strap /
Lashing belt centered on outer Drumclip;
*lashing belt **behind** the horizontal strap*

Variante 5b / *Variant 5b:*

- die Fassreihe wurde mit einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief mittig über die äußeren Drumclips und **vor** dem horizontalen Strap **über** den Strap / *The row of drums was lashed down with a lashing belt (LC = 2,500 daN), the belt ran centrally over the outer Drumclips and **in front of** the horizontal strap **over** the horizontal strap.*

Variante 5b: Spanngurtverlauf **über** den Strap /
*Variant 5b: Course of lashing belt **over** the strap*



Spanngurt mittig auf äußeren Drumclip,
Spanngurt **über** dem horizontalen Strap /
Lashing belt centered on outer Drumclip,
*lashing belt **over** the horizontal strap*

Die Spezifikationen des Straps und des Umreifungsgerätes sind Anlage 2 zu entnehmen / *The specifications of strap and strapping tool can be found in Annex 2.*

Ein Spanngurtverlauf über dem horizontalen Strap (Variante 5b) ist nach Einschätzung des zuständigen Sachverständigen nicht zulässig, wenn der Spanngurt auf den horizontal verlaufenden Strap drückt und dadurch die Vorspannungen von Strap und Gurt beeinflusst werden können. Zum einen wird die Spannkraft des Straps dadurch undefiniert erhöht. Die zusätzliche Belastung des Straps könnte dann zu einem Nachgeben oder gar Versagen führen, wodurch eine sichere Umspannung der Fässer zu einer Ladeeinheit nicht mehr gewährleistet wäre. Zum anderen wird bei Nachlassen der Spannung im Strap auch die Vorspannung im Zurrgurt abfallen. Diese ist jedoch bei der hier angewandten Sicherungsart „Niederzurren“ für eine ausreichende Ladungssicherung von zentraler Bedeutung /

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In the opinion of the competent expert, it is not permissible for the tensioning belt to run over the horizontal strap (variant 5b) if the tensioning belt presses on the horizontal strap and the pretensioning of strap and belt can be influenced by this. On the one hand, the tension force of the strap is increased in an undefined manner. The additional load on the strap could then lead to yielding or even failure, as a result of which safe loop lashing of the drums to form a cargo unit would no longer be guaranteed. On the other hand, if the tension in the strap is reduced, the pretension in the lashing belt will also be reduced. However, with the "tie-down lashing" securing method used here, for adequate load securing this is of central importance.

2.2.2. Prüfkräfte / *Test forces*

Die Prüfkräfte sind in Absatz 2.1.2. erläutert / *The test forces are explained in paragraph 2.1.2..*

2.2.3. Messinstrumente / *Measuring instruments*

Die Beschleunigungs- und die Verzögerungswerte wurden unabhängig voneinander durch die Firmen IPS Technology und durch die TÜV Rheinland Kraftfahrt GmbH (TRK) gemessen. Die Firma IPS Technology verwendete hierfür die Messeinrichtung SAVER9X$_{GPS}$ (Seriennumer: 1006-112, Hersteller: Lansmont). Die TRK führte die Messung mit der VBOX 3i (Gerätenummer: 8614, Hersteller: Racelogic) durch. Nachfolgend ist die Position der Messinstrumente dargestellt /
The acceleration and deceleration values were measured independently by IPS Technology and TÜV Rheinland Kraftfahrt GmbH (TRK). IPS Technology used the SAVER9X$_{GPS}$ measuring device (serial number: 1006-112, manufacturer: Lansmont). The TRK carried out the measurement with the VBOX 3i (serial number: 8614, manufacturer: Racelogic). In the following the position of the measuring instruments is shown.

Positionen der Messeinrichtungen / *Positions of the measuring instruments*: 1. SAVER9X$_{GPS}$;
2. VBOX 3i

2.2.4. Prüfergebnisse / *Test results*

Im Folgenden sind die einzelnen Ergebnisse und Auffälligkeiten der Versuche dargestellt. Weitere Bilder sowie Filme zu den einzelnen Versuchen sind in Anlage 5 (USB-Datenträger) zu finden /
The individual results and peculiarities of the tests are presented below. Further pictures and films of the individual tests can be found in Appendix 5 (USB-stick).

2.2.4.1. Fahrversuch Bremsen / *Driving test braking*

Insgesamt wurden acht Versuche durchgeführt. Die Versuche wurden auf Basis der vorherigen Versuche (1 bis 8) von 2018 weiter hochgezählt / *A total of eight tests were carried out. The tests numbering was further increased on the basis of the previous tests (1 to 8) from 2018.*

Versuch 9 / *Test 9*:
Das Fahrzeug war mit Variante 4 beladen. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8°g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Deshalb war eine Beurteilung anhand des Versuches nicht möglich /
The vehicle was loaded with variant 4. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to a standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.
Therefore, an assessment based on the test was not possible.

Versuch 10 / *Test 10*:
Das Fahrzeug war mit den Varianten 4 und 5a beladen Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Bei der Variante 4 wurde eine Verschiebung der Beladung von < 20 mm festgestellt. Die Positionen der Drumclips, Straps und des Spanngurtes wiesen keine Veränderung auf.
Die Variante 5a wurde frei und war nicht mehr gesichert (Fail-Versuch) /
The vehicle was loaded with variants 4 and 5a. A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.
In the case of variant 4, a shift of the load of < 20 mm was detected. The positions of the Drumclips, straps and the lashing belt were not changed.
Variant 5a became free and was no longer secured (fail test).

Versuch 11 / *Test 11*:
Das Fahrzeug war mit Variante 4 beladen. Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Es wurde eine Verschiebung der Beladung von < 20 mm festgestellt. Die Positionen der Drumclips, Straps und des Spanngurts wiesen keine Veränderung auf /
The vehicle was loaded with variant 4. A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms was achieved.
A shift of the load of < 20 mm was detected. The positions of the Drumclips, straps and the lashing belt were not changed.

Versuch 12 / *Test 12*:
Das Fahrzeug war mit den Varianten 4 und 5b beladen. Die Variante 5b war aufgrund des Spanngurtverlaufs **über** dem horizontalen Strap durch den Sachverständigen bereits als nicht zulässig eingeordnet worden. Auf Kundenwunsch wurde die Variante dennoch gefahren. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand

abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Deshalb war eine Beurteilung anhand des Versuches nicht möglich /
*The vehicle was loaded with variants 4 and 5b. Variant 5b had already been classified as not permissible by the expert due to the run of the lashing belt **over** the horizontal strap. However, at the customer's request, the variant was nevertheless tested/driven. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.*
Therefore, an assessment based on the test was not possible.

Versuch 13 / *Test 13*:
Das Fahrzeug war mit den Varianten 4 und 5b beladen. Die Variante 5b war aufgrund des Spanngurtverlaufs **über** dem horizontalen Strap durch den Sachverständigen bereits als nicht zulässig eingeordnet worden. Auf Kundenwunsch wurde die Variante dennoch gefahren. Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Bei der Variante 4 wurde eine Verschiebung der Beladung von < 30 mm festgestellt. Die Positionen der Drumclips, Straps und des Spanngurtes wiesen keine Veränderung auf.
Bei der Variante 5b änderten sich die Position der Beladung, der Drumclips, der Straps und des Spanngurtes nicht /
*The vehicle was loaded with variants 4 and 5b. Variant 5b had already been classified as not permissible by the expert due to the run of the lashing belt **over** the horizontal strap. However, at the customer's request, the variant was nevertheless tested/driven. A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms was achieved.*
A shift of the load of < 30 mm was detected. The positions of the Drumclips, straps and the lashing belt were not changed.
In variant 5b the position of the load, the drum clips, the straps and the lashing belt did not change.

Versuch 14 / *Test 14*:
Das Fahrzeug war mit der Variante 5b beladen. Diese war aufgrund des Spanngurtverlaufs **über** dem horizontalen Strap durch den Sachverständigen bereits als nicht zulässig eingeordnet worden. Auf Kundenwunsch wurde die Variante dennoch gefahren. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8 g über einen Zeitspanne von ≥ 80 ms erreicht werden.
Deshalb ist eine Beurteilung anhand des Versuches nicht möglich /
*The vehicle was loaded with variant 5b. This had already been classified as not permissible by the expert due to the run of the lashing belt **over** the horizontal strap. However, at the customer's request, the variant was nevertheless tested. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.*
Therefore, an assessment based on the test is not possible.

Versuch 15 / *Test 15*:
Das Fahrzeug war mit Variante 5b beladen. Diese war aufgrund des Spanngurtverlaufs **über** dem horizontalen Strap durch den Sachverständigen bereits als nicht zulässig eingeordnet worden. Auf Kundenwunsch wurde die Variante dennoch gefahren. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8 g über einen Zeitspanne von ≥ 80 ms erreicht werden.
Deshalb ist eine Beurteilung anhand des Versuches nicht möglich /
*The vehicle was loaded with variant 5b. This had already been classified as not permissible by the expert due to the run of the lashing belt **over** the horizontal strap. However, at the customer's request,*

the variant was nevertheless tested/driven. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved. Therefore, an assessment based on the test was not possible.

Versuch 16 / *Test 16*:
Das Fahrzeug war mit Variante 5b beladen. Diese war aufgrund des Spanngurtverlaufs **über** dem horizontalen Strap durch den Sachverständigen bereits als nicht zulässig eingeordnet worden. Auf Kundenwunsch wurde die Variante dennoch gefahren. Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Die Positionen der Beladung, der Drumclips, der Straps und des Spanngurtes änderten sich nicht /
*The vehicle was loaded with variant 5b. This had already been classified as not permissible by the expert due to the run of the lashing belt **over** the horizontal strap. However, at the customer's request, the variant was nevertheless tested. A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved. The position of the load, the Drumclips, the straps and the lashing belt did not change.*

2.2.4.2. Fahrversuch Kreisfahrt / *Driving test circular drive*

Die Beladungen verhielten sich bei den Kreisfahrten, welche bei den vorherigen Prüfungen im November 2018 durchgeführt wurden, vollkommen neutral. Die Sicherungsvariante 4 bildet (wie die Sicherungsvarianten 1 bis 3) Ladeeinheiten, bestehend aus den Fässern und einer Palette. Deswegen wurde bei Kreisfahrten mit der Variante 4 ein gleiches Ladungsverhalten wie bei den Kreisfahrten der Varianten 1 bis 3 erwartet. Somit wurde bei den Prüfungen im Oktober 2019 von weiteren Kreisfahrten abgesehen. In Folge dessen konnte die Position der Ladung auf dem Sattelzug vernachlässigt werden, da nur Bremsversuche durchgeführt wurden /
The loadings behaved completely neutral during the circular driving tests carried out during the previous tests in November 2018. Securing variant 4 (like securing variants 1 to 3) forms load units consisting of the drums and a pallet. For this reason, the same load behavior was expected for circular driving with variant 4 as for circular driving with variants 1 to 3. Consequently, the tests in October 2019 did not include any further circular driving tests. As a result, the position of the load on the semi-trailer truck could be neglected as only braking tests were carried out.

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Nachfolgend sind die im Fahrversuch gemessenen Werte zusammengefasst dargestellt:

Fahrmanöver	Sicherungs-varianten	v_{max} [km/h]	a_{max} [g] (IPS)	$t_{a\geq0,8g} \geq 80$ ms [Ja / Nein] (TÜV)	Ergebnis	Bemerkung
Versuch 09 Bremsung	4	43	0,55	Ja	keine Wertung	a_{max} zu niedrig
Versuch 10 Bremsung	4 5a	43	1	Ja	Var. 4 positiv Var. 5a negativ	 Var. 5a frei
Versuch 11 Bremsung	4	43	0,95	Ja	Var. 4 positiv	./.
Versuch 12 Bremsung	4 5b	43	0,8	Nein	keine Wertung	$t_{a\geq0,8g}$ zu kurz
Versuch 13 Bremsung	4 5b	43	0,87	Ja	Var. 4 positiv Var. 5b negativ	 Var. 5b Zurrung
Versuch 14 Bremsung	5b	43	1,06	Nein	keine Wertung	$t_{a\geq0,8g}$ zu kurz
Versuch 15 Bremsung	5b	43	/	Nein	keine Wertung	a_{max} unklar $t_{a\geq0,8g}$ zu kurz
Versuch 16 Bremsung	5b	43	0,97	Ja	Var. 5b negativ	Var. 5b Zurrung

Übersicht der Fahrdynamischen Anforderungen und Ergebnisse

The values measured in the driving test are summarized below.

Driving manoeuvres	*Variants of securing*	v_{max} *[km/h]*	a_{max} *[g] (IPS)*	$t_{a\geq0,8g} \geq 80$ ms *[Yes / No] (TÜV)*	*Result*	*Remark*
Test 09 Breaking	*4*	*43*	*0,55*	*Yes*	*No assessment*	a_{max} too low
Test 10 Breaking	*4* *5a*	*43*	*1*	*Yes*	*Var. 4 positive* *Var. 5a negative*	 *Var. 5a free*
Test 11 Breaking	*4*	*43*	*0,95*	*Yes*	*Var. 4 positive*	./.
Test 12 Breaking	*4* *5b*	*43*	*0,8*	*No*	*No assessment*	$t_{a\geq0,8g}$ *too short*
Test 13 Breaking	4 5b	43	0,87	Yes	Var. 4 positive Var. 5b negative	 Var. 5b Lashing
Test 14 Breaking	*5b*	*43*	*1,06*	*No*	*No assessment*	$t_{a\geq0,8g}$ too short
Test 15 Breaking	*5b*	*43*	*/*	*No*	*No assessment*	a_{max} unclear $t_{a\geq0,8g}$ too short
Test 16 Breaking	*5b*	*43*	*0,97*	*Yes*	*Var. 5b negative*	Var. 5b Lashing

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2.3. Weitere Prüfungen in 2020 / *Further tests in 2020*

Auf Wunsch des Auftraggebers wurden am 13.06.2020 Zwecks Erweiterung des Verwendungsbereichs weitere Sicherungsvarianten der Fasssicherung Drumclip des Typs DC18A RED mit Hilfe von Fahrversuchen untersucht /

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At the customer's request further securing variants of the drum securing device Drumclip type DC18A RED were investigated on 13th of June 2020 by means of further road tests in order to extend the range of application.

2.3.1. Anforderungen an die einzusetzenden Ladungssicherungsmittel / *Requirements for the load securing equipment to be used*

Folgende Anforderungen entsprechen den Bedingungen unter Absatz 2.1.1.: die Fasssicherung (Drumclip, Typ DC18A RED), die Fassart (Spundfässer), die Anzahl der Fässer pro Palette, die Palettenausführung, die Fassfüllung, die generellen Gewichte sowie die Reibwerte zwischen Palette und Fässern /
The following requirements meet the requirements under 2.1.1.: the drum safety device (Drumclip, type DC18A RED), the drum type (bung drums), the number of drums per pallet, the pallet version, the drum filling, the general weights and the values of friction between pallet and drums.

Die Fasssicherung erfolgte in einer weiteren Variante, bei denen im Gegensatz zu den vorherigen Versuchen von 2018 und 2019 die Fässer, statt mit Folie oder mit Straps, mit Cordstrap® gesichert waren. Für eine einfachere Gesamtübersicht wurde diese auf Basis der vorherigen Varianten (1 bis 5) weiter hochgezählt */ The drums were secured in one further variant, in which, in contrast to the previous tests from 2018 and 2019, the drums were secured with Cordstrap® instead of foil or straps. For a simpler overall view, this were further counted up on the basis of the previous variants (1 to 5).*

Variante 6 / *Variant 6:*

- 4 Fässer, händisch mit einem horizontalen und einem vertikalen Cordstrap® umspannt (Spannkraft jeweils 2.000 N), auf einer Palette. Durch den vertikalen Cordstrap® bilden die Fässer und die Palette eine Ladeeinheit / *4 drums, manually strapped with a horizontal and a vertical Cordstrap® (tension force 2,000 N each), on a pallet. Due to the vertical Cordstrap®, the drums and the pallet form one load unit).*
- jeweils zwei Fässer einer Ladeeinheit sind durch einen Drumclip verbunden (zwei Drumclips pro Ladeeinheit - diese sind notwendig, um den vertikalen Cordstrap® um die Ladeeinheit zu spannen) */ two drums of each load unit are connected by a Drumclip (two drum clips per load unit - these are necessary to tighten the vertical Cordstrap® around the load unit)*
- Der Cordstrap-Verschluss darf die anderen Cordstrap®, den Spanngurt und die Fässer nicht berühren und muss dementsprechend positioniert werden (um Beschädigungen zu vermeiden) */ The cordstrap fastener is not to contact the other Cordstrap®, the lashing belt and the drums and must be positioned accordingly (to prevent damage).*
- 2 Ladeeinheiten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander / *2 load units with anti-slip material beneath (μ ≥ 0.6) side by side*
- die Fassreihe wurde mit einem Spanngurt (LC = 2.500 daN) niedergezurrt. Der Gurt verlief mittig über die äußeren Drumclips und hinter dem horizontalen Cordstrap® (kontaktlos) vertikal nach unten / *The row of drums was lashed down with a lashing belt (LC = 2,500 daN). The belt ran centrally over the outer Drumclips and vertically downwards behind the horizontal Cordstrap® (contactless).*

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Horizontaler und vertikaler Cordstrap®, Spanngurt hinter dem horizontalen Cordstrap® / *Horizontal and vertical Cordstrap®, lashing belt behind the horizontal Cordstrap®*

Zwei Drumclips pro Ladeeinheit / *Two Drumclips per load unit*

Cordstrap-Verschlüsse kontaktlos positioniert / *Cordstrap fasteners positioned without contact*

Die Spezifikation des Cordstrap®, des Cordstrap-Verschlusses und des Spanngeräts sind Anlage 3 zu entnehmen / *The specification of the Cordstrap®, the cordstrap fastener and the tensioner can be found in Annex 3.*

2.3.2. Prüfkräfte / *Test forces*

Die Prüfkräfte sind in Absatz 2.1.2. erläutert / *The test forces are explained in paragraph 2.1.2..*

2.3.3. Messinstrumente / *Measuring instruments*

Die Beschleunigungs- und die Verzögerungswerte wurden unabhängig voneinander durch zwei verschieden Messeinrichtungen des TÜV Rheinland Kraftfahrt GmbH (TRK) gemessen. Die eine Messeinrichtung umfasst zwei Beschleunigungssensoren, einen Universalverstärker und die Software Catman. Die andere Messeinrichtung umfasst eine VBOX 3i mit einem dazugehörigen Beschleunigungssensor. Folgend sind die Positionen der Beschleunigungssensoren dargestellt / *The acceleration and deceleration values were measured independantly by two different measuring devices of TÜV Rheinland Kraftfahrt GmbH (TRK). The one measuring device comprises two acceleration sensors, a universal amplifier and the Catman software. The other measuring device comprises a VBOX 3i with an associated acceleration sensor. In the following the positions of the accelerometers are shown.*

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Positionen der Beschleunigungssensoren / *Positions of the acceleration sensors*:

2.3.4. Prüfergebnisse / *Test results*

Im Folgenden sind die einzelnen Ergebnisse und Auffälligkeiten der Versuche dargestellt. Weitere Bilder sowie Filme zu den einzelnen Versuchen sind in Anlage 5 (USB-Datenträger) zu finden /
The individual results and peculiarities of the tests are presented below. Further pictures and films of the individual tests can be found in Appendix 5 (USB-stick).

2.3.4.1. Fahrversuch Bremsen / *Driving test braking*

Insgesamt wurden fünf Versuche durchgeführt. Die Versuche wurden auf Basis der vorherigen Versuche (1 bis 16) weiter hochgezählt / *A total of five tests were carried out. The tests numbering was further increased on the basis of the previous tests (1 to 16).*

Versuch 17 / *Test 17*:
Das Fahrzeug war mit Variante 6 beladen. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8°g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Deshalb war eine Beurteilung anhand des Versuches nicht möglich /
The vehicle was loaded with variant 6. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to a standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.
Therefore, an assessment based on the test was not possible.

Versuch 18 / *Test 18*:
Das Fahrzeug war mit Variante 6 beladen. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8°g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Deshalb war eine Beurteilung anhand des Versuches nicht möglich /
The vehicle was loaded with variant 6. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to a standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.
Therefore, an assessment based on the test was not possible.

Versuch 19 / *Test 19*:
Das Fahrzeug war mit Variante 6 beladen. Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Es wurde keine Verschiebung der Beladung festgestellt. Die Positionen der Drumclips, der Cordstrap® und des Spanngurts wiesen keine Veränderung auf /
The vehicle was loaded with variant 6. A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms was achieved.
No shift of the load was detected. The positions of the Drumclips, the Cordstrap® and the lashing belt were not changed.

Versuch 20 / *Test 20*:
Das Fahrzeug war mit Variante 6 beladen. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8°g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Deshalb war eine Beurteilung anhand des Versuches nicht möglich /
The vehicle was loaded with variant 6. It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to a standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.
Therefore, an assessment based on the test was not possible.

Versuch 21 / *Test 21*:
Das Fahrzeug war mit Variante 6 beladen. Es konnte eine Längsverzögerung von ≥ 0,8 g (- 0,05 g) über eine Zeitspanne von ≥ 80 ms erreicht werden.
Es wurde keine Verschiebung der Beladung festgestellt. Die Positionen der Drumclips, der Cordstrap® und des Spanngurts wiesen keine Veränderung auf /
The vehicle was loaded with variant 6. A longitudinal deceleration of ≥ 0.8 g (- 0,05 g) *over a period of ≥ 80 ms was achieved.*
No shift of the load was detected. The positions of the Drumclips, the Cordstrap® and the lashing belt were not changed.

2.3.4.2. Fahrversuch Kreisfahrt / *Driving test circular drive*

Die Sicherungsvariante 6 bildet (wie die Sicherungsvarianten 1 bis 4) Ladeeinheiten, bestehend aus den Fässern und einer Palette. Deshalb wurden bei den aktuellen Prüfungen im Juni 2020, wie bei den Prüfungen im Oktober 2019, von Kreisfahrten abgesehen (beschrieben im Absatz 2.2.4.2.). In Folge dessen konnte die Position der Ladung auf dem Sattelzug vernachlässigt werden, da nur Bremsversuche durchgeführt wurden /
Securing variant 6 (like securing variants 1 to 4) forms load units consisting of the drums and a pallet. For this reason, the current tests in June 2020, as well as the tests in October 2019, did not include circular driving tests (described in paragraph 2.2.4.2.). As a result, the position of the load on the semi-trailer truck could be neglected as only braking tests were carried out.

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Nachfolgend sind die im Fahrversuch gemessenen Werte zusammengefasst dargestellt:

Fahrmanöver	Sicherungs-varianten	v ≥ 40 km/h	$t_{a\geq 0,8g}$ ≥ 80 ms [Ja / Nein] (TÜV)	Ergebnis	Bemerkung
Versuch 17 Bremsung	6	erfüllt	nicht erfüllt	keine Wertung	$t_{a\geq 0,8g}$ zu kurz
Versuch 18 Bremsung	6	erfüllt	nicht erfüllt	keine Wertung	$t_{a\geq 0,8g}$ zu kurz
Versuch 19 Bremsung	6	erfüllt	erfüllt	positiv	./.
Versuch 20 Bremsung	6	erfüllt	nicht erfüllt	keine Wertung	$t_{a\geq 0,8g}$ zu kurz
Versuch 21 Bremsung	6	erfüllt	erfüllt	positiv	a = 0,8 g - 0,05 g

Übersicht der Fahrdynamischen Anforderungen und Ergebnisse

The values measured in the driving test are summarized below.

