

Worthington Industries Inc. **TEST REPORT**

SCOPE OF WORKS

Non-standard Test Report – Refillable Refrigerant Cylinders

REPORT NUMBER

104013221COL-001

ISSUE DATE

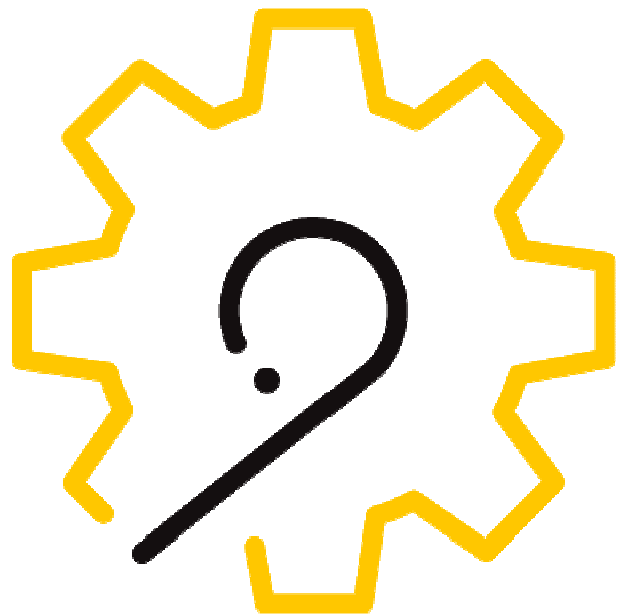
7 – AUGUST – 2019

PAGES

14

DOCUMENT CONTROL NUMBER

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WORTHINGTON INDUSTRIES, INC,

200 W OLD WILSON BRIDGE RD, WORTHINGTON OHIO 43085

Report No.: 104013221COL-001

Date: August, 7, 2019

1717 Arlingate Lane
Columbus, OH 43228
USA

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OBJECTIVE

The objective of this evaluation was to determine the weight of particulate contamination as well as the weight of oil/hydrocarbon contamination in a cylinder

HYPOTHESIS

Hypothesis 1:

Residual oil and other hydrocarbons found within the cylinder shall not be greater than 2.5 milligrams (mg) per square foot of internal surface area and shall not exceed 20 mg per cylinder regardless of the size of the cylinder.

Hypothesis 2:

There shall be no measurable particulate matter found following extraction of the residual oil and hydrocarbon residue

CONCLUSION

Based on the data collected for sample COL1907120853-001, Hypothesis 1 is **ACCEPTED**: Residual oil and other hydrocarbons found within the cylinder did not exceed 2.5 milligrams (mg) per square foot of internal surface area and did not exceed 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907120853-001, Hypothesis 2 is **ACCEPTED**: There were no measurable particulate matter found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-001, Hypothesis 1 is **REJECTED**: Residual oil and other hydrocarbons found within the cylinder exceeded 2.5 milligrams (mg) per square foot of internal surface area and exceeded 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907111059-001, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-002, Hypothesis 1 is **REJECTED**: Residual oil and other hydrocarbons found within the cylinder exceeded 2.5 milligrams (mg) per square foot of internal surface area and exceeded 20 mg per cylinder regardless of the size of the cylinder.

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Based on the data collected for sample COL1907111059-002, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-003, Hypothesis 1 is **ACCEPTED**: Residual oil and other hydrocarbons found within the cylinder did not exceed 2.5 milligrams (mg) per square foot of internal surface area and did not exceed 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907111059-003, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-004, Hypothesis 1 is **REJECTED**: Residual oil and other hydrocarbons found within the cylinder exceeded 2.5 milligrams (mg) per square foot of internal surface area and exceeded 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907111059-004, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

ENGINEER

REVIEWER

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SECTION 2

OBJECTIVE

The objective of this evaluation was to determine the weight of particulate contamination as well as the weight of oil/hydrocarbon contamination in a cylinder

SECTION 3

PARAMETERS

The following parameters are controlled

VALUE	DESCRIPTION	UNITS	METHOD	MU
Temperature	Evaporation Temperature	°C	Oven	n/a

