

Test Report No. T14756-01-1 Issue 1 N95 Performance Testing: NIOSH TEB-APR-STP-0003, NIOSH TEB-APR-STP-0007, and abbreviated form of NIOSH TEB-APR-STP-0059 Lumino Capital LLC KN95 Respirator 02 July 2020



Authorized by:

BIG

Dale Pfriem President ICS Laboratories, Inc.

Performed by:

Kg Oel

Kayci Adams Analytical Chemist Respiratory and Chemical Protective Equipment

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Summary:

 Date:
 02 July 2020

 Report:
 T14756-01-1

 Issue:
 1

 Page:
 1 of 7

10 KN95 respirators were tested for filtration efficiency, three full aerosol loads and seven instantaneous aerosol loads, at the client's request to an abbreviated form of NIOSH standard TEB-APR-STP-0059. Three KN95 respirators were tested for exhalation resistance and inhalation resistance to NIOSH standards TEB-APR-STP-0003 and TEB-APR-STP-0007. The samples were submitted by Lumino Capital LLC. All samples met exhalation and inhalation resistance requirements as well as N95 filtration efficiency requirements, having exhalation resistances < 25 mmH₂O, inhalation resistances < 35 mmH₂O, and maximum penetrations < 5%. Note this limited testing is not representative of these respirators' performance and does not designate them as N95 equivalents.

Objectives:

Testing to: NIOSH Procedure TEB-APR-STP-0003 Determination of Exhalation Resistance Test, Air-Purifying Respirators Standard Testing Procedure (STP) Revision: 2.4, 15 Mar 2019 NIOSH Procedure TEB-APR-STP-0007 Determination of Inhalation Resistance Test, Air-Purifying Respirators Standard Testing Procedure (STP) Revision: 2.3, 8 Mar 2019
 Abbreviated testing to: NIOSH Procedure TEB-APR-STP-0059, "Determination of Particulate Filter Efficiency Level for N95 Series Filters against Solid Particulates for Non-Powered, Air-Purifying Respirators Standard Testing Procedure" Revision 3.2, 13 December 2019 [Three full loadings, seven instantaneous loadings]

Materials:

Item	Description	Qty
KN95	20	
Date provided by the Clien Date Testing Authorized:	t: 22 May 2020 21 May 2020	

Equipment:

Dates of tests:

Manufacturer/Supplier

TSI 8130A Filter Tester, test bench configured for sodium chloride aerosol (EQ1279). *Flow Meters*, Fisher & Porter Co., (EQ0098-03 & EQ0098-04) Calibrated *Digital Manometer*; Dwyer Instruments, (EQ0501) Calibrated *Humidity chamber*, Envirotronics (EQ0327) *Vacuum Pumps*; Marathon Electric (EQ0088-04-02 &-03) *ISI Headform* (EQ0477) *Mask Fixture*, Custom design ICS Labs *Sodium Chloride*, 99+%, Fisher Chemical, (C0015-03)

18-24 June 2020

Lumino Capital LLC

Procedure:

All tests were conducted in a standard laboratory atmosphere unless otherwise specified. The equipment and instrument calibrations were verified current and within specification prior to use. The materials for assessment were inventoried, numbered, and logged upon receipt.

The exhalation resistance test was performed in general accordance with NIOSH Procedure TEB-APR-STP-0003. A positive 85 LPM airflow through the respirator was established and the pressure difference across the respirator was determined with the digital manometer. The pressure was corrected for systemic resistance and recorded in mmH_2O column height.





02 July 2020

Report: T14756-01-1

Date:

Issue: 1

Page: 2 of 7

Issued to: Lumino Capital LLC 70 South Lake Ave. Suite 920 Pasadena, CA 91101 USA

Procedure (cont.):

The inhalation resistance test was performed in general accordance with NIOSH Procedure TEB-APR-STP-0007. A negative 85 LPM airflow through the respirator was established and the pressure difference across the respirator was determined with the digital manometer. The pressure was corrected for systemic resistance and recorded in mmH₂O column height.

