

Project 23552-10

Clegg Industries, Inc.
ISO Container

Shielding Effectiveness Test Report

Prepared for:

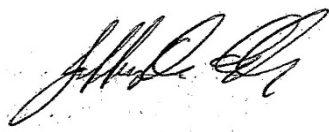
Clegg Industries, Inc.
16400 Northwest Zac Lentz Parkway
Victoria, TX 77905

By

Nemko USA, Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

January 13, 2023

Reviewed by



Jeffrey A. Lenk

Written by



Haletha Judkins
Technical Writer

Revision History

Revision Number	Description	Date
00	Initial Release	January 13, 2023

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(3) The significance of this report is dependent on the representative character of the test sample submitted for evaluation and the results apply only in reference to the sample tested. The manufacturer must continuously implement the changes shown herein to attain and maintain the required degree of compliance.



Test Summary

Applicant: Clegg Industries, Inc.
Applicant's Address: 16400 Northwest Zac Lentz Parkway
Victoria, Texas 77905

EUT: ISO Container
EUT ID Number:
Project Number: 23552-10

The **Clegg Industries, Inc. ISO Container** was subjected to shielding effectiveness testing as indicated in the following table. Results presented in this report relate only to the item tested, as detailed in section 1.2.

NSA-94-106				
Test	Level	Test Dates	Test Results	Site
Shielding Effectiveness	1 kHz to 10 GHz	11/10/2022	The measurements were completed and forwarded to the client for review. The client did not inform PTI of the results of that analysis.	Onsite

Test Site: Testing was performed at the customer's facility.

I, Jeffrey A. Lenk, for Nemko USA, Inc., being familiar with the electromagnetic compatibility rules and test procedures, have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

A handwritten signature in black ink, appearing to read "Jeffrey A. Lenk", with a stylized flourish at the end.

Jeffrey A. Lenk

1.0 Introduction

1.1 Scope

This test report details the measurements resulting from shielding effectiveness testing on the Clegg Industries ISO Container and the manner in which those measurements were performed. The testing was performed in accordance with the NSA 94-106 standard and the client's specifications.

1.2 EUT Description

The EUT is the **Clegg Industries, Inc. ISO Container**. The system tested is defined in Table 1.2.1.

Table 1.2.1: Equipment Under Test

EUT Definition		Project #:	23552-10
EUT Manufacturer Name:	Clegg Industries, Inc.		
Manufacturer Address:	16400 Northwest Zac Lentz Parkway Victoria, TX 77905		
EUT Name:	ISO Container		
EUT ID Number:	N/A		
EUT Serial Number:	None		
Additional Electrically Equivalent EUT Model Numbers:	N/A		
EUT Description:	The EUT is an ISO container with the following physical specifications: 50 feet (length) x 10 feet (width) x 9.5 feet (height).		
EUT Usage Type:	Floor-Standing	EUT Usage Location:	Professional, Commercial, or Industrial

2.0 Applicable Documents

The following documents were used as reference for the test procedures specified herein.

Document Identifier/Revision	Title/Description	Date of Publication
NSA 94-106	National Security Agency Specification for Shielded Enclosures	10/24/1994

3.0 Shielding Effectiveness Testing

The shielding effectiveness test was performed in accordance with the NSA 94-106 standard and the client's specifications.

3.1 Shielding Effectiveness Measurements

The testing was performed on-site at the client's location (16304 Northwest Zac Lentz Parkway, Victoria, Texas 77905). The ISO Container, the equipment under test (EUT), was positioned outside on ground level for the duration of the testing.

3.1.1 Test Procedure

Shielding effectiveness was measured using a spectrum analyzer to perform measurements between two antennas (receive and transmit). The measurements were conducted over a frequency range of 10 kHz to 10 GHz.

Three sets of receive and transmit antennas were used to cover the frequency range:

- Two loop antennas were used for the 1 kHz to 1 MHz range.
- Two biconical and two log periodic antennas were used for the 10 MHz to 1000 MHz range.
- Two horn antennas were used for the 1 GHz to 10 GHz range.