The following parameters are monitored

VALUE	DESCRIPTION	UNITS	METHOD	MU
Temperature	Temperature of Evaporation	°C	Temperature Data Logger	± 0.2°C
Mass	Mass of Residual Residue	g	Analytical Balance	±0.04%

SECTION 4

SAMPLE ACQUISITION

Samples acquired by Intertek from Client:

SAMPLE #	DESCRIPTION	SERIAL #	PURCHASE LOCATION	RECEIVED	CONDITION
COL1907120853-001	Worthington Cyl New 125# Refillable Cylinder	n/a	Shipped by Client	7/18/2019	Good Condition
COL1907111059-001	Cylinder A; 125# Refillable Cylinder with Green Valve Wheel	n/a	Shipped by Client	7/18/2019	Good Condition
COL1907111059-002	Cylinder B; 125# Refillable Cylinder	n/a	Shipped by Client	7/18/2019	Good Condition
COL1907111059-003	Cylinder C; Used 125# Refillable Cylinder with Green Top	n/a	Shipped by Client	7/18/2019	Good Condition
COL1907111059-004	Worthington Cyl New 125# Refillable Cylinder with Orange Circle Sticker	n/a	Shipped by Client	7/18/2019	Good Condition

SECTION 5
HYPOTHESIS

Hypothesis 1:

Residual oil and other hydrocarbons found within the cylinder shall not be greater than 2.5 milligrams (mg) per square foot of internal surface area and shall not exceed 20 mg per cylinder regardless of the size of the cylinder.

Hypothesis 2:

There shall be no measurable particulate matter found following extraction of the residual oil and hydrocarbon residue

SECTION 6
EQUIPMENT LIST

#	EQUIPMENT DESCRIPTION	MANUFACTURER'S NAME		INTERTEK ASSET #	CALIBRATION DATE	CALIBRATION DUE	RANGE USED
		MODEL #	SERIAL #				
1	Balance	Ohaus/AP210S/M79924		CE1017	8/16/19	8/16/20	0g-200g
2	Oven	Binder/VDL115/06-08843		CE2346	Verify Before Use	Verify Before Use	23°C - 120°C
3	TC	n/a		CE2761	Initial Calibration Only	Initial Calibration Only	23°C - 120°C
4	Temp Data Logger	Omega/HH500P/131002805		CE2373	7/8/2019	7/8/2020	23°C - 120°C
5	Stop Watch	Extech/365510		E396	1/9/2019	1/9/2020	0 – 600 sec
6	Tape Measure	Stanley/25'		CE2417	11/17/2017	Initial Cal Only	0 – 40"
7	Isopropyl Alcohol	CAT# LC157505/Lot# J186-21		n/a	n/a	n/a	n/a
8	Graduated Cylinder	ACE Glass/ 100mL		n/a	Verify Before Use	Verify Before Use	0-100mL
9	Pan Balance	Mettler Toledo/ME4002E/B804328046		CE2692	2/22/2019	2/22/2020	0-2000g
10	Digital Thermometer	Thermolyne/PM20700/5C02640		CE2015	10/2/2018	10/2/2019	23-105°C

Note: The equipment measurement uncertainty is stated in Section 3

Testing was conducted at: 1717 Arlingate Lane, Columbus, Ohio 43228:

SECTION 7

PROCEDURE DESCRIPTION AND TEST DATA

Oil and hydrocarbon residue.

First the approximate surface area of each sample cylinder was measured. Next, the exterior surface of each cylinder was cleaned to remove any residue and/or particulate from the wetted surfaces of the cylinder valve and surrounding areas. 100mL of clean, residue free isopropyl alcohol was added for each square foot of internal surface area. The cylinders were then placed on their side and rolled through 360 degrees on a level surface for a minimum of 10 minutes to assure all the internal surfaces have been thoroughly wetted with solvent. The solvent was then extracted into a clean glass vessel. Any undissolved liquid floating on the surface of the solvent was noted as the presence of water or glycerin. The solvent extract was then analyzed for hydrocarbons by Evaporation method.