The filter efficiency test was performed in general accordance with NIOSH Procedure TEB-APR-STP-0059. The respirators were challenged to a sodium chloride aerosol neutralized to a Boltzmann equilibrium state at $25 \pm -5^{\circ}$ C and a relative humidity of $30 \pm -10^{\circ}$. Particle size distribution was verified to be a count median diameter of 0.075 + -0.020 microns, with a geometric standard deviation not exceeding 1.86.

The respirators were conditioned at 85 % +/- 5 % relative humidity and 38°C +/- 2°C for 25 hours prior to the filter efficiency test. Three respirators were selected at random from the quantity provided. Each respirator was then assembled into a fixture and subjected to aerosol loading. The filter loading was performed by depositing 200 mg of sodium chloride aerosol at airflow rate of 85 LPM. Flow rate was monitored every 5-10 minutes on average and adjusted to maintain a flow rate of 85 LPM +/- 2 LPM. The initial flow rate, initial resistance, initial penetration, and maximum penetration data were recorded.

An aerosol loading graph for each respirator was created to determine the filter type. The respirator was identified as a Type II based on the performance graph. As such, the following 7 samples, selected at random, were subjected to instantaneous aerosol loading. The loading was performed by depositing sodium chloride aerosol at an airflow rate of 85 LPM for one minute. Flow rate was maintained at 85 LPM +/- 2 LPM. The flow rate, resistance, and penetration data were recorded for each respirator.

Results:

The results for the exhalation and inhalation resistance of the respirators are provided in Table I.

Breathir	ng Resistance – KN95 Disp	oosable Respirator			
Sample No.	Exhalation Resistance * (mmH ₂ O)	Inhalation Resistance * (mmH ₂ O)	Results		
LC-11	11.2	12.7	Pass		
LC-12	11.0	11.9	Pass		
LC-13	12.2	12.7	Pass		
NIOSH Specification:**	≤ 25	≤ 35			

Table I

*Resistance corrected for systemic response **Specification based on non-powered air purifying respirator

Table II outlines the results of the full loading tests. All respirators followed the Type II filter profile defined by NIOSH TEB-APR-STP-0059.



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 Date:
 02 July 2020

 Report:
 T14756-01-1

 Issue:
 1

 Page:
 3 of 7

Sample ID	Initial Flow Rate (LPM)	Initial Resistance (mmH2O)	Initial Penetration (%)	Maximum Penetration (%)	Filter Efficiency* (%)	Result
LC-01	LC-01 84.99		3.45	3.45	96.55	Pass
LC-02	84.97	8.68	2.87	2.87	97.13	Pass
LC-03	LC-03 85.00		2.83	2.83	97.17	Pass
Specification:	81-89	≤ 35.0		≤ 5.0	≥ 95.0	

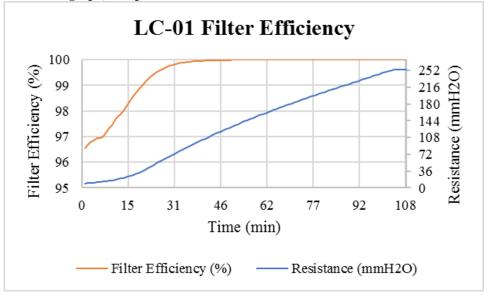
 <u>Table II</u>

 Full Loading Efficiencies – KN95 Disposable Respirator

*Filter efficiency percent is based on maximum penetration value.

Below are the filter efficiency and resistance graphs over the loading time for each test. Raw data tables are located in the appendix of this report.

