

Transport Simulation Test Report

Single-Use Shipper with 20 X 20 L CryoVault® Containers



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* For the purpose of this report, Meissner's CryoVault® container is referred to by its total capacity (20 L) not by its maximum fill volume (16 L).

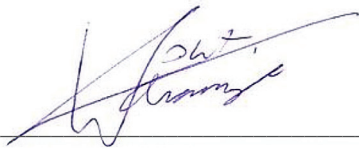
Approval Signatures



Written: _____ Date: 12 February 2024

Antonio Francisco da Fonseca

Topa Institute, Mechanical Project Engineer



Verified: _____ Date: 12 February 2024

Wout Adriaanse

Topa Institute, Thermal Project Coordinator

Date: 12 February 2024
Report number: T23-1239
Revision: 0
Research Date: 26 January 2024

Customer: Topa Thermal
Torenlaan 10
2215 RW Voorhout
The Netherlands

Test Facility: Topa Thermal
Torenlaan 10
2215 RW Voorhout
The Netherlands

Abstract: This report details the methods, specifications and results for the transport simulation of Single-Use Shipper with 20 x 20 L CryoVault® containers.

2. Test Overview

2.1 Objective

The objective of this test is to investigate the influence of worldwide pallet transport on the Single-Use Shipper with 20 x 20 L CryoVault® containers.

2.2 Test Results

The Single-Use Shipper with 20 x 20 L CryoVault® containers has been tested with the following results:

Test	Results
Preconditioning & Packing	No remarks
Rotational Corner Drop	No remarks
Rotational Flat Drop	No remarks
Random Vibration	No remarks
Rotational Corner Drop	No remarks
Rotational Flat Drop	No remarks

2.3 Conclusions

No visual damage to the outside of the pallet load or on the CryoVault® containers. The Single-Use Shipper with 20 x 20 L CryoVault® containers is suitable for worldwide pallet transport.

2.4 Recommendations

Corrugated cardboard has a lower tolerance for humidity than plastic. Replacing the current CryoVault® handling box from corrugated cardboard to 3 mm corrugated plastic will improve the performance of the handling box.

3. Test Product

The test product consists of:

Insulated Container

Description: One fully conditioned KCVS-DS0001A

Dimensions: 1,570 x 1,100 x 1,610 mm

Weight: 360.0 kg (including dry ice)

The KCVS-DS0001A will contain the following product load:

Product Load

Description: One pallet load containing 20 CryoVault® containers.

Dimensions: 1,200 x 800 x 1,280 mm

Weight: 151.0 kg

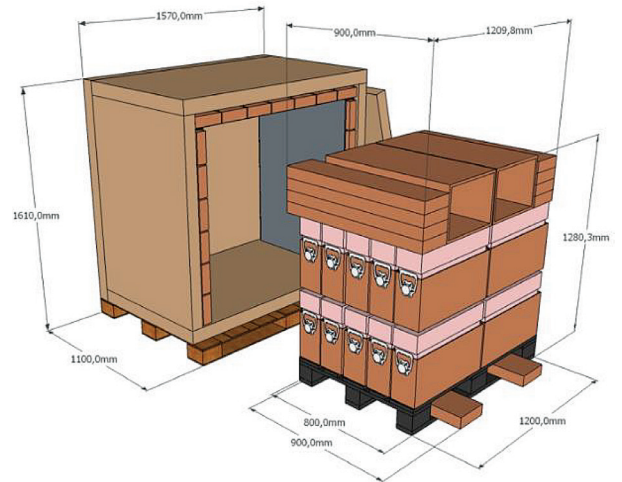


Figure 1: Fully packed GTS-1150L4D-DI container

4. Test Procedure

The testing procedure, according ASTM D4169-22, Distribution Cycle 2, consists of the following parts:

4.1 Pre-Test Inspection

Before the start of the test, the bags, components, and the insulated containers are inspected by an engineer from Topa Institute. Any damage or irregularities are noted. All faces of the test pallet are identified according to **Figure 2**, where Face 5 is one of the smallest vertical faces of the pallet.

4.2 Preconditioning & Packing

The CryoVault® containers are conditioned at -80 °C for at least 72 hours prior to packing. Once the CryoVault® containers are conditioned, a pallet load of 20 CryoVault® containers are built and placed inside the container before the start of the test.

4.3 Rotational Corner Drop Test (Method B)

A rotational corner drop test is conducted with a loaded pallet. Four drops are conducted; one drop on each corner of the pallet. The opposite corner of the corner on which the pallet is dropped is supported by a 100 mm thick piece of timber.

The drop height depends on the weight of the pallet. This test is based on ASTM D4169-22 and D6179-07 (Assurance Level II, Method B).

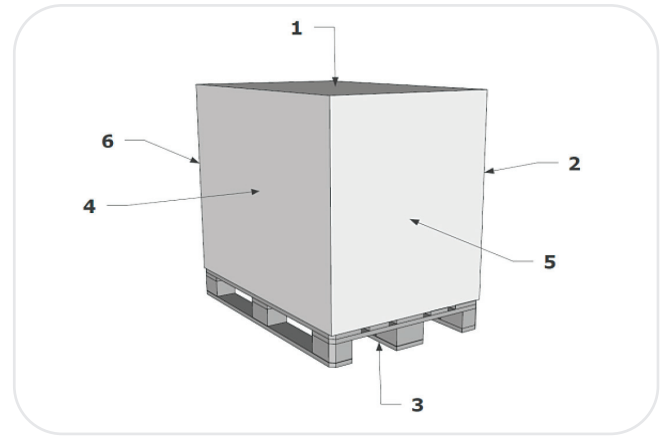


Figure 2: Conditioning setup

Pallet Weight	Assurance Level I	Assurance Level II	Assurance Level III
0 to 226.8 kg	305 mm	229 mm	152 mm
226.8 kg and up	229 mm	152 mm	76 mm

Table: Drop Heights



Figure 3: Rotational Corner Drop setup



Figure 4: Rotational Flat Drop Test

4.4 Rotational Flat Drop Test (Method C)

A rotational flat drop test is conducted with a loaded pallet. Two drops are conducted; one drop on the handling side of the pallet and one drop on the opposite side of the pallet. If the pallet can be handled in all directions, a flat drop on all four sides is conducted. The drop height depends on the weight of the pallet. This test is based on ASTM D4169-22 and D6179-07 (Assurance Level II, Method C).

Pallet Weight	Assurance Level I	Assurance Level II	Assurance Level III
0 to 226.8 kg	305 mm	229 mm	152 mm
226.8 kg and up	229 mm	152 mm	76 mm

Table: Drop Heights

4.5 Random Vibration Test

4.5.1 Truck Transport

In order to simulate vibrations during truck transport, a random vibration test is conducted. Three test profiles from ASTM D4169-22 and D4728-17 are used with a frequency range from 1 Hz to 200 Hz and average loads of 0.40 Grms for 40 minutes, 0.54 Grms for 15 minutes, and 0.70 Grms for 5 minutes. The entire test lasts 60 minutes.

	Truck Low Level	Truck Medium Level	Truck High Level
Average Load	0.40 Grms	0.54 Grms	0.70 Grms
Test Duration	40 minutes	15 minutes	5 minutes

Table: Random Truck Vibration Test Distribution



Figure 5: Random Vibration Test setup

4.5.2 Air Transport

In order to simulate vibrations during air transport, a random vibration test is conducted. Three test profiles from ASTM D4169-22 and D4728-17 are used with a frequency range from 1 Hz to 200 Hz and average loads of 0.16 Grms for 27 minutes, 0.22 Grms for 10 minutes, and 0.29 Grms for 3 minutes. This sequence is repeated three times. The entire test lasts 120 minutes.

	Air Low Level	Air Medium Level	Air High Level
Average load	0.16 Grms	0.22 Grms	0.29 Grms
Test duration	27 minutes (3x)	10 minutes (3x)	3 minutes (3x)

Table: Random Air Vibration Test Distribution

4.6 Rotational Corner Drop Test (Method B)

A rotational corner drop test is conducted with a loaded pallet. Four drops are conducted; one drop on each corner of the pallet. The opposite corner of the corner on which the pallet is dropped is supported by a 100 mm thick piece of timber. The drop height depends on the weight of the pallet. This test is based on ASTM D4169-22 and D6179-07 (Assurance Level II, Method B).

Pallet Weight	Assurance Level I	Assurance Level II	Assurance Level III
0 to 226.8 kg	305 mm	229 mm	152 mm
226.8 kg and up	229 mm	152 mm	76 mm

Table: Drop heights

4.7 Rotational Flat Drop Test (Method C)

A rotational flat drop test is conducted with a loaded pallet. Two drops are conducted; one drop on the handling side of the pallet and one drop on the opposite side of the pallet. If the pallet can be handled in all directions, a flat drop on all four sides is conducted. The drop height depends on the weight of the pallet. This test is based on ASTM D4169-22 and D6179-07 (Assurance Level II, Method C).

Pallet Weight	Assurance Level I	Assurance Level II	Assurance Level III
0 to 226.8 kg	305 mm	229 mm	152 mm
226.8 kg and up	229 mm	152 mm	76 mm

Table: Drop Heights

4.8 Post-Test Inspection

After all tests are performed, the bags, components, and the insulated containers are inspected by an engineer from Topa Institute. Any damage or irregularities are noted.

5. Test results

5.1 Pre-Test Inspection

Before the tests are performed, the outside of the pallet load is visually inspected by an engineer from Topa Institute.

Observations:

No remarks.

5.2 Preconditioning & Packing

The CryoVault® containers are conditioned at -80 °C for at least 72 hours prior to packing.

Observations:

No remarks.



Figures 6 to 9: Packing

5.3 Rotational Corner Drop Test (Method B)

Weight: Product/Packaging Combination	511.0 kg
Drop Height	152 mm
Faces Tested	5, 2, 6, and 4

Table: Rotational Corner Drop Test

Observations:

No remarks.

5.4 Rotational Flat Drop Test (Method C)

Weight: Product/Packaging Combination	511.0 kg
Drop Height	152 mm
Faces Tested	5, 2, 6, and 4

Table: Rotational Corner Drop Test

Observations:

No remarks.