Driving manoeuvres	*Variants of securing*	*v ≥ 40 km/h*	$t_{a\geq 0,8g}$ ≥ 80 ms *[Yes / No] (TÜV)*	*Result*	*Remark*
Test 17 Breaking	*6*	*pass*	*not passed*	*No assessment*	*$t_{a\geq 0,8g}$ too short*
Test 18 Breaking	*6*	*pass*	*not passed*	*No assessment*	*$t_{a\geq 0,8g}$ too short*
Test 19 Breaking	*6*	*pass*	*passed*	*positiv*	*./.*
Test 20 Breaking	6	pass	not passed	*No assessment*	*$t_{a\geq 0,8g}$ too short*
Test 21 Breaking	*6*	*pass*	*passed*	*positiv*	a = 0,8 g - 0,05 g

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3. Anlagen / *annexes*

Anlage / *annex* 0: Änderungen, 1 Seite
Alterations, 1 page

Anlage / *annex* 1: Spezifikation: Folie, 1 Seite
Specification: Foil, 1 page

Anlage / *annex* 2: Spezifikation: Strap und Umreifungsmaschine, 2 Seiten /
Specification: Strap and strapping machine, 2 pages

Anlage / *annex* 3: Spezifikation: Cordstrap®, Cordstrap-Verschluss und Spanngerät, 2 Seiten
Specifikation: Cordstrap®, cordstrap fastener and tensioner, 2 pages

Anlage / *annex* 4: Technische Zeichnung (Drumclip, Typ DC18A RED), 2 Seiten
Technical drawing (Drumclip, type DC18A RED), 2 pages

Anlage / *annex* 5: USB-Stick (Fotos, Filme, Messwerte, Technischer Bericht), 1 Seite /
USB-stick (photos, films, measurements, Technical Report), 1 page

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4. Zusammenfassung / *Summary*

Auf Wunsch des Auftraggebers wurde eine neuartige Fasssicherung (Drumclip, Typ DC18A RED) in verschiedenen Versuchsreihen auf ihre Eignung zur Ladungssicherung untersucht. Diese Art der Sicherung erforderte das Vorhandensein von:

- stabilen Ladeeinheiten
  - o durch mindestens 8-fache Umwicklung der Stahlfässer unter Einbeziehung der Palette mit Folie,

  oder
  - o durch Umspannen der Stahlfässer mit einem horizontalen und einem vertikalen Strap (Spannkraft jeweils 2.500 N), um eine Einbeziehung der Palette in die Ladeeinheit zu gewährleisten, die Spezifikationen des Straps und des Umreifungsgerätes sind Anlage 2 zu entnehmen,
    Hinweis: wegen des vertikalen Straps sind zwei Fasssicherungen pro Ladeeinheit zu verwenden!

  oder
  - o durch händisches Umspannen der Stahlfässer mit einem horizontalen und einem vertikalen Cordstrap® (Spannkraft jeweils 2.000 N), um eine Einbeziehung der Palette in die Ladeeinheit zu gewährleisten, die Spezifikationen des Cordstrap®, des Cordstrap-Verschlusses und des Spanngeräts sind Anlage 3 zu entnehmen,
    Hinweis: wegen des vertikalen Cordstrap® sind zwei Fasssicherungen pro Ladeeinheit zu verwenden! Der Cordstrap-Verschluss darf die anderen Cordstrap®, den Spanngurt und die Fässer nicht berühren und muss dementsprechend positioniert werden (um Beschädigungen zu vermeiden)!
- einer Verladung unter Verwendung von Antirutschmatten (μ ≥ 0,6),
- jeweils einem Spanngurt mit einer Belastbarkeit von 2.500 daN,
- eine Abspannung des Gurtes nach unten unter 90° zur Fahrtrichtung.
  Hinweis: ein Spanngurtverlauf mit Kontakt zum horizontalen Strap ist unzulässig!

Bei Erfüllung dieser Anforderungen ist ein sicherer Einsatz des Drumclips des Typs DC18A RED möglich /
At the customer's request a new type of drum securing device (Drumclip, type DC18A RED) was tested in various test series to determine its suitability for load securing. This type of securing required the presence of:

- *stable loading units*
  - o *by wrapping the steel drums at least 8 times, including the pallet, with foil,*

  or
  - o *by strapping the steel drums with a horizontal and a vertical strap (tension force 2,500 N each) to ensure that the pallet is included in the load unit, the specifications of strap and strapping tool can be found in Annex 2,*
    Note: Because of the vertical strap, two drum securing devices must be used per loading unit!

  or
  - o *by manually strapping the open head drums with a horizontal and a vertical Cordstrap® (tension force 2,000 N each) to ensure that the pallet is included in the loading unit, the specifications of the Cordstrap®, the cordstrap fastener and the tensioner can be found in Annex 3,*
    Note: Because of the vertical Cordstrap®, two drum securing devices must be used per loading unit! The cordstrap fastener is not to contact the other Cordstrap®, the lashing belt and the drums and must be positioned accordingly (to prevent damage)!

- *using anti-slip mats for loading (μ ≥ 0.6),*
- *one lashing belt each with a load capacity of 2,500 daN,*
- *a belt tensioning downwards at 90° to the direction of travel.*
  Note: It is not permitted for the lashing belt to run in contact with the horizontal strap!

If these requirements are met, Drumclip type DC18A RED could be used safely.

Die im Bericht enthaltenen Fotos stellen nur eine Auswahl dar. Die weiteren zu den Versuchen vorhandenen Fotos, Filme und Diagramme wurden dem Kunden elektronisch zur Verfügung gestellt / *The photos contained in the report are only a selection. The other photos, films and diagrams available for the tests were made available to the customer electronically.*

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Das geprüfte Ladungssicherungskonzept erfüllt für die dokumentierte Sicherungssituation die Anforderungen der DIN EN 12195-1. Diese europäische Norm gilt nicht für Fahrzeuge mit einem zulässigen Gesamtgewicht bis einschließlich 3.500 kg, da bei diesen durchaus höhere Beschleunigungen auftreten können /
The tested load securing concept fulfils the requirements of DIN EN 12195-1 for the documented securing situation. This European standard does not apply to vehicles with a permissible gross weight of up to and including 3,500 kg, as higher accelerations can occur in these vehicles.

Der Technische Bericht umfasst 27 Seiten sowie die Anlagen 0 bis 5 und darf ohne schriftliche Genehmigung des Prüflaboratoriums nicht auszugsweise vervielfältigt werden. Er verliert seine Gültigkeit, wenn sich die unter Punkt 1.3. genannte Prüfgrundlage ändert /
The Technical Report comprises 27 pages and Annexes 0 to 5 and may not be reproduced in whole or in part without the written permission of the testing laboratory. It loses its validity if the test basis mentioned under point 1.3. changes.

Köln, den 28.09.2020 /
Cologne, 28th of September 2020
hsm

Prüflaboratorium
Typprüfstelle Fahrzeuge/Fahrzeugteile
im Technologiezentrum Verkehrssicherheit
der TÜV Rheinland Kraftfahrt GmbH

Dipl.-Ing. Th. Husemann

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **0**

0. Änderungen / *Alterations*

0.1.	Es wird berichtigt / *Is corrected*	: - --
0.2.	Es wird geändert / *Is changed*	: - editorielle Änderungen / *editorial changes*
0.3.	Es wird hinzugefügt / *Is added*	: - Variante der Ladungssicherung mit Cordstrap® / *Variant of load securing with Cordstrap®*
0.4.	Es entfällt / *Is not applicable*	: - --

TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **2**

Umreifungsgerät / *strapping machine*

Signode Akku Umreifungsgerät BXT 3-19

	BXT3-13 Light	BXT3-16 Universal	BXT3-19 Heavy
Strap type	PET + PP	PET + PP	PET + PP
Strap width	9 - 13 mm	13 - 16 mm	16 - 19 mm
Strap thickness	PET: 0.4 - 0.8 mm; PP: 0.5 - 0.8 mm	0.5 - 1.0 mm	0.8 - 1.3 mm
Weight	3.6 kg	3.8 kg	4.3 kg
Tension force	150 - 1200 N	400 - 2500 N	400 - 4500 N
Variable Tension Speed	0 - 290 mm/s	0 - 220 mm/s	0 - 120 mm/s
Cycles / Charge	up to 800	up to 800	up to 800
Battery	Bosch Li-Ion 18V, 2.0Ah	Bosch Li-Ion 18V, 2.0Ah	Bosch Li-Ion 18V, 4.0Ah
Charging time battery	15 - 30 min	15 - 30 min	25 - 35 min
Motor technology	Single motor technology, brushless	Single motor technology, brushless	Single motor technology, brushless
Dimension (L x W x H)	370 x 141 x 135 mm	370 x 141 x 135 mm	370 x 143 x 135 mm

Quelle / *Source*: https://www.signode-bxt.com/en/product/tools/

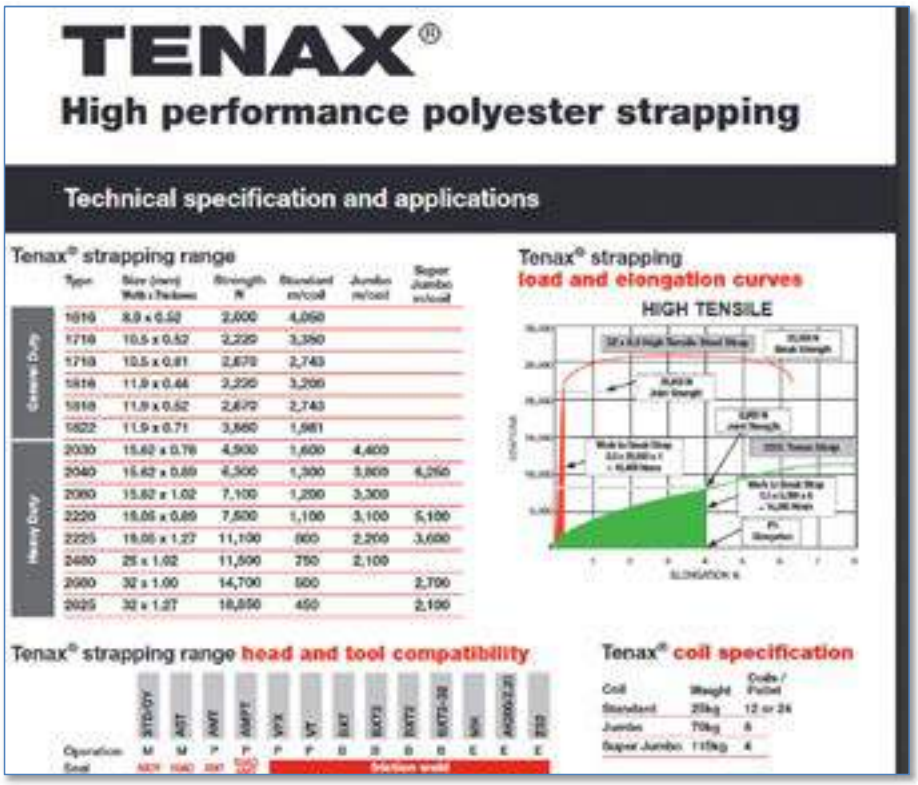
TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **2**

Strap
Strapart / *Strap type*: Signode Tenax 2220
Material / *Material*: Polyester
Breite / *Width*: 19 mm
Dicke / *Thickness*: 0,89 mm / *0.89 mm*
Vorspannung / *Pre-tension*: 2.500 N / *2,500 N*
Verschweißlevel / *Welding time level*: 4



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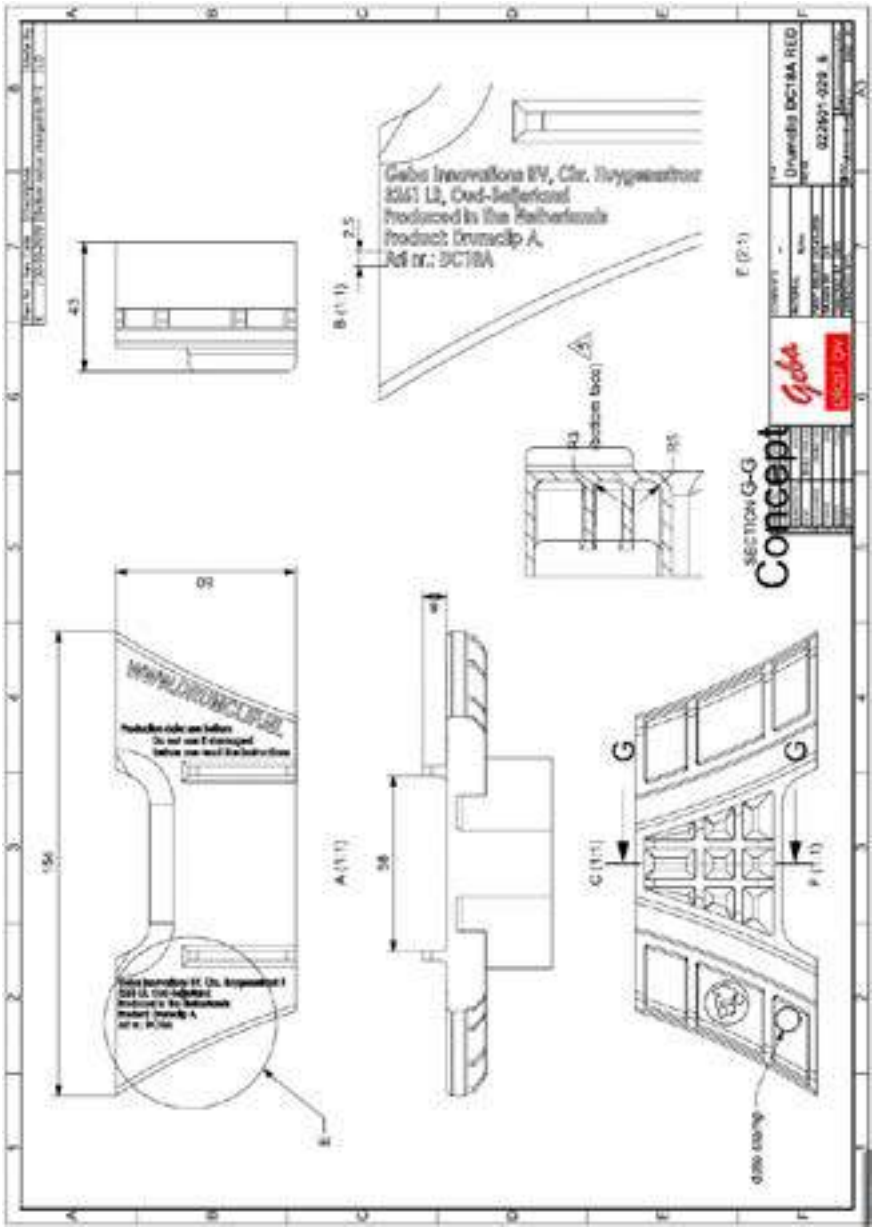
Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **4**

Technische Zeichnung Drumclip Typ DC18A RED */ technical drawing Drumclip type DC18A RED*

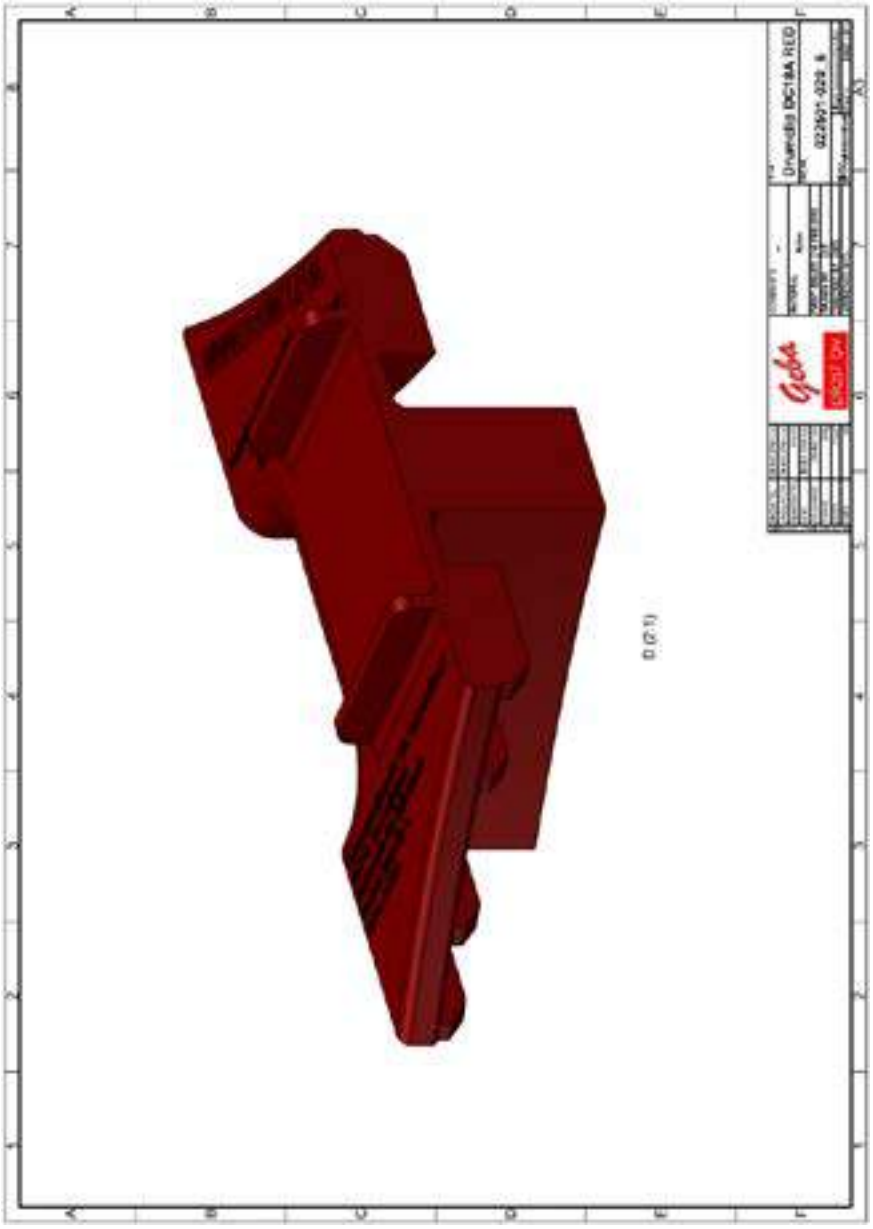


TÜV Rheinland Group

Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **4**



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Technischer Bericht: 195XS0017-03
/ Technical Report

Bauteil / *Component* **: Drumclip DC18A RED**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **5**

USB-Datenträger / *USB-stick*

3.7 Test Report ISTA | DRUMCLIP DC18A RED

Test Report

IPS 7898-80

ISTA 3E PERFORMANCE TEST

DRUMCLIP DC18A RED
with
TIGHT HEAD BARREL DRUMS

The IPS-report may be released for viewing to relevant parties.

IPS Technology is an independent packaging and tooling design agency. Aside from designing IPS also performs research, delivers advice on packaging issues and performs packaging test in its own test facility.

Reference : IPS 7898 - 80
Page : 2/21

Reference : IPS 7898 - 80
Description : Test Report ISTA 3E Drumclip DC18A Red with Tight Head Barrel Drums
Date : August 19. 2019
Author(s) : Marten Ries

Client : Geba Innovations B.V.
Chr. Huygensstraat 3
3261 LR Oud-Beijerland
The Netherlands
Contacts : Wouter Geldhof

Test performed by : Marten Ries
Test Date(s) : August 16, 2019
Test Facility : IPS Technology, Eindhoven The Netherlands
ISTA Certified Testing Laboratory, Member ID: 9778 (Appendix A)

Table of Contents

Reference : IPS 7898 - 80
Page : 3/21

1. Scope of test

The goal of this transport simulation test, performed according to the ISTA 3E-2017 Standard for Unitized Loads, is to validate the capability of the Drumclip system for sufficient load stability subjected to rough mechanical handling; forklift truck handling and warehousing stacking.

Four Standard Tight Head Barrel Drums 200L are placed on a pallet and secured with two Drumpclips and secured with two polyester lashings.

Securing of the pallets during Full Truckload (FTL) will be done with help of strapping belts and is not in scope of this test.

Figure 1. Test configuration

Reference : IPS 7898 - 80
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Details of tested configuration:

The tested configuration is built up with components listed below:

Item	Remark
Standard Tight Head Barrel Drums 200L. Quantity: 4	Drums fully filled with water. Used condition.
Pallet type: CP-9	Chemie Pallet,1140x1140x156mm, used condition.
Lashing: Signode Tenax 2040 Strapping. Quantity: 2	Polyester Strapping 16mm, thickness 0,89mm Location of the strapping shown in Figure 1.
Drumpclip type: DC18A RED	Quantity used: 2x

Lashing is assembled with Plastic Strapping Handtool: Strapex STB75.
Pre-tension on strapping: 2100N, Weldingtime level: 4

Parameter	Value
Total mass DUT:	892 kg
Dimensions:	1170x1170x1030mm (LxWxH).
Sample Numbers to be tested:	1

Remark:
The drums are exceeding the base dimensions of the pallet.
The Tenax strapping will be applied just before the execution of the test program.

Identification of sides (according to ISTA 3E) see Figure 2.

Figure 2. Faces of DUT identified.

Reference : IPS 7898 - 80
Page : 5/21

2. Product Damage Tolerance and Package Degradation Allowance

The product will be tested in the prepared configuration. Replacement of components of DUT is not allowed.

Product Damage Allowance:
During horizontal impact tests the drums will impact the ridged wall of the Horizontal Impact Tester. The drums are exceeding the dimensions of the pallet base.
It will we expected that damage to the drums cannot be avoided during the executing of this tests. Damage to the drums caused by this impacts is within the allowance criteria.

Package Degradation Allowance:
During and after the test the integrity of the DUT must be guaranteed.
- All drums are placed on the pallet bottom during and after the execution of the test.
- The forklift truck can interface the pallet during and after the execution of the test.
- The Drumclip is not broken-heavily damaged (validation by Geba Innovations)

Reference : IPS 7898 - 80
Page : 6/21

3. Test plan

The test plan is based on the ISTA 3E -2017 procedure.

According ISTA 3E the test sequence will be executed as stated in the table below.

Performance Test Schedule	*Description*	*Note*
1st	Atmospheric preconditioning	Ambient level
2nd	Shock; horizontal impact	1,2 m/s
3rd	Shock: rotational edge drop	Drop height 150mm
4th	Compression	Apply and release method
5th	Vibration: random	Overall Grms= 0.54
6th	Shock: rotational edge drop	Drop height 150mm

3.1 Atmospheric Conditioning

The sample will be conditioned to ambient laboratory level.

Reference : IPS 7898 - 80
Page : 7/21

3.2 Shock; horizontal impact 1, 2ms

The DUT will be exposed to horizontal impacts in order and under the conditions as stated in the table below.

Sequence No.	*Specific Face*	*Impact Speed*
1	Face 6	1,2 m/s
2	Face 5	1,2 m/s
3	Face 2	1,2 m/s
4	Face 4	1,2 m/s

Horizontal impact testing will be performed with the IPS Technology horizontal impact tester.

Specifications of the horizontal impact tester can be found in Appendix B.

Figure 3.DUT on horizontal impact tester.

Reference : IPS 7898 - 80
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3.3 Shock; 1st Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.
During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.
The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	*Specific edge*	*Drop height*
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm

Figure 4. Set-up Rotational Edge Drop Test

Reference : IPS 7898 - 80
Page : 9/21

3.4 Compression Test; Machine Apply and Release

The DUT will be exposed to a; 'Machine Apply and Release' compression test according to the ISTA 3E test protocol. For the calculation for compression (Apply and Release method) the formula AR = {[Wt x (S-1) +(Wt/L) x (L-1)] x F – (Wt / L) (L-1)} x 1,4 x 9,8 is applicable.

Wt	Total weight of packaged product (Kilograms)	892 Kg	
S	Total number of potential unitized loads in a warehouse stack or a vehicle stack	4	Including the bottom unitized load
L	Total number of layers in the unitized load	1	
F	Compensating factor	3	Typical compensating factor
9,8	Metric conversion factor	9,8	
1,4	Factor to account for time of compression	1,4	
AR	Result of calculation: Test Load for Apply and Release (Newton)	36.793 N	= 3750 Kg

The test will be performed with an additional (empty) pallet on top of the DUT. This will be done in order to simulate the reality of stacking load. Figure is showing the compression test setup.

Figure 5. Test set-up Compression Test

Reference : IPS 7898 - 80
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3.5 Vibration; ISTA Steel Spring Truck Random Vibration

The DUT will be exposed to a vibration test without compressive load, to simulate transport vibrations. The test is performed under 'loose load' conditions. For the test setup see Figure .
The during of 60minutes will be equivalent to a transport of 480km.

Orientation	*Vibration Profile acc.*	*Duration*
Face 3 down (bottom face)	ISTA Steel Spring Truck	60 minutes

Specifications of the vibration test equipment can be found in Appendix C.