Filter performance graph, Sample LC-01



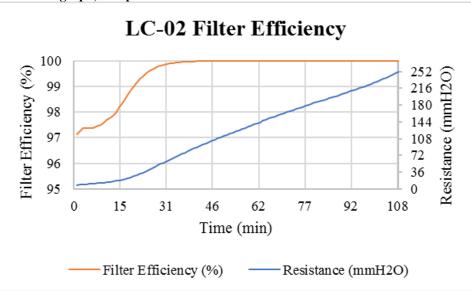




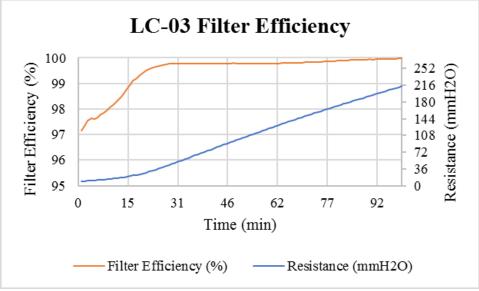
Results (cont.):

Filter performance graph, Sample LC-02

02 July 2020 Date: Report: T14756-01-1 Issue: 1 Page: 4 of 7



Filter performance graph, Sample LC-03



As outlined in TEB-APR-STP-0059, the respirator was identified as Type II filter by its loading profile. Table III outlines the 7 instantaneous aerosol loading test results for each respirator.





 Date:
 02 July 2020

 Report:
 T14756-01-1

 Issue:
 1

 Page:
 5 of 7

<u>Table III</u>
Instantaneous Loading Efficiencies – KN95 Disposable Respirator

Sample ID	Flow Rate (LPM)	Resistance (mmH2O)	Penetration (%)	Filter Efficiency (%)	Result
LC-04	86	10.8	2.02	97.98	Pass
LC-05	86	10.9	2.03	97.97	Pass
LC-06	85	11.4	2.74	97.26	Pass
LC-07	86	11.1	3.29	96.71	Pass
LC-08	85	11.5	2.52	97.48	Pass
LC-09	85	11.7	2.34	97.66	Pass
LC-10	85	10.9	2.40	97.60	Pass
Specification:	81-89	≤ 35.0	≤ 5.0	≥ 95.0	

Photographs:



Figure 1: KN95 Disposable Respirator



Figure 2. Respirator under test



Photographs (cont.):

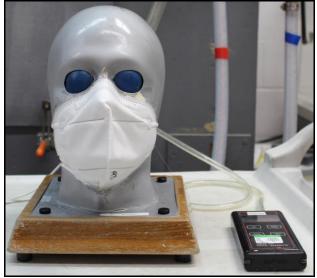


Figure 3. Resistance measurement

Appendix:

Loading data for Sample LC-01

1		Resistance (mmH ₂ O)		Time (min)	Flow (LPM)	Resistance (mmH ₂ O)	% Penetration	Time (min)	Flow (LPM)	Resistance (mmH ₂ O)	% Penetration
1	84.99	9,59	3.45	37	84.06	93,35	0.06	73	83.26	188.63	0.00
2	84.94	10.18	3.34	38	84.03	96.52	0.05	74	83.24	190.92	0.00
3	84.89	10.75	3.20	39	83.99	99.58	0.05	75	83.22	193.13	0.00
4	84.86	11.29	3.16	40	83.96	102.71	0.04	76	83.20	195.49	0.00
5	84.80	11.98	3.05	41	83.93	105.71	0.03	77	83.17	197.76	0.00
6	84.78	12.64	3.07	42	83.91	108.71	0.03	78	83.15	199.93	0.00
7	84.78	13.38	3.02	43	83.87	111.73	0.02	79	83.14	202.17	0.00
8	84.76	14.17	2.85	44	83.86	114.68	0.02	80	83.13	204.33	0.00
9	84.74	15.04	2.67	45	83.83	117.60	0.01	81	83.11	206.51	0.00
10	84.74	15.94	2.54	46	83.81	120.43	0.01	82	83.08	208.53	0.00
11	84.70	17.01	2.34	47	83.78	123.22	0.01	83	83.06	210.69	0.00
12	84.70	18.23	2.22	48	83.77	125.98	0.01	84	83.04	212.84	0.00
13	84.68	19.70	2.13	49	83.75	128.73	0.01	85	83.01	214.93	0.00
14	84.68	21.23	1.97	50	83.74	131.53	0.00	86	83.01	216.95	0.00
15	84.65	23.14	1.79	51	83.69	134.29	0.00	87	82.98	219.08	0.00
16	84.64	25.14	1.62	52	83.67	137.03	0.00	88	82.98	221.18	0.00
17	84.61	27.39	1.44	53	83.63	139.78	0.00	89	82.94	223.18	0.00
18	84.61	29.96	1.28	54	83.61	142.42	0.00	90	82.92	225.30	0.00
19	84.59	32.71	1.15	55	83.59	145.05	0.00	91	82.89	227.39	0.00
20	84.55	35.76	1.01	56	83.58	147.66	0.00	92	82.88	229.54	0.00
21	84.52	39.02	0.87	57	83.55	150.26	0.00	93	82.86	231.63	0.00
22	84.50	42.35	0.76	58	83.53	152.82	0.00	94	82.83	233.64	0.00
23	84.48	45.86	0.65	59	83.51	155.44	0.00	95	82.80	235.67	0.00
24	84.45	49.39	0.57	60	83.50	157.81	0.00	96	82.78	237.81	0.00
25	84.43	53.01	0.48	61	83.48	160.32	0.00	97	82.75	240.01	0.00
26	84.38	56.58	0.41	62	83.47	162.80	0.00	98	82.72	242.15	0.00
27	84.35	60.12	0.34	63	83.44	165.21	0.00	99	82.72	244.33	0.00
28	84.34	63.72	0.29	64	83.42	167.61	0.00	100	82.70	246.48	0.00
29	84.29	67.13	0.24	65	83.41	169.99	0.00	101	82.69	248.70	0.00
30	84.26	70.55	0.20	66	83.38	172.35	0.00	102	82.67	250.87	0.00
31	84.23	73.88	0.16	67	83.36	174.74	0.00	103	82.66	253.00	0.00
32	84.22	77.19	0.13	68	83.34	177.13	0.00	104	82.63	254.72	0.00
33	84.19	80.48	0.12	69	83.32	179.39	0.00	105	82.62	254.72	0.00
34	84.13	83.69	0.10	70	83.32	181.78	0.00	106	82.60	254.72	0.00
35	84.10	86.93	0.08	71	83.30	184.08	0.00	107	82.57	254.72	0.00
36	84.06	90.18	0.07	72	83.28	186.40	0.00	108	82.55	254.72	0.00



