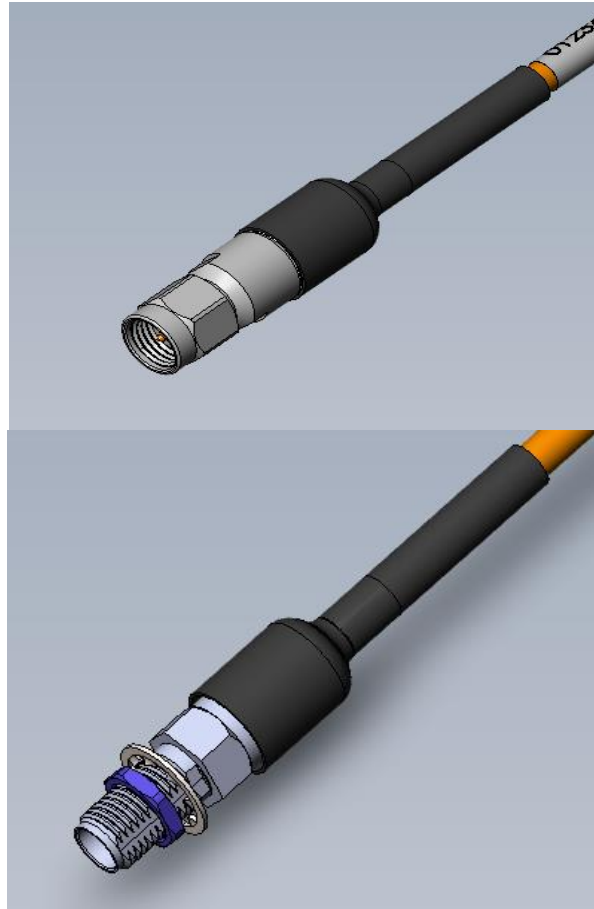




Project Number: Design Qualification Test Report	Tracking Code: CR-1133501_Report_Rev_1
Requested by: Jenny Chou	Date: 9/5/2024
Part #: LL043-01SP-505050-0152/ LL043-01BJ-505050-0152	Tech: Peter Chen
Part description: LL043-01SP / LL043-01BJ	Qty to test: 20
Test Start: 8/10/2024	Test Completed: 8/20/2024



DESIGN QUALIFICATION TEST REPORT

LL043-01SP / LL043-01BJ
LL043-01SP-505050-0152/ LL043-01BJ-505050-0152

Tracking Code: CR-1133501_Report_Rev_1	Part #: LL043-01SP-505050-0152/ LL043-01BJ-505050-0152
Part description: LL043-01SP / LL043-01BJ	

REVISION HISTORY

DATA	REV.NUM.	DESCRIPTION	ENG
8/26/2024	1	Initial Issue	PC

CERTIFICATION

All instruments and measuring equipment were calibrated to National Institute for Standards and Technology (NIST) traceable standards according to ISO 10012-1 and ANSI/NCSL 2540-1, as applicable.

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SCOPE

To perform the following tests: Design Qualification test. Please see test plan.

APPLICABLE DOCUMENTS

Standards: MIL-PRF-39012

TEST SAMPLES AND PREPARATION

- 1) All materials were manufactured in accordance with the applicable product specification.
- 2) All test samples were identified and encoded to maintain traceability throughout the test sequences.
- 3) After soldering, the parts to be used for LLCR testing were cleaned according to TLWI-0001.
- 4) Either an automated cleaning procedure or an ultrasonic cleaning procedure may be used.
- 5) The automated procedure is used with aqueous compatible soldering materials.
- 6) Parts not intended for testing LLCR are visually inspected and cleaned if necessary.
- 7) Any additional preparation will be noted in the individual test sequences.
- 8) Solder Information: Lead Free

FLOWCHARTS**Mating/Unmating/Durability**Group 1

LL043-01SP-505050-0152

LL043-01BJ-505050-0152

4 Assemblies

Step	Description
1.	Length & Mass
2.	Interface Gaging MAX. CONTACT DEPTH = 0.008 "
3.	DWV at Test Voltage ⁽¹⁾ - Non Standard DWV = 500 VAC
4.	LLCR ⁽²⁾ - Non Standard <i>Note: Signal and ground.</i>
5.	Cycles Quantity = 500 Cycles <i>Note: By hand. Torque each time to 8 in-lbs. Rotate plug coupling nut only. Do not rotate entire assembly. MIL-PRF-39012, Paragraph. 4.6.12</i>
6.	LLCR ⁽²⁾ - Non Standard Max Delta = 15 mOhm <i>Note: Signal and ground.</i>
7.	Interface Gaging MAX. CONTACT DEPTH = 0.008 "