The Power Spectral Densities ISTA Steel Spring Truck profile is given in the figure below.

Frequency (Hz)	PSD Level g²/Hz
1.0	0.00072
3.0	0.018
4.0	0.018
6.0	0.00072
12.0	0.00072
15.0	0.0036
25.0	0.0036
30.0	0.00072
40.0	0.0036
60.0	0.0036
100.0	0.00036
200.0	0.000018

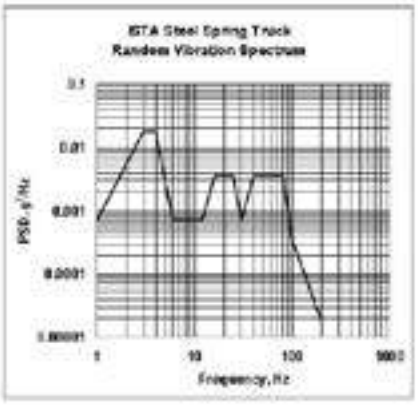

Figure 2. Power Spectral Densities – Steel Spring Truck Random Vibration

Reference : IPS 7898 - 80
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Figure 6. Test setup for vibration test

Reference : IPS 7898 - 80
Page : 12/21

3.6 Shock; 2nd Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.
During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.
The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	*Specific edge*	*Drop height*
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm

Figure 7. Set-up Rotational Edge Drop Test

4. Test Results

The tests are executed according to test plan. In the following chapters the test results can be found per test.

4.1 Atmospheric Conditioning

The DUT has been conditioned to ambient laboratory level.

4.2 Shock; Horizontal I mpact

The horizontal impact test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. The impact speed is measured at 1,2 m/s. See for the speed graph Appendix D.

4.3 Shock; 1 Rotational Edge Dr op

The Rotational Edge Drop Sequence is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence.

4.4 Compre ssion ; Machine Apply and Release

No remarkable event occurred before, during or after the Test Sequence.
A screenshot of the compression test is shown in a graph in Appendix E.

4.5 Vibration; ISTA S teel Spring Truck Random Vibration

The vibration test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. A screenshot of the PSD during the test is shown in Appendix F.

Reference : IPS 7898 - 80
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4.6 Shock; 2nd Rotational Edge Drop

The Rotational Edge Drop Sequence is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence.

5. Inspection after test

After execution of the complete test cycle no remarkable – unexpected damages to the DUT and it components could be found. The expected damage to the drums could be found on only on face 4. The condition of the CP-9 pallet was still in useable condition.

Figure 8. Damage to drums; only face 4.

Examination of the condition by personnel of Geba Innovations B.V.of the Drumclips after the test showed no visible damage or wear.

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6. Conclusions

The test has been executed according to the test plan.
No remarkable-unexpected events and/or damage has occurred before, during or after the test to the DUT.

The Drumclip system in combination with the defined lashing configuration is fully capable to ensure safe individual pallet mechanical pallet handling and warehouse stacking.

Eindhoven, August 20, 2019

Checked and approved by:

Marten Ries
Sr. Project Engineer

Marijn Sijbers
Test Engineer

Reference : IPS 7898 - 80
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Appendix A. ISTA Certified Testing Laboratory

Figure 9. IPS Technology ISTA Laboratory Certification

Reference : IPS 7898 - 80
Page : 17/21

Appendix B. Test Equipment: Impact Tester

Fabrikant
IPS Technology

Oppervlakte
245x250 cm

Max. productmassa
1300 kg

Opspanning
Horizontaal

Botssnelheden
2-10 km/h

Datalogging
Snelheidsmeetsysteem registreert de snelheid bij botsing

Optioneel
Versnellingsmetingen aan het product met een drie-assige versnellingsopnemer

Normen (o.a.):
ASTM D 5487
ISO 2244

Reference : IPS 7898 - 80
Page : 18/21

Appendix C. Test Equipment : Shaker

- Manufacturer : Lansmont model 10000 TTV II
- Max. specimen size : 152 x 152 cm
- Max. specimen weight : 2200 kg
- Max. amplitude (peak to peak) : 6,4 cm
- Frequency-range : 3 - 300 Hz
- Frequency-rang at max. load : 3 - 200 Hz
- Acceleration range : 0 - 8 g
- Max. acceleration at max. load : 2 g
- Automatic displacement or acceleration control
- Automatic sweep generator and random vibration facilities (Lansmont TouchTest Vibration system)
- Accelerometer

Reference : IPS 7898 - 80
Page : 19/21

Appendix D. Impact speed

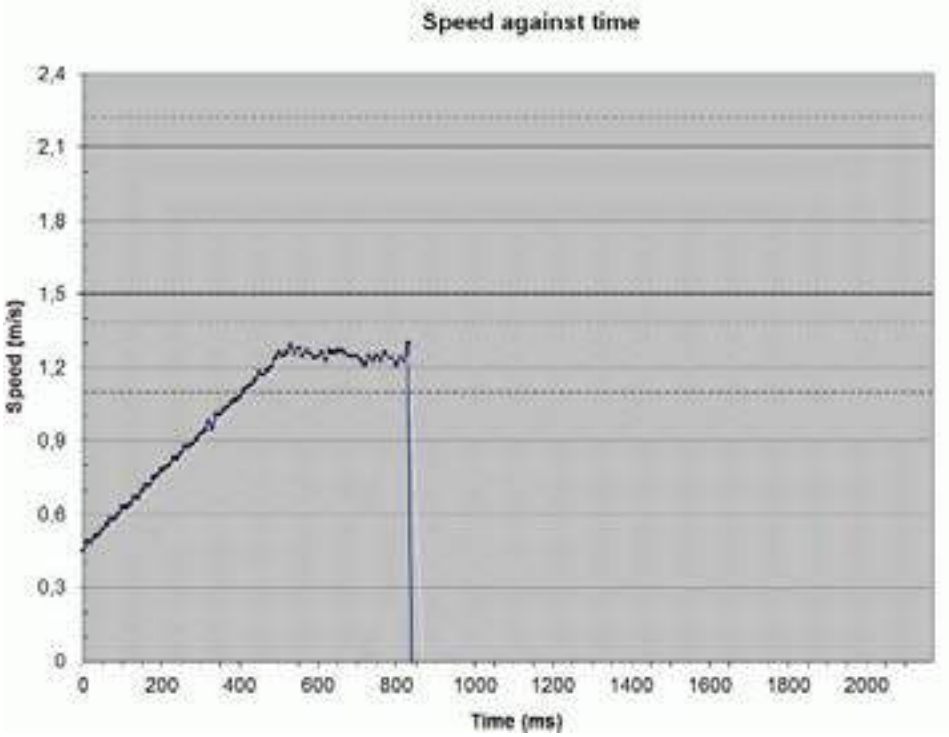

Figure 10. Impact speed >1,2m/s

Reference : IPS 7898 - 80
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Appendix E. Compression test graph

TouchTest Compression

Lansmont

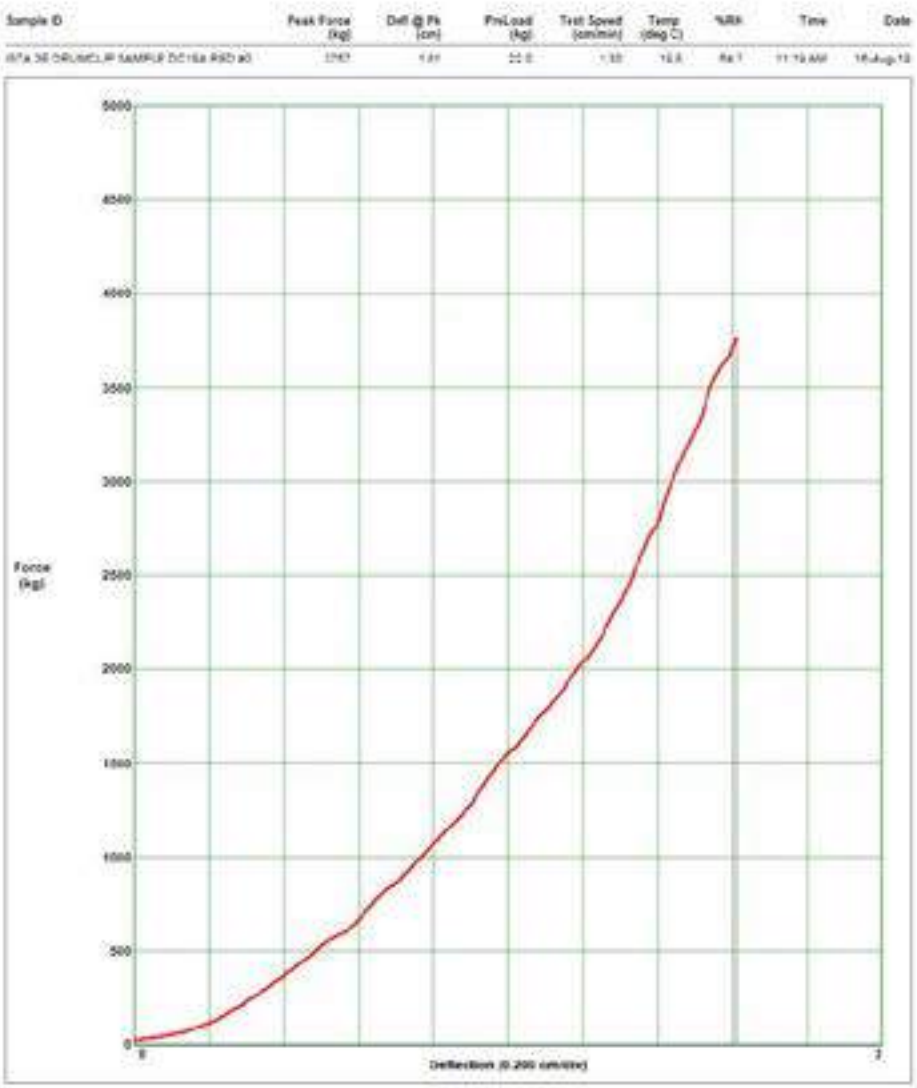

Figure 11. Compression test graph – Apply and release compression test

Reference : IPS 7898 - 80
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Appendix F. Power Spectral Densities Profile

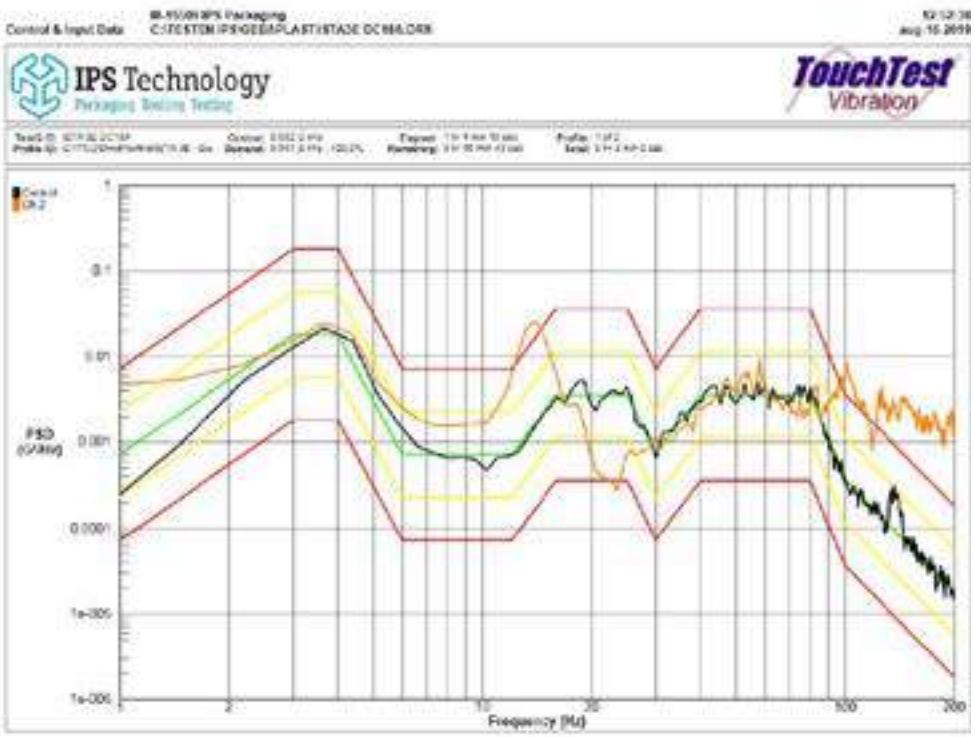


Figure 12. Power Spectral Densities - ISTA Steel Spring Truck Random Vibration; 1 hr 4min.

Figure 13. Location accelerometer Ch2. for response monitoring (examination only)

3.8 Test Report EUMOS | DRUMCLIP DC18A RED

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip Test	Reference TH DC 18 A 2 S2	Revision 01

1. Load unit descriptive data

- *Dimensions (mm):* 1000 X 1150 X 1150
- *Weight (kg):* 850
- *Center of Gravity (mm):* H 590 x L575 x W575
- *Nature of the Products:* tighthead drums
- *Description of Primary Pack:* 4 metal Tighhead drums SIGNODE 2 Straps 2 drumclips DC 18 A red
- *Layer Stacking pattern:* 1 layer of 4 drums
- *Type of Pallet:* CP 9
- *Responsible of the description:* Dhr. Wouter Geldhof

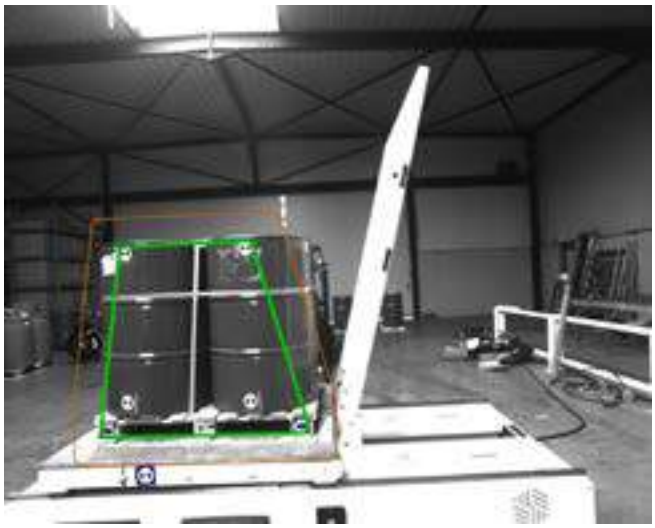
EUMOS 40509 - 4 Tighthead DC18A Signode – page 1

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip Test	Reference TH DC 18 A 2 S2	Revision 01

2. Test related data

2.1. Orientation of the test: Length

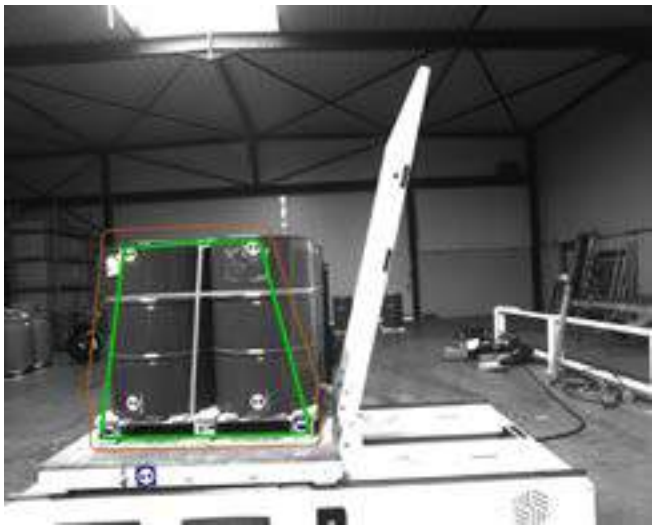
- *Date of Test:* 10/5/2022
- *Place:* Brugge
- *Rigidity (g):* 0.80G
- *Testing History:* non



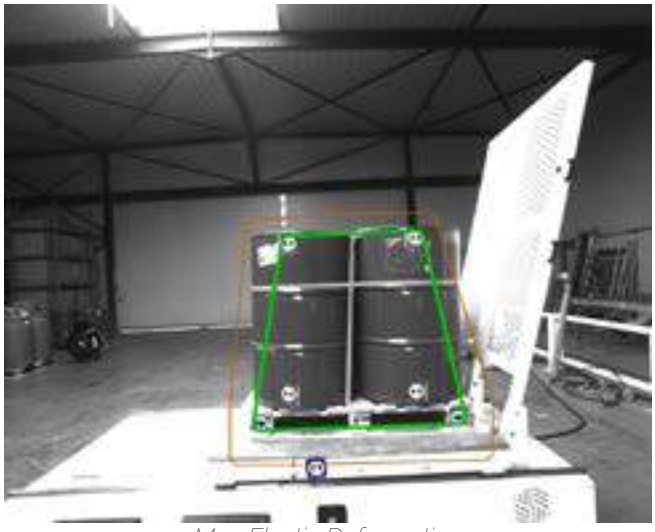
Load Before Test

3. Tight head UN200 litre drum

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip Test	Reference TH DC 18 A 2 S2	Revision 01



Permanent Deformation



Max Elastic Deformation

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip Test	Reference TH DC 18 A 2 S2	Revision 01

3. Test Validation

- *Temperature of the test area:* 22°
- *Humidity of the test area:* 65%
- *Responsible of Report:* Dhr. Geert Frans
- *Sign:*

4. Open head UN200 litre drum

Drums with an open head (UN200 litre drums) can be recognised by an open top edge that can be closed with a loose lid and a sealing ring (see Figure 12). The DRUMCLIP DC19B GREEN has been designed for these drums.

Figure 12: UN200 litre open head drum

4.1 DRUMCLIP DC19B GREEN

DRUMCLIP DC19B GREEN is a plastic tool that should be used for open head UN200 litre drums. The DRUMCLIP DC19B GREEN can also be used for securing Plastic drums (see Chapter 5) to pallets (not for use of plastic drums during transport). Figures 13, 14 and 15 below show the use of DRUMCLIP DC19B GREEN on an open head UN200 litre drum.

Figure 13: DRUMCLIP DC19B GREEN between 2 open head UN200 litre drums

4. Open head UN200 litre drum

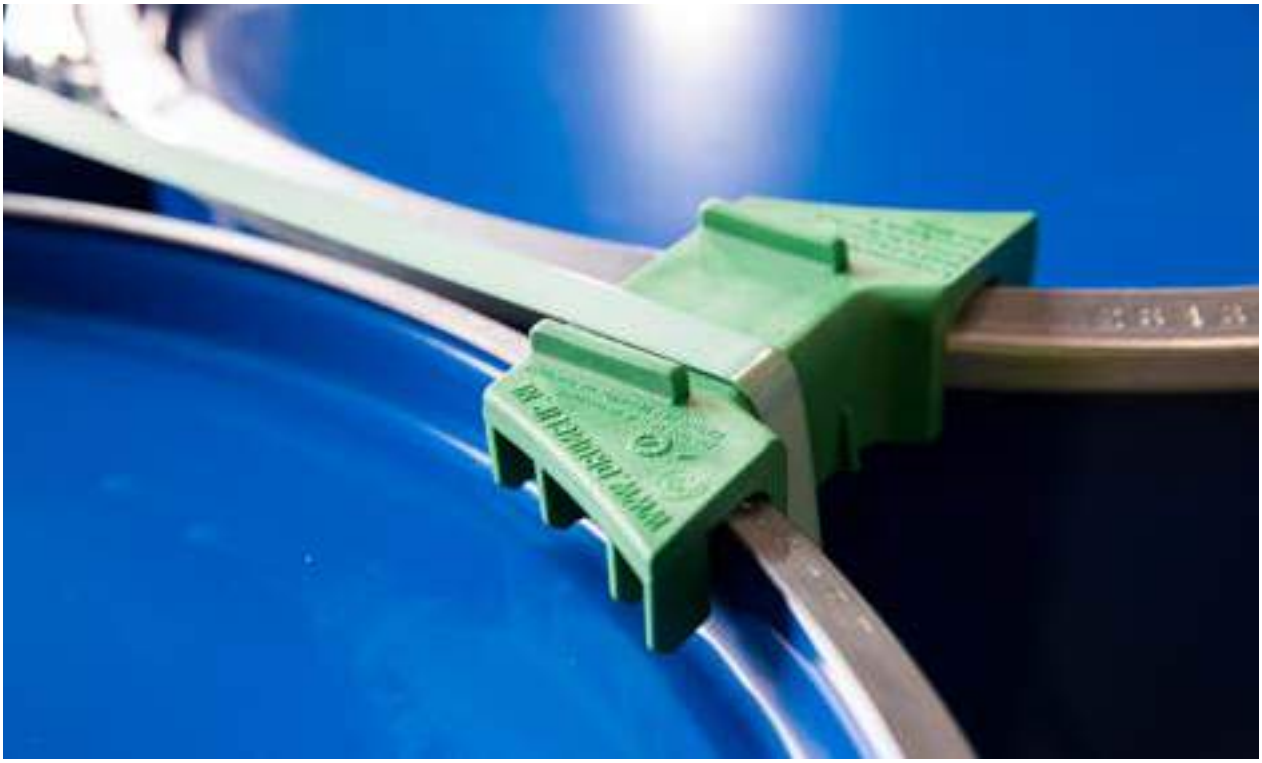


Figure 14: DRUMCLIP DC19B GREEN secured with Signode Tenax T2220 Polyester strap

Figure 15: DRUMCLIP DC19B GREEN secured with universal lashing strap.

4.2 Technical information DRUMCLIP DC19B GREEN

The DRUMCLIP DC19B GREEN is made of a glass-fibre reinforced plastic base material mixed with a green dye. The ambient temperature at which the Drumclip may be used lies between -10°C and + 50°C. The technical specifications are shown in Figures 16a and 16b. Each Drumclip can be recognised by the text:

Geba Innovations BV
Chr. Huygenstraat 3
3261 LR Oud-Beijerland
Produced in The Netherlands
Product: DRUMCLIP B
Art. Nr: DC19B

Each Drumclip has a unique article number that can be found under the text. The Drumclip can be used for a maximum of two years after production. Therefore, there is a production date on every Drumclip. The Drumclip is certified for 2 years after the production date. Once these 2 years have passed, the Drumclip may no longer be used. The date stamp is shown in the following location in Figure 17.