The receiver antenna was connected to the spectrum analyzer that was used to measure the signal outside the shielded container (EUT). The source signal was sent through a signal generator and connected to the transmit antenna that was positioned inside the EUT. For the loop antenna frequencies, the source signal was sent through a preamp to increase dynamic range. A total of 66 cm in distance was maintained between the antennas for frequencies up to 10 MHz and a distance of 150 cm for frequencies above 10 MHz.

In order to calibrate the test setup, both antennas were placed outside the enclosure (>1 m from the nearest wall) at a distance of 61 cm plus 5 cm (thickness of the wall) for tested frequencies 1 kHz, 10 kHz, 100 kHz, 1 MHz and 10 MHz. For frequencies of 100 MHz, 400 MHz, 1 GHz, and 10 GHz, a distance of 145 cm plus 5 cm (thickness of the wall) was used for the calibration procedure. All the same cabling was used during calibration to ensure accurate results during testing. The calibration routine was to set the signal required on the signal generator and the spectrum analyzer. Then, set the signal generator amplitude was set to a high value to measure the highest value possible on the receive antenna with nothing obstructing the antennas. The calibration was performed for both horizontal and vertical orientations and for parallel orientation on the loop antenna. Once the calibration values were obtained, the transmit antenna was placed inside the EUT and the actual shielding measurements were taken on all sides and seams of the EUT.

Measurement antenna placement during testing was as follows:

Loop Antennas

1. Rear Side of EUT
2. Right Side of EUT at the Hatch Door
3. Front Left Side of Door
4. Front Right Side of Door
5. Front of Door
6. Left Side of EUT at Open Panel