(1) DWV at Test Voltage = Other

Test Condition = 1 (Sea Level) Test voltage applied for 60 seconds
MIL-PRF-39012, Paragraph. 4.6.14 per MIL-STD-202-301

(2) LLCR = Other

Open Circuit Voltage = 20 mV Max

Test Current = 100 mA Max

MIL-PRF-39012, Paragraph 4.6.13 except current to be 100mA nominal and voltage to be 20 mV maximum.

FLOWCHARTS Continued**IR/DWV****Pin-to-Ground**Group 1

LL043-01SP-505050-0152

LL043-01BJ-505050-0152

4 Assemblies

Step	Description
1.	Length & Mass
2.	Interface Gaging MAX. CONTACT DEPTH = 0.008 "
3.	IR (2) - Non Standard
4.	DWV at Test Voltage ⁽¹⁾ - Non Standard Test Voltage = 500 VAC
5.	LLCR (3) - Non Standard <i>Note: Signal and ground.</i>
6.	Thermal Shock (4) - Non Standard
7.	IR (2) - Non Standard
8.	DWV at Test Voltage ⁽¹⁾ - Non Standard Test Voltage = 500 VAC
9.	LLCR (3) - Non Standard Max Delta = 15 mOhm <i>Note: Signal and ground.</i>
10.	Interface Gaging MAX. CONTACT DEPTH = 0.008 "

(1) DWV at Test Voltage = Other
Test Condition = 1 (Sea Level) Test voltage applied for 60 seconds
MIL-PRF-39012, Paragraph. 4.6.14 per MIL-STD-202-301

(2) IR = Other
Test Condition = 500V DC, 2 Minutes Max
MIL-PRF-39012, Paragraph 4.6.8 per MIL-STD-202-302

(3) LLCR = Other
Open Circuit Voltage = 20 mV Max
Test Current = 100 mA Max
MIL-PRF-39012, Paragraph 4.6.13 except current to be 100mA nominal and voltage to be 20 mV maximum.

(4) Thermal Shock = Other
Exposure Time at Temperature Extremes = 1/2 Hour
Test Condition = I (-65°C to +125°C)
Test Duration = test condition B except 10 cycles instead of 5.
MIL-PRF-39012, Paragraph. 4.6.17 per MIL-STD-202-107

FLOWCHARTS Continued

Cable Pull

Group 1
LL043-01SP-505050-0152

4 Assemblies
0 Degrees

Step	Description
1.	Cable Retention (2) - Non Standard <i>Note: Pull-to-destruct.</i>

Group 2
LL043-01BJ-505050-0152

4 Assemblies
0 Degrees

Step	Description
1.	Cable Retention (2) - Non Standard <i>Note: Pull-to-destruct.</i>

Group 3
LL043-01SP-505050-0152
LL043-01BJ-505050-0152

4 Assemblies
0 Degrees

Step	Description
1.	Length & Mass
2.	Interface Gaging MAX. CONTACT DEPTH = 0.008 "
3.	LLCR (3) - Non Standard <i>Note: Signal and ground.</i>
4.	Cable Retention (1) - Non Standard <i>Note: Apply 20 pounds (9.07 kg) for Cable Retention test.</i>
5.	LLCR (3) - Non Standard <i>Note: Signal and ground.</i>
6.	Interface Gaging MAX. CONTACT DEPTH = 0.008 "

-
- (1) Cable Retention = Other
Apply 20 pounds (9.07 kg) for Cable Retention test.
MIL-PRF-39012, Paragraph 4.6.21
- (2) Cable Retention = Other
Pull-to-destruct.
MIL-PRF-39012, Paragraph 4.6.21
- (3) LLCR = Other
Open Circuit Voltage = 20 mV Max
Test Current = 100 mA Max
MIL-PRF-39012, Paragraph 4.6.13 except current to be 100mA nominal and voltage to be 20 mV maximum.

ATTRIBUTE DEFINITIONS

The following is a brief, simplified description of attributes.