5.5 Random Vibration Test

	Truck Low Level	Truck Medium Level	Truck High Level
Average Load	0.40 Grms	0.54 Grms	0.70 Grms
Test Duration	40 minutes	15 minutes	5 minutes

Table: Random Truck Vibration Test Distribution Results

	Air Low Level	Air Medium Level	Air High Level
Average Load	0.16 Grms	0.22 Grms	0.29 Grms
Test Duration	27 minutes (3x)	10 minutes (3x)	3 minutes (3x)

Table: Random Air Vibration Test Distribution Results

Results graphs for the random vibration tests can be found in Appendix B.

Observations:

No remarks.

5.6 Rotational Corner Drop Test (Method B)

Weight: Product/Packaging Combination	511.0 kg
Drop Height	152 mm
Faces Tested	5, 2, 6 and 4

Table: Rotational Corner Drop Test Results

Observations:

No remarks.

5.7 Rotational Flat Drop Test (Method C)

Weight: Product/Packaging Combination	511.0 kg
Drop Height	152 mm
Faces Tested	5, 2, 6 and 4

Table: Rotational Flat Drop Test Results

Observations:

No remarks.

5.8 Post-Test Inspection

After all tests are performed, the test product is thawed at lab conditions and is visually inspected with the following results:

Observations:

No visual damage to the outside of the pallet load.

No damage is found on the CryoVault® containers.



Figures 10 and 11: Pallet load after testing

The Topa Institute for packaging and distribution is emphasizing its activities on research and the optimization of products and packaging in their performance during their actual lifetime and distribution. Concerning advice and research, the Topa Institute for packaging and distribution is independent from any company, institute, or organization.

Responsibility

The Topa Institute for packaging and distribution or people acting in research activities are not responsible for damage sustained after use of results of research activities.

Appendix A: Applied Testing Equipment

1. Vibration Test System

• Manufacturer:	Lansmont Model 10000 TTV II
• Maximum size:	152 x 152 cm
• Maximum specimen weight:	1,100 kg
• Maximum amplitude (peak to peak):	6.4 cm
• Frequency range:	1 - 300 Hz
• Frequency range at maximum load:	1 - 200 Hz
• Acceleration range:	0 - 8 g
• Maximum acceleration at maximum load:	0.77 g
• Automatic displacement or acceleration control	
• Automatic sweep generator and random vibration facilities (Lansmont TouchTest Vibration system)	
• Accelerometer	
• Calibration due date:	June 2024

Certificate of Calibration

Certificate number: TC-6013-6

Applicant	Name:	Topa Instituut
	Address :	Torenlaan 10 2215 RW Voorhout

Shaker System	Manufacturer :	Lansmont
	Model	10000 TTV2
	Serial number	M-15356
	Customer ID nr	-

Ref transducer	Manufacturer :	Kistler
	Model	8704B100
	Serial number	2097568
	Customer ID nr	-

Calibration method:

The calibration was performed on site. A reference accelerometer is attached near to the center of the table and the values are compared to the display read out values of the system. Overall values are measured and FFT spectra taken

Uncertainties:

The uncertainties were calculated in accordance with EA-4/02: Expression of Uncertainty of Measurement in Calibration. A coverage factor of 2 sigma ($k=2$) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95%. Uncertainty 5 %

Traceability:

The measurements have been executed using standards traceable to (inter)national standards. Supporting documentation relative to traceability is on file and is available on request

Environmental conditions:

Air pressure	-	hPa
Temperature	-	°C
Relative humidity	-	%

Date of Receipt	At location in Voorhout
Date of Calibration :	15 juni 2023
Date of Certificate :	15 juni 2023



Ing. P. Smit

Authorized Signatory : Calibration Manager



Visual Inspection

Results

Connectors Ok
Housing mechanics Ok

Reference transducer fixing Wax and cable protectors

The input is generated by applying several known profiles

The values are then compared with a calibrated accelerometer output. Profiles are measured from 1 Hz to 1 kHz as Overall value.

If the significant frequency is known then measured with a FFT analyser from 0 - 500 Hz with a 0,625 Hz bandwidth.

Calibration profile : ASTM D 4169-09 rail level III

Ref value	Displayed value LANSMONT	Deviation	Unit
0,209	0,204	-0,005	g RMS

Calibration profile : ASTM D 4169-09 truck level II

Ref value	Displayed value LANSMONT	Deviation	Unit
0,528	0,521	-0,007	g RMS

Calibration profile : ASTM D 4169-09 air level I

Ref value	Displayed value LANSMONT	Deviation	Unit
1,538	1,510	-0,028	g RMS

Calibration profile : ASTM D 4169-09 air low 2022

Ref value	Displayed value LANSMONT	Deviation	Unit
0,163	0,157	-0,006	g RMS

Calibration profile : ISTA 3 A Pickup and delivery

Ref value	Displayed value LANSMONT	Deviation	Unit
0,460	0,458	-0,002	g RMS

Calibration profile : 1 " loose load test

4 Hz

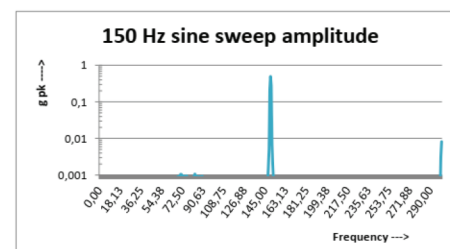
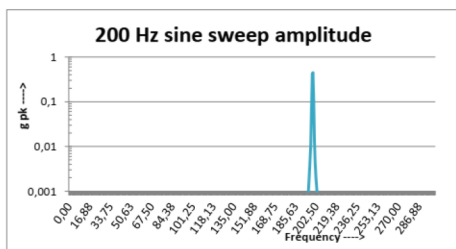
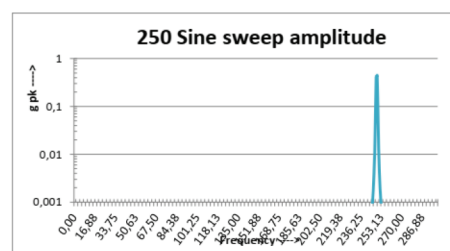
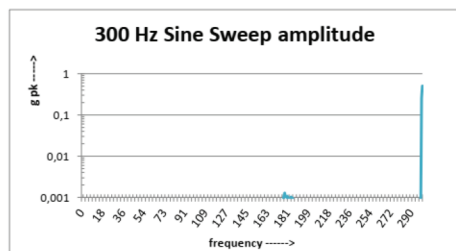
Ref value 4Hz	Displayed value LANSMONT	Deviation	Unit
0,730	0,820	0,090	g pk



Calibration profile : Sine Sweep 3 - 300 Hz

Frequency in Hz	Ref value in g pk	Displayed value LANSMONT in g pk	Deviation in g pk
5	0,533	0,500	-0,033
10	0,510	0,500	-0,010
20,1	0,501	0,500	-0,001
40,2	0,507	0,500	-0,007
80	0,504	0,500	-0,004
150,1	0,496	0,500	0,004
199,7	0,514	0,500	-0,014
250	0,513	0,500	-0,013
300	0,504	0,500	-0,004

With $g = 9,80665 \text{ m/s}^2$

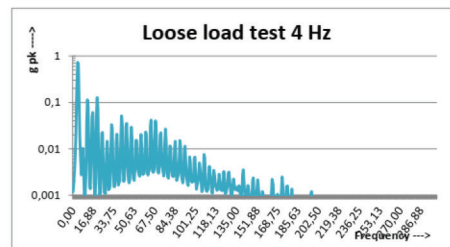
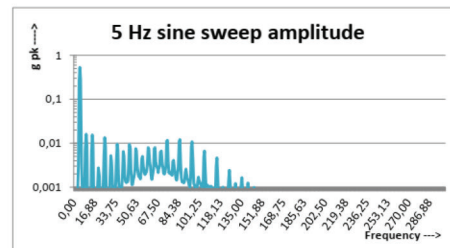
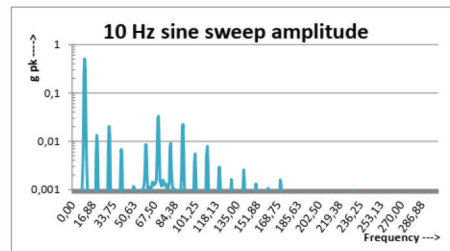
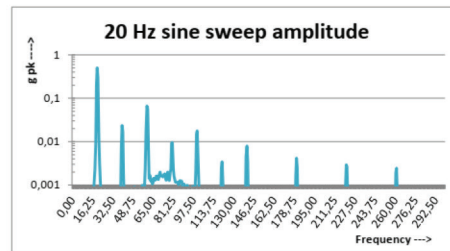
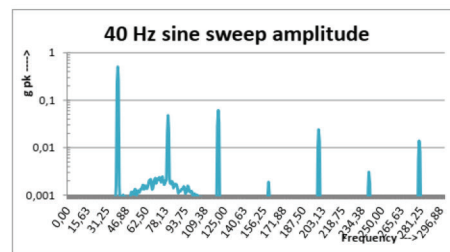
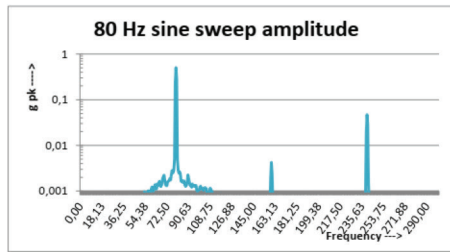


TC-6013-6

Certificate nr.: TC-6013-6

Reproduction of the complete certificate is allowed. Parts of the certificate may only be reproduced with written approval of Sonor Kalibratie Laboratory.