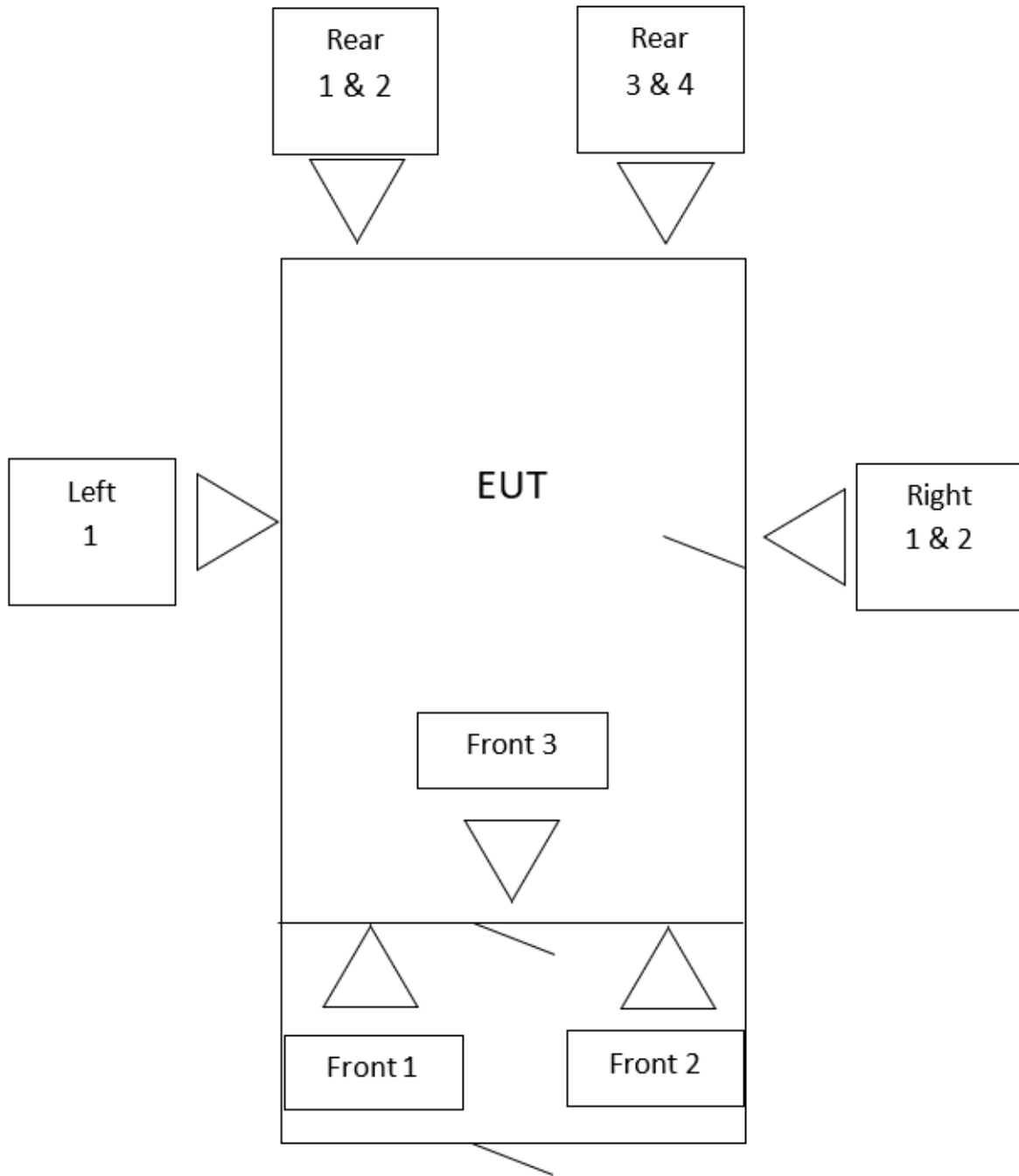
Biconical and Log Periodic Antennas

1. Rear Side of EUT
2. Right Side of EUT at the Hatch Door
3. Front Left Side of Door
4. Front Right Side of Door
5. Front of Door
6. Left Side of EUT at Open Panel

Horn Antennas

1. Rear Side of EUT
2. Right Side of EUT at the Hatch Door
3. Front Left Side of Door
4. Front Right Side of Door
5. Front of Door
6. Left Side of EUT at Open Panel

A diagram of the setup used to calibrate the shielding effectiveness measurement is given as Figure 3.1.1.1.



**Figure 3.1.1.1: Loop Receiver Antenna Positions Test Setup
(10 kHz, 100 kHz, 1 MHz, 100 MHz, 400 MHz, 1 GHz, and 10 GHz)**

3.1.2 Test Results

The test log, setup equipment, and test results are shown in the following tables.

Table 3.1.2.1: Shielding Effectiveness Test Log

Nemko USA, Inc.					
Test Method:	Shielding Effectiveness				
In accordance with:	NSA 94-106 and client's specifications				
Section:	N/A				
Test Date(s):	11/10/2022	EUT Serial #:	None		
Customer:	Clegg Industries, Inc.	EUT Part #:	None		
Project Number:	23552-10	Test Technician:	Daniel Ramirez		
Purchase Order #:	532-161	Supervisor:	Larry Finn		
Equip. Under Test:	ISO Container	Witness:	John Clegg		
Test Log Sheet					
Temperature:	28.33 °C	Humidity	33% RH	Barometric Pressure:	29.7 in Hg
Test Location:	Onsite (Client's Location)				
Test Status:	Testing Complete				

Table 3.1.2.2: Shielding Effectiveness Test Equipment

Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
2081	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303313	7/21/2023
2188	HP	83732B	Synthesized Signal Generator	US73102317	5/18/2023
1933	HP	33120A	Generator, 15 MHz Func/Arb Waveform	US34001010	11/11/2023
955	Varian	VZM6991K3	Amplifier, 20W, 40dB, 8-18 GHz	1133	N/A
350	EMCO	6511	Antenna, Loop, Pas, 20Hz-5MHz	Prototype	N/A
6	EMCO	6502	Antenna, Loop, Active, .01-30MHz	1030	5/11/2023
1499	EMCO	3110B	Antenna, Bi Con, 30-300MHz	9905-3268	5/10/2023
303	EMCO	3109	Antenna, Bi Con, 20-300MHz	2002	1/10/2023
461	EMCO	3146	Antenna, Log Periodic, .2-1GHz	9105-3088	5/19/2023
755	EMCO	3146	Antenna, Log Periodic, .2-1GHz	9003-2766	5/5/2022
77	EMCO	3115	Antenna, Horn, DRG, 1-18GHz	9010-3578	N/A
C006	None	None	Cable Coax, SMA-SMA, 10m, Armored, 9 kHz - 30 MHz	None	1/19/2024
C091	Astrolab	16301	Cable RF, N-N 2 m, White, DC-12.4 GHz	None	8/8/2024
C368	Belden	RG-58/U	Cable, RF, BNC-BNC, 1.83m	None	3/16/2024
C200	PTI	none	Cable, RF, N-N, DC-8GHz	None	3/4/2024
C282	None	RG-214/U	Cable, N-N, 0.965m, Black, DC-8.5 GHz	None	3/21/2023
2138	Fluke	87V	DMM	23440018	7/29/2024