THERMAL SHOCK:

- 1) MIL-PRF-39012, *Paragraph. 4.6.17 per MIL-STD-202-107*
- 2) Test Condition: I (-65°C to +125°C)
- 3) Test Time: ½ hour dwell at each temperature extreme
- 4) Test Duration: Test condition B except 10 cycles instead of 5.
- 5) All test samples are pre-conditioned at ambient.
- 6) All test samples are exposed to environmental stressing in the mated condition.

LLCR:

- 1) MIL-PRF-39012, Paragraph 4.6.13, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets.*
- 2) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 3) The following guidelines are used to categorize the changes in LLCR as a result from stressing
 - a. <= +5.0 mOhms: -----Stable
 - b. +5.1 to +10.0 mOhms:-----Minor
 - c. +10.1 to +15.0 mOhms: -----Acceptable
 - d. +15.1 to +50.0 mOhms: -----Marginal
 - e. +50.1 to +1000 mOhms: -----Unstable
 - f. >+1000 mOhms:-----Open Failure

INSULATION RESISTANCE (IR):

To determine the resistance of insulation materials to leakage of current through or on the surface of these materials when a DC potential is applied.

- 1) PROCEDURE:
 - a. Reference document: MIL-PRF-39012, Paragraph 4.6.8 per MIL-STD-202-302, *Insulation Resistance Test Procedure for Electrical Connectors.*
 - b. Test Conditions:
 - i. Between Adjacent Contacts or Signal-to-Ground
 - ii. Electrification Time 2.0 minutes
 - iii. Test Voltage (500 VDC) corresponds to calibration settings for measuring resistances.
- 2) MEASUREMENTS:
- 3) When the specified test voltage is applied (VDC), the insulation resistance shall not be less than 1000 megohms.

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

To determine if the sockets can operate at its rated voltage and withstand momentary over potentials due to switching, surges, and other similar phenomenon. Separate samples are used to evaluate the effect of environmental stresses so not to influence the readings from arcing that occurs during the measurement process.

1) PROCEDURE:

- a. Reference document: MIL-PRF-39012, Paragraph. 4.6.14 per MIL-STD-202-301, *Withstanding Voltage Test Procedure for Electrical Connectors*.
- b. Test Conditions:
 - i. Between Adjacent Contacts or Signal-to-Ground
 - ii. Barometric Test Condition 1
 - iii. Rate of Application 500 V/Sec
 - iv. Test Voltage (VAC) until breakdown occurs

2) MEASUREMENTS/CALCULATIONS

- a. The breakdown voltage shall be measured and recorded.
- b. The dielectric withstanding voltage shall be recorded as 75% of the minimum breakdown voltage.
- c. The working voltage shall be recorded as one-third (1/3) of the dielectric withstanding voltage (one-fourth of the breakdown voltage).

ATTRIBUTE DEFINITIONS Continued

The following is a brief, simplified description of attributes

CABLE PULL:

- 1) Secure cable near center and pull on connector
 - a. At 0°, in-line with cable



Fig. 1
0° Connector pull

RESULTS

Interface Gaging

Mating/Unmating Durability Group

01SP

Initial

- Min ----- 0.0023 Inch (0.058 mm)
- Max ----- 0.0051 Inch (0.129 mm)

After 500 cycles

- Min ----- 0.0045 Inch (0.114 mm)
- Max ----- 0.0070 Inch (0.178 mm)

01BJ

Initial

- Min ----- 0.0003 Inch (0.008 mm)
- Max ----- 0.0013 Inch (0.033 mm)

After 500 cycles

- Min ----- 0.0015 Inch (0.038 mm)
- Max ----- 0.0065 Inch (0.165 mm)

IR/DWV Group

01SP

Initial

- Min ----- 0.0023 Inch (0.058 mm)
- Max ----- 0.0051 Inch (0.129 mm)

After Thermal shock

- Min ----- 0.0055 Inch (0.140 mm)
- Max ----- 0.0075 Inch (0.191 mm)

01BJ

Initial

- Min ----- 0.0006 Inch (0.015 mm)
- Max ----- 0.0043 Inch (0.109 mm)

After Thermal shock

- Min ----- 0.0010 Inch (0.025 mm)
- Max ----- 0.0035 Inch (0.089 mm)

Cable Pull Group

01SP

Initial

- Min ----- 0.0038 Inch (0.097 mm)
- Max ----- 0.0071 Inch (0.180 mm)