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2. Pulley Block

• Manufacturer:	Demag
• Lifting capacity:	1,250 kg
• Hoisting velocity:	4 m/min or 2 m/min
• Year of construction:	2005
• Inspection due date:	April 2024

V	MENNENS Amsterdam	020-5811811
	MENNENS Dongen	0162-383800
	MENNENS Groningen	050-3183031
	MENNENS Hengelo	074-2503504
	MENNENS Rotterdam	010-4373033

Opdrachtgever	Topa Verpakking bv	Werktuignummer	Kraan 1							
Adres	Torenlaan 10	Bouwjaar	01-01-2005							
Plaats	2215 RW Voorhout	Capaciteit	1.250				kg	2		
Opdrachtnummer	760628	Hijshoogte	3.0	mtr.	FEM	1Cm	Hoogste Hijssnelh.	4/1	m/min.	
Keuringsdatum	29 maart 2023	Locatie	Topa Instituut							



BASISGEGEVENS > FABRIKAAT / MERK		Snelheden	MODEL / TYPE	SERIENUMMER	Electr.	Luft	Hydr	Hand	Dww
Kraan	Demag		Katbalk INP180x7000						
Takel	Demag	2V	DKUN 5-630 K V1 F4	61655659	V				
Loopkat	Demag		EU-RU 11 DK	61655659				V	

100	ALGEMEEN	A	B	C	400	HUIZEN / VIERN	TAKEL 1			TAKEL 2			600	KRAANRIJDEN	A	B
							A	B	C	A	B	C				
101	Kraanboek aanwezig	-	-	-	401	Elektromotor	-	-	-	-	-	-	601	Elektromotor	-	-
102	Staalabelcertificaat	-	-	-	402	Koppeling	-	-	-	-	-	-	602	Koppeling	-	-
103	Lastkettincertificaat	-	-	-	403	Remtrommel	-	-	-	-	-	-	603	Remtrommel	-	-
104	Lasthaakcertificaat	-	-	-	404	Remvoering (mm)	V	-	-	-	-	-	604	Remvoering (mm)	-	-
105	Overzichtstekeningen	-	-	-	405	Remschijf (mm)	V	-	-	-	-	-	605	Remschijf (mm)	-	-
106	Schema's	-	-	-	406	Rembeweging (slag mm)	V	-	-	-	-	-	606	Rembeweging (slag mm)	-	-
107	Berekening lastdragende delen	-	-	-	407	Worm- / tandwielkasten	V	-	-	-	-	-	607	Worm- / tandwielkasten	-	-
108	Toegang voor onderhoud	V	-	-	408	Open tandwiel overbrenging	V	-	-	-	-	-	608	Open tandwiel overbrenging	-	-
109	Onderhouds- / bediening voorschriften	-	-	-	409	Assen en lagers	V	-	-	-	-	-	609	Assen en lagers	-	-
110	EG-verklaring (CE)	-	-	-	410	Bevestiging aandrijving	V	-	-	-	-	-	610	Bevestiging aandrijving	-	-
111	Draaglast aanduiding	V	-	-	411	Hulprembeweging of 2e rem	V	-	-	-	-	-	611	Hulprembeweging of 2e rem	-	-
112	Functietest beveiligingen	-	-	-	412	Nestenschijf	V	-	-	-	-	-	612	Loopwielen / Rondsels	-	-
113	Controle verlichting	-	-	-	413	Staalakabels (mm)	-	-	-	-	-	-	700	ELEKTRISCH GEDEELTE	A	B
200	CONSTRUCTIE	A	B	C	414	Staalakabelbevestiging	-	-	-	-	-	-	701	Hoofdschakelaar	V	-
201	Bevestiging kraanbaan	-	-	-	415	Kabelschijven en lagers	-	-	-	-	-	-	702	Hoofdstroomramp (open)	-	-
202	Kraanbaan	-	-	-	416	Kabelgeleider / -spanning	-	-	-	-	-	-	703	Koker sleepleidingen	-	-
203	Katbaan	V	-	-	417	Lastkettincertificaat (D 5.3 x 15.2 mm)	V	-	-	-	-	-	704	Kabelkat installatie	V	-
204	Speling loopvlak / wielwiel	V	-	-	418	Kettingbak / -zak	V	-	-	-	-	-	705	Kabelhaspel	-	-
205	Portaal van de kraan	-	-	-	419	Kettingbevestiging / -eindstop	V	-	-	-	-	-	706	Bekabeling	V	-
206	Staaners (vaste bok)	-	-	-	420	Kettingen en lagers	V	-	-	-	-	-	707	Kabeldoorvoering / -wartels	-	-
207	Hoofddrager en hulpdrager	-	-	-	421	Slipkoppeling	V	-	-	-	-	-	708	Schakelkasten	-	-
208	Wielkasten	-	-	-	422	Ophangoog / -haak	V	-	-	-	-	-	709	Verdeelkasten	-	-
209	Baan eindstoppen / Buffers	V	-	-	423	Hijshaak / Onderblok(Y mm)	-	1	1	-	-	-	710	Stuurstroomgedeelte 400 V	-	-
210	Zwenkarm en kolom	-	-	-									711	Aarding	-	-
211	Draaikransen	-	-	-									712	Weerstand	-	-
212	Trappen en bordessen	-	-	-									713	Hangdruknopkast	V	-
213	Lasverbindingen	-	-	-	500	KATRIJDEN	LOOPKAT 1			LOOPKAT 2			714	Draadloze besturing	-	-
214	Bout- / penvbindingen	V	-	-			A	B	C	A	B	C	715	Akoestische / optische signalering	-	-
215	Uithouders	V	-	-	501	Elektromotor	-	-	-	-	-	-	716	Lastaanwijzingen	-	-
216	Conservering	V	-	-	502	Koppeling	-	-	-	-	-	-	717	Bedrijfsuren teller : uur	-	-
300	BEVEILIGINGEN / VEILIGHEID	A	B	C	503	Remtrommel	-	-	-	-	-	-	718	beschermingsleiding (NEN 3140)	-	-
301	Ontsporing- / opwip beveiliging (BL)	-	-	-	504	Remvoering (mm)	-	-	-	-	-	-		aantal metingen:		
302	Ontsporing- / opwip beveiliging (OH)	V	-	-	505	Remschijf (mm)	-	-	-	-	-	-	719	isolatieweerstand (NEN 3140)	-	-
303	Stormverankering	-	-	-	506	Rembeweging (slag mm)	-	-	-	-	-	-		aantal metingen:		
304	Overlast beveiliging	-	1	14	507	Worm- / tandwielkasten	-	-	-	-	-	-	720	aardlekschakelaar (NEN 3140)	-	-
305	Beveiliging overbelastingstroom	-	-	-	508	Open tandwiel overbrenging	-	-	-	-	-	-	800	Cabine	A	B
306	Werk- / eindschakelaars hysen	-	-	-	509	Assen en lagers	V	-	-	-	-	-	801	Constructie	-	-
307	Werk- / eindschakelaars katrijden	-	-	-	510	Bevestiging aandrijving	-	-	-	-	-	-	802	Standencontrollers	-	-
308	Werk- / eindschakelaars kraanrijden	-	-	-	511	Hulprembeweging of 2e rem	-	-	-	-	-	-	803	Verlichting Cabine	-	-
309	Botsbeveiliging	-	-	-	512	Loopwielen / Rondsels	V	-	-	-	-	-	804	Verwarming / koeling cabine	-	-
310	Zone- / inlokbeveiliging	-	-	-									805	Brandblusmiddelen	-	-
311	Noodstopvoorziening	V	-	-									806	Vluchtmiddelen / -mogelijkheden	-	-

- A GEEN GEBREK
B GEBREK RISICOKLASSE, ZIE BLAD Opm.
C OPMERKING NUMMER, ZIE BLAD Opm.

000	afsluitende beoordeling	
001	hoogst gemeten risicoklasse	1
002	kraan vrijgegeven	Ja
003	kraan afgetest met proeflast	Ja
004	goedkeuringssticker geplakt	Ja
005	stickernummer:	

423 Onderblok kan niet naar de grond i.v.m. aanwezig valklem in haak.

Naam keurmeester :	T. de Groot
Handtekening	
Naam contactpersoon :	
Handtekening	

3. Pallet Truck With Weighing Scale

• Manufacturer pallet truck:	Toyota BT Lifter LHM200SC
• Manufacturer weighing scale:	Ravas
• Range weighing scale:	0.0 – 2,000.0 Kg ($\pm 0.1\%$)
• Record:	Digital
• Dimensions weighing platforms:	1,190 x 540 mm
• Year of construction:	2019
• Calibration due date:	April 2024

Mettler Toledo B.V.
Franklinstraat 5
4004 JK
TIEL (NL)
0344-638363



Kalibratiecertificaat

Accuracy Calibration Certificate

Klant

Bedrijfsnaam: Topa Verpakking BV
Adres: Torenlaan 10
Plaats: VOORHOUT Contactpersoon: Brigitte Zwart
Postcode: 2215 RW

Weeginstrument

Fabrikant: TOYOTA Type apparaat: Weeginstrument
Model: LHM200SC / 2000kg Inventarisnr: n.v.t.
Serienr: 21903798.191402 Terminal type: n.v.t.
Gebouw: Loods Terminal serienr.: n.v.t.
Verdieping: BG Terminal inv.nr.: n.v.t.
Kamer: Expeditie

Bereik	Max. capaciteit	Afreesbaarheid (d)
1	200 kg	0,2 kg
2	500 kg	0,5 kg
3	2000 kg	1 kg

Procedure

Kalibratierichtlijn: EURAMET cg-18 v. 4.0 (11/2015)
Mettler Toledo Werkinstructie: WI CAL 02

De kalibratie werd uitgevoerd bij de klant, tenzij anders aangegeven bij opmerkingen.

Het weeginstrument werd bijgeregeld vóór de nacontrole met een extern kalibratiegewicht.

In overeenstemming met EURAMET cg-18 (11/2015) werden de testbelastingen geselecteerd om het specifieke gebruik van de weeginrichting weer te geven of om rekening te houden met specifieke kalibratievoorwaarden.