Shielding Effectiveness Test Results – Loop Receiver Antenna**Table 3.1.2.3: Shielding Effectiveness Test Results – Loop Receiver Antenna (1 kHz)**

Test Frequency:				1 kHz		Wall Thickness (cm)			5		
Calibration Distance (cm):				66							
Calibration Setting (dBm) w/Preamp:				21							
Calibration Reading (dBm):				-44							
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-64	-64	-65	-64	-63	-64.5	-65	-64	-65.5	-60	
Shielding Effectiveness (dB):	20	20	21	20	19	20.5	21	20	21.5	16	

Table 3.1.2.4: Shielding Effectiveness Test Results – Loop Receiver Antenna (10 kHz)

Test Frequency:					10 kHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					66						
Calibration Setting (dBm) w/Preamp:					20						
Calibration Reading (dBm):					-20						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-69	-71	-72	-71	-70	-71.2	-60	-58	-60	-59	
Shielding Effectiveness (dB):	49	51	52	51	50	51.2	40	38	40	39	

Table 3.1.2.5: Shielding Effectiveness Test Results – Loop Receiver Antenna (100 kHz)

Test Frequency:				100 kHz		Wall Thickness (cm)			5		
Calibration Distance (cm):				66							
Calibration Setting (dBm) w/Preamp:				0							
Calibration Reading (dBm):				4							
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-91	-92.2	-90	-89.5	-90	-91	-85	-86	-81	-82	
Shielding Effectiveness (dB):	95	96.2	94	93.5	94	95	89	90	85	86	

Table 3.1.2.6: Shielding Effectiveness Test Results – Loop Receiver Antenna (1 MHz)

Test Frequency:					1 MHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					66						
Calibration Setting (dBm) w/Preamp:					10						
Calibration Reading (dBm):					-0.4						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-101.1	-101.2	-100.6	-100.8	-101	-104	-105	-104.5	-105.6	-101.2	
Shielding Effectiveness (dB):	100.7	100.8	100.2	100.4	100.6	103.6	104.6	104.1	105.2	100.8	

Shielding Effectiveness Test Results – Biconical and Log Periodic Receiver Antennas

Table 3.1.2.7: Shielding Effectiveness Test Results – 10 MHz, Horizontal

Test Frequency:					10 MHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					66						
Calibration Setting (dBm) w/Preamp:					18						
Calibration Reading (dBm):					-16						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-116	-117	-117	-118	-116	-116.5	-110	-114	-95	-103	
Shielding Effectiveness (dB):	100	101	101	102	100	100.5	94	98	79	87	

Table 3.1.2.8: Shielding Effectiveness Test Results – 10 MHz, Vertical

Test Frequency:					10 MHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					66						
Calibration Setting (dBm) w/Preamp:					18						
Calibration Reading (dBm):					-16.5						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-116.5	-116.8	-117	-117.2	-116	-117	-112	-111.5	-115	-117.5	
Shielding Effectiveness (dB):	100	100.3	100.5	100.7	99.5	100.5	95.5	95	98.5	101	

Table 3.1.2.9: Shielding Effectiveness Test Results – 100 MHz, Horizontal

Test Frequency:				100 MHz		Wall Thickness (cm)			5		
Calibration Distance (cm):				150							
Calibration Setting (dBm) w/Preamp:				16							
Calibration Reading (dBm):				0							
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-108	-107.5	-107	-102	-103	-103	-103	-103.5	-103.6	-101	
Shielding Effectiveness (dB):	108	107.5	107	102	103	103	103	103.5	103.6	101	