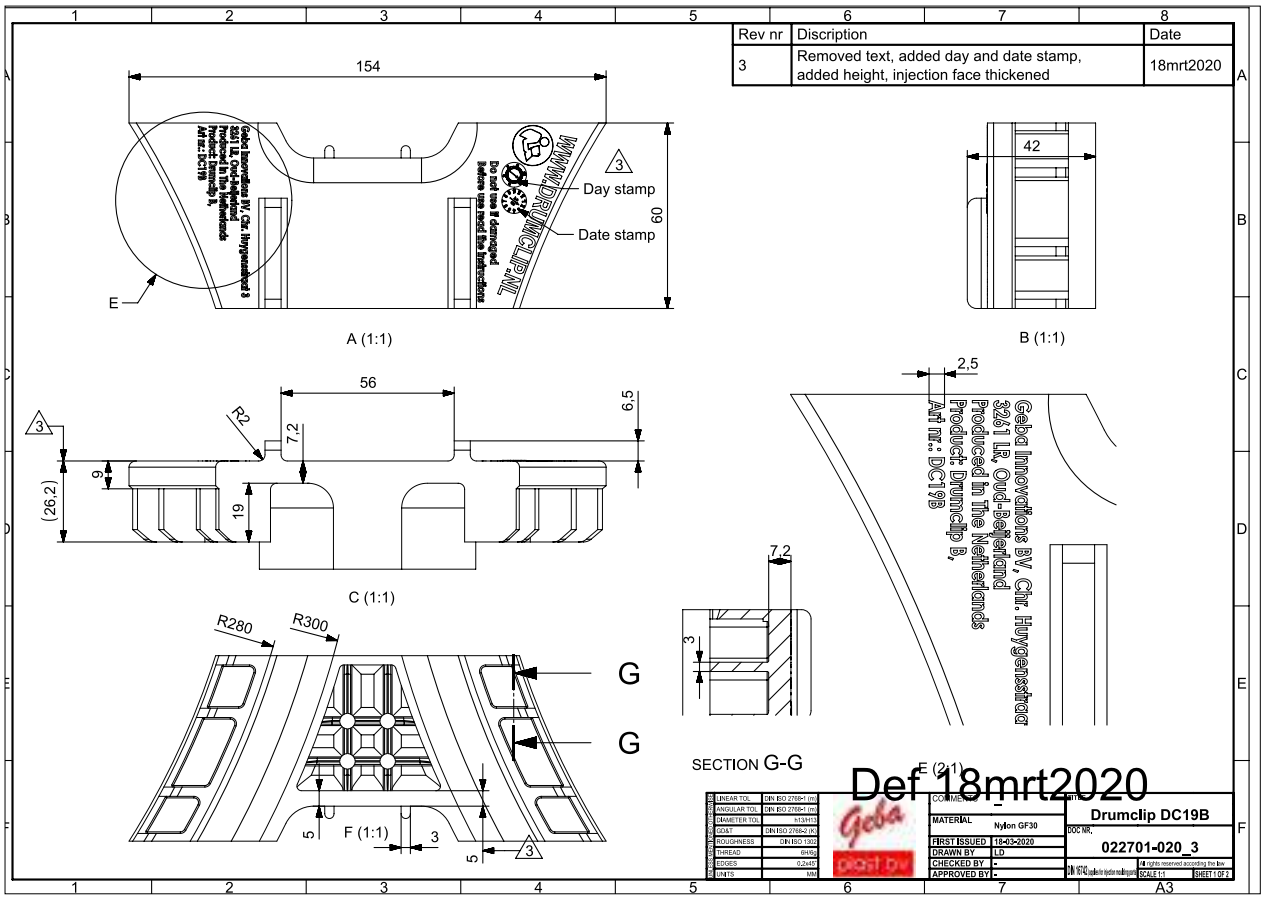


Figure 16a: 2D drawing DRUMCLIP DC19B GREEN

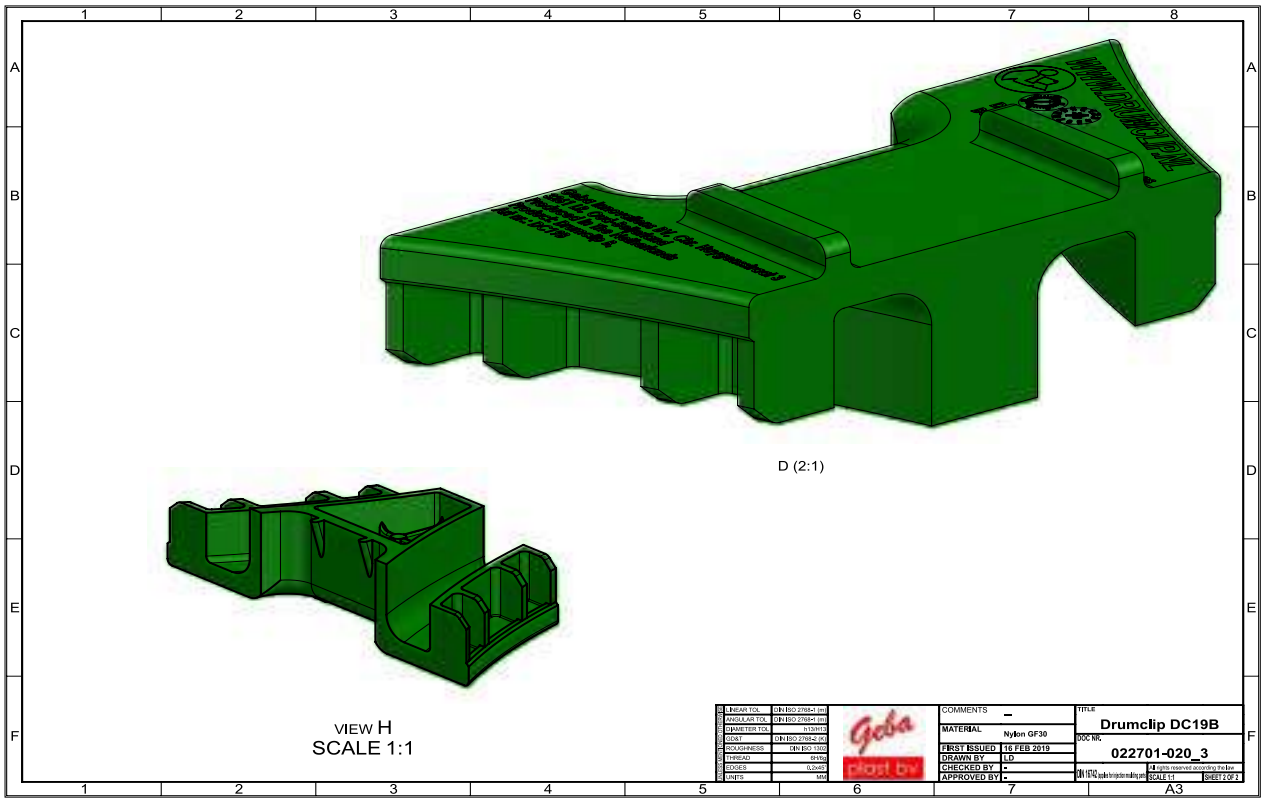


Figure 16b: Isometric view DRUMCLIP DC19B GREEN

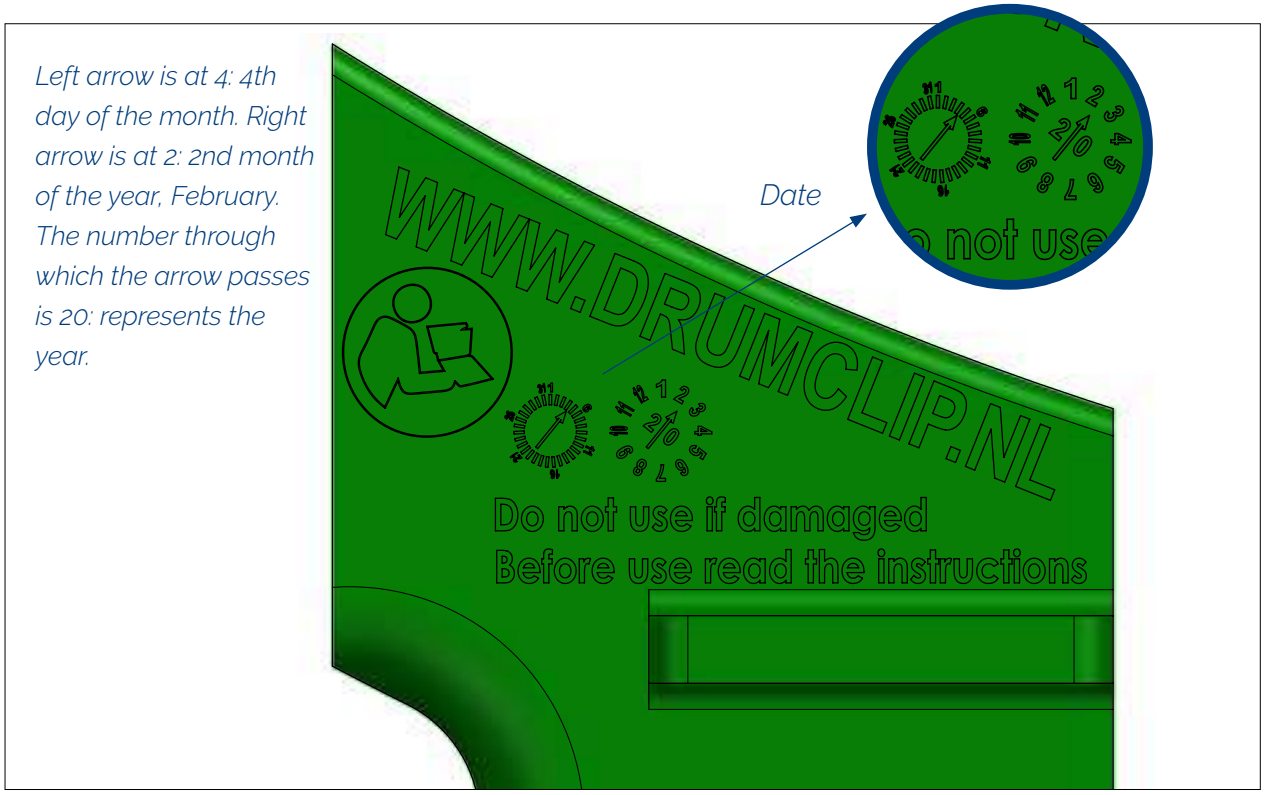


Figure 17: Stamp production date DC19B GREEN

4.3 Certification DRUMCLIP DC19B GREEN

4.3.1 DIN EN 12195-1 | Load securing

The Drumclip has been tested by TÜV Rheinland, in accordance with DIN EN 12642 Annex B for the guidelines according to load securing DIN EN 12195-1. The certificate can be found in Figure 18a, b and c. The complete test report can be found in Section 4.6 Test report TÜV Rheinland | DRUMCLIP DC19B GREEN.

TÜVRheinland®
Genau. Richtig.

Certificate

10TVS9350030-01

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Herewith we certify / *Hiermit bescheinigen wir*

Geba Innovations B.V.
Christiaan Huygensstraat 3
NL-3261 LR Oud-Beijerland

for the utility for securing bung drums and open head drums /
für das Hilfsmittel zur Spundfass- und Deckelfasssicherung

DRUMCLIP (Type: DC19B GREEN)

the effective securing of cargo according to the procedures of DIN EN 12642 annex B and requirements of DIN EN 12195-1 /
die wirksame Ladungssicherung gemäß den Ausführungen der DIN EN 12642 Anhang B und den Anforderungen der DIN EN 12195-1.

The "Drumclip", a support utility for the safe transport of bung drums and open head drums on road vehicles, requires the availability of stable load units (by strapping of the barrels and palette with horizontal and vertical straps), load restraint assembling with web lashings and loading application with anti slip mats. Details can be found in the manufacturer's operating instructions. The manufacturer's instructions must be observed. /
Der „Drumclip", ein Hilfsmittel zur Transportsicherung von Spund- und Deckelfässern auf Straßenfahrzeugen, erfordert das Vorhandensein von stabilen Ladeeinheiten (durch Zurren der Fässer und Palette mit horizontalen und vertikalen Bändern), die Abspannung durch textile Spanngurte und einer Verladung unter Verwendung von Antirutschmatten. Details dazu sind der Bedienungsanleitung des Herstellers zu entnehmen. Die Anweisungen des Herstellers sind zu beachten.

Technologiezentrum Verkehrssicherheit
TÜV Rheinland Kraftfahrt GmbH
Am Grauen Stein, 51105 Köln, Deutschland

Seite 1 von 3 Seiten

Figure 18a

TÜVRheinland®
Genau. Richtig.

Certificate
10TVS9350030-01

TÜVRheinland
TESTED

Cargo
Securing
Equipment

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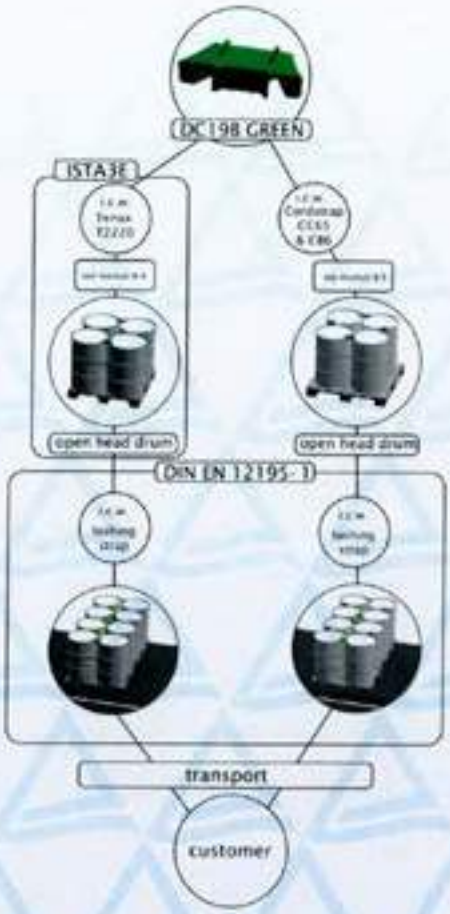
HOW TO USE..



Technologiezentrum Verkehrssicherheit
TÜV Rheinland Kraftfahrt GmbH
Am Grauen Stein, 51105 Köln, Deutschland

Seite 2 von 3 Seiten

Figure 18b

TÜVRheinland®
Genau. Richtig.

Certificate

10TVS9350030-01

TÜVRheinland TESTED

Cargo Securing Equipment

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The product has been tested by TÜV Rheinland Kraftfahrt GmbH for its suitability as a load securing aid. In addition to the basically required driving dynamics tests, tests were also carried out on mechanical safety, ageing resistance, pollutant content and completeness and comprehensibility of the instructions for use.
Furthermore, the manufacture of the product is subject to annual monitoring by TÜV Rheinland LGA Product GmbH /
Das Produkt wurde durch die TÜV Rheinland Kraftfahrt GmbH auf seine Eignung als Ladungssicherungshilfsmittel getestet. Dazu wurden neben den grundsätzlich erforderlichen fahrdynamischen Prüfungen zusätzlich Prüfungen zu mechanischer Sicherheit, Alterungsbeständigkeit, Schadstoffinhalt und Vollständigkeit & Verständlichkeit der Gebrauchsanleitung durchgeführt.
Weiterhin unterliegt die Fertigung des Produktes einer jährlichen Überwachung durch die TÜV Rheinland LGA Produkte GmbH.

The test results are documented in the following reports / *Die Prüfergebnisse sind in folgenden Berichten dokumentiert*: 205XS0164-01 (TRK), 40-2021-02-000563-G001 (FUI TRLP).

This certificate is valid until / *Dieses Zertifikat ist gültig bis*: 18.03.2025

Cologne, March 22nd, 2022 / Köln, 22. März 2022

Uwe Ziegler
Head of Department
EG/ECE FMVSS
Mobility

Thomas Husemann
Head of Department
Vehicle and Component Testing
Mobility

Technologiezentrum Verkehrssicherheit
TÜV Rheinland Kraftfahrt GmbH
Am Grauen Stein, 51105 Köln, Deutschland

Seite 3 von 3 Seiten

Figure 18c

4.3.2. ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safety

The Drumclip is certified is for pallet stability, in accordance with ISTA 3E Pallet Stability and EUMOS 40509 Transport Safe. The Drumclip is DIN EN 12195-1, ISTA 3E Pallet Stability and EUMOS 40509 Transport Safe certified. The complete test reports can be found in Chapter 4.7 Test report ISTA | DRUMCLIP DC19B GREEN and Chapter 4.8 Test report EUMOS | DRUMCLIP DC19B GREEN.

ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe	Signode	(Figure 19)
Item	Description	Specifications
Pallet type	CP-9	Chemicals Pallet,1140x1140x156mm.
Drums	Open head UN200	4 Pieces
Straps	Signode Tenax 2220 Strapping	Polyester | width 19mm, thickness: 0,89mm | 1x horizontal, 1x vertical (2 in total)
Machine setting	Signode BXT3-19	2500 N
Type of Drumclip	DC19B	2 pieces

Figure 19

4.4 Requirements DRUMCLIP DC19B GREEN

The certification DIN EN 12195-1 Load securing, ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe of the DRUMCLIP DC19B GREEN was obtained in combination with Signode supplies. See also Chapter 2 Applications.

4.4.1 Signode

Signode's requirements for meeting the above certifications are:

- Signode Tenax T2220 Polyester straps (Figure 20a)
- Signode BXT3 – 19 strapping machine (Figure 20b)

SIGNODE

Tenax 2220 (19*0,89)

PRODUCT DATA SHEET

This is to certify that the product supplied by us is manufactured according to quality procedures in compliance with ISO 9001, ISO14001, EN 13891 and EN 13394.
Made of 100% of recycled PET

Produced in Netherlands

Product description	Product designation:	Tenax 2220 (19*0,89)
	Item code:	670273
	Material type:	Polyester
	Production technology:	Strand
	Surface:	Flat
	Colour:	Green

Strap properties		Minimum	Nominal	Maximum
	Width (mm):	18.4	19	19.6
	Thickness (mm):	0.84	0.89	0.94
	Elongation (%):	10		15
	Break Strength (daN):	675	750	

Coils details	Coil Type:	standard
	Coil Inside Diameter (mm):	408
	Coil Outside Diameter (mm):	610
	Coil Width (mm):	153
	Net Coil Weight (kg):	24.684
	Meters per coil:	1100

Pallet details	Package Dimensions (LxWxH):	1200 x 1200 x 1100
	Number of Coils per Pallet:	24
	Approx. Gross Weight per Pallet (kg):	646

Date of issue: 19/02/2020

Figure 20a

Technical Data Sheet BXT3-19

SIGNODE
TRANSIT PACKAGING SOLUTIONS

Strapping tool	**BXT3-19**
Operation mode	auto / semi / manual
Tension force range Standard	1300 – 4500N (290 – 1000 lbf)
Soft	400 – 1600 (90 – 340 lbf)
Variable tension speed range	0 – 120 mm/s (4,7 in/s)
Weight (incl. battery)	4,3 kg (9,5 lb)
Dimensions (L x W x H)	370 x 143 x 135 mm 15.5" x 5.6" x 5.3"
Working temperature	-10°C to +40°C (14-104 °F)
Relative humidity	up to 90%
Battery / Charger	
Charger type	Bosch
Battery charger voltage	100 or 110 or 230 V
Charging time	25-35 min.
Battery type	Bosch Li-ion 18V, 4.0 Ah
Cycles per battery charge	
- Low tension	800
- Medium tension	500
- High tension	300
Strap	
Strap	PET (Polyester) PP (Polypropylene)
Width	15-16, 18-19 mm (5/8", 3/4")
Thickness	0,8-1,3 mm (.031"-0.51")
Features	
Real time indication of applied tension force	√
Variable tension speed	√
Favorite strapping function	√
Display color indication for tool status information	√
Strap alignment indication	√
Strap dust blow out vent	√
Battery protection	√
0-Tension welding	√

Figure 20b

4.5 Operating Instructions DRUMCLIP DC19B GREEN

Main steps to be taken before using the Drumclip.

- Check the Drumclip for any damages.
- Check the production date on the upper side of the Drumclip. The Drumclip must not be used for more than 2 years after the production date.
- The Drumclip may be cleaned with water and soap.
- If the Drumclip has been in contact with chemicals, it may no longer be used.
- The Drumclip may only be used on trucks with a gross weight of 3,500 kg or more.
- Drumclips must be stored in dry, moderately heated conditions and protected from sunlight and mechanical damage.
- The Drumclip may not be dried or stored near fire or in places with elevated temperatures.
- The maximum temperature at which the Drumclip can be used is -10C Degrees Celsius + 50 Degrees Celsius.

The operation instructions must always be followed.

DRUM CLIP

Operating Instructions DC19B GREEN
for open head drums in combination with Signode

Operating Instructions DRUMCLIP DC19B GREEN
In combination with two Signode Tennax T2220 (19x0.89mm) straps.

The DRUMCLIP DC19B GREEN is an innovative tool that makes it **safer** and **easier** to secure 200-litre open head drums to a pallet and/or trailer, without the use of additional pallets or other equipment. The DC19B has been tested with a 0.8g brake delay in combination with a strap (Signode Tenax 2220). This solution is DIN EN 12195-1, ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe certified. This combination can be used for transport and pallet stabilisation of UN 200 litre open head drums on pallets.

Important information
- Check the Drumclip before use. A damaged Drumclip may not be used again.
- Check the production date on the upperside of the Drumclip. The Drumclip must not be used for longer than 2 years after the production date.
- The Drumclip can be cleaned with water and soap.
- If the Drumclip has been in contact with chemicals, it may no longer be used.
- The Drumclip may only be used on trucks of 3.500 kg or more.
- Drumclips must be kept in dry, moderately heated conditions and protected from sunlight and mechanical damage.
- The Drumclip may not be dried or stored near fire or in places with elevated temperatures.

Step 1
Place four drums on a wooden pallet.
Place two Drumclips opposite each other between two drums with the wide side facing outwards. Use two Signode Tenax T2220 straps. One strap is stretched horizontally in the middle of the drums. The other strap is stretched vertically across the two Drumclips and under the pallet. Both straps should be tensioned with a force of 2500 N. Do this with each pallet of drums to be transported.

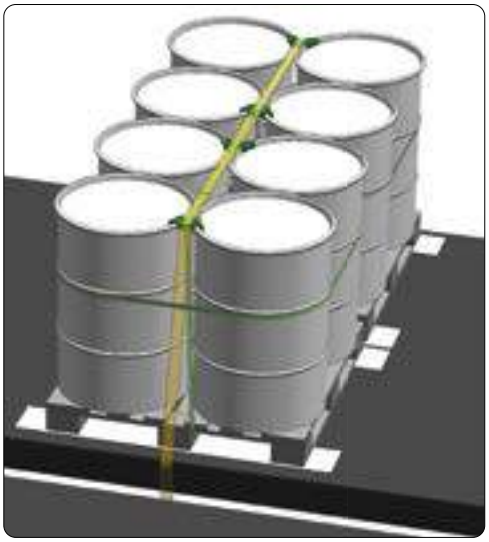
Figure 21 - Page 1

DRUM CLIP

Operating Instructions DC19B GREEN
for open head drums in combination with Signode

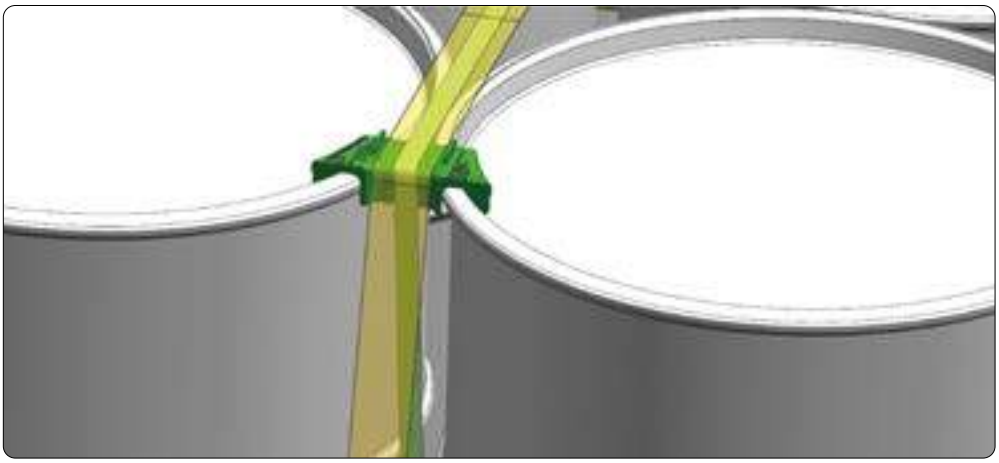
Step 2

Place the pallets of drums (with a forklift truck) on the trailer (in single or double rows) in such a way that the Drumclips are visible at the side of the trailer (the tension strap will be put on these later). Place the pallets on anti-slip mats that have a minimum friction resistance of 0.6u.



Step 3

Use a lashing strap with a minimum StF value of 350 DaN for a double row of drums. In this way, drums can be secured as shown in the illustration. Consult the guidelines for the lashing strap here.
Place the strap across the drums and the Drumclips, so that the strap is between the strap guides of the Drumclips.
Make sure the strap is not twisted.
The strap should be placed on both sides of the vehicle under the horizontal strap that goes around the drums.



Step 4

Then attach the strap hooks to the anchor points on the vehicle. Use an ergo ratchet and a strap (50mm LC=2,500 daN) to secure the drum pallets to the vehicle.
Lead the strap into the ergo ratchet and hand-tension with a force of SHF daN (50 kilograms).
The strap should be at a 90-degree angle to the direction of travel and attached to the vehicle in line with the Drumclips.