The solvent was evaporated to dryness at slightly below the boiling point of the solvent and then finished in a drying oven at 221 °F (105 °C) ±1.8 °F (1 °C) for 15 minutes. The vessels were then cooled to ambient temperature and the residue was re-dissolved with an additional 100mL of solvent, then transferred to pre-weighed aluminum weighing dishes and once again evaporated at 221 °F (105 °C) ±1.8 °F (1 °C) until all traces of isopropyl alcohol was gone.

A control sample was prepared and analyzed to determine the residue within the solvent. Finally, the milligrams of extracted oil was calculated by mass difference after subtraction of the residual mass from the solvent control sample.

Particulate Test:

The residue was then re-dissolved in 100mL of solvent and passed through a pre-weighed filter paper. The filter paper was dried in a clean box over-night. The filter paper was then re-weighed and the weight of the particulates was calculated after the residual mass was subtracted from the control sample.

Weight of oil/hydrocarbons will equal weight of residue – weight of particulates- weight of control sample residue

Mass of Extracted Residual Oil and Hydrocarbons

Sample	Residual Oil and Hydrocarbons (mg)	Residual Oil and Hydrocarbons (mg/ft ²)	PASS/ FAIL
COL1907120853-001	<0.1	<0.1	PASS
COL1907111059-001	39.8	2.8	FAIL
COL1907111059-002	37.5	2.6	FAIL
COL1907111059-003	11.2	0.8	PASS
COL1907111059-004	54.4	3.6	FAIL

Mass of Extracted Particles

Sample	Residual Particulate Matter (mg)	PASS/FAIL
COL1907120853-001	<0.1	PASS
COL1907111059-001	10.6	FAIL
COL1907111059-002	1.2	FAIL
COL1907111059-003	2.3	FAIL
COL1907111059-004	0.6	FAIL

SECTION 8 CONCLUSION

Based on the data collected for sample COL1907120853-001, Hypothesis 1 is **ACCEPTED**: Residual oil and other hydrocarbons found within the cylinder did not exceed 2.5 milligrams (mg) per square foot of internal surface area and did not exceed 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907120853-001, Hypothesis 2 is **ACCEPTED**: There were no measurable particulate matter found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-001, Hypothesis 1 is **REJECTED**: Residual oil and other hydrocarbons found within the cylinder exceeded 2.5 milligrams (mg) per square foot of internal surface area and exceeded 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907111059-001, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-002, Hypothesis 1 is **REJECTED**: Residual oil and other hydrocarbons found within the cylinder exceeded 2.5 milligrams (mg) per square foot of internal surface area and exceeded 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907111059-002, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-003, Hypothesis 1 is **ACCEPTED**: Residual oil and other hydrocarbons found within the cylinder did not exceed 2.5 milligrams (mg) per square foot of internal surface area and did not exceed 20 mg per cylinder regardless of the size of the cylinder.



Based on the data collected for sample COL1907111059-003, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

Based on the data collected for sample COL1907111059-004, Hypothesis 1 is **REJECTED**: Residual oil and other hydrocarbons found within the cylinder exceeded 2.5 milligrams (mg) per square foot of internal surface area and exceeded 20 mg per cylinder regardless of the size of the cylinder.

Based on the data collected for sample COL1907111059-004, Hypothesis 2 is **REJECTED**: Measurable particulate matter was found following extraction of the residual oil and hydrocarbon residue

This test is for information only. Final acceptance of the evaluation and final conclusions are to be conducted by the client