After Retention force

- Min ----- 0.0035 Inch (0.089 mm)
- Max ----- 0.0065 Inch (0.165 mm)

01BJ

Initial

- Min ----- 0.0010 Inch (0.025 mm)
- Max ----- 0.0039 Inch (0.099 mm)

After Retention force

- Min ----- 0.0020 Inch (0.051 mm)
- Max ----- 0.0055 Inch (0.140 mm)

RESULTS Continued

Cable Pull force

- 0° Pull
 - 01SP
 - Min -----51.53 lbs
 - Max -----54.85 lbs
 - 01BJ
 - Min -----46.84 lbs
 - Max -----63.61 lbs

Insulation Resistance minimums, IR

01SP

Pin to Ground

- Initial
 - Mated -----45000 Meg Ω ----- Passed
- Thermal Shock
 - Mated -----45000 Meg Ω ----- Passed

01BJ

Pin to Ground

- Initial
 - Mated -----45000 Meg Ω ----- Passed
- Thermal Shock
 - Mated -----45000 Meg Ω ----- Passed

Dielectric Withstanding Voltage minimums, DWV

01SP

- Minimums
 - Test Voltage -----500 VAC

Pin to Ground

- Initial DWV -----Passed
- Thermal DWV -----Passed

01BJ

- Minimums
 - Test Voltage -----500 VAC

Pin to Ground

- Initial DWV -----Passed
- Thermal DWV -----Passed

Dielectric Withstanding Voltage minimums, DWV (Durability)

- Minimums
 - Test Voltage -----500 VAC

Pin to Ground

- Initial DWV -----Passed

RESULTS Continued

LLCR Durability (4 signal and 4 ground LLCR test points)

- Signal Pin**
- **Initial** ----- 11.30 mOhms Max
- Ground Pin**
- **Initial** -----7.49 mOhms Max
 - **Durability, 500 Cycles**
 - **<= +5.0 mOhms**-----8 Points ----- Stable
 - **+5.1 to +10.0 mOhms** -----0 Points ----- Minor
 - **+10.1 to +15.0 mOhms** -----0 Points ----- Acceptable
 - **+15.1 to +50.0 mOhms** -----0 Points ----- Marginal
 - **+50.1 to +1000 mOhms**-----0 Points ----- Unstable
 - **>+1000 mOhms**-----0 Points ----- Open Failure

LLCR IR/DWV (4 signal and 4 ground LLCR test points)

- Signal Pin**
- **Initial** ----- 11.25 mOhms Max
- Ground Pin**
- **Initial** -----7.28 mOhms Max
 - **Thermal Shock**
 - **<= +5.0 mOhms**-----8 Points ----- Stable
 - **+5.1 to +10.0 mOhms** -----0 Points ----- Minor
 - **+10.1 to +15.0 mOhms** -----0 Points ----- Acceptable
 - **+15.1 to +50.0 mOhms** -----0 Points ----- Marginal
 - **+50.1 to +1000 mOhms**-----0 Points ----- Unstable
 - **>+1000 mOhms**-----0 Points ----- Open Failure

LLCR Cable Pull (4 signal and 4 ground LLCR test points)

- Signal Pin**
- **Initial** ----- 11.26 mOhms Max
- Ground Pin**
- **Initial** -----7.04 mOhms Max
 - **20 Ib Retention**
 - **<= +5.0 mOhms**-----8 Points ----- Stable
 - **+5.1 to +10.0 mOhms** -----0 Points ----- Minor
 - **+10.1 to +15.0 mOhms** -----0 Points ----- Acceptable
 - **+15.1 to +50.0 mOhms** -----0 Points ----- Marginal
 - **+50.1 to +1000 mOhms**-----0 Points ----- Unstable
 - **>+1000 mOhms**-----0 Points ----- Open Failure

DATA SUMMARIES Continued**INTERFACE GAGING****Durability**

Gaging (0.0/0.008)(inch)			
01SP	Initial	After Cycles	Delta
1	0.0039	0.0065	0.0026
2	0.0023	0.0045	0.0022
3	0.0051	0.0070	0.0019
4	0.0045	0.0050	0.0005

Gaging (0.0/0.008)(inch)			
01BJ	Initial	After Cycles	Delta
1	0.0011	0.0065	0.0054
2	0.0003	0.0015	0.0012
3	0.0013	0.0025	0.0012
4	0.0008	0.0045	0.0037