 Date:
 02 July 2020

 Report:
 T14756-01-1

 Issue:
 1

 Page:
 6 of 7



Appendix (cont.): Loading data for Sample LC-02



02 July 2020 Date: Report: T14756-01-1 Issue: 1 Page: 7 of 7

LUaum	g uala I	tor Sample L	AC-04								
Time (min)	Flow (LPM)	$Resistance \ (mmH_2O)$	% Penetration	Time (min)	Flow (LPM)	$Resistance \ (mmH_2O)$	% Penetration	Time (min)	Flow (LPM)	$Resistance \ (mmH_2O)$	% Penetration
1	84.97	8.68	2.87	37	84.19	77.98	0.04	73	84.41	169.33	0.00
2	84.94	9.13	2.74	38	84.13	81.01	0.04	74	84.42	171.41	0.00
3	84.90	9.54	2.64	39	84.09	83.89	0.03	75	84.38	173.64	0.00
4	84.88	10.04	2.62	40	84.08	86.76	0.03	76	84.37	175.82	0.00
5	84.83	10.54	2.63	41	84.05	89.48	0.02	77	84.31	178.00	0.00
6	84.83	11.11	2.62	42	84.03	92.33	0.02	78	84.31	180.08	0.00
7	84.83	11.65	2.59	43	84.00	95.12	0.02	79	84.28	182.14	0.00
8	84.81	12.21	2.54	44	83.97	97.89	0.01	80	84.27	184.29	0.00
9	84.78	12.94	2.52	45	83.93	100.61	0.01	81	84.21	186.31	0.00
10	84.77	13.54	2.41	46	83.91	103.34	0.01	82	84.21	188.35	0.00
11	84.78	14.39	2.31	47	83.88	105.98	0.01	83	84.16	190.46	0.00
12	84.76	15.21	2.23	48	83.86	108.54	0.01	84	84.15	192.47	0.00
13	84.75	16.21	2.15	49	83.84	111.14	0.00	85	84.13	194.56	0.00
14	84.73	17.31	2.02	50	83.82	113.75	0.00	86	84.10	196.65	0.00
15	84.72	18.51	1.81	51	83.81	116.24	0.00	87	84.10	198.74	0.00
16	84.70	19.92	1.67	52	83.78	118.74	0.00	88	84.07	200.74	0.00
17	84.68	21.54	1.50	53	83.78	121.31	0.00	89	84.03	202.78	0.00
18	84.67	23.21	1.33	54	83.76	123.84	0.00	90	84.03	204.92	0.00
19	84.65	25.20	1.16	55	83.74	126.27	0.00	91	84.00	207.12	0.00
20	84.63	27.29	1.00	56	83.71	128.63	0.00	92	84.00	209.27	0.00
21	84.63	29.61	0.85	57	83.69	131.10	0.00	93	83.99	211.49	0.00
22	84.59	32.11	0.71	58	83.69	133.44	0.00	94	83.95	213.68	0.00
23	84.58	34.90	0.60	59	83.67	135.74	0.00	95	83.94	215.95	0.00
24	84.55	37.69	0.49	60	83.63	138.02	0.00	96	83.91	218.16	0.00
25	84.54	40.70	0.40	61	83.62	140.38	0.00	97	83.91	220.38	0.00
26	84.51	43.77	0.33	62	83.61	142.62	0.00	98	83.88	222.65	0.00
27	84.49	46.94	0.27	63	84.60	146.74	0.00	99	83.86	225.07	0.00
28	84.46	50.26	0.23	64	84.59	149.00	0.00	100	83.84	227.54	0.00
29	84.42	53.46	0.19	65	84.56	151.29	0.00	101	83.83	230.12	0.00
30	84.39	56.75	0.16	66	84.55	153.56	0.00	102	83.80	232.74	0.00
31	84.38	59.91	0.13	67	84.53	155.84	0.00	103	83.79	235.61	0.00
32	84.32	62.98	0.11	68	84.48	158.13	0.00	104	83.76	238.46	0.00
33	84.29	66.12	0.09	69	84.48	160.40	0.00	105	83.74	241.39	0.00
34	84.27	69.09	0.08	70	84.48	162.62	0.00	106	83.71	244.69	0.00
35	84.27	72.09	0.06	71	84.45	164.84	0.00	107	83.69	248.28	0.00
36	84.21	75.02	0.05	72	84.43	167.07	0.00	108	83.66	251.62	0.00