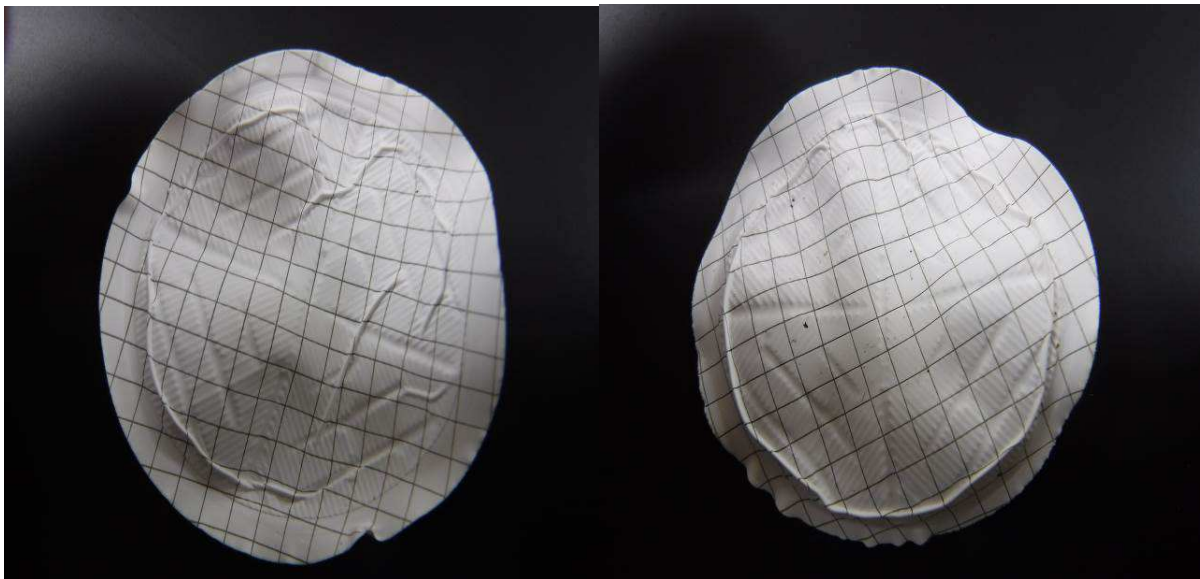
SECTION 9
TECHNICAL STAFF

Completed by:	Angie Janakievaska	Reviewed by:	John Senediak
Title:	Regulatory Analyst	Title:	Reviewer
Signature:		Signature:	
Date:	7-August – 2019	Date:	7-August-2019

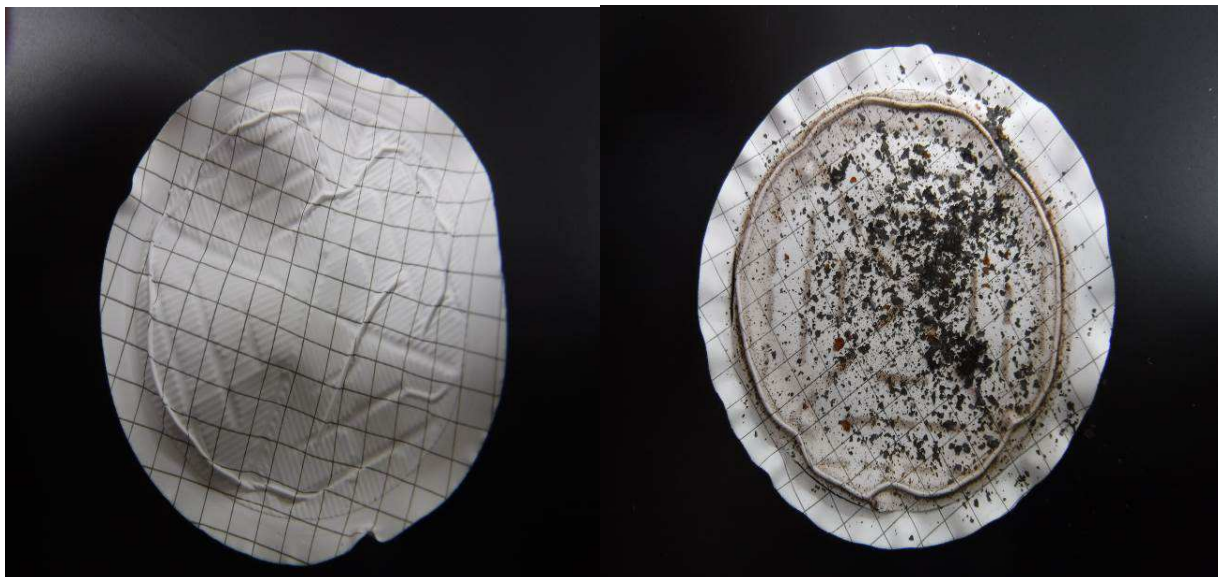
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SECTION 10