Figure 21 - Page 2

4.6 Test Report TÜV Rheinland | DRUMCLIP DC19B GREEN

TÜV Rheinland Group

Technischer Bericht: 205XS0164-00
/ Technical Report

Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Technischer Bericht: 205XS0164-00
/ Technical Report

„Beurteilung der Eignung eines Ladungssicherungskonzepts für den Transport von Stahlfässern – fahrdynamische Untersuchungen“
/ Assessment of the suitability of a load securing concept for the transport of steel drums - vehicle dynamics investigations

September / *September* **2020**

Auftraggeber / *Client*:
Fa. InVaGo BVBA,
NL-3261 PB Oud Beijerland

Bearbeitung / *Handling*:
TÜV Rheinland Kraftfahrt GmbH
Technologiezentrum
Verkehrssicherheit (TVS)
Typprüfstelle Fahrzeuge/Fahrzeugteile
Am Grauen Stein
51105 Köln

Dieser Technische Bericht dient ausschließlich der Dokumentation von Prüfergebnissen
/ This technical report is intended exclusively for the documentation of test results.

TÜV Rheinland Group

Technischer Bericht: 205XS0164-00
/ *Technical Report*

Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

1. Allgemeine Angaben / *General information*

1.1.	Technischer Bericht / *Technical report*	: 205XS0164-00
1.2.	Bauteil / *Component*	: Drumclip
1.3.	Typ / *Type*	: DC19B GREEN
1.4.	Prüfgrundlage / *Test basis*	: in Anlehnung an DIN EN 12195-1 (Stand: 11/2010) Beurteilung der Eignung eines Beladungssicherungs-konzepts für den Transport von Stahlfässern – fahrdynamische Untersuchung / *following DIN EN 12195-1 (2010-11) Assessment of the suitability of a load securing concept for the transport of steel drums - a vehicle dynamics study*
1.5.	Auftraggeber / *Client*	: InVaGo BV Poortlaan 6 NL-3261 PB Oud Beijerland
1.6.	Prüflabor / *Testing laboratory*	: TÜV Rheinland Kraftfahrt GmbH Technologiezentrum Verkehrssicherheit Typprüfstelle Fahrzeuge/Fahrzeugteile Am Grauen Stein D - 51105 Köln
1.7.	Antrag vom / *Application from*	: Juni 2020
1.8.	Prüfmuster eingegangen am / *Test sample received on*	: entfällt / *not applicable*
1.9.	Art der Prüfmuster / *Type of test sample*	: Drumclip, Typ DC19B GREEN
1.10.	Kennzeichnung / *Marking*	: www.drumclip.nl
1.11.	Prüfdatum / *Test date*	: 13. Juni 2020, Rotterdam
1.12.	Prüfort / *Test location*	: C. Steinweg-Handelsveem BV Theemsweg 26 NL-3197 KM Botlek Rotterdam Haven 5111

TÜV Rheinland Group

Technischer Bericht: 205XS0164-00
/ Technical Report

Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

2. Prüfungen / *Tests*

2.1. Allgemeines / *General information*

Auf Wunsch des Auftraggebers wurde eine weitere Ausführung der Fasssicherung Drumclip des Typs DC19B GREEN im Fahrversuch auf ihre Eignung als Hilfsmittel zur Ladungssicherung untersucht. Folgend ist ein Drumclip des Typs DC19B GREEN dargestellt /
At the customer's request a further type of drum securing device Drumclip type DC19B GREEN was tested in a driving test to determine its suitability as a load securing aid. In the following a Drumclip type DC19B GREEN is shown.

Drumclip DC19B GREEN (verschiedene Ansichten) / *Drumclip DC19B GREEN (different views)*

2.1.1. Anforderungen an die einzusetzenden Ladungssicherungsmittel / *Requirements for the load securing equipment to be used*

Für die Prüfungen wurden Spundfässer mit der UN Zulassung 1A1/X1.6/250 mit einem Fassungsvermögen von ca. 216 l und Stahl-Deckelfässer mit den UN Zulassungen 1A2/Y1.5/150 für Flüssigstoffe sowie 1A2/X420/S für Feststoffe mit einem Fassungsvermögen von ca. 212 l verwendet. Jeweils vier gleiche Fässer wurden auf einer Holzpalette 1.200 x 1.200 mm² abgestellt. Die Fässer wurden entweder maschinell mit Straps (Spannkraft jeweils 2.500 N) oder händisch mit Cordstrap® (Spannkraft jeweils 2.000 N) umspannt. Die Umspannung erfolgte horizontal und vertikal. Durch die vertikale Umspannung wurden Ladeeinheiten aus Fässern und Palette gebildet. Die Fässer der Ladeeinheit wurden mit Drumclips des Typs DC19B GREEN verbunden, um die vertikalen Umspannungen zu ermöglichen. Die Spezifikation des Straps sowie des Umreifungsgerätes sind Anlage 1 und die Spezifikationen des Cordstrap®, des Cordstrap-Verschlusses und des Spanngeräts sind Anlage 2 zu entnehmen. Folgend ist eine Ladeeinheit aus Fässern und Palette mit Drumclips auf den äußeren Fässern für die vertikale Umspannung dargestellt */ For the tests, bung drums with UN approval 1A1/X1.6/250 with a capacity of approx. 216 l and steel lid drums with UN approvals 1A2/Y1.5/150 for liquids and 1A2/X420/S for solids with a capacity of approx. 212 l were used. Four identical drums each were placed on a wooden pallet 1,200 x 1,200 mm². The drums were either mechanically strapped with straps (tension force 2,500 N each) or manually with Cordstrap® (tension force 2,000 N each). The strapping was applied horizontally and vertically. The vertical strapping formed load units of drums and pallet. The drums of the load unit were connected with Drumclips type DC19B GREEN to enable the vertical strapping to be applied. The specification the specifications of strap and strapping tool can be found in Annex 1 and the specifications of the Cordstrap®, the cordstrap fastener and the tensioner in Annex 2. In the following a load unit of drums and pallet with Drumclips on the outermost drums for the vertical strapping is shown.*

TÜV Rheinland Group

Technischer Bericht: 205XS0164-00
/ Technical Report

Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Ladeeinheit mit Drumclips außen auf den Fässern /
Load unit with Drumclips on the outer side of the drums

Die Fässer waren gleichmäßig mit Wasser befüllt. Das Gesamtgewicht je Ladeeinheit mit Spundfässern betrug 800 kg und je Ladeeinheit mit Stahl-Deckelfässer 624 kg. Zwischen Trailerboden und Palette wurde Antirutschmaterial (μ ≥ 0,6) eingesetzt. Zwei nebeneinander positionierte Ladeeinheiten mit denselben Fässern wurden mit einer Ratsche (STF = 500 daN) und einem Spanngurt (LC = 2.500 daN) niedergezurrt. Der Spanngurt verlief mittig über die äußeren beiden Drumclips der Ladereihe, senkrecht nach unten und unterhalb der horizontalen Straps oder Cordstrap®
/ The drums were evenly filled with water. The total weight per loading unit with bung drums was 800 kg and per loading unit with open head drums 624 kg. Anti-slip material (μ ≥ 0.6) was used between the trailer floor and the pallet. Two load units positioned next to each other with the same drums were lashed down with a ratchet (STF = 500 daN) and a tension belt (LC = 2,500 daN).The lashing belt ran centrally over the outer Drumclips of the loading row and vertically downwards behind the horizontal straps or Cordstrap®*.*

2.1.2. Beladungen / *Loads*

Insgesamt wurden 3 verschiedene Sicherungsvarianten untersucht, die nachfolgend beschrieben sind / *A total of 3 different securing variants were tested, which are described in the following.*

Variante 1 / *Variant 1:*

- 4 Spundfässer, maschinell mit einem horizontalen und einem vertikalen Strap umspannt (Spannkraft jeweils 2.500 N), auf einer Palette. Durch den vertikalen Strap bilden die Fässer und die Palette eine Ladeeinheit */ 4 bung drums, mechanically strapped with a horizontal and a vertical strap (tension force 2,500 N each), on a pallet. Due to the vertical strap, the drums and the pallet form one load unit.*
- die jeweils äußeren beiden Fässer einer Ladeeinheit sind durch einen Drumclip verbunden (zwei Drumclips pro Ladeeinheit - diese sind notwendig, um den vertikalen Strap um die Ladeeinheit zu spannen) */ The two outermost drums of each load unit are connected by a Drumclip (two drum clips per load unit - these are necessary to tighten the vertical strap around the load unit).*
- 2 Ladeeinheiten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander */ 2 load units with anti-slip material beneath (μ ≥ 0.6) side by side.*
- die Fassreihe wurde mit einer Ratsche (STF = 500 daN) und einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief mittig über die äußeren Drumclips und hinter

dem horizontalen Strap (kontaktlos) vertikal nach unten / *The row of drums was lashed down with a ratchet (STF = 500 daN) and a lashing belt (Lc = 2,500 daN), the belt ran centrally over the outer Drumclips and vertically downwards behind the horizontal strap (contactless).*

Horizontaler und vertikaler Strap, Spanngurt hinter dem horizontalen Strap / *Horizontal and vertical strap, lashing belt behind the horizontal strap*

Spanngurt mittig auf äußeren Drumclip, Spanngurt hinter dem horizontalen Strap / *Lashing belt centered on outer drum clip, lashing belt behind the horizontal strap*

Zwei Drumclips pro Ladeeinheit / *Two Drumclips per load unit*

Detailansicht zwei Drumclips pro Ladeeinheit / *Detailed view of two Drumclips per load unit*

Variante 2 / *Variant 2:*

- 4 Stahl-Deckelfässer, maschinell mit einem horizontalen und einem vertikalen Strap umspannt (Spannkraft jeweils 2.500 N), auf einer Palette. Durch den vertikalen Strap bilden die Fässer und die Palette eine Ladeeinheit */ 4 open head drums, mechanically strapped with a horizontal and a vertical strap (tension force 2,500 N each), on a pallet. Due to the vertical strap, the drums and the pallet form one load unit.*
- die jeweils äußeren beiden Fässer einer Ladeeinheit sind durch einen Drumclip verbunden (zwei Drumclips pro Ladeeinheit - diese sind notwendig, um den vertikalen Strap um die Ladeeinheit zu spannen) */ The two outermost drums of each load unit are connected by a Drumclip (two drum clips per load unit - these are necessary to tighten the vertical strap around the load unit).*
- 2 Ladeeinheiten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander */ 2 load units with anti-slip material beneath (μ ≥ 0.6) side by side.*
- die Fassreihe wurde mit einer Ratsche (STF = 500 daN) und einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief mittig über die äußeren Drumclips und hinter dem horizontalen Strap (kontaktlos) vertikal nach unten */ The row of drums was lashed down with a ratchet (STF = 500 daN) and a lashing belt (Lc = 2,500 daN), the belt ran centrally over the outer Drumclips and vertically downwards behind the horizontal strap (contactless).*

TÜV Rheinland Group

Technischer Bericht: 205XS0164-00
/ Technical Report

Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Horizontaler und vertikaler Strap, Spanngurt hinter dem horizontalen Strap / *Horizontal and vertical strap, lashing belt behind the horizontal strap*

Zwei Drumclips pro Ladeeinheit / *Two Drumclips per load unit*

Variante 3 / *Variant 3*:

- 4 Stahl-Deckelfässer, händisch mit einem horizontalen und zwei vertikalen Cordstrap® umspannt (Spannkraft jeweils 2.000 N), auf einer Palette. Durch die vertikalen Cordstrap® bilden die Fässer und die Palette eine Ladeeinheit / *4 open head drums, manually strapped with a horizontal and two vertical Cordstrap® (tension force 2,000 N each), on a pallet. Due to the vertical cordsstraps, the drums and the pallet form one load unit.*
- die jeweils äußeren beiden Fässer einer Ladeeinheit sind durch einen Drumclip verbunden (vier Drumclips pro Ladeeinheit - diese sind notwendig, um die beiden vertikalen Cordstrap® um die Ladeeinheit zu spannen) / *The two outermost drums of each load unit are connected by a Drumclip (four drum clips per load unit - these are necessary to tighten the two vertical Cordstrap® around the load unit).*
- Der Cordstrap-Verschluss darf die anderen Cordstrap®, den Spanngurt und die Fässer nicht berühren und muss dementsprechend positioniert werden (um Beschädigungen zu vermeiden) / *The cordstrap fastener is not to contact the other Cordstrap®, the lashing belt and the drums and must be positioned accordingly (to prevent damage).*
- 2 Ladeeinheiten mit unterlegtem Antirutschmaterial (μ ≥ 0,6) nebeneinander / *2 load units with anti-slip material beneath (μ ≥ 0.6) side by side.*
- die Fassreihe wurde mit einer Ratsche (STF = 500 daN) und einem Spanngurt (LC = 2.500 daN) niedergezurrt, der Gurt verlief mittig über die äußeren Drumclips und hinter dem horizontalen Cordstrap® (kontaktlos) vertikal nach unten / *The row of drums was lashed down with a ratchet (STF = 500 daN) and a lashing belt (Lc = 2,500 daN), the belt ran centrally over the outer Drumclips and vertically downwards behind the horizontal Cordstrap® (contactless).*

TÜV Rheinland Group

Technischer Bericht: 205XS0164-00
/ Technical Report

Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Horizontaler und vertikaler Cordstrap®, Spanngurt hinter dem horizontalen Cordstrap® / *Horizontal and vertical* Cordstrap®, *lashing belt behind the horizontal* Cordstrap®

Vier Drumclips pro Ladeeinheit / *Four Drumclips per load unit*

Cordstrap-Verschlüsse kontaktlos positioniert / *Cordstrap fasteners positioned without contact*

2.1.3. Prüfkräfte / *Test forces*

Als Prüfgrundlage wurde die DIN EN 12195-1 „Berechnung von Sicherungskräften“ herangezogen. In Kapitel 4.2 der Norm sind als Beschleunigungsbeiwerte für nicht kippgefährdete Transportmittel für Fahrzeuge ab 3.500 kg die folgenden Werte zu finden /
DIN EN 12195-1 "Calculation of securing forces" was used as the test basis. In Chapter 4.2 of the standard, the following values can be found as acceleration coefficients for non-tilt-endangered means of transport for vehicles from 3,500 kg upwards:

Sichern in *Securing for*	Beschleunigungsbeiwerte / *Acceleration coefficients*			
	a_x		a_y	a_z
	Nach vorne *To the front*	Nach hinten *To the rear*	Nur Rutschen *Sliding only*	Nach unten *Downwards*
Längsrichtung *Longitudinal direction*	0,8	0,5	./.	./.
Querrichtung *Transverse direction*	./.	./.	0,5	./.
Vertikal	./.	./.	./.	1,0

TÜV Rheinland Group

Technischer Bericht: 205XS0164-00
/ Technical Report

Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Übersicht zu den Beschleunigungsbeiwerten / *Overview of the acceleration coefficients*

Diese europäische Norm gilt nicht für Fahrzeuge mit einem Gesamtgewicht bis einschließlich 3.500 kg, da bei diesen höhere Beschleunigungen auftreten können /
This European standard does not apply to vehicles with a total weight of up to and including 3,500 kg, as these vehicles may have higher accelerations.

2.1.4. Messinstrumente / *Measuring instruments*

Die Beschleunigungs- und die Verzögerungswerte wurden unabhängig voneinander durch zwei verschieden Messeinrichtungen des TÜV Rheinland Kraftfahrt GmbH (TRK) gemessen. Die eine Messeinrichtung umfasst zwei Beschleunigungssensoren, einen Universalverstärker und die Software Catman. Die andere Messeinrichtung umfasst eine VBOX 3i mit einem dazugehörigen Beschleunigungssensor. Folgend sind die Positionen der Beschleunigungssensoren dargestellt / *The acceleration and deceleration values were measured independantly by two different measuring devices of TÜV Rheinland Kraftfahrt GmbH (TRK). The one measuring device comprises two acceleration sensors, a universal amplifier and the Catman software. The other measuring device comprises a VBOX 3i with an associated acceleration sensor. In the following the positions of the accelerometers are shown*

Positionen der Beschleunigungssensoren / *Positions of the acceleration sensors*:

2.2. Prüfergebnisse / *Test results*

Im Folgenden sind die einzelnen Ergebnisse und Auffälligkeiten der Versuche dargestellt. Weitere Bilder sowie Filme zu den einzelnen Versuchen sind in Anlage 4 (USB-Datenträger) zu finden /
The individual results and peculiarities of the tests are presented below. Further pictures and films of the individual tests can be found in Appendix 4 (USB-stick).

2.2.1. Fahrversuch Bremsen / *Driving test braking*

Versuch 1 / *Test 1:*

Das Fahrzeug war mit Variante 3 (Stahl-Deckelfässer) und 1 (Spundfässer) beladen. Es war geplant, das Fahrzeug aus einer Geschwindigkeit von ca. 40 km/h mit maximaler Verzögerung bis zum Stillstand abzubremsen. Es konnte keine Längsverzögerung von ≥ 0,8°g über eine Zeitspanne von ≥ 80 ms erreicht werden.

Deshalb war eine Beurteilung anhand des Versuches nicht möglich /
The vehicle was loaded with variant 3 (open head drums) and 1 (bung drums). It was planned to brake the vehicle from a speed of approx. 40 km/h with maximum deceleration to a standstill. No longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms could be achieved.
Therefore, an assessment based on the test was not possible.

Versuch 2 / *Test 2:*

Das Fahrzeug war mit Variante 2, 3 (jeweils Stahl-Deckelfässer) und 1 (Spundfässer) beladen. Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Es wurde keine Verschiebung der Beladung festgestellt. Die Positionen der Drumclips, Straps, Cordstrap® und der Spanngurte wiesen keine Veränderung auf /
The vehicle was loaded with variant 2, 3 (each open head drums) and 1 (bung drums). A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms was achieved.
No shift of the load was detected. The positions of the Drumclips, straps, Cordstrap® and the lashing belt were not changed.

Versuch 3 / *Test 3:*

Das Fahrzeug war mit Variante 2, 3 (jeweils Stahl-Deckelfässer) und 1 (Spundfässer) beladen. Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Es wurde keine Verschiebung der Beladung festgestellt. Die Positionen der Drumclips, Straps, Cordstrap® und der Spanngurte wiesen keine Veränderung auf /
The vehicle was loaded with variant 2, 3 (each open head drums) and 1 (bung drums). A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms was achieved.
No shift of the load was detected. The positions of the Drumclips, straps, Cordstrap® and the lashing belt were not changed.

Versuch 4 / *Test 4:*

Das Fahrzeug war mit Variante 2, 3 (jeweils Stahl-Deckelfässer) und 1 (Spundfässer) beladen. Es konnte eine Längsverzögerung von ≥ 0,8 g über eine Zeitspanne von ≥ 80 ms erreicht werden.
Es wurde keine Verschiebung der Beladung festgestellt. Die Positionen der Drumclips, Straps, Cordstrap® und der Spanngurte wiesen keine Veränderung auf /
The vehicle was loaded with variant 2, 3 (each open head drums) and 1 (bung drums). A longitudinal deceleration of ≥ 0.8 g over a period of ≥ 80 ms was achieved.
No shift of the load was detected. The positions of the Drumclips, straps, Cordstrap® and the lashing belt were not changed.

2.2.2. Fahrversuch Kreisfahrt / *Driving test circular drive*

Bei Kreisfahrten sind die Belastungen auf den Drumclip vergleichbar mit denen des Drumclips DC18A RED (siehe Bericht 195XS0017-03). Die Beladung verhielt sich bei den Kreisfahrten des Drumclips DC18A RED vollkommen neutral. Deshalb konnte von weiteren Kreisfahrten abgesehen werden / *In circular driving tests the loads on the Drumclip are comparable to those on the DC18A RED Drumclip (see report 195XS0017-03). The load on the Drumclip DC18A RED was completely neutral during the circular driving test of the Drumclip DC18A RED. Therefore it was possible to do without further circular driving test.*

TÜV Rheinland Group

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Nachfolgend sind die im Fahrversuch gemessenen Werte zusammengefasst dargestellt:

Fahrmanöver	Sicherungs-varianten	v ≥ 40 km/h	$t_{a\geq 0,8g}$ ≥ 80 ms [Ja / Nein] (TÜV)	Ergebnis	Bemerkung
Versuch 1 Bremsung	1 3	erfüllt	nicht erfüllt	keine Wertung	$t_{a\geq 0,8g}$ zu kurz
Versuch 2 Bremsung	1 2 3	erfüllt	erfüllt	positiv	./.
Versuch 3 Bremsung	1 2 3	erfüllt	erfüllt	positiv	Ein Peak unterhalb 0,8 g
Versuch 4 Bremsung	1 2 3	erfüllt	erfüllt	positiv	Ein Peak unterhalb 0,8 g

Übersicht der Fahrdynamischen Anforderungen und Ergebnisse

The values measured in the driving test are summarized below.

Driving manoeuvres	*Variants of securing*	*v ≥ 40 km/h*	$t_{a\geq 0,8g}$ ≥ 80 ms *[Yes / No] (TÜV)*	*Result*	*Remark*
Test 1 Breaking	*1* *3*	*pass*	*not passed*	*No assessment*	$t_{a\geq 0,8g}$ *too short*
Test 2 Breaking	*1* *2* *3*	*pass*	*passed*	*positiv*	*./.*
Test 3 Breaking	*1* *2* *3*	*pass*	*passed*	*positiv*	*One peak below 0.8 g*
Test 4 Breaking	1 2 3	*pass*	*passed*	*positiv*	*One peak below 0.8 g*

Overview of the driving dynamics requirements and results

TÜV Rheinland Group

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Auftraggeber / *Client* **: InVaGo BVBA**

3. Anlagen / *annexes*

Anlage / *annex* 0: Änderungen, 1 Seite
Alterations, 1 page

Anlage / *annex* 1: Spezifikation: Strap und Umreifungsmaschine, 2 Seiten /
Specification: Strap and strapping machin, 2 pages

Anlage / *annex* 2: Spezifikation: Cordstrap®, Cordstrap-Verschluss und Spanngerät, 2 Seiten
Specifikation: Cordstrap®, cordstrap fastener and tensioner, 2 pages

Anlage / *annex* 3: Technische Zeichnung (Drumclip, Typ DC19B GREEN), 2 Seiten
Technical drawing (Drumclip, type DC19B GREEN), 2 pages

Anlage / *annex* 4: USB-Stick (Fotos, Filme, Messwerte, Technischer Bericht), 1 Seite /
USB-stick (photos, films, measurements, Technical Report), 1 page

TÜV Rheinland Group

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Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

4. Zusammenfassung / *Summary*

Auf Wunsch des Auftraggebers wurde eine neue Ausführung DC19B GREEN der Fasssicherung „Drumclip“ in verschiedenen Versuchsreihen auf ihre Eignung zur Ladungssicherung untersucht.

Diese Art der Sicherung erforderte für **Spundfässer** das Vorhandensein von:

- stabilen Ladeeinheiten
  - durch maschinelles Umspannen der Spundfässer mit einem horizontalen und einem vertikalen Strap (Spannkraft jeweils 2.500 N), um eine Einbeziehung der Palette in die Ladeeinheit zu gewähr-leisten, die Spezifikationen des Straps und des Umreifungsgerätes sind Anlage 1 zu entnehmen,
    Hinweis: wegen des vertikalen Straps sind zwei Fasssicherungen pro Ladeeinheit zu verwenden!
- einer Verladung unter Verwendung von Antirutschmatten (μ ≥ 0,6),
- jeweils eine Ratsche mit einer normalen Handkraft von 500 daN und einem Spanngurt mit einer Belastbarkeit von 2.500 daN,
- eine Abspannung des Gurtes nach unten unter 90° zur Fahrtrichtung.
  Hinweis: ein Spanngurtverlauf mit Kontakt zum horizontalen Strap ist unzulässig!