Loading data for Sample LC-03

Time (min)	Flow (LPM)	Resistance (mmH ₂ O)	% Penetration	Time (min)	Flow (LPM)	Resistance (mmH ₂ O)	% Penetration	Time (min)	Flow (LPM)	Resistance (mmH ₂ O)	% Penetration
1	85.00	9.19	2.83	37	84.61	67.37	0.24	73	83.95	156.00	0.17
2	84.99	9.61	2.65	38	84.58	69.99	0.23	74	83.91	158.25	0.16
3	84.97	10.10	2.46	39	84.57	72.70	0.22	75	83.90	160.54	0.16
4	84.93	10.63	2.36	40	84.56	75.25	0.22	76	83.88	162.77	0.15
5	84.90	11.15	2.39	41	84.55	77.85	0.23	77	83.88	164.93	0.14
6	84.87	11.72	2.34	42	84.53	80.35	0.23	78	83.85	167.17	0.14
7	84.89	12.25	2.21	43	84.50	82.98	0.22	79	83.84	169.35	0.13
8	84.89	12.89	2.15	44	84.51	85.55	0.22	80	83.85	171.45	0.12
9	84.86	13.47	2.05	45	84.49	88.07	0.22	81	83.83	173.67	0.11
10	84.87	14.23	1.92	46	84.49	90.59	0.22	82	83.81	175.74	0.10
11	84.88	14.96	1.84	47	84.45	93.14	0.22	83	83.78	177.87	0.09
12	84.87	15.82	1.72	48	84.45	95.66	0.21	84	83.77	180.08	0.09
13	84.86	16.76	1.57	49	84.43	98.20	0.22	85	83.75	182.26	0.08
14	84.84	17.81	1.41	50	84.42	100.70	0.22	86	83.75	184.42	0.07
15	84.85	18.95	1.22	51	84.40	103.19	0.22	87	83.74	186.57	0.07
16	84.84	20.15	1.07	52	84.36	105.66	0.22	88	83.73	188.72	0.07
17	84.83	21.60	0.90	53	84.36	108.13	0.22	89	83.71	190.80	0.07
18	84.84	22.94	0.80	54	84.35	110.71	0.24	90	83.69	192.92	0.05
19	84.82	24.65	0.68	55	84.33	113.20	0.23	91	83.67	195.01	0.07
20	84.80	26.30	0.58	56	84.32	115.72	0.23	92	83.67	197.23	0.06
21	84.80	28.15	0.50	57	84.30	118.19	0.23	93	83.65	199.32	0.05
22	84.79	30.16	0.43	58	84.28	120.65	0.23	94	83.63	201.48	0.05
23	84.76	32.29	0.38	59	84.25	123.08	0.22	95	83.64	203.52	0.04
24	84.77	34.50	0.34	60	84.20	125.50	0.22	96	83.60	205.62	0.04
25	84.76	36.80	0.32	61	84.21	127.88	0.22	97	83.61	207.73	0.04
26	84.75	39.17	0.28	62	84.18	130.34	0.21	98	83.59	209.76	0.04
27	84.73	41.55	0.25	63	84.15	132.74	0.21	99	83.59	211.94	0.03
28	84.73	44.06	0.24	64	84.12	135.13	0.21	100	83.54	214.09	0.03
29	84.71	46.51	0.22	65	84.09	137.47	0.21				
30	84.71	49.06	0.23	66	84.07	139.80	0.20				
31	84.69	51.75	0.22	67	84.06	142.14	0.20				
32	84.66	54.37	0.22	68	84.02	144.49	0.20				
33	84.64	56.96	0.22	69	84.03	146.81	0.18				
34	84.65	59.56	0.22	70	84.01	149.15	0.17				
35	84.63	62.16	0.22	71	83.98	151.52	0.18				
36	84.62	64.81	0.23	72	83.97	153.77	0.17				

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C. LABORATORIES

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- 3. ICS shall keep documents and information related to Client confidential and will not disclose any such information to third parties without written consent. ICS will disclose such information in response to compulsory legal process, (only after providing Client with notice-of and/or a copy of such process).
- 4. ICS Reports apply only to the standards or procedures identified therein and to the sample(s) assessed. Test results are not indicative of the qualities of the lot from which the sample was taken or of apparently identical or similar products.
- 5. ICS Test Reports and their insignia are for the exclusive use of the Client. Reports, in their entirety, may be utilized at the discretion of Clients and/or their authorized agents for purposes including, but not limited to, research & development, recordkeeping, product packaging, educational and promotional materials in various formats, certification, and compliance. As an accredited independent testing laboratory, ICS maintains an interest in preventing the misrepresentation of the contents of its test reports. As such, Clients may NOT use, reproduce or otherwise disseminate excerpted, partial, redacted or otherwise altered ICS test reports without the prior review of such use by ICS and the granting of its written approval. Further, Clients are prohibited from manipulating data and/or extrapolatingfrom-it statistics or conclusions that contradict or eclipse the empirical results of testing as reflected by the totality of the report. Clients are to refrain from utilizing ICS Test Reports and/or the ICS logo in a manner that suggests any extra-report conclusions are provided and/or endorsed by ICS Laboratories.
- 6. The name(s) listed as the "Issued to" party on test reports may not reflect the actual entity submitting and/or contracting the assessment.
- 7. ICS shall retain copies of testing job files (including reports) for a period of at least six (6) years and when applicable, evidentiary test samples for a length of time agreed to or deemed appropriate. If Client requests additional copies of Reports during this period, an additional charge will apply for the preparation and delivery of such reports.
- 8. Test reports are valid for certification purposes for one year from date of issue, inclusive of retest or variant additions, which must be performed within one year of date of issue to avoid full retest.
- Client is responsible for procuring, at its cost, insurance protecting the value of its property, extending to provided samples.
- 10. For the safety of our personnel, Client must advise if samples are known or suspected to contain hazardous substances. Safety Data Sheets must be provided upon request.
- 11. ICS represents that Services shall be performed according to terms and specification agreed to by Client, and in a manner consistent with 23. All costs associated with compliance with any subpoena (s) for good laboratory practice. No other Representations to client, express or implied, and no warranty or guarantee is included or intended in this agreement, or in any other report or document related to the services. ICS does not guarantee product performance or compliance.
- 12. Schedules are confirmed upon acceptance of quotation. All reasonable efforts will be made to comply with provided timeline. Guarantees are neither implied nor promised.