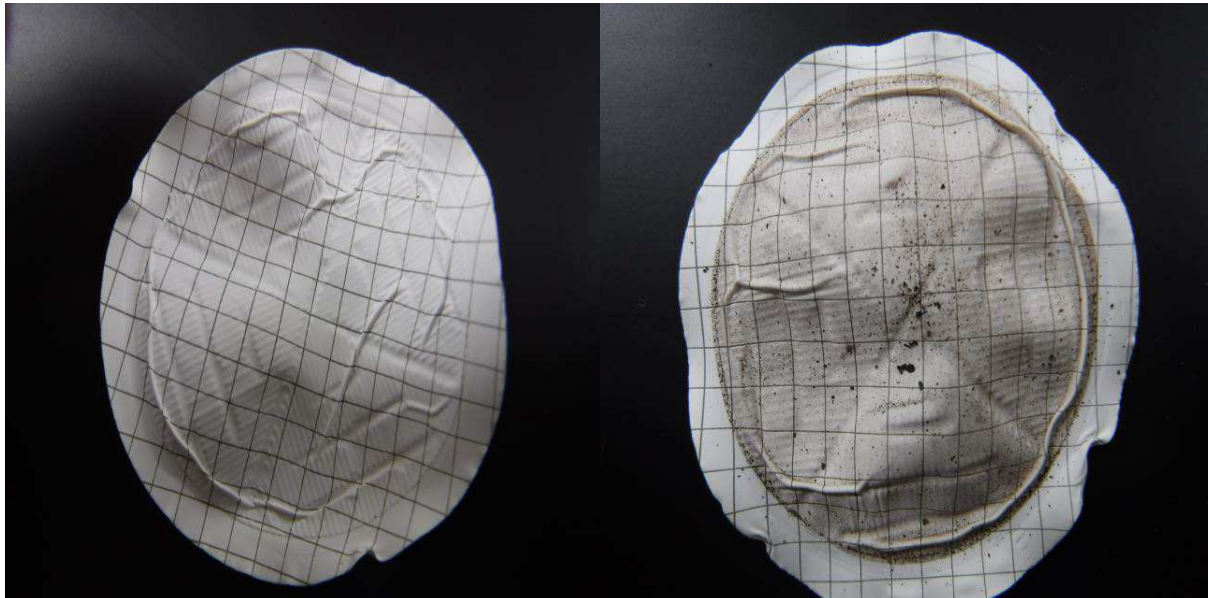
PHOTOS



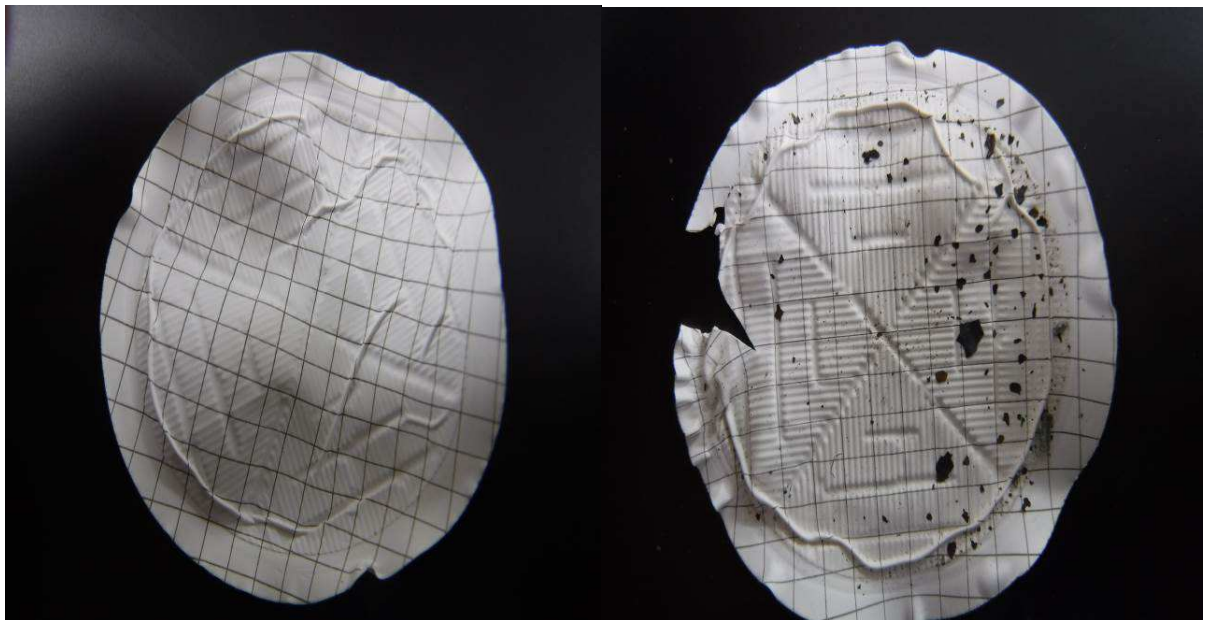
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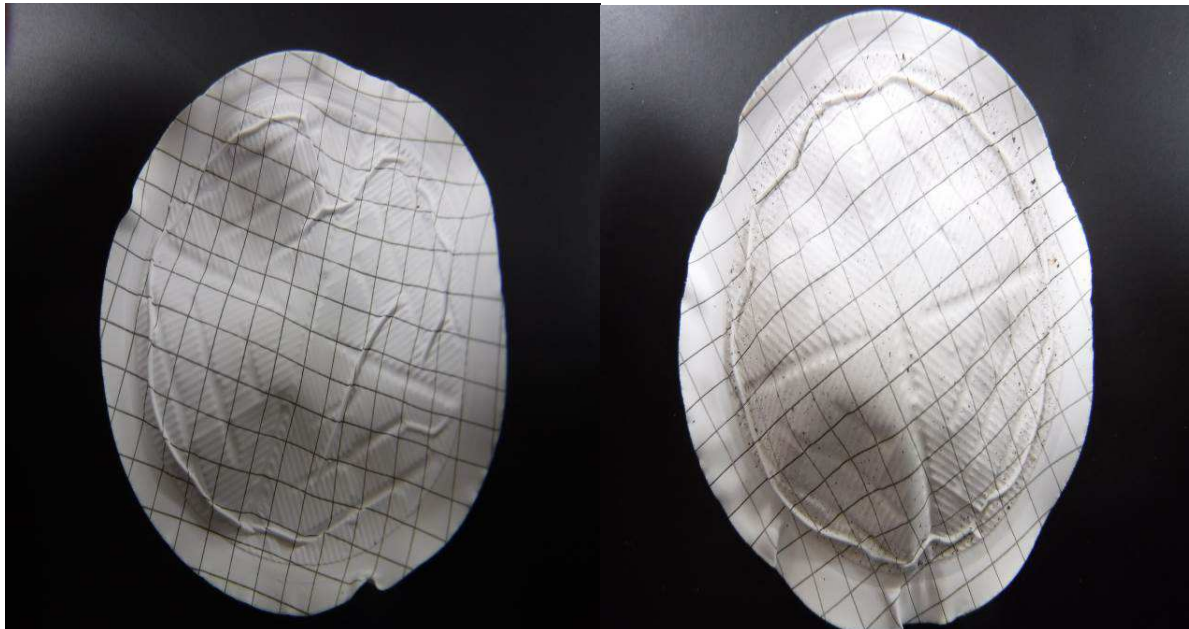
Left: Control Right: COL1907111059-001



Left: Control Right: COL1907111059-002



Left: Control Right: COL1907111059-003
(Filter paper tore after final weighing)



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