Diese Art der Sicherung erforderte für **Stahl-Deckelfässer** das Vorhandensein von:

- stabilen Ladeeinheiten
  - durch maschinelles Umspannen der Stahl-Deckelfässer mit einem horizontalen und einem vertikalen Strap (Spannkraft jeweils 2.500 N), um eine Einbeziehung der Palette in die Ladeeinheit zu gewähr-leisten, die Spezifikationen des Straps und des Umreifungsgerätes sind Anlage 1 zu entnehmen,
    Hinweis: wegen des vertikalen Straps sind zwei Fasssicherungen pro Ladeeinheit zu verwenden!
  - durch händisches Umspannen der Stahl-Deckelfässer mit einem horizontalen und zwei überkreuzte vertikale Cordstrap® (Spannkraft jeweilige 2.000 N), um eine Einbeziehung der Palette in die Ladeeinheit zu gewährleisten, die Spezifikationen des Cordstrap®, des Cordstarps-Verschlusses und des Spanngeräts sind Anlage 2 zu entnehmen,
    Hinweis: wegen der zwei vertikalen Cordstrap® sind vier Fasssicherungen pro Ladeeinheit zu verwenden! Der Cordstrap-Verschluss darf die anderen Cordstrap®, den Spanngurt und die Fässer nicht berühren und muss dementsprechend positioniert werden (um Beschädigungen zu vermeiden)!
- einer Verladung unter Verwendung von Antirutschmatten (μ ≥ 0,6),
- jeweils einem Spanngurt mit einer Belastbarkeit von 2.500 daN und einer Ratsche mit einer normalen Handkraft von 500 daN,
- eine Abspannung des Gurtes nach unten unter 90° zur Fahrtrichtung.
  Hinweis: ein Spanngurtverlauf mit Kontakt zum horizontalen Strap oder Cordstrap® ist unzulässig!

Bei Erfüllung dieser Anforderungen ist ein sicherer Einsatz des Drumclips des Typs DC19B GREEN möglich /
*At the customer's request further type of drum securing device Drumclip type DC19B GREEN was tested in various test series to determine its suitability for load securing. This type of securing required by **bung drums** the presence of:*

- *stable load units*

- *by mechanically strapping the bung drums with a horizontal and a vertical strap (tension force 2,500 N each) to ensure that the pallet is included in the loading unit, the specifications of the strap and the strapping device can be found in Annex 1,*
  Note: Because of the vertical strap, two drum securing devices must be used per loading unit!

- *using anti-slip mats for loading (μ ≥ 0.6),*
- *one lashing belt each with a load capacity of 2,500 daN and a ratchet with a normal hand force of 500 daN,*
- *a belt tensioning downwards at 90° to the direction of travel.*
  Note: It is not permissible for the lashing belt to run in contact with the horizontal strap!

*This type of securing required by **open head drums** the presence of:*

- *stable load units*
  - *by mechanically strapping the open head drums with a horizontal and a vertical strap (tension force 2,500 N each) to ensure that the pallet is included in the loading unit, the specifications of the strap and the strapping device can be found in Annex 1,*
    Note: Because of the vertical strap, two drum securing devices must be used per loading unit!
  - *by manually strapping the open head drums with one horizontal and two crossed vertical Cordstrap® (tension force 2,000 N each) to ensure that the pallet is included in the loading unit, the specifications of the Cordstrap®, the cordstrap fastener and the tensioner can be found in Annex 2,*
    Note: Because of the two vertical Cordstrap®, four drum securing devices must be used per loading unit! The cordstrap fastener is not to contact the other Cordstrap®, the lashing belt and the drums and must be positioned accordingly (to prevent damage)!
- *using anti-slip mats for loading (μ ≥ 0.6),*
- *one lashing belt each with a load capacity of 2,500 daN and a ratchet with a normal hand force of 500 daN,*
- *a belt tensioning downwards at 90° to the direction of travel.*
  Note: It is not permissible for the lashing belt to run in contact with the horizontal strap or Cordstrap®!

If these requirements are met, Drumclip type DC19B GREEN could be used safely.

Die im Bericht enthaltenen Fotos stellen nur eine Auswahl dar. Die weiteren zu den Versuchen vorhandenen Fotos, Filme und Diagramme wurden dem Kunden elektronisch zur Verfügung gestellt / *The photos contained in the report are only a selection. The other photos, films and diagrams available for the tests were made available to the customer electronically.*

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Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Das geprüfte Ladungssicherungskonzept erfüllt für die dokumentierte Sicherungssituation die Anforderungen der DIN EN 12195-1. Diese europäische Norm gilt nicht für Fahrzeuge mit einem zulässigen Gesamtgewicht bis einschließlich 3.500 kg, da bei diesen durchaus höhere Beschleunigungen auftreten können /
The tested load securing concept fulfils the requirements of DIN EN 12195-1 for the documented securing situation. This European standard does not apply to vehicles with a permissible gross weight of up to and including 3,500 kg, as higher accelerations can occur in these vehicles.

Der Technische Bericht umfasst 14 Seiten sowie die Anlagen 0 bis 4 und darf ohne schriftliche Genehmigung des Prüflaboratoriums nicht auszugsweise vervielfältigt werden. Er verliert seine Gültigkeit, wenn sich die unter Punkt 1.3. genannte Prüfgrundlage ändert /
The Technical Report comprises 14 pages and Annexes 0 to 4 and may not be reproduced in whole or in part without the written permission of the testing laboratory. It loses its validity if the test basis mentioned under point 1.3. changes.

Köln, den 28.09.2020 /
Cologne, 28th of September 2020
hsm

Prüflaboratorium
Typprüfstelle Fahrzeuge/Fahrzeugteile
im Technologiezentrum Verkehrssicherheit
der TÜV Rheinland Kraftfahrt GmbH

Dipl.-Ing. Th. Husemann

TÜV Rheinland Group

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Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **0**

0. Änderungen / *Alterations*

0.1. Es wird berichtigt / *Is corrected* : - --

0.2. Es wird geändert / *Is changed* : - --

0.3. Es wird hinzugefügt / *Is added* : - --

0.4. Es entfällt / *Is not applicable* : - --

TÜV Rheinland Group

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Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **1**

Umreifungsgerät / *strapping machine*

Signode Akku Umreifungsgerät BXT 3-19

Strap type	PET + PP	PET + PP	PET + PP
Strap width	9 - 13 mm	13 - 16 mm	16 - 19 mm
Strap thickness	PET: 0.4 - 0.8 mm; PP: 0.5 - 0.8 mm	0.5 - 1.0 mm	0.8 - 1.3 mm
Weight	3.6 kg	3.8 kg	4.3 kg
Tension force	150 - 1200 N	400 - 2500 N	400 - 4500 N
Variable Tension Speed	0 - 290 mm/s	0 - 220 mm/s	0 - 120 mm/s
Cycles / Charge	up to 800	up to 800	up to 800
Battery	Bosch Li-Ion 18V, 2.0Ah	Bosch Li-Ion 18V, 2.0Ah	Bosch Li-Ion 18V, 4.0Ah
Charging time battery	15 - 30 min	15 - 30 min	25 - 35 min
Motor technology	Single motor technology, brushless	Single motor technology, brushless	Single motor technology, brushless
Dimension (L x W x H)	370 x 141 x 135 mm	370 x 141 x 135 mm	370 x 143 x 135 mm

Quelle / *Source*: https://www.signode-bxt.com/en/product/tools/

TÜV Rheinland Group

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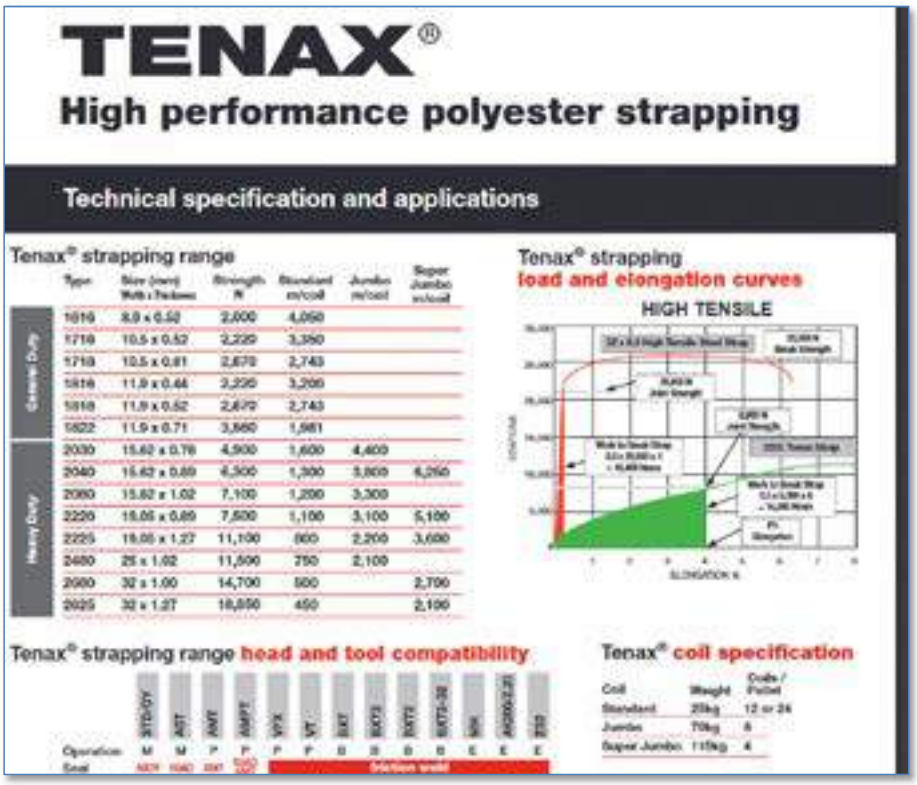
Bauteil / *Component* **: Drumclip DC19B GREEN**
Auftraggeber / *Client* **: InVaGo BVBA**

Anlage / *Annex* **1**

Strap
Strapart / *Strap type*: Signode Tenax 2220
Material / *Material*: Polyester
Breite / *Width*: 19 mm
Dicke / *Thickness*: 0,89 mm / *0.89 mm*
Vorspannung / *Pre-tension*: 2.500 N / *2,500 N*
Verschweißlevel / *Welding time level*: 4



4.7 Test Report ISTA | DRUMCLIP DC19B GREEN

Test Report

IPS 7898-81

ISTA 3E PERFORMANCE TEST

DRUMCLIP DC 19B GREEN
with
OPEN HEAD BARREL DRUMS

The IPS-report may be released for viewing to relevant parties.

IPS Technology is an independent packaging and tooling design agency. Aside from designing IPS also performs research, delivers advice on packaging issues and performs packaging test in its own test facility.

Reference : IPS 7898 - 81
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Reference : IPS 7898 - 81
Description : Test Report ISTA 3E Drumclip DC19B Green with Open Head Barrel Drums
Date : August 19. 2019
Author(s) : Marten Ries

Client : Geba Innovations B.V.
Chr. Huygensstraat 3
3261 LR Oud-Beijerland
The Netherlands
Contacts : Wouter Geldhof

Test performed by : Marten Ries
Test Date(s) : August 16. 2019
Test Facility : IPS Technology, Eindhoven The Netherlands
ISTA Certified Testing Laboratory, Member ID: 9778 (Appendix A)

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1. Scope of t est

The goal of this transport simulation test, performed according to the ISTA 3E-2017 Standard for Unitized Loads, is to validate the capability of the Drumclip system for sufficient load stability subjected to rough mechanical handling; forklift truck handling and warehousing stacking.

Four Standard Open Head Barrel Drums 200L are placed on a pallet and secured with two Drumpclips and secured with two polyester lashings.

Securing of the pallets during Full Truckload (FTL) will be done with help of strapping belts and is not in scope of this test.

Figure 1. Test configuration

CHERISHING INDUSTRIAL PRODUCTS

IPS Technology
Packaging Tooling Testing

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Details of tested configuration:

The tested configuration is built up with components listed below:

Item	Remark
Standard Open Head Barrel Drums 200L. Quantity: 4	Drums fully filled with water. Used condition.
Pallet type: CP-9	Chemie Pallet,1140x1140x156mm, used condition.
Lashing: Signode Tenax 2040 Strapping. Quantity: 2	Polyester Strapping 16mm, thickness 0,89mm Location of the strapping shown in Figure 1.
Drumpclip type: DC19B Green	Quantity used: 2x

Lashing is assembled with Plastic Strapping Handtool: Strapex STB75.
Pre-tension on strapping: 2100N, Weldingtime level: 4

Parameter	Value
Total mass DUT:	853 kg
Dimensions:	Approx. 1170x1170x1030mm (LxWxH).
Sample Numbers to be tested:	1

Remark:
The drums are exceeding the base dimensions of the pallet.
The Tenax strapping will be applied just before the execution of the test program.

Identification of sides (according to ISTA 3E) see Figure 2.

Figure 2. Faces of DUT identified.

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2. Product Damage Tolerance and Package Degradation Allowance

The product will be tested in the prepared configuration. Replacement of components of DUT is not allowed.

Product Damage Allowance:
During horizontal impact tests the drums will impact the ridged wall of the Horizontal Impact Tester. The drums are exceeding the dimensions of the pallet base.
It will we expected that damage to the drums cannot be avoided during the executing of this tests. Damage to the drums caused by this impacts is within the allowance criteria.

Package Degradation Allowance:
During and after the test the integrity of the DUT must be guaranteed.
- All drums are placed on the pallet bottom during and after the execution of the test.
- The forklift truck can interface the pallet during and after the execution of the test.
- The Drumclip is not broken-heavily damaged (validation by Geba Innovations)

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3. Test plan

The test plan is based on the ISTA 3E -2017 procedure.

According ISTA 3E the test sequence will be executed as stated in the table below.

Performance Test Schedule	*Description*	*Note*
1st	Atmospheric preconditioning	Ambient level
2nd	Shock; horizontal impact	1,2 m/s
3rd	Shock: rotational edge drop	Drop height 150mm
4th	Compression	Apply and release method
5th	Vibration: random	Overall Grms= 0.54
6th	Shock: rotational edge drop	Drop height 150mm

3.1 Atmospheric Conditioning

The sample will be conditioned to ambient laboratory level.

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3.2 Shock; horizontal impact 1, 2ms

The DUT will be exposed to horizontal impacts in order and under the conditions as stated in the table below.

Sequence No.	*Specific Face*	*Impact Speed*
1	Face 6	1,2 m/s
2	Face 5	1,2 m/s
3	Face 2	1,2 m/s
4	Face 4	1,2 m/s

Horizontal impact testing will be performed with the IPS Technology horizontal impact tester.

Specifications of the horizontal impact tester can be found in Appendix B.

Figure 3.DUT on horizontal impact tester.

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3.3 Shock; 1st Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.
During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.
The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	*Specific edge*	*Drop height*
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm

Figure 4. Set-up Rotational Edge Drop Test

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3.4 Compression Test; Machine Apply and Release

The DUT will be exposed to a; 'Machine Apply and Release' compression test according to the ISTA 3E test protocol. For the calculation for compression (Apply and Release method) the formula AR = {[Wt x (S-1) +(Wt/L) x (L-1)] x F – (Wt / L) (L-1)} x 1,4 x 9,8 is applicable.

Wt	Total weight of packaged product (Kilograms)	853 Kg	
S	Total number of potential unitized loads in a warehouse stack or a vehicle stack	4	Including the bottom unitized load
L	Total number of layers in the unitized load	1	
F	Compensating factor	3	Typical compensating factor
9,8	Metric conversion factor	9,8	
1,4	Factor to account for time of compression	1,4	
AR	Result of calculation: Test Load for Apply and Release (Newton)	35.145 N	= 3.582,6 Kg

The test will be performed with an additional (empty) pallet on top of the DUT. This will be done in order to simulate the reality of stacking load. Figure is showing the compression test setup.

Figure 5. Test set-up Compression Test

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3.5 Vibration; ISTA Steel Spring Truck Random Vibration

The DUT will be exposed to a vibration test without compressive load, to simulate transport vibrations. The test is performed under 'loose load' conditions. For the test setup see Figure .
The during of 60minutes will be equivalent to a transport of 480km.

Orientation	*Vibration Profile acc.*	*Duration*
Face 3 down (bottom face)	ISTA Steel Spring Truck	60 minutes

Specifications of the vibration test equipment can be found in Appendix C.

The Power Spectral Densities ISTA Steel Spring Truck profile is given in the figure below.

Frequency (Hz)	PSD Level g²/Hz
10	0.00072
30	0.018
40	0.018
60	0.00072
120	0.00072
150	0.0036
250	0.0036
300	0.00072
400	0.0036
600	0.0036
1000	0.00036
2000	0.000018

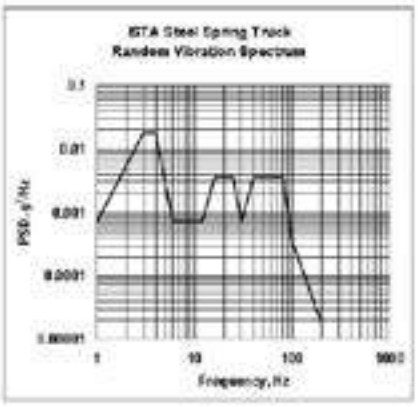

Figure 2. Power Spectral Densities – Steel Spring Truck Random Vibration

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Figure 6. Test setup for vibration test

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3.6 Shock; 2nd Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.
During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.
The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	*Specific edge*	*Drop height*
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm

Figure 7. Set-up Rotational Edge Drop Test

4. Test Results

The tests are executed according to test plan. In the following chapters the test results can be found per test.

4.1 Atmospheric Conditioning

The DUT has been conditioned to ambient laboratory level.

4.2 Shock; Horizontal I mpact

The horizontal impact test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. The impact speed is measured at 1,2 m/s. See for the speed graph Appendix D.

4.3 Shock; 1 Rotational Edge Dr op

The Rotational Edge Drop Sequence is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence.

4.4 Compre ssion ; Machine Apply and Release

The compression test is executed with a higher load, 172kg higher then defined in the test plan.
No remarkable event occurred before, during or after the Test Sequence.
A screenshot of the compression test is shown in a graph in Appendix E.

4.5 Vibration; ISTA Steel Spring Truck Random Vibration

The vibration test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. A screenshot of the PSD during the test is shown in Appendix F.

Reference : IPS 7898 - 81
Page : 14/21

4.6 Shock; 2nd Rotational Edge Drop

The Rotational Edge Drop Sequence is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence.

5. Inspection after test

After execution of the complete test cycle no remarkable – unexpected damages to the DUT and it components could be found. The expected damage to the drums could be found on only on face 4. The condition of the CP-9 pallet was still in useable condition.

Figure 8. Damage to drum ring; only face 4.

Examination of the condition by personnel of Geba Innovations B.V. of the Drumclips after the test showed no visible damage or wear.

Reference : IPS 7898 - 81
Page : 15/21

6. Conclusions

The test has been executed according to the test plan.
No remarkable-unexpected events and/or damage has occurred before, during or after the test to the DUT.

The Drumclip system in combination with the defined lashing configuration is fully capable to ensure safe individual pallet mechanical pallet handling and warehouse stacking.

Eindhoven, August 20, 2019

Checked and approved by:

Marten Ries
Sr. Project Engineer

Marijn Sijbers
Test Engineer

Reference : IPS 7898 - 81
Page : 16/21

Appendix A. ISTA Certified Testing Laboratory

Figure 9. IPS Technology ISTA Laboratory Certification

CHERISHING INDUSTRIAL PRODUCTS

IPS Technology
Packaging Tooling Testing

Reference : IPS 7898 - 81
Page : 17/21

Appendix B. Test Equipment: Impact Tester

Fabrikant
IPS Technology

Oppervlakte
245x250 cm

Max. productmassa
1300 kg

Opspanning
Horizontaal

Botssnelheden
2-10 km/h

Datalogging
Snelheidsmeetsysteem registreert de snelheid bij botsing

Optioneel
Versnellingsmetingen aan het product met een drie-assige versnellingsopnemer

Normen (o.a.):
ASTM D 5487
ISO 2244

Reference : IPS 7898 - 81
Page : 18/21

Appendix C. Test Equipment : Shaker

- Manufacturer : Lansmont model 10000 TTV II
- Max. specimen size : 152 x 152 cm
- Max. specimen weight : 2200 kg
- Max. amplitude (peak to peak) : 6,4 cm
- Frequency-range : 3 - 300 Hz
- Frequency-rang at max. load : 3 - 200 Hz
- Acceleration range : 0 - 8 g
- Max. acceleration at max. load : 2 g
- Automatic displacement or acceleration control
- Automatic sweep generator and random vibration facilities (Lansmont TouchTest Vibration system)
- Accelerometer

Reference : IPS 7898 - 81
Page : 19/21

Appendix D. Impact speed

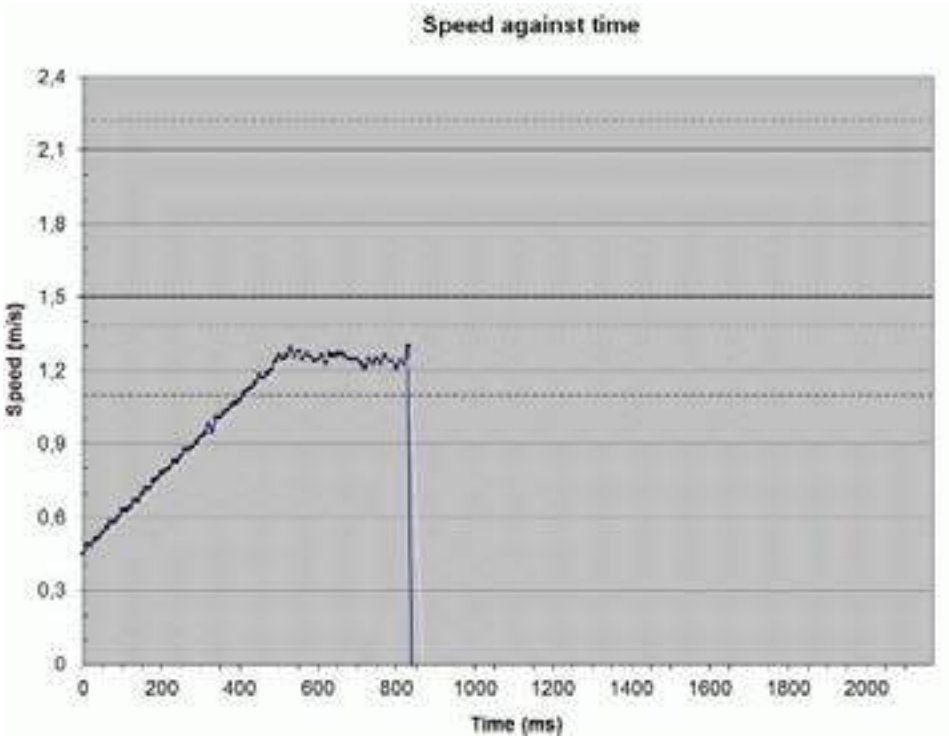

Figure 10. Impact speed >1,2m/s

Reference : IPS 7898 - 81
Page : 20/21

Appendix E. Compression test graph

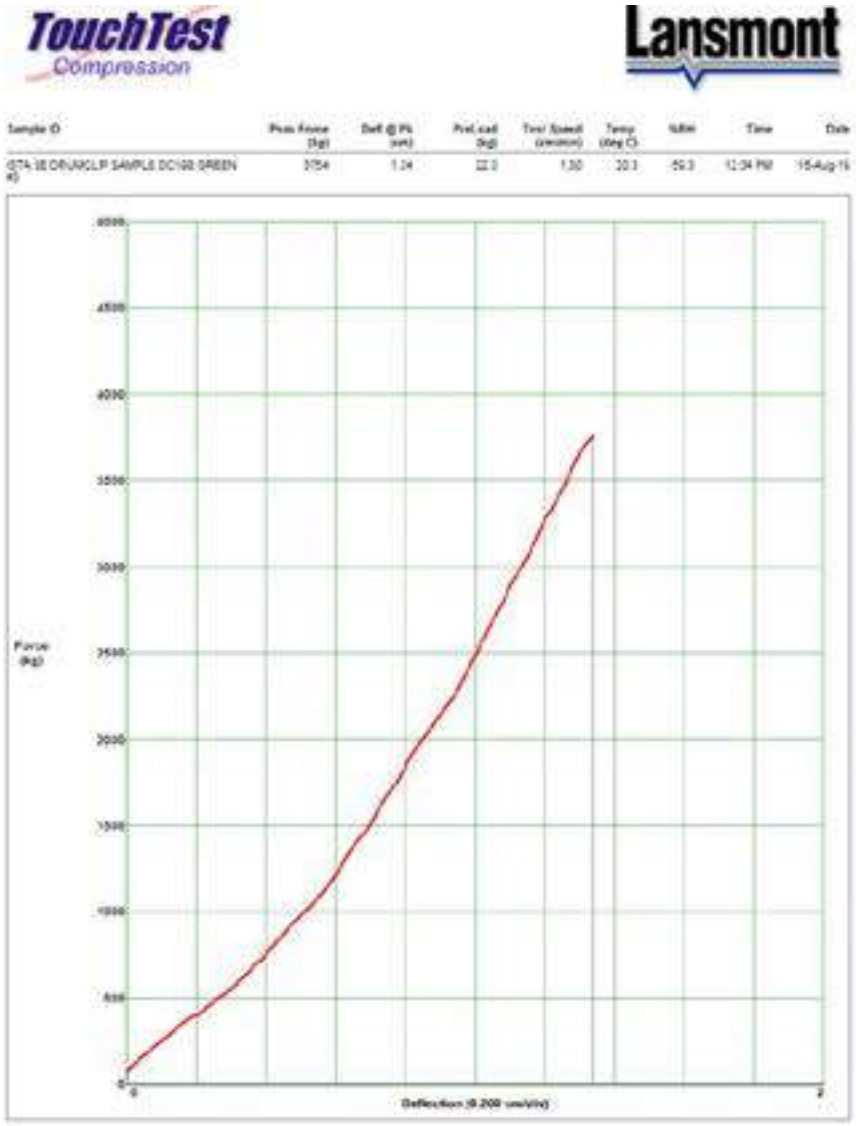

Figure 11. Compression test graph – Apply and release compression test

Reference : IPS 7898 - 81
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Appendix F. Power Spectral Densities Profile