	Temperatuur	
Voorcontrole	Start: 18,3 °C	Einde: 18,3 °C
Nacontrole	Start: 17,5 °C	Einde: 17,5 °C

Datum voorcontrole: 14-apr-2023 Servicetechnicus: 
Datum nacontrole: 14-apr-2023
Datum van uitgifte: 14-apr-2023
Gewenste volgende kalibratiedatum: 30-apr-2024 Eric Geurtsen

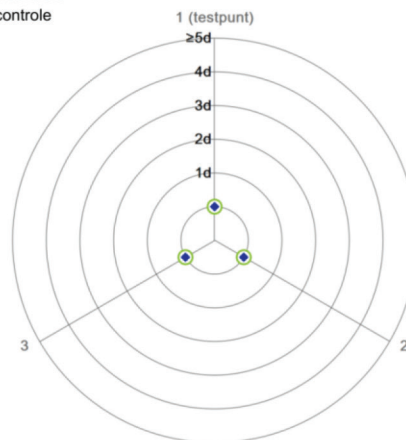
Meetresultaten

Herhaalbaarheid

Testgewicht: 200 kg

	Voorcontrole	Nacontrole
1	201,5 kg	200,0 kg
2	201,5 kg	200,0 kg
3	201,5 kg	200,0 kg

○ Voorcontrole
◆ Nacontrole



std afwijking	0,00 kg	0,00 kg
---------------	---------	---------

De "d" in de grafiek vertegenwoordigt de afleesbaarheid van het bereik waarin de test werd uitgevoerd

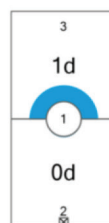
De resultaten in de grafiek zijn gebaseerd op de absolute waarden als verschil van de gemiddelde waarde.

Excentrische belasting

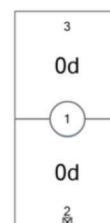
Testgewicht: 750 kg

Positie	Voorcontrole	Nacontrole
1	756 kg	750 kg
2	756 kg	750 kg
3	757 kg	750 kg

Maximale afwijking	1 kg	0 kg
--------------------	------	------



Voorcontrole



Nacontrole

De "d" in de grafiek vertegenwoordigt de afleesbaarheid van het bereik waarin de test werd uitgevoerd

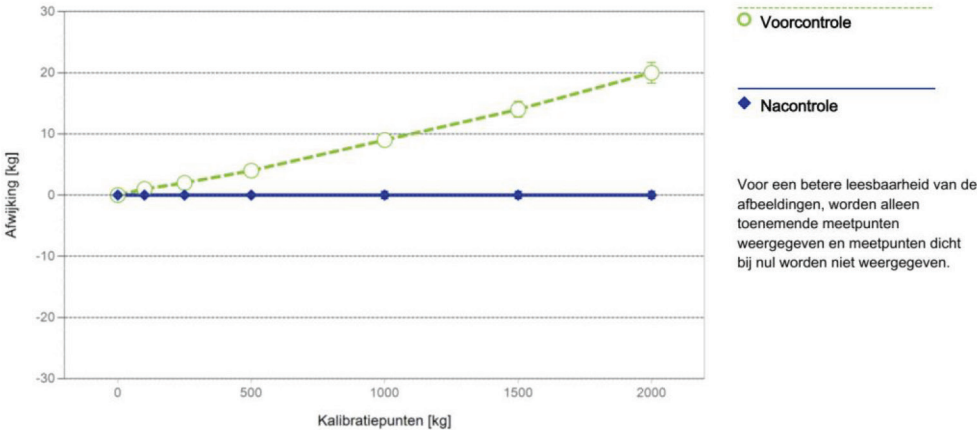
Afwijking

Voorcontrole

	Referentiewaarde	Aflezings	Afwijking	Vergrote onzekerheid	k
1	0 kg	0,0 kg	0,0 kg	0,12 kg	2
2	20 kg	20,0 kg	0,0 kg	0,16 kg	2
3	100 kg	101,0 kg	1,0 kg	0,18 kg	2
4	250 kg	252,0 kg	2,0 kg	0,37 kg	2
5	500 kg	504 kg	4 kg	0,7 kg	2
6	1000 kg	1009 kg	9 kg	1,0 kg	2
7	1500 kg	1514 kg	14 kg	1,3 kg	2
8	2000 kg	2020 kg	20 kg	1,7 kg	2

Nacontrole

	Referentiewaarde	Aflezings	Afwijking	Vergrote onzekerheid	k
1	0 kg	0,0 kg	0,0 kg	0,12 kg	2
2	20 kg	20,0 kg	0,0 kg	0,16 kg	2
3	100 kg	100,0 kg	0,0 kg	0,16 kg	2
4	250 kg	250,0 kg	0,0 kg	0,31 kg	2
5	500 kg	500 kg	0 kg	0,31 kg	2
6	1000 kg	1000 kg	0 kg	0,6 kg	2
7	1500 kg	1500 kg	0 kg	0,6 kg	2
8	2000 kg	2000 kg	0 kg	0,6 kg	2



De gerapporteerde onzekerheid is de vergrote onzekerheid, ontstaan door de standaardonzekerheid te vermenigvuldigen met een dekkingsfactor k , welke groter kan zijn dan 2 volgens EURAMET cg-18. Deze waarde ligt binnen een betrouwbaarheidsinterval van ongeveer 95 %. De standaardonzekerheid is bepaald volgens EA-4/02. Mettler Toledo adviseert de gebruiker om dezelfde omgevingscondities en dezelfde instellingen van het weeginstrument te handhaven als waren deze tijdens het uitvoeren van de kalibratie.

Testapparatuur

De metingen zijn uitgevoerd met standaarden waarvan de herleidbaarheid naar (inter-)nationale standaarden is aangetoond. Deze standaarden werden gekalibreerd en gecertificeerd door een geaccrediteerd kalibratielaboratorium.

Gewichtenset 1: OIML F1

Gewichtensetnr.:	798	Datum van uitgifte:	14-mrt-2023
Certificaatnummer:	E23/073/036	Volgende kalibratiedatum:	14-mrt-2024

Gewichtenset 2: OIML M1

Gewichtensetnr.:	DO6	Datum van uitgifte:	26-sep-2022
Certificaatnummer:	E22/269/029	Volgende kalibratiedatum:	26-sep-2023

Gewichtenset 3: OIML M1

Gewichtensetnr.:	C041	Datum van uitgifte:	26-sep-2022
Certificaatnummer:	E22/260/026	Volgende kalibratiedatum:	26-sep-2023

Gewichtenset 4: OIML M1

Gewichtensetnr.:	C040	Datum van uitgifte:	26-sep-2022
Certificaatnummer:	E22/269/022	Volgende kalibratiedatum:	26-sep-2023

Gewichtenset 5: OIML M1

Gewichtensetnr.:	B008	Datum van uitgifte:	26-sep-2022
Certificaatnummer:	E22/269/021	Volgende kalibratiedatum:	26-sep-2023

Gewichtenset 6: OIML M1

Gewichtensetnr.:	B010	Datum van uitgifte:	26-sep-2022
Certificaatnummer:	E22/269/021	Volgende kalibratiedatum:	26-sep-2023

Opmerkingen

De gebruiker dient de prestaties van de apparatuur ter plaatse opnieuw te verifiëren met de juiste normen voorafgaand aan gebruik

Meetonzekerheid van het weeginstrument in gebruik

De opgegeven onzekerheid is de vergrote onzekerheid met $k = 2$ in gebruik. De formule dient gebruikt te worden voor een inschatting van de onzekerheid met inachtneming van de lineariteit. De R-waarde is de netto aflezing in de afleeseenheid van het apparaat.

Temperatuurcoëfficiënt t.b.v. de bepaling van de meetonzekerheid in gebruik: $10,0 \cdot 10^{-6} / K$

Temperatuurbereik ter plaatse t.b.v. de bepaling van de meetonzekerheid in gebruik: 20 K

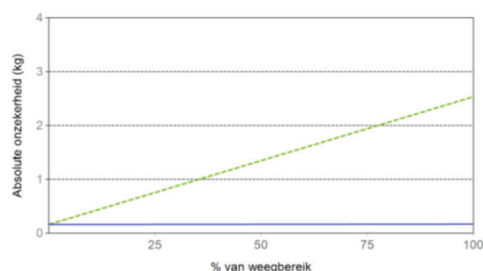
Formule ten behoeve van de onzekerheidsberekening

	Bereik		Voorcontrole	Nacontrole
	d	Max		
1	0,2 kg	200 kg	$U_1 = 163 \text{ g} + 11,9 \text{ g/kg} \cdot R$	$U_1 = 163 \text{ g} + 0,0333 \text{ g/kg} \cdot R$
2	0,5 kg	500 kg	$U_2 = 311 \text{ g} + 12,0 \text{ g/kg} \cdot R$	$U_2 = 311 \text{ g} + 0,0431 \text{ g/kg} \cdot R$
3	1 kg	2000 kg	$U_3 = 589 \text{ g} + 12,3 \text{ g/kg} \cdot R$	$U_3 = 589 \text{ g} + 0,0825 \text{ g/kg} \cdot R$

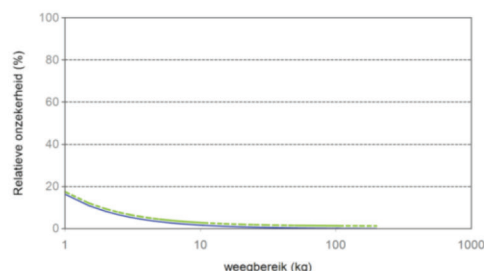
Om de stabiliteit van de linearisatie te optimaliseren, worden naast de nullast, alleen meetpunten gebruikt met een proefbelasting van 5% van het meetbereik of groter voor de berekening van de lineaire vergelijking.

Absolute- en relatieve meetonzekerheid bij gebruik voor verschillende netto indicaties (voorbeelden)

Netto aflezing	Voorcontrole		Nacontrole	
2,0 kg	0,19 kg	9,3%	0,16 kg	8,2%
20,0 kg	0,40 kg	2,0%	0,16 kg	0,82%
200,0 kg	2,5 kg	1,3%	0,17 kg	0,085%
1000 kg	13 kg	1,3%	0,67 kg	0,067%
2000 kg	25 kg	1,3%	0,75 kg	0,038%



Voorcontrole



Nacontrole

Het weegbereik in de onzekerheidsgrafiek heeft betrekking op het fijnbereik of eerste interval van het weeginstrument

4. Ultra Low Freezer #15

• Manufacturer:	NuAire
• Type:	6512E
• Dimensions chamber (width x depth x height):	63 x 60 x 128 cm
• Door dimensions:	63 x 128 cm
• Temperature range:	-85 °C to -40 °C (± 2 °C)
• Programmable microprocessor for temperature:	N/A: constant temperature only
• Calibration due date:	February 2024

Certificate of Calibration

Fluke Nederland B.V.