Table 3.1.2.10: Shielding Effectiveness Test Results – 100 MHz, Vertical

Test Frequency: 100 MHz					Wall Thickness (cm)			5		
Calibration Distance (cm): 150										
Calibration Setting (dBm) w/Preamp: 16										
Calibration Reading (dBm): 0										
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1
Test Reading (dBm):	-103	-103.5	-104	-103.5	-106	-107	-102	-101	-101.5	-101
Shielding Effectiveness (dB):	103	103.5	104	103.5	106	107	102	101	101.5	101

Shielding Effectiveness Test Results – Bicon Log Antenna (Continued)**Table 3.1.2.11: Shielding Effectiveness Test Results – 400 MHz, Horizontal**

Test Frequency:					400 MHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					150						
Calibration Setting (dBm) w/Preamp:					16						
Calibration Reading (dBm):					-1						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-105	-103	-101	-101	-107	-107	-99	-101	-104	-102	
Shielding Effectiveness (dB):	104	102	100	100	106	106	98	100	103	101	

Table 3.1.2.12: Shielding Effectiveness Test Results – 400 MHz, Vertical

Test Frequency:					400 MHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					150						
Calibration Setting (dBm) w/Preamp:					16						
Calibration Reading (dBm):					-2						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-107	-104	-103	-104	-106	-107	-101	-103	-102	-102	
Shielding Effectiveness (dB):	105	102	101	102	104	105	99	101	100	100	

Shielding Effectiveness Test Results – Horn Receiver Antenna**Table 3.1.2.13: Shielding Effectiveness Test Results – 1 GHz, Horizontal**

Test Frequency:				1 GHz	Wall Thickness (cm)			5		
Calibration Distance (cm):				150						
Calibration Setting (dBm) w/Preamp:				18						
Calibration Reading (dBm):				-8						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1
Test Reading (dBm):	-108	-108	-108	-108	-110	-108.5	-107.8	-108.2	-108.4	-107.4
Shielding Effectiveness (dB):	100	100	100	100	102	100.5	99.8	100.2	100.4	99.4

Table 3.1.2.14: Shielding Effectiveness Test Results – 1 GHz, Vertical

Test Frequency:				1 GHz	Wall Thickness (cm)				5	
Calibration Distance (cm):				150						
Calibration Setting (dBm) w/Preamp:				18						
Calibration Reading (dBm):				-8						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1
Test Reading (dBm):	-108	-108	-96	-98	-108	-109	-108.2	-108	-109	-109.1
Shielding Effectiveness (dB):	100	100	88	90	100	101	100.2	100	101	101.1

Table 3.1.2.15: Shielding Effectiveness Test Results – 10 GHz, Horizontal

Test Frequency:					10 GHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					150						
Calibration Setting (dBm) w/Preamp:					18						
Calibration Reading (dBm):					-3						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-104	-104	-103	-103	-103	-103	-104	-103.8	-103.2	-103.5	
Shielding Effectiveness (dB):	101	101	100	100	100	100	101	100.8	100.2	100.5	

Table 3.1.2.16: Shielding Effectiveness Test Results – 10 GHz, Vertical





Test Frequency:					10 GHz		Wall Thickness (cm)			5	
Calibration Distance (cm):					150						
Calibration Setting (dBm) w/Preamp:					18						
Calibration Reading (dBm):					-3						
Parallel Antenna Position:	Rear 1	Rear 2	Rear 3	Rear 4	Right 1	Right 2	Front 1	Front 2	Front 3	Left 1	
Test Reading (dBm):	-103	103	-104	-103.5	-103	-103.5	-103.1	-102.3	-103.2	-103.2	
Shielding Effectiveness (dB):	100	-106	101	100.5	100	100.5	100.1	99.3	100.2	100.2	