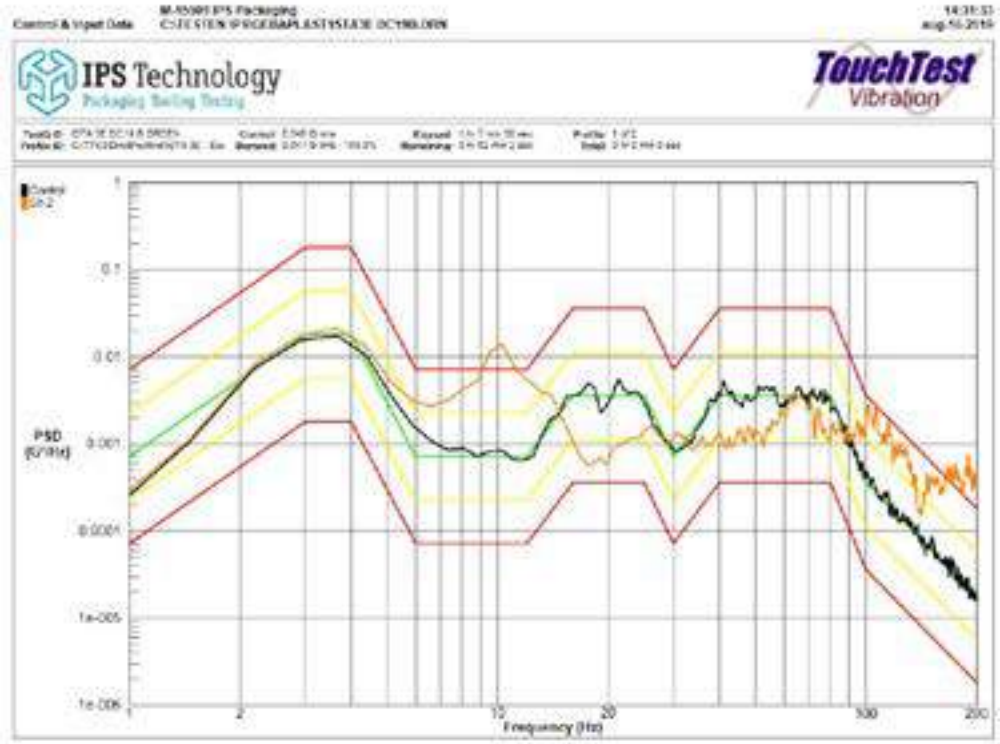


Figure 12. Power Spectral Densities - ISTA Steel Spring Truck Random Vibration; 1 hr 8 min.

Remark: Location accelerometer place on top of Drumclip Ch2. for response monitoring (examination only)

4.8 Test Report EUMOS | DRUMCLIP DC19B GREEN

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip	Reference OH DC 19 B 2 S2	Revision 01

1. Load unit descriptive data

- *Dimensions (mm):* 1000 X 1150 X 1150
- *Weight (kg):* 850
- *Center of Gravity (mm):* H 600 x L575 x W575
- *Nature of the Products:* Metal drums open head
- *Description of Primary Pack:* 4 metal open head drums SIGNODE 2 Straps 2 drumclips DC 19 B Green
- *Layer Stacking pattern:* 1 layer of 4 drums
- *Type of Pallet:* CP 9
- *Responsible of the description:* Dhr. Wouter Geldhof

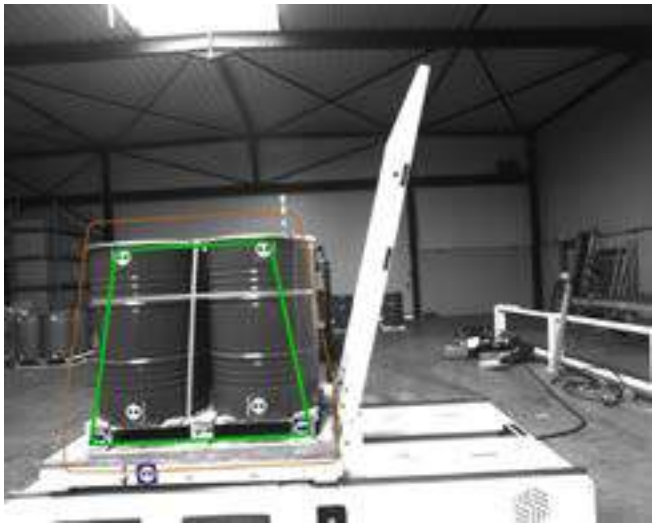
EUMOS 40509 - 4 Open head DC19B Signode – page 1

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip	Reference OH DC 19 B 2 S2	Revision 01

2. Test related data

2.1. Orientation of the test: Length

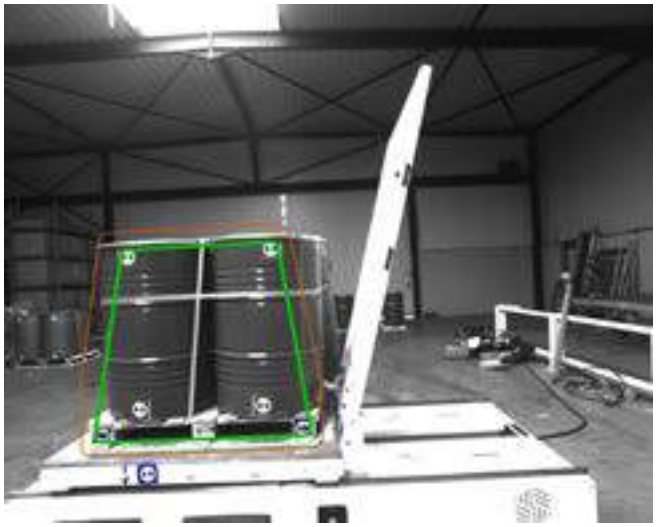
- *Date of Test:* 10/5/2022
- *Place:* Brugge
- *Rigidity (g):* 0.70G
- *Testing History:* non



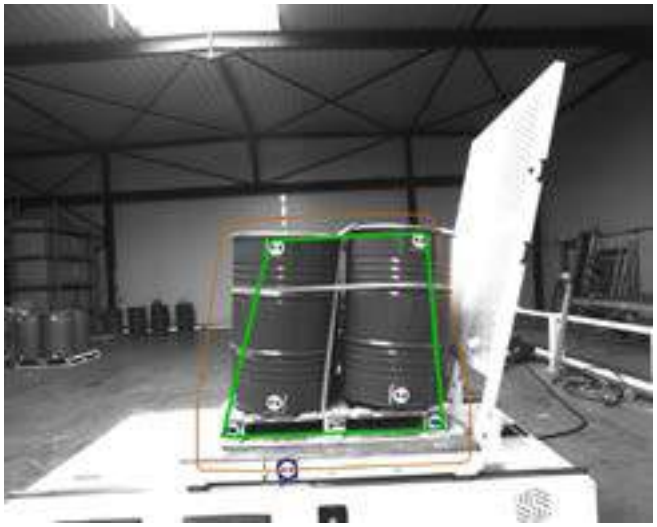
Load Before Test

4. Open head UN200 litre drum

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip	Reference OH DC 19 B 2 S2	Revision 01



Permanent Deformation



Max Elastic Deformation

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip	Reference OH DC 19 B 2 S2	Revision 01

3. Test Validation

- *Temperature of the test area:* 22°
- *Humidity of the test area:* 65%
- *Responsible of Report:* Dhr. Geert Frans
- *Sign:*

5. Plastic drums

Plastic drums can be recognised by their closed top with two lockable openings (See Figure 22). DRUMCLIP DC19B GREEN can be used to create pallet stability for these drums. DRUMCLIP DC19B GREEN can be used for pallet stability and transport safety.

Figure 22: Plastic drum

5.1 DRUMCLIP DC19B GREEN

The DRUMCLIP DC19B GREEN is a plastic tool that can be used to secure plastic drums to the pallet. This Drumclip is primarily designed for Openhead UN 200 litre drums (see Chapter 4). The DRUMCLIP DC19B GREEN in combination with plastic drums, is ISTA 3E Pallet Stability and EUMOS 40509 Transport Safe certified.
Figure 23 below show the application of DRUMCLIP DC19B GREEN on a plastic drum.

Figure 23: DRUMCLIP DC19B GREEN secured with Signode Tenax T2220 Polyester strap

5.2 Technical information DRUMCLIP DC19B GREEN

DRUMCLIP DC19B GREEN is made of a glass-fibre reinforced plastic base material mixed with a green dye. The ambient temperature at which the Drumclip may be used lies between -10°C and + 50°C. The technical specifications are given in Figures 24a and 24b. Each Drumclip can be identified by the text:

Geba Innovations BV
Chr. Huygenstraat 3
3261 LR Oud-Beijerland
Produced in The Netherlands
Product: DRUMCLIP B
Art. No.: DC19B

Each Drumclip has a unique article number that can be found below the text. The Drumclip can be used for a maximum of two years after production. Therefore, there is a production date on every Drumclip. The Drumclip is certified for 2 years after the production date. Once these 2 years have passed, the Drumclip can no longer be used. The date stamp is shown in the following location in Figure 25.

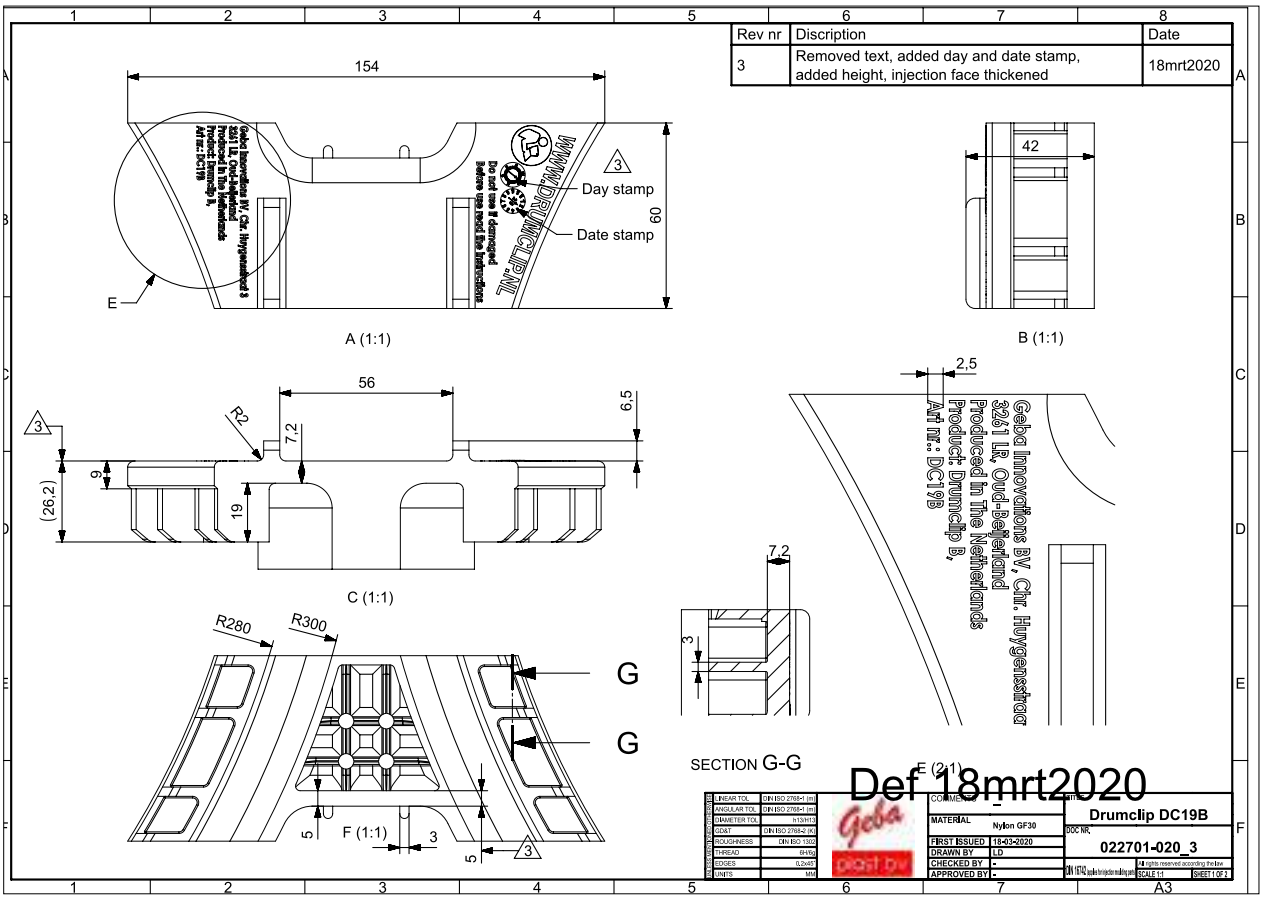


Figure 24a: 2D drawing DRUMCLIP DC19B GREEN

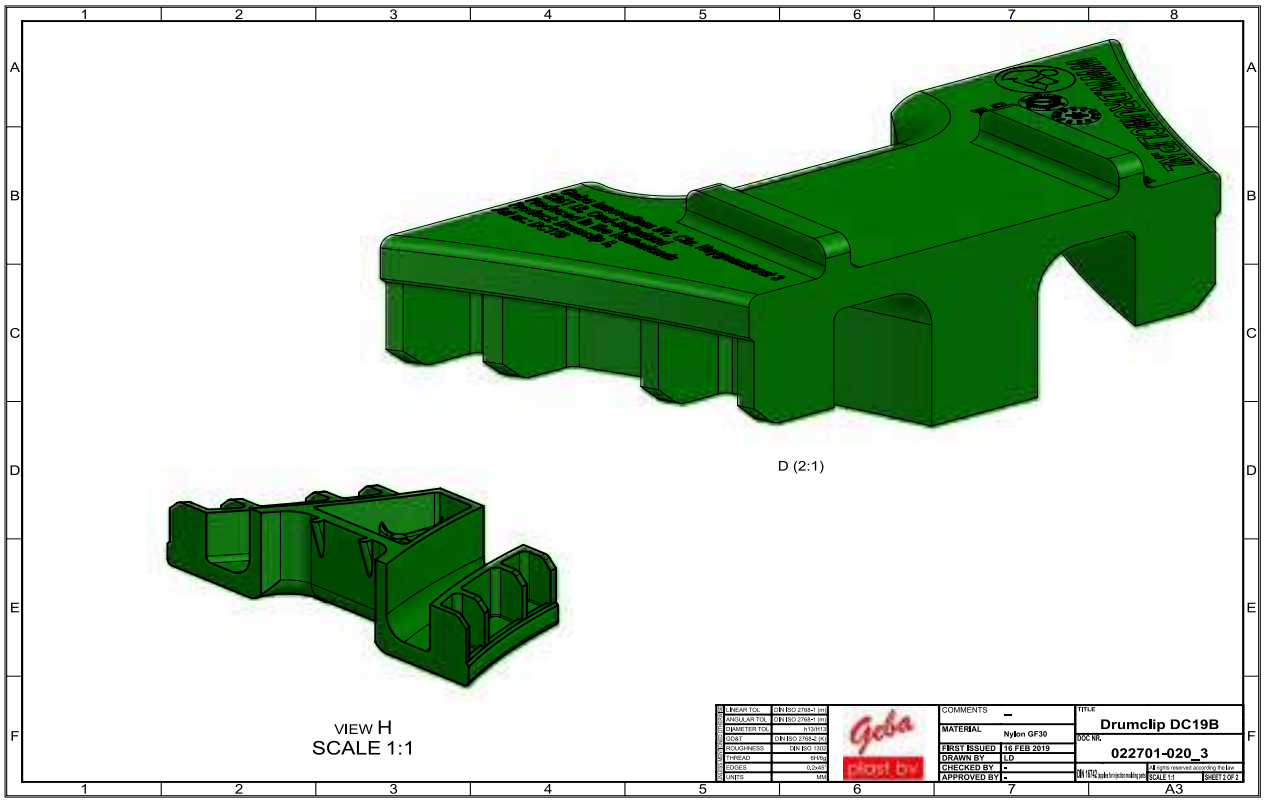


Figure 24b: Isometric view DRUMCLIP DC19B GREEN

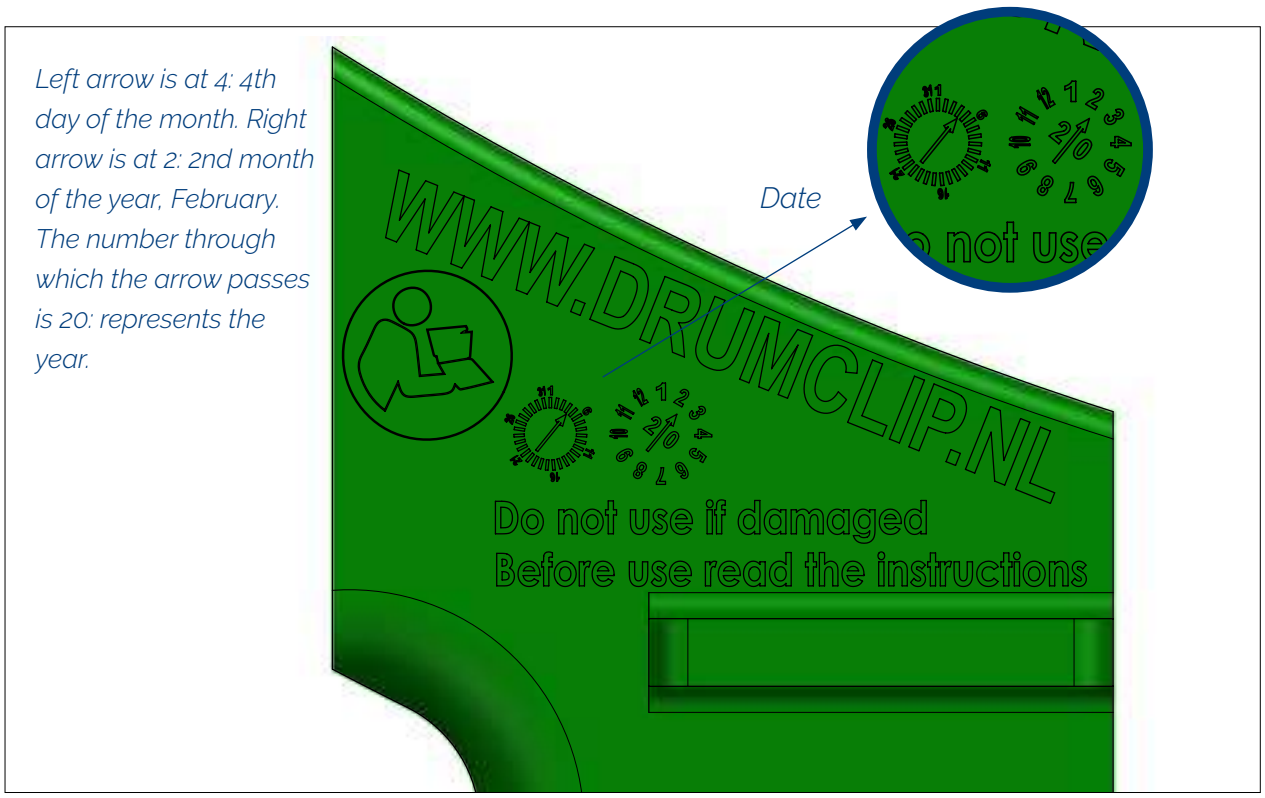


Figure 25: Stamp production date DC19B GREEN

5.3 Certification DRUMCLIP DC19B GREEN

The Drumclip is certified for pallet stability according to ISTA 3 E and EUMOS 40509 Transport safe. The Drumclip is certified ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe. The complete test reports can be found in Chapter 5.6 Test report ISTA | DRUMCLIP DC19B GREEN and Chapter 5.7 Test report EUMOS | DRUMCLIP DC19B GREEN.

ISTA 3E Pallet Stability and EU-MOS 40509 Transport Safe	Signode	(Figure 26)
Item	**Description**	**Specifications**
Pallet type	CP-9	Chemicals Pallet,1140x1140x156mm.
Drums	Plastic	4 Plastic Drums
Straps	Signode Tenax 2220	Polyester | width: 19mm, thickness: 0.89mm | 1x horizontal, 1x vertical (2 in total)
Machine setting	Signode BXT3-19	2500 N
Type of Drumclip	DC19B	4 Pieces
Anti-slip mats	3 pieces	Minimum resistance value of 0,6µ

Figure 26

5.4 Requirements DRUMCLIP DC19B GREEN

The certificating ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe of the DRUMCLIP DC19B GREEN was obtained in combination with supplies from Signode. See also Chapter 2.

5.4.1 Signode

Signode's requirements for compliance with ISTA 3 E pallet stability certification are:

- Signode Tenax T2220 Polyester straps (Figure 27a)
- Signode BXT3 – 19 strapping machine (Figure 27b)

SIGNODE

Tenax 2220 (19*0,89)

PRODUCT DATA SHEET

This is to certify that the product supplied by us is manufactured according to quality procedures in compliance with ISO 9001, ISO14001, EN 13891 and EN 13394.
Made of 100% of recycled PET

Produced in Netherlands

Product description	Product designation:	Tenax 2220 (19*0,89)
	Item code:	670273
	Material type:	Polyester
	Production technology:	Strand
	Surface:	Flat
	Colour:	Green

Strap properties		Minimum	Nominal	Maximum
	Width (mm):	18.4	19	19.6
	Thickness (mm):	0.84	0.89	0.94
	Elongation (%):	10		15
	Break Strength (daN):	675	750	

Coils details	Coil Type:	standard
	Coil Inside Diameter (mm):	408
	Coil Outside Diameter (mm):	610
	Coil Width (mm):	153
	Net Coil Weight (kg):	24.684
	Meters per coil:	1100

Pallet details	Package Dimensions (LxWxH):	1200 x 1200 x 1100
	Number of Coils per Pallet:	24
	Approx. Gross Weight per Pallet (kg):	646

Date of issue: 19/02/2020

Figure 27a

Technical Data Sheet BXT3-19

SIGNODE
TRANSIT PACKAGING SOLUTIONS

Strapping tool		BXT3-19
Operation mode		auto / semi / manual
Tension force range	Standard	1300 – 4500N (290 – 1000 lbf)
	Soft	400 – 1600 (90 – 340 lbf)
Variable tension speed range		0 – 120 mm/s (4,7 in/s)
Weight (incl. battery)		4,3 kg (9,5 lb)
Dimensions (L x W x H)		370 x 143 x 135 mm 15.5" x 5.6" x 5.3"
Working temperature		-10°C to +40°C (14-104 °F)
Relative humidity		up to 90%
Battery / Charger		
Charger type		Bosch
Battery charger voltage		100 or 110 or 230 V
Charging time		25-35 min.
Battery type		Bosch Li-ion 18V, 4.0 Ah
Cycles per battery charge		
- Low tension		800
- Medium tension		500
- High tension		300
Strap		
Strap		PET (Polyester) PP (Polypropylene)
Width		15-16, 18-19 mm (5/8", 3/4")
Thickness		0,8-1,3 mm (.031"-0.51")
Features		
Real time indication of applied tension force		√
Variable tension speed		√
Favorite strapping function		√
Display color indication for tool status information		√
Strap alignment indication		√
Strap dust blow out vent		√
Battery protection		√
0-Tension welding		√

Figure 27b

5.5 Operating instructions DRUMCLIP DC19B GREEN

Main steps to be taken before using the Drumclip.