Certificate Number:	SA01141933	Date of Calibration:	22 Feb 2023
Receive Condition:	IN TOLERANCE	Date of Recalibration:	22 Feb 2024
Return Condition:	IN TOLERANCE	Place of Calibration:	Voorhout
Manufacturer:	NUAIRE	Temperature within:	(23.0 ± 5) °C
Model:	NU-6512E	Humidity within:	(50 ± 30) %rh
Serial Number:	90403726		
Description:	ULTRA LOW FREEZER -40 TO -85 DEGREES		
Procedure:	Manual Procedure		

Customer:	TOPA INSTITUTE VOORHOUT
Customer Asset ID:	FREEZER 15
RMA Number:	606300972

All measurements are traceable to national and/or international standards or have been derived by approved ratio techniques. When possible standards used for this calibration are ISO/IEC 17025 accredited calibrated.

This calibration is performed by a DEKRA certified lab for ISO 9001. This certificate may not be reproduced other than in full. Calibration certificates without signatures, either electronic or handwritten, are not valid.



Issue Date: 22 Feb 2023

Electronically signed

Authorized By
D.W.G. de Visser

Certificate of Calibration

Certificate Number: SA01141933

Remarks

- The calibration status found in this certificate on the top of each results page must be interpreted as:
 - As Found : Data collected before the unit was adjusted and / or repaired
 - As Left : Data collected after the unit has been adjusted and / or repaired
 - Found / Left : Data collected without any adjustment and / or repair performed
- The calibration interval (due date) is the responsibility of the end user.
- According to the European norm 'Operation of electrical installations' NEN-EN 50110-1 release 2013 and the Dutch norm NEN 3140 release 2015 paragraph 5.102.12 through 5.102.16, a safety test is not required. Therefore not performed.
- Temperature conversions (if applicable) are performed according to ISO/IEC 60584:2013 for thermocouples, and ISO/IEC 60751:2022 for resistance temperature devices.

Standards and test-equipment used

Inventory No	Model	Serial No
TS0094	2626-S	C19075
TS0249	TEMPERATURE-PROBE	FTE PT-100 SET

Calibration Data Report

Certificate number: SA01141933

Calibration Date: 22 Feb 23

Supplied value		Location	Lower limit	Measured value	Upper limit	% of Tol.
Temperature (ITS-90) calibration						
setpoint	indicator					
-85 °C	-84 °C	1	-90.0	-84.0 °C	-80.0	1
-85 °C	-84 °C	2	-90.0	-83.8 °C	-80.0	3
Temperature variation over time (30 minutes)			-1.0	0.8 °C	1.0	80
setpoint	indicator					
-40 °C	-41 °C	1	-45.0	-40.9 °C	-35.0	3
-40 °C	-41 °C	2	-45.0	-39.6 °C	-35.0	36
Temperature variation over time (30 minutes)			-1.0	0.2 °C	1.0	22
Location:						
1			Lower			
2			Upper			

Remarks :

This measurement was done without test object(s) in the chamber.

Customer specification $\pm 2^{\circ}\text{C}$ and $\pm 1^{\circ}\text{C}$ for stability

5. Ultra Low Freezer #20

• Manufacturer:	NuAire
• Type:	6625V30
• Dimensions chamber (width x depth x height):	86 x 60 x 128 cm
• Door dimension:	86 x 128 cm
• Temperature range:	-85 °C to -40 °C (± 2 °C)
• Programmable microprocessor for temperature:	N/A: constant temperature only
• Calibration due date:	February 2024

Certificate of Calibration

Fluke Nederland B.V.

Certificate Number:	SA01140641	Date of Calibration:	20 Feb 2023
Receive Condition:	IN TOLERANCE	Date of Recalibration:	20 Feb 2024
Return Condition:	IN TOLERANCE	Place of Calibration:	Voorhout
Manufacturer:	NEW BRUNSWICK	Temperature within:	(23.0 ± 5) °C
Model:	C660	Humidity within:	(50 ± 30) %rh
Serial Number:	1004-5488-0404		
Description:	ULTRA DEEP FREEZER		
Procedure:	Manual Procedure		

Customer:	TOPA INSTITUTE VOORHOUT
Customer Asset ID:	FREEZER 20
RMA Number:	606300972

All measurements are traceable to national and/or international standards or have been derived by approved ratio techniques. When possible standards used for this calibration are ISO/IEC 17025 accredited calibrated.

This calibration is performed by a DEKRA certified lab for ISO 9001. This certificate may not be reproduced other than in full. Calibration certificates without signatures, either electronic or handwritten, are not valid.



Issue Date: 20 Feb 2023

Electronically signed

Authorized By

D.W.G. de Visser

Fluke Nederland B.V.

E-mail

Telephone

Rev 230217

Brainport Industries Campus 1, 5657 BX, Eindhoven

service.nl@fluke.com

+31 40 267 5300

Page 1 of 3

Certificate of Calibration

Certificate Number: SA01140641

Remarks

- The calibration status found in this certificate on the top of each results page must be interpreted as:
 - As Found : Data collected before the unit was adjusted and / or repaired
 - As Left : Data collected after the unit has been adjusted and / or repaired
 - Found / Left : Data collected without any adjustment and / or repair performed
- The calibration interval (due date) is the responsibility of the end user.
- According to the European norm 'Operation of electrical installations' NEN-EN 50110-1 release 2013 and the Dutch norm NEN 3140 release 2015 paragraph 5.102.12 through 5.102.16, a safety test is not required. Therefore not performed.
- Temperature conversions (if applicable) are performed according to ISO/IEC 60584:2013 for thermocouples, and ISO/IEC 60751:2022 for resistance temperature devices.

Standards and test-equipment used

Inventory No	Model	Serial No
TS0094	2626-S	C19075
TS0249	TEMPERATURE-PROBE	FTE PT-100 SET

Calibration Data Report

Certificate number: SA01140641

Calibration Date: 20 Feb 23

Supplied value	Location	Lower limit	Measured value	Upper limit	% of Tol.	
Temperature (ITS-90) calibration						
setpoint	indicator					
-50.0 °C	-50.0 °C	1	-55.0	-51.0 °C	-45.0	21
-50.0 °C	-50.0 °C	2	-55.0	-51.1 °C	-45.0	22
-50.0 °C	-50.0 °C	3	-55.0	-50.2 °C	-45.0	4
-50.0 °C	-50.0 °C	4	-55.0	-49.7 °C	-45.0	6
-50.0 °C	-50.0 °C	5	-55.0	-50.4 °C	-45.0	8
Temperature variation over time (30 minutes)						
		-1.0	1.0 °C	1.0	99	
Temperature (ITS-90) calibration						
setpoint	indicator					
-86.0 °C	-84.0 °C	1	-91.0	-86.2 °C	-81.0	4
-86.0 °C	-84.0 °C	2	-91.0	-86.2 °C	-81.0	4
-86.0 °C	-84.0 °C	3	-91.0	-83.9 °C	-81.0	42
-86.0 °C	-84.0 °C	4	-91.0	-83.5 °C	-81.0	50
-86.0 °C	-84.0 °C	5	-91.0	-84.2 °C	-81.0	36
Temperature variation over time (30 minutes)						
		-1.0	0.1 °C	1.0	10	

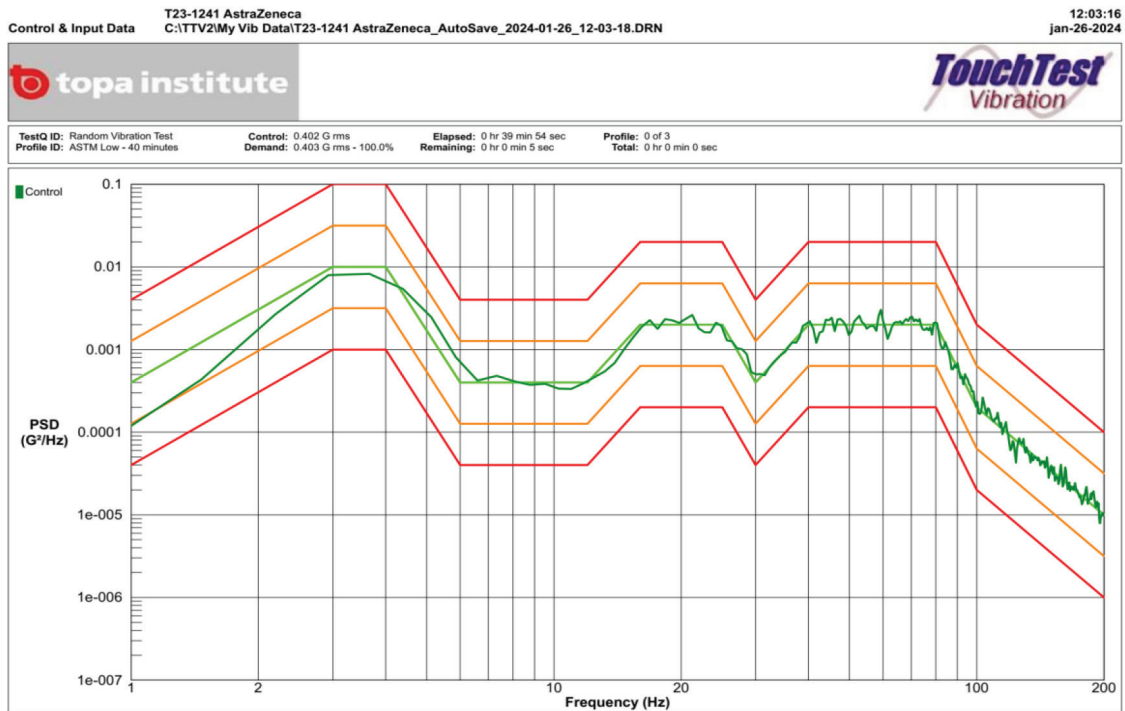
Location:

- 1 Lower left front
- 2 Upper left rear
- 3 Upper right front
- 4 Lower right rear
- 5 Center

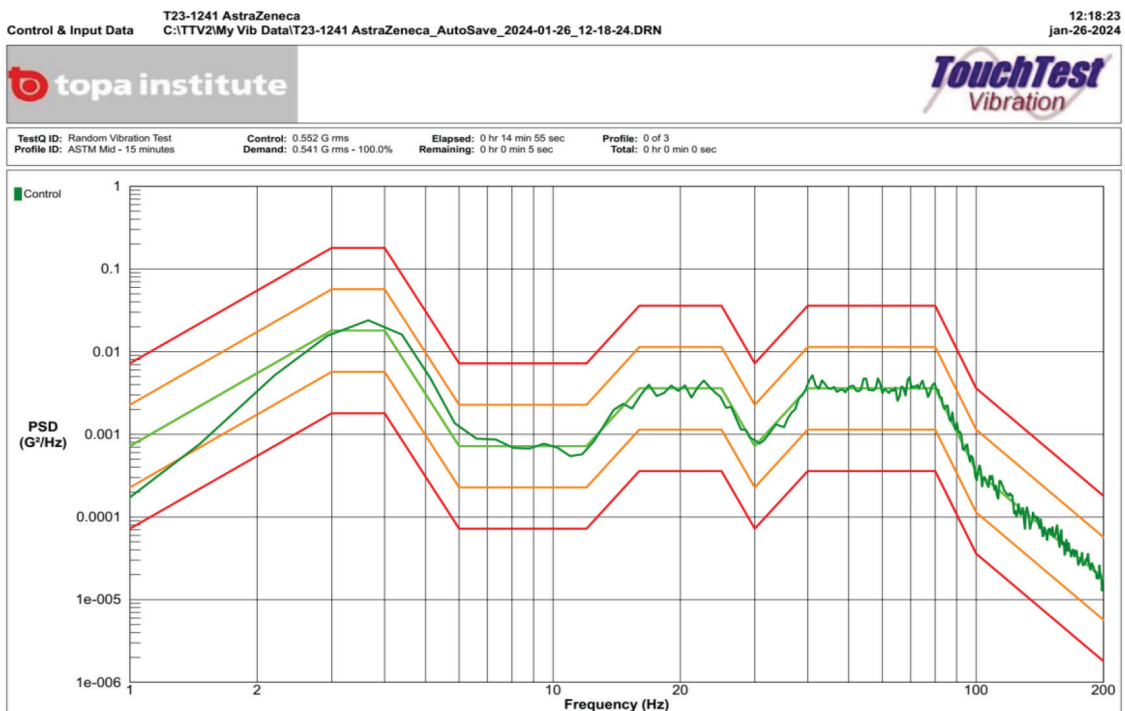
Remarks :

This measurement was done with little test object(s) in the chamber.

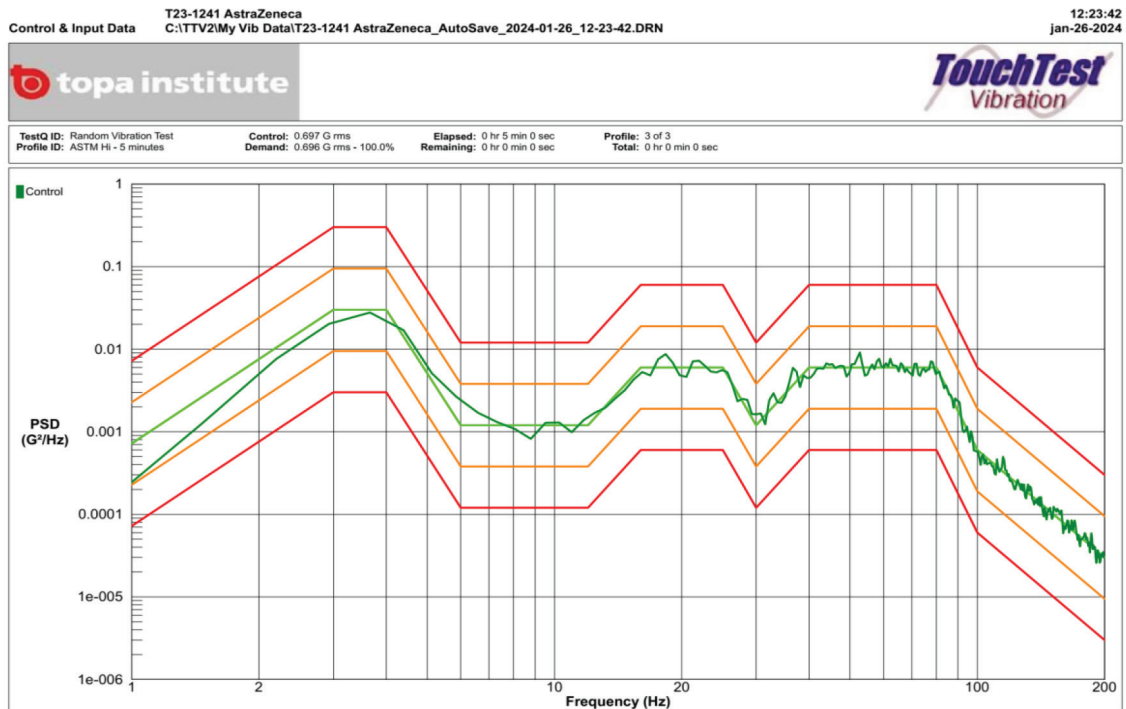
Appendix B: Random Vibration Test Graphs



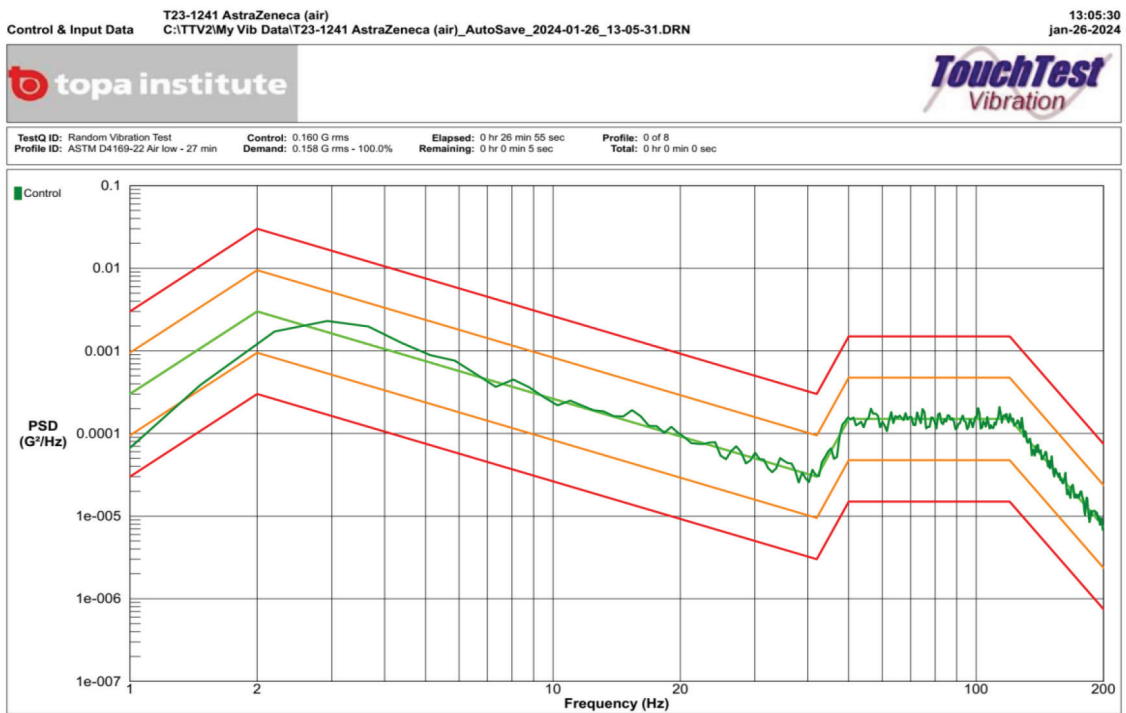
Graph of the Random Vibration Test, Truck Transport Low Level



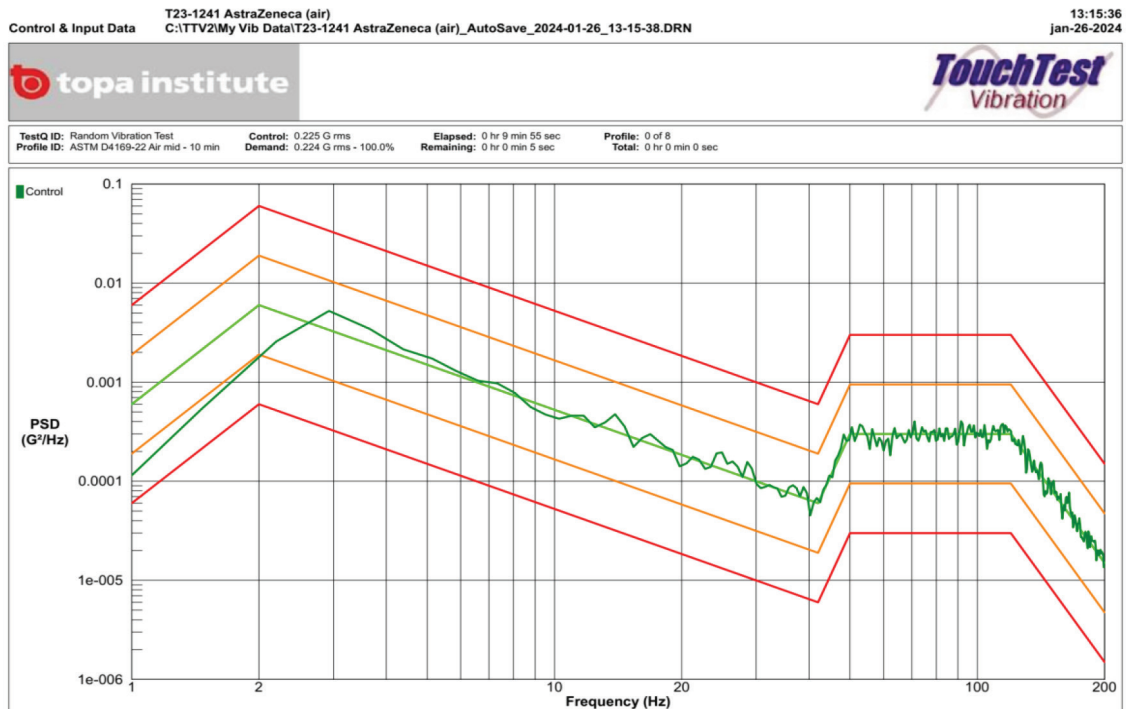
Graph of the Random Vibration Test, Truck Transport Medium Level