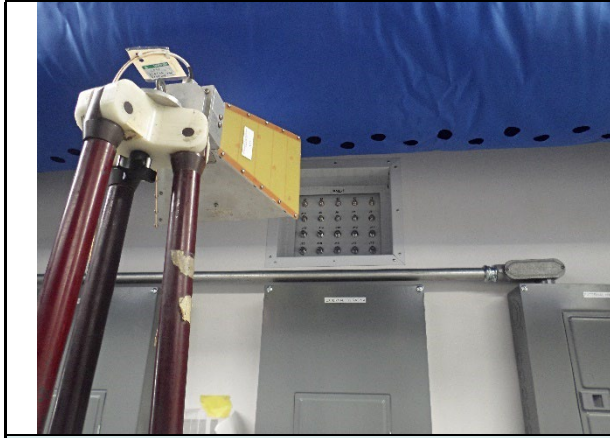
Table 3.1.2.17: Shielding Effectiveness Test Setup Photographs, Page 1

Nemko USA, Inc.			
Test Method:	Shielding Effectiveness		
In Accordance With:	NSA 94-106 and client's specifications		
Section:	N/A		
Test Date(s):	11/10/2022	EUT Serial #:	None
Customer:	Clegg Industries, Inc.	EUT Part #:	None
Project Number:	23552-10	Test Technician:	Daniel Ramirez
Purchase Order #:	532-161	Supervisor:	Larry Finn
Equip. Under Test:	ISO Container	Witness:	John Clegg
Shielding Effectiveness Test Setup Photographs			
			
EUT Wall Thickness		Loop Antenna Calibration	
			
Bicon Antenna Calibration		Bicon Antenna Calibration	
			

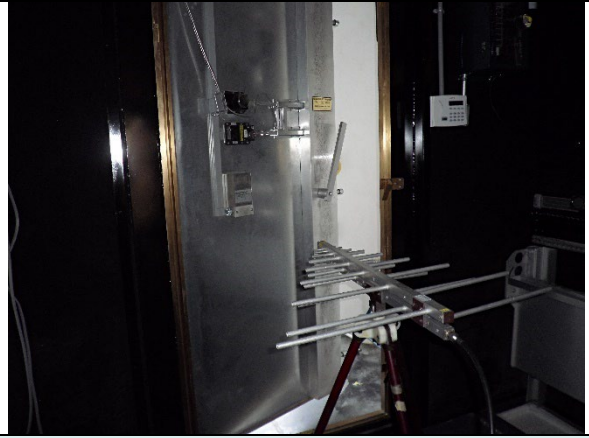
Log Antenna Calibration	Log Antenna Calibration
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Table 3.1.2.18: Shielding Effectiveness Test Setup Photographs, Page 2

Nemko USA, Inc.			
Test Method:	Shielding Effectiveness		
In Accordance With:	NSA 94-106 and client's specifications		
Section:	N/A		
Test Date(s):	11/10/2022	EUT Serial #:	None
Customer:	Clegg Industries, Inc.	EUT Part #:	None
Project Number:	23552-10	Test Technician:	Daniel Ramirez
Purchase Order #:	532-161	Supervisor:	Larry Finn
Equip. Under Test:	ISO Container	Witness:	John Clegg
Shielding Effectiveness Test Setup Photographs			
			
Horn Antenna Calibration		Rear Location Transmit Antenna	
			
Rear Location Transmit Antenna		Right Location Transmit Antenna	



Left Location Transmit Antenna



Front Location Transmit Antenna

Table 3.1.2.19: Shielding Effectiveness Test Setup Photographs, Page 3

Nemko USA, Inc.			
Test Method:	Shielding Effectiveness		
In Accordance With:	NSA 94-106 and client's specifications		
Section:	N/A		
Test Date(s):	11/10/2022	EUT Serial #:	None
Customer:	Clegg Industries, Inc.	EUT Part #:	None
Project Number:	23552-10	Test Technician:	Daniel Ramirez
Purchase Order #:	532-161	Supervisor:	Larry Finn
Equip. Under Test:	ISO Container	Witness:	John Clegg
Shielding Effectiveness Test Setup Photographs			
			
Receive Antenna Rear Side		Receive Antenna Rear Side	
			
Receive Antenna Right Side		Receive Antenna Front Side	
			

Receive Antenna Front Side	Receive Antenna Front Side
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End of Report

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