- Check the Drumclip for any damages.
- Check the production date on the upper side of the Drumclip. The Drumclip must not be used for more than 2 years after the production date.
- The Drumclip may be cleaned with water and soap.
- If the Drumclip has been in contact with chemicals, it may no longer be used.
- The Drumclip may only be used on trucks with a gross weight of 3,500 kg or more.
- Drumclips must be stored in dry, moderately heated conditions and protected from sunlight and mechanical damage.
- The Drumclip may not be dried or stored near fire or in places with elevated temperatures.
- The maximum temperature at which the Drumclip can be used is -10C Degrees Celsius + 50 Degrees Celsius.

The operation instructions must always be followed.

DRUM CLIP

Operating Instructions DC19B GREEN
for plastic drums in combination with Signode

Operating Instructions DRUMCLIP DC19B GREEN
In combination with two Signode Tennax T2220 (19x0.89mm) straps.

DRUMCLIP DC19B GREEN is an innovative tool that makes it **safer** and **easier** to secure plastic drums to a pallet, without the use of additional pallets or other equipment. This solution is ISTA 3 E Pallet Stability and EUMOS 40509 Transport Safe certified. This combination is useful for pallet stabilisation of 200 litre plastic drums on pallets.

Important information
- Check the Drumclip before use. A damaged Drumclip may not be used again.
- Check the production date on the upperside of the Drumclip. The Drumclip must not be used for longer than 2 years after the production date.
- The Drumclip can be cleaned with water and soap.
- If the Drumclip has been in contact with chemicals, it may no longer be used.
- Drumclips must be kept in dry, moderately heated conditions and protected from sunlight and mechanical damage.
- The Drumclip may not be dried or stored near fire or in places with elevated temperatures.

Step 1
Place four plastic drums on a wooden pallet.

Step 2
Place two Drumclips opposite each other between two drums with the wide side facing outwards. Use two Signode Tenax T2220 straps. One strap is stretched horizontally at the centre of the drums. The other strap is stretched vertically over the two Drumclips and under the pallet. Both straps are tensioned with a force of 2500 N. Now the pallet is safely certified according to ISTA 3E Pallet Stability and EUMOS 40509 Transport Safe. The above step should be performed for each pallet with drums.

DRUMCLIP | Operating Instructions DC19B GREEN for plastic drums in combination with Signode **Page 1**

Figure 28 - Page 1

5.6 Test Report ISTA | DRUMCLIP DC19B GREEN

Test Report

IPS 7898-82

ISTA 3E PERFORMANCE TEST

DRUMCLIP DC 19B GREEN
with
PLASTIC DRUMS

The IPS-report may be released for viewing to relevant parties.

IPS Technology is an independent packaging and tooling design agency. Aside from designing IPS also performs research, delivers advice on packaging issues and performs packaging test in its own test facility.

Reference : IPS 7898 - 82
Page : 2/22

Reference : IPS 7898 - 82
Description : Test Report ISTA 3E Drumclip DC19B GREEN with Plastic Drums
Date : August 19. 2019
Author(s) : Marten Ries

Client : Geba Innovations B.V.
Chr. Huygensstraat 3
3261 LR Oud-Beijerland
The Netherlands
Contacts : Wouter Geldhof

Test performed by : Marten Ries
Test Date(s) : August 16. 2019
Test Facility : IPS Technology, Eindhoven The Netherlands
ISTA Certified Testing Laboratory, Member ID: 9778 (Appendix A)

Table of Contents

Reference : IPS 7898 - 82
Page : 3/22

1. Scope of te st

The goal of this transport simulation test, performed according to the ISTA 3E-2017 Standard for Unitized Loads, is to validate the capability of the Drumclip system for sufficient load stability subjected to rough mechanical handling; forklift truck handling and warehousing stacking.

Four Standard Plastic Drums 200L are placed on a pallet and secured with four Drumpclips and secured with three polyester lashings.

Securing of the pallets during Full Truckload (FTL) will be done with help of strapping belts and is not in scope of this test.

Figure 1. Test configuration

Reference : IPS 7898 - 82
Page : 4/22

Details of tested configuration:

The tested configuration is built up with components listed below:

Item	Remark
Standard Plastic Drums 200L. Quantity: 4	Drums fully filled with water. Used condition.
Pallet type: CP-9	Chemie Pallet,1140x1140x156mm, used condition.
Lashing: Signode Tenax 2040 Strapping. Quantity: 3	Polyester Strapping 16mm, thickness 0,89mm Location of the strapping shown in Figure 1.
Drumpclip type: DC19B GREEN	Quantity used: 4x

Lashing is assembled with Plastic Strapping Handtool: Strapex STB75.
Pre-tension on strapping: 2100N, Weldingtime level: 4

Parameter	Value
Total mass DUT:	892 kg
Dimensions:	1170x1170x1030mm (LxWxH).
Sample Numbers to be tested:	1

Remark:
The drums are exceeding the base dimensions of the pallet.
The Tenax strapping will be applied just before the execution of the test program.

Reference : IPS 7898 - 82
Page : 5/22

2. Product Damage Tolerance and Package Degradation Allowance

The product will be tested in the prepared configuration. Replacement of components of DUT is not allowed.

Product Damage Allowance:
During horizontal impact tests the drums will impact the ridged wall of the Horizontal Impact Tester. The drums are exceeding the dimensions of the pallet base.
It will we expected that damage to the drums cannot be avoided during the executing of this tests. Damage to the drums caused by this impacts is within the allowance criteria.

Package Degradation Allowance:
During and after the test the integrity of the DUT must be guaranteed.
- All drums are placed on the pallet bottom during and after the execution of the test.
- The forklift truck can interface the pallet during and after the execution of the test.
- The Drumclip is not broken-heavily damaged (validation by Geba Innovations B.V.)

Reference : IPS 7898 - 82
Page : 6/22

3. Test plan

The test plan is based on the ISTA 3E -2017 procedure.

According ISTA 3E the test sequence will be executed as stated in the table below.

Performance Test Schedule	*Description*	*Note*
1st	Atmospheric preconditioning	Ambient level
2nd	Shock; horizontal impact	1,2 m/s
3rd	Shock: rotational edge drop	Drop height 150mm
4th	Compression	Apply and release method
5th	Vibration: random	Overall Grms= 0.54
6th	Shock: rotational edge drop	Drop height 150mm

3.1 Atmospheric Conditioning

The sample will be conditioned to ambient laboratory level.

Reference : IPS 7898 - 82
Page : 7/22

3.2 Shock; horizontal impact 1, 2ms

The DUT will be exposed to horizontal impacts in order and under the conditions as stated in the table below.

Sequence No.	*Specific Face*	*Impact Speed*
1	Face 6	1,2 m/s
2	Face 5	1,2 m/s
3	Face 2	1,2 m/s
4	Face 4	1,2 m/s

Horizontal impact testing will be performed with the IPS Technology horizontal impact tester.

Specifications of the horizontal impact tester can be found in Appendix B.

Figure 3.DUT on horizontal impact tester.

Reference : IPS 7898 - 82
Page : 8/22

3.3 Shock; 1st Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.
During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.
The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	*Specific edge*	*Drop height*
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm

Figure 4. Set-up Rotational Edge Drop Test

Reference : IPS 7898 - 82
Page : 9/22

3.4 Compression Test; Machine Apply and Release

The DUT will be exposed to a; 'Machine Apply and Release' compression test according to the ISTA 3E test protocol. For the calculation for compression (Apply and Release method) the formula AR = {[Wt x (S-1) +(Wt/L) x (L-1)] x F – (Wt / L) (L-1)} x 1,4 x 9,8 is applicable.

Wt	Total weight of packaged product (Kilograms)	921 Kg	
S	Total number of potential unitized loads in a warehouse stack or a vehicle stack	3	Including the bottom unitized load
L	Total number of layers in the unitized load	1	
F	Compensating factor	3	Typical compensating factor
9,8	Metric conversion factor	9,8	
1,4	Factor to account for time of compression	1,4	
AR	Result of calculation: Test Load for Apply and Release (Newton)	25.339N	= 2.583 Kg

The test will be performed with an additional (empty) pallet on top of the DUT. This will be done in order to simulate the reality of stacking load.

Figure 5. Set-up compression test

Reference : IPS 7898 - 82
Page : 10/22

3.5 Vibration; ISTA Steel Spring Truck Random Vibration

The DUT will be exposed to a vibration test without compressive load, to simulate transport vibrations. The test is performed under 'loose load' conditions. For the test setup see Figure .
The during of 60minutes will be equivalent to a transport of 480km.

Orientation	*Vibration Profile acc.*	*Duration*
Face 3 down (bottom face)	ISTA Steel Spring Truck	60 minutes

Specifications of the vibration test equipment can be found in Appendix C.

The Power Spectral Densities ISTA Steel Spring Truck profile is given in the figure below.

Frequency (Hz)	PSD Level g²/Hz
10	0.00072
30	0.018
40	0.018
60	0.00072
120	0.00072
150	0.0036
250	0.0036
300	0.00072
400	0.0036
600	0.0036
1000	0.00090
2000	0.000018

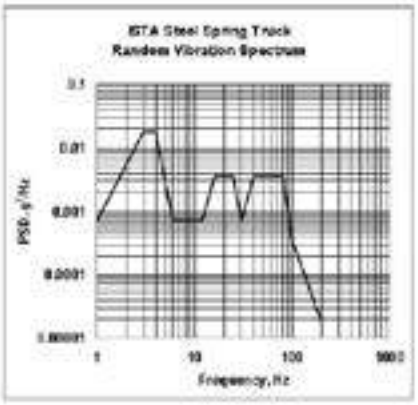


Figure 2. Power Spectral Densities – Steel Spring Truck Random Vibration

Reference : IPS 7898 - 82
Page : 11/22

Figure 6. Test setup for vibration test

Reference : IPS 7898 - 82
Page : 12/22

3.6 Shock; 2nd Rotational Edge Drop

Based on the mass of the DUT >230kg the drop height is set on 150mm.
During the drop test, the side opposite to the drop side is supported by a timber with a height of 90mm.
The DUT is exposed to rotational edge drops in order and under the conditions according to the table below.

Sequence No.	*Specific edge*	*Drop height*
1	Edge 3-6	150mm
2	Edge 3-2	150 mm
3	Edge 3-5	150 mm

Figure 7. Set-up Rotational Edge Drop Test

Reference : IPS 7898 - 82
Page : 13/22

4. Test Results

The tests are executed according to test plan. In the following chapters the test results can be found per test.

4.1 Atmospheric Conditioning

The DUT has been conditioned to ambient laboratory level.

4.2 Shock; Horizontal I mpact

The horizontal impact test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. The impact speed is measured at 1,2 m/s. See for the speed graph Appendix D.

4.3 Shock; 1 Rotational Edge Drop

The Rotational Edge Drop Sequence is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence.

4.4 Compre ssion ; Machine Apply and Release

The compression test is executed according test plan. At a load of approx. 1600 kg wooden bars parts of the top part of the pallet base cracked.
A screenshot of the compression test and the crack is shown in a graph in Appendix E.

4.5 Vibration; ISTA Steel Spring Truck Random Vibration

The vibration test is executed according test plan. No remarkable event occurred before, during or after performance of this Test Sequence. A screenshot of the PSD during the test is shown in Appendix F.

4.6 Shock; 2nd Rotational Edge Drop

The Rotational Edge Drop Sequence is executed according test plan.
During execution of the test bending of the pallet bottom could been seen.

Figure 8. Bended pallet bottom

Reference : IPS 7898 - 82
Page : 15/22

5. Inspection after test

After execution of the complete test cycle no remarkable – unexpected damages to the DUT and it components could be found. The expected damage to the drums was not found.

The condition of the CP-9 pallet was still in useable condition. However several cracks in the wooden carriage were found. It has to be remarked that the pallet quality was poor.

During and after execution of the test the position of the Drumclip were not levelled to the top surface of the plastic drums. Also is this position the Drumclips interfaced mechanically with the edge of the plastic drums.

Figure 8. Position of drum clips during drop testing.

Examination of the condition by personnel of Geba Innovations B.V. of the Drumclips after the test showed no visible damage or wear.

Reference : IPS 7898 - 82
Page : 16/22

6. Conclusions

The test has been executed according to the test plan.
With exception of the damage occurred during the compression test no remarkable-unexpected events and/or damage has occurred before, during or after the test to the DUT.
Despite the poor pallet quality the tested configuration maintained the position of the plastic drums on the pallet bottom.

The Drumclip system in combination with the defined lashing configuration is fully capable to ensure safe individual mechanical pallet handling and warehouse stacking.

Eindhoven, August 20, 2019

Marten Ries
Sr. Project Engineer

Checked and approved by:

Marijn Sijbers
Test Engineer

Reference : IPS 7898 - 82
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Appendix A. ISTA Certified Testing Laboratory

Figure 9. IPS Technology ISTA Laboratory Certification

Reference : IPS 7898 - 82
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Appendix B. Test Equipment: Impact Tester

Fabrikant
IPS Technology

Oppervlakte
245x250 cm

Max. productmassa
1300 kg

Opspanning
Horizontaal

Botssnelheden
2-10 km/h

Datalogging
Snelheidsmeetsysteem registreert de snelheid bij botsing

Optioneel
Versnellingsmetingen aan het product met een drie-assige versnellingsopnemer

Normen (o.a.):
ASTM D 5487
ISO 2244

Reference : IPS 7898 - 82
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Appendix C. Test Equipment : Shaker

- Manufacturer : Lansmont model 10000 TTV II
- Max. specimen size : 152 x 152 cm
- Max. specimen weight : 2200 kg
- Max. amplitude (peak to peak) : 6,4 cm
- Frequency-range : 3 - 300 Hz
- Frequency-rang at max. load : 3 - 200 Hz
- Acceleration range : 0 - 8 g
- Max. acceleration at max. load : 2 g
- Automatic displacement or acceleration control
- Automatic sweep generator and random vibration facilities (Lansmont TouchTest Vibration system)
- Accelerometer

Reference : IPS 7898 - 82
Page : 20/22

Appendix D. Impact speed

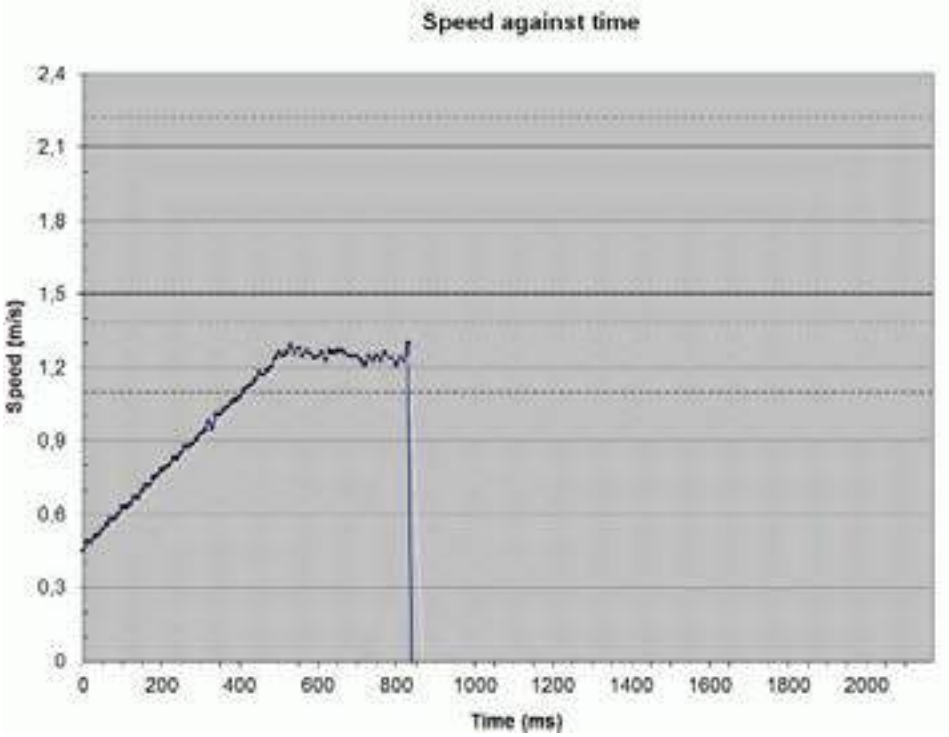

Figure 10. Impact speed >1,2m/s

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Appendix E. Compression test graph

Figure 11. Compression test graph – Apply and release compression test

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Appendix F. Power Spectral Densities Profile

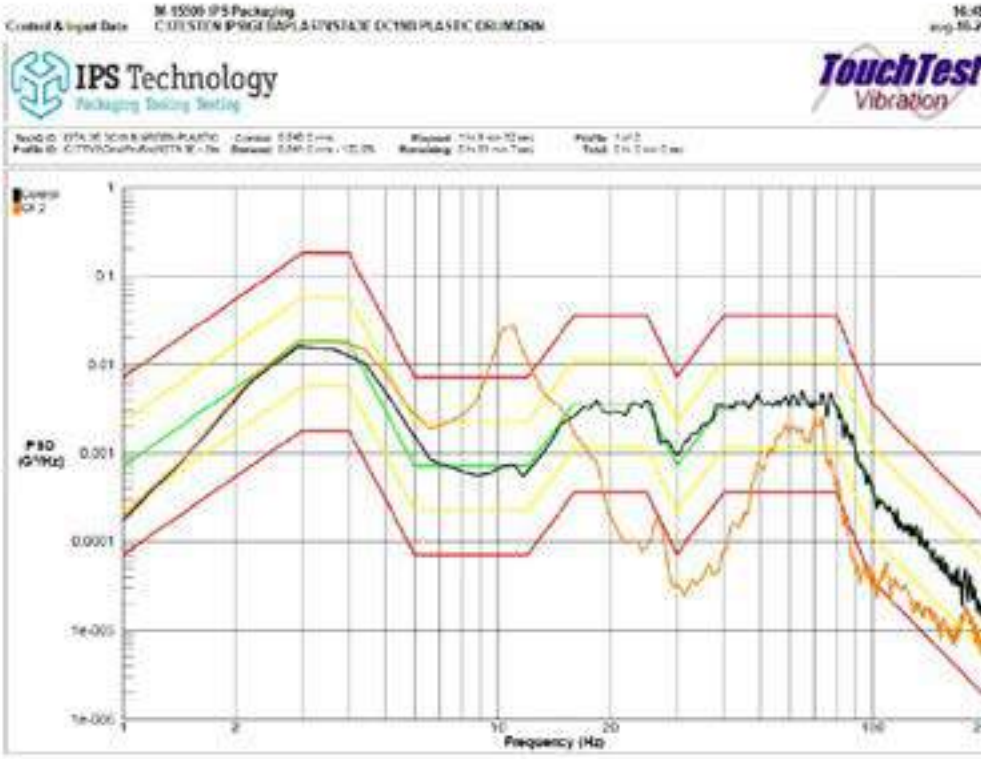


Figure 12. Power Spectral Densities - ISTA Steel Spring Truck Random Vibration; 1 hr 9min.

Remark; accelerometer Ch2 placed on top of the Drumclip for response monitoring (examination only).

5.7 Test Report EUMOS | DRUMCLIP DC19B GREEN

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip test	Reference PE DC 19 B 4 S4	Revision 01

1. Load unit descriptive data

- *Dimensions (mm):* 1000 X 1150 X 1150
- *Weight (kg):* 850
- *Center of Gravity (mm):* H 600 x L575 x W575
- *Nature of the Products:* Plastic drums
- *Description of Primary Pack:* 4 plastic drums SIGNODE 4 Straps 4 drumclips DC 19 B Green
- *Layer Stacking pattern:* 1 layer of 4 drums
- *Type of Pallet:* CP 9
- *Responsible of the description:* Dhr. Wouter Geldhof

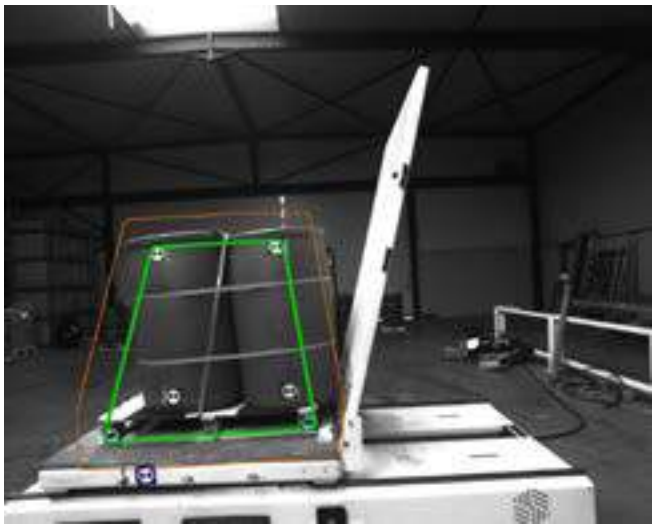
EUMOS 40509 - 4 Plastic Drums DC19B Signode - page 1

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip test	Reference PE DC 19 B 4 S4	Revision 01

2. Test related data

2.1. Orientation of the test: Length

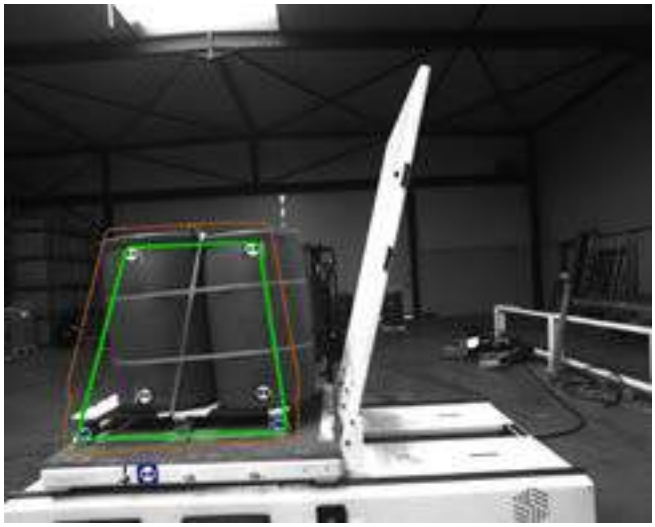
- *Date of Test:* 10/5/2022
- *Place:* Brugge
- *Rigidity (g):* 0.80G
- *Testing History:* non



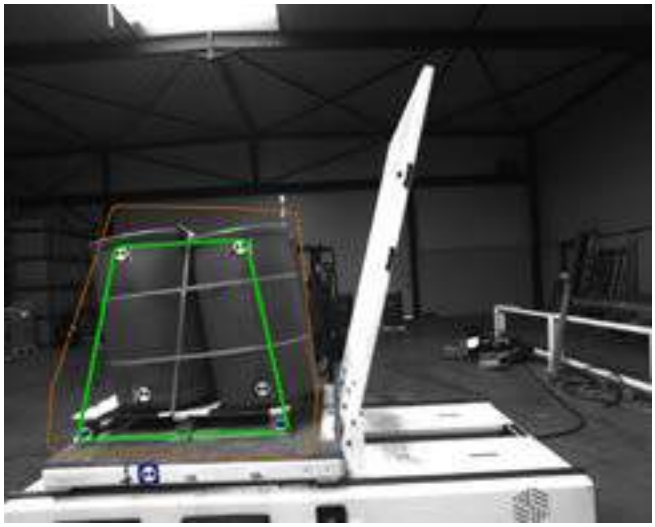
Load Before Test

5. Plastic drums

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip test	Reference PE DC 19 B 4 S4	Revision 01



Permanent Deformation



Max Elastic Deformation

Standard EUMOS 40509 – TEST REPORT			
	Customer DRUMCLIP	Date 10-5-2022	
	Project Drumclip test	Reference PE DC 19 B 4 S4	Revision 01

3. Test Validation

- *Temperature of the test area:* 22°
- *Humidity of the test area:* 65%
- *Responsible of Report:* Dhr. Geert Frans
- *Sign:*