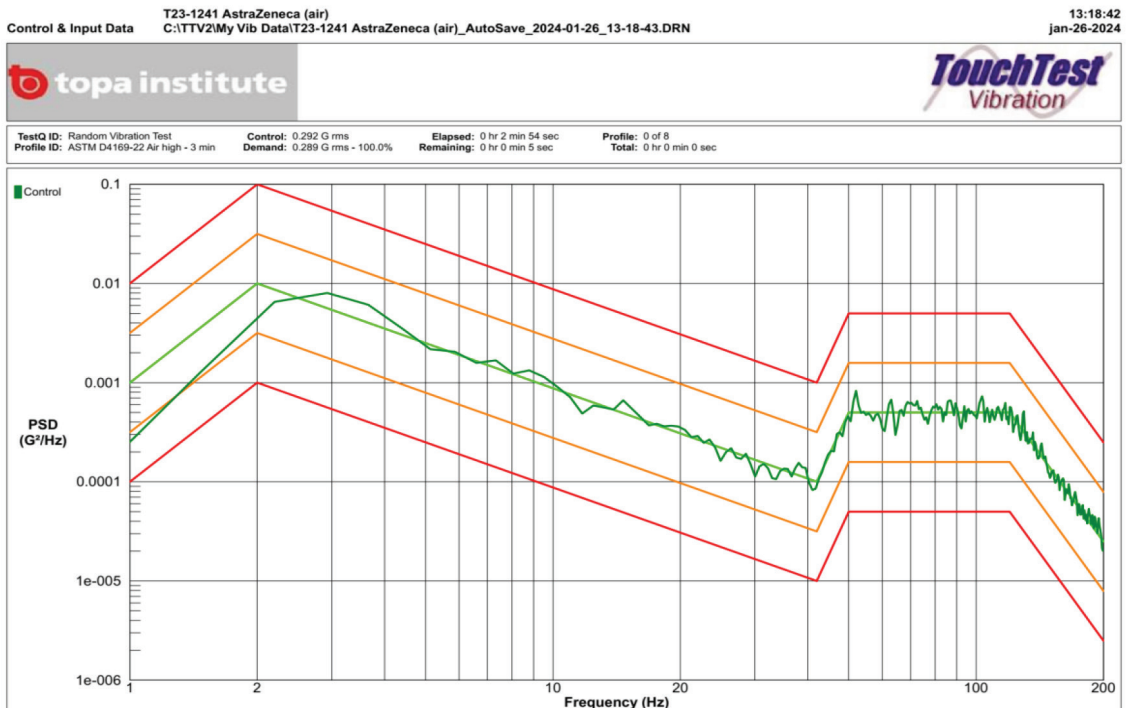
Graph of the Random Vibration Test, Truck Transport High Level



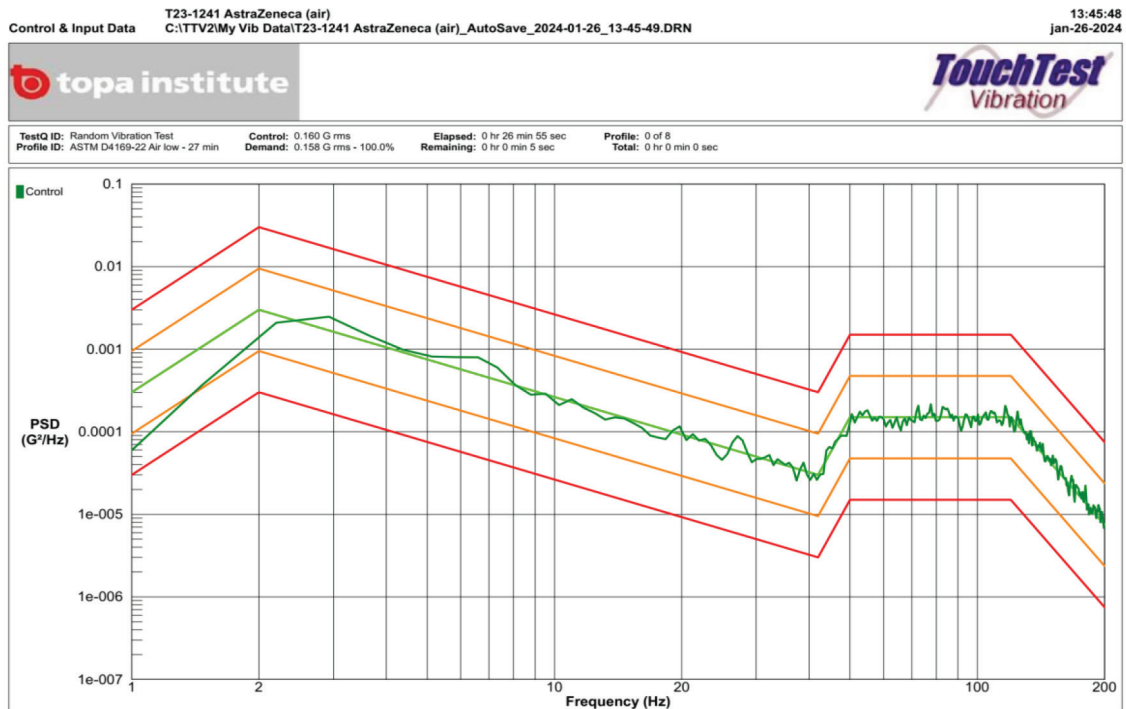
Graph of the Random Vibration Test, Air Transport Low Level, Cycle 1



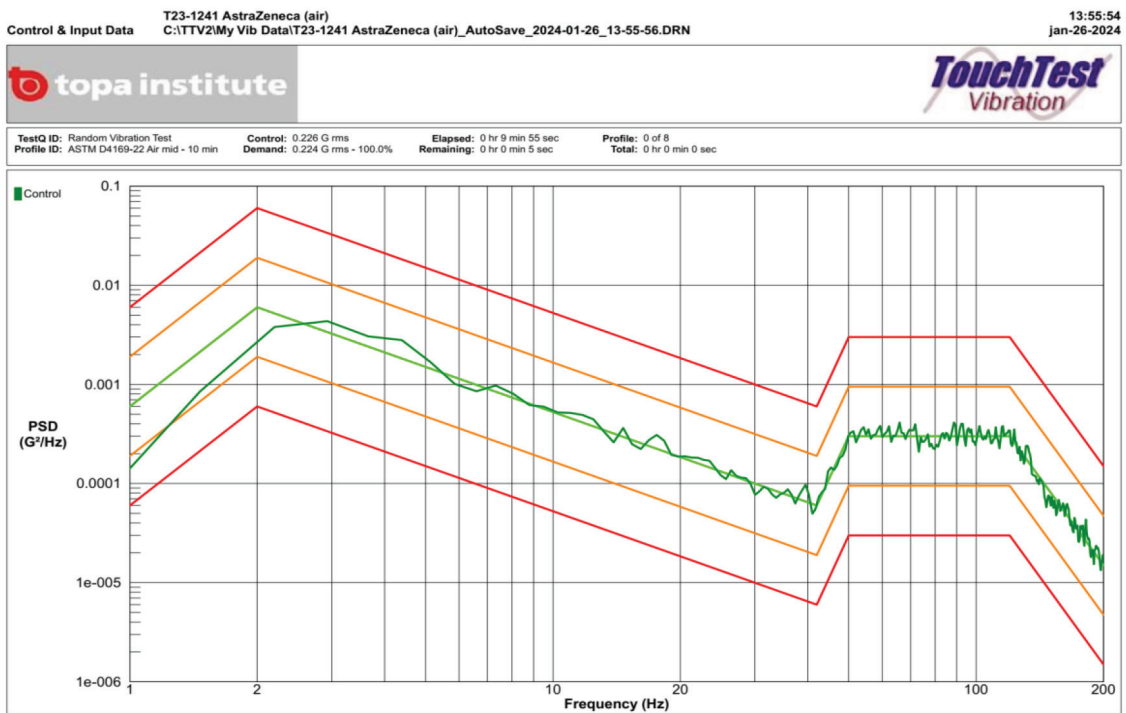
Graph of the Random Vibration Test, Air Transport Medium Level, Cycle 1