- 13. Certain work may be subcontracted to ICS-approved laboratories as required or applicable. Client will be notified of this in advance.
- 14. Client agrees to pay any and all additional costs associated with unexpected or above-standard communications and/or consultations with Client or third parties as designated by Client.
- 15. Client agrees to pay any and all additional costs for work additional to the original scope of work as agreed to by Client.
- 16. Client understands and agrees that ICS, in entering into this Contract and by performing services hereunder, does not assume, abridge, abrogate or undertake to discharge any duty or responsibility of Client to any other party or parties. No one other than Client shall have any right to rely on any Report or other representation or conduct of ICS and ICS disclaims any obligations of any nature whatsoever with respect to such third parties.
- 17. For statements of conformity (pass/fail/"meets") regarding qualitative test results, ICS utilizes simple acceptance as its basis. For most statements of conformity relating to quantitative test results, the decision rule and associated uncertainty is inherent in the standard method. As such, simple acceptance is typically applied. Results on or near pass/fail thresholds or otherwise upon Client request or appeal will be evaluated with reference to the measurement uncertainty of relevant testing practices, equipment and other inputs/variables.
- 18. Client agrees, in consideration of ICS undertaking to perform the test(s) hereunder, to protect, defend and indemnify ICS from any and all claims, damages, expenses either direct or consequential for injuries to persons or property arising out of or in consequence of the performance of the testing, inspection and reporting hereunder and/or the performance of the products tested or inspected hereunder, unless caused by the negligence of ICS.
- 19. It is agreed that if ICS should be found liable for any losses or damages attributable to the services hereunder in any respect, its liability shall not exceed the amount of the fee paid by Client for services rendered and Client's sole remedy at law or in equity shall be the right to recover that sum.
- 20. Quotations are valid for 30 days from date of issue. Standard Terms: 30% Laboratory/Testing fees invoiced and payable upon acceptance of quotation. 15 days net. Any change to these terms requires written approval by the President, Executive Vice President or Accounting Manager. ICS retains the right to require prepayment in full at any time. Cancelled jobs will be invoiced for work performed and/or setup costs incurred. Shipping costs incurred by ICS will be invoiced at cost +10% handling fee. A minimum USD \$25.00 handling fee will be invoiced on all sample returns. Shipping costs incurred by ICS will be invoiced \$25.00 or cost +10%, whichever amount is higher.
- 21. ICS hereby objects to any conflicting terms contained in any order, acceptance or other subsequent correspondence submitted by Client.
- 22. In the event that payment is not received within 15 days of invoice date, Client agrees to pay a late payment charge on the unpaid balance equal to 1-1/2% per month or the maximum charge allowed by law, whichever is less, and all costs and expenses, including attorney's fees where recovery of the same is not prohibited by law, incurred by ICS in collecting such invoices.
- documents, testimony in a court of law, or for any other purpose relating to work performed by ICS in connection with work performed for that Client, shall be paid by Client. Client shall also pay costs related to deposition and trial testimony.
- 24. Cancelled/discontinued orders: Client responsible for all administrative and testing charges up to point of cancellation.

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