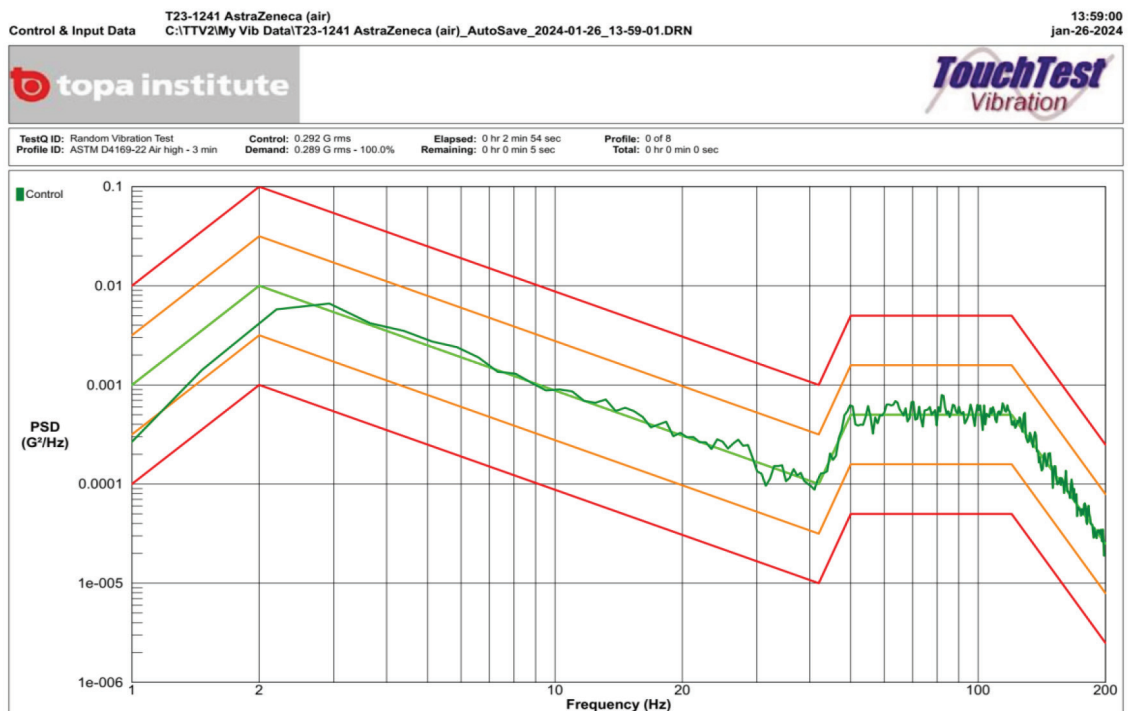
Graph of the Random Vibration Test, Air Transport High Level, Cycle 1



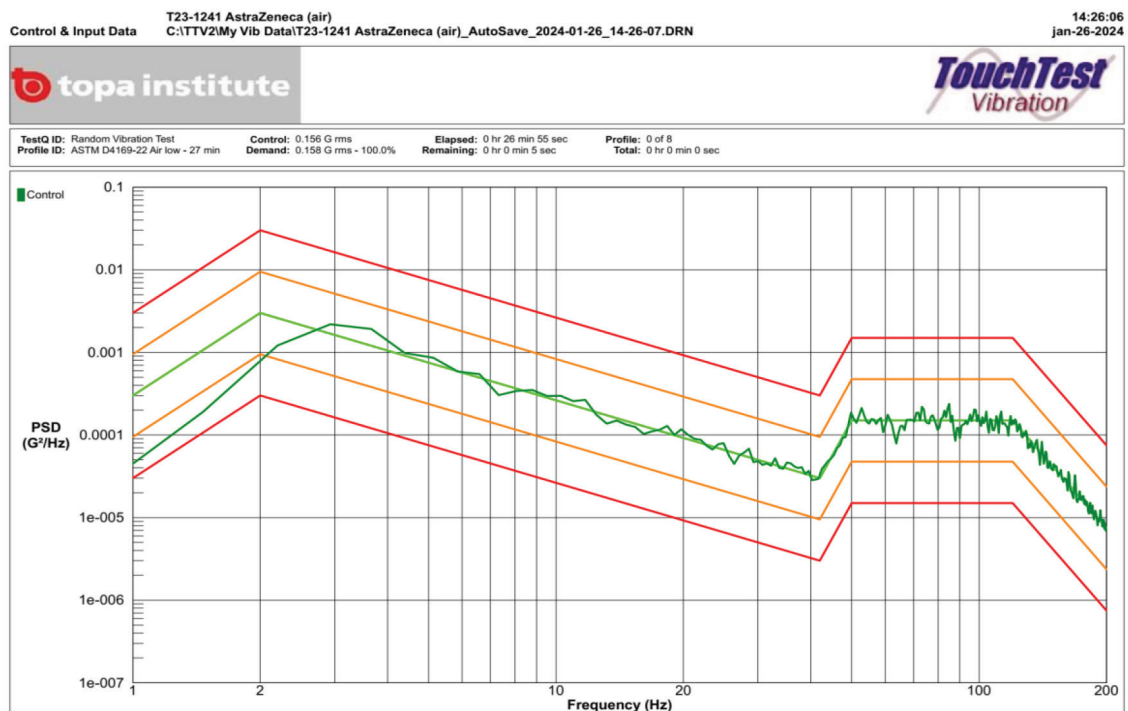
Graph of the Random Vibration Test, Air Transport Low Level, Cycle 2



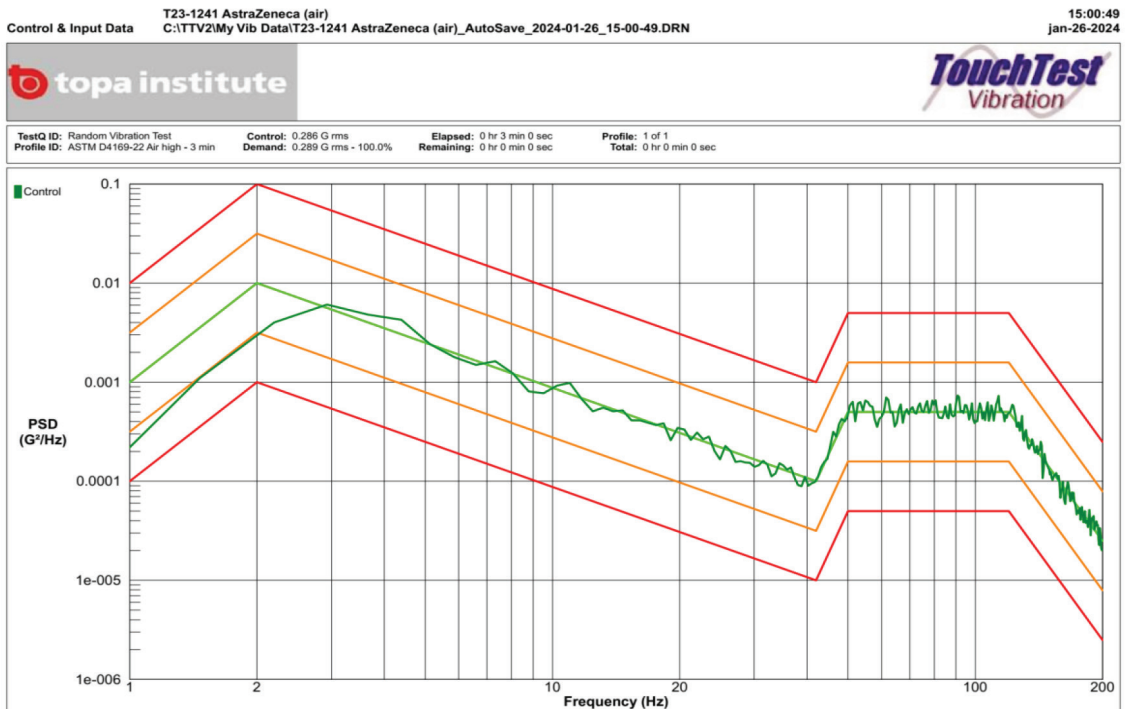
Graph of the Random Vibration Test, Air Transport Medium Level, Cycle 2



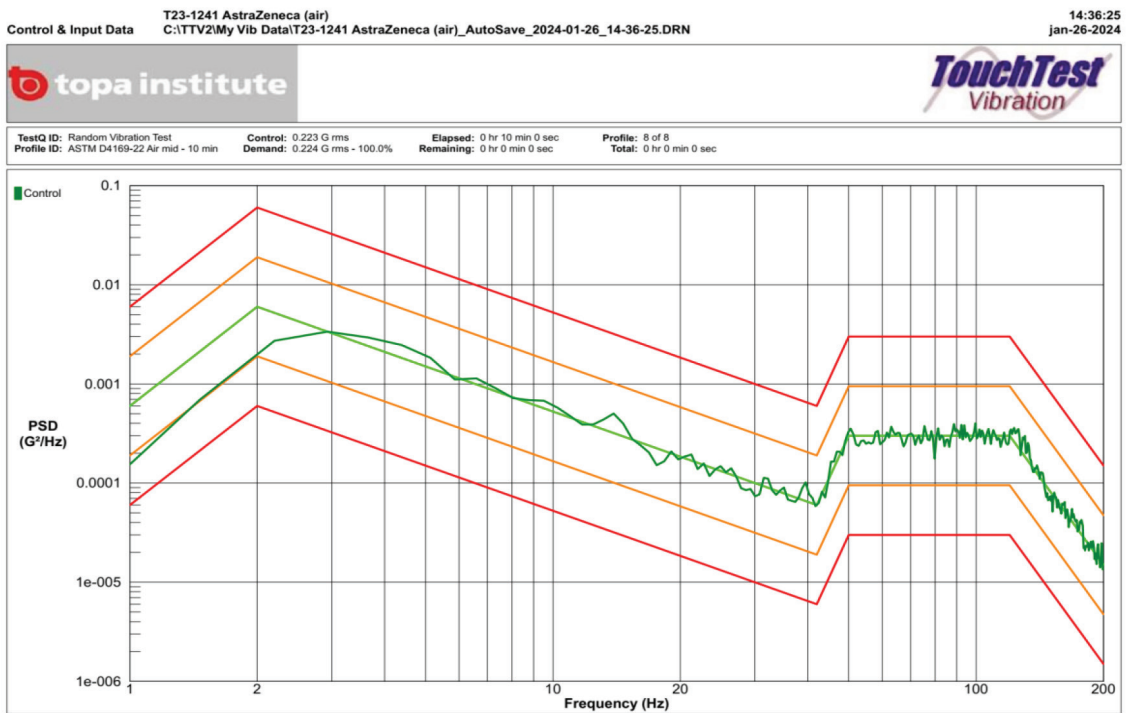
Graph of the Random Vibration Test, Air Transport High Level, Cycle 2



Graph of the Random Vibration Test, Air Transport Low Level, Cycle 3



Graph of the Random Vibration Test, Air Transport Medium Level, Cycle 3



Graph of the Random Vibration Test, Air Transport High Level, Cycle 3

Appendix C: History of Change

0	AF	12 February 2024	All	Create new document