IR/DWV Group

Gaging (0.0/0.008)(inch)			
01SP	Initial	Thermal Shock	Delta
1	0.0039	0.0075	0.0036
2	0.0023	0.0060	0.0037
3	0.0051	0.0055	0.0004
4	0.0045	0.0060	0.0015

Gaging (0.0/0.008)(inch)			
01BJ	Initial	Thermal Shock	Delta
1	0.0009	0.0010	0.0001
2	0.0025	0.0035	0.0010
3	0.0006	0.0035	0.0029
4	0.0043	0.0035	0.0008

DATA SUMMARIES Continued

Cable Pull

Gaging (0.0/0.008)(inch)			
01SP	Initial	After pull	Delta
1	0.0046	0.0050	0.0004
2	0.0038	0.0035	0.0003
3	0.0044	0.0040	0.0004
4	0.0071	0.0065	0.0006

Gaging (0.0/0.008)(inch)			
01BJ	Initial	After pull	Delta
1	0.0014	0.0020	0.0006
2	0.0010	0.0055	0.0045
3	0.0039	0.0055	0.0016
4	0.0017	0.0035	0.0018

**Cable Pull Force:
0° Pull**

01SP	Force (lbs)
Minimum	51.53
Maximum	54.85
Average	53.43

01BJ	Force (lbs)
Minimum	46.84
Maximum	63.61
Average	56.23

DATA SUMMARIES

DIELECTRIC WITHSTANDING VOLTAGE (Durability):

Pin to Ground (500 VAC)	
Initial Test Voltage	Pass

INSULATION RESISTANCE (IR):

	Pin to Ground
	Mated
Minimum	01SP/01BJ
Initial	45000
Thermal Shock	45000

DIELECTRIC WITHSTANDING VOLTAGE (DWV):

Pin to Ground (500 VAC)	
Initial Test Voltage	Pass
After Thermal Shock Test Voltage	Pass

DATA SUMMARIES Continued

LLCR Durability:

- 1) A total of 4 signal and 4 ground points were measured.
- 2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets*.
- 3) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 4) The following guidelines are used to categorize the changes in LLCR as a result from stressing.
 - a. $\leq +5.0$ mOhms: -----Stable
 - b. $+5.1$ to $+10.0$ mOhms: -----Minor
 - c. $+10.1$ to $+15.0$ mOhms: -----Acceptable
 - d. $+15.1$ to $+50.0$ mOhms: -----Marginal
 - e. $+50.1$ to $+1000$ mOhms: -----Unstable
 - f. $>+1000$ mOhms: -----Open Failure

LLCR Measurement Summaries by Pin Type			
Date	8/12/2024	8/14/2024	
Room Temp (Deg C)	22	22	
Rel Humidity (%)	50	50	
Technician	Peter Chen	Peter Chen	
mOhm values	Actual	Delta	
	Initial	Cycles	
Pin Type: Signal 1			
Average	11.22	0.42	
St. Dev.	0.07	0.41	
Min	11.12	0.09	
Max	11.3	1.02	
Summary Count	4	4	
Total Count	4	4	
Pin Type: GND 1			
Average	7.02	1.96	
St. Dev.	0.39	1.60	
Min	6.57	0.52	
Max	7.49	4.21	
Summary Count	4	4	
Total Count	4	4	

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	$>5 \ \& \ \leq 10$	$>10 \ \& \ \leq 15$	$>15 \ \& \ \leq 50$	$>50 \ \& \ \leq 1000$	>1000
Cycles	8	0	0	0	0	0

DATA SUMMARIES Continued

LLCR IR/DWV:

- 1) A total of 4 signal and 4 ground points were measured.
- 2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets*.
- 3) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 4) The following guidelines are used to categorize the changes in LLCR as a result from stressing.
 - a. $\leq +5.0$ mOhms: -----Stable
 - b. $+5.1$ to $+10.0$ mOhms:-----Minor
 - c. $+10.1$ to $+15.0$ mOhms: -----Acceptable
 - d. $+15.1$ to $+50.0$ mOhms: -----Marginal
 - e. $+50.1$ to $+1000$ mOhms: -----Unstable
 - f. $>+1000$ mOhms:-----Open Failure

LLCR Measurement Summaries by Pin Type				
Date	8/12/2024	8/14/2024		
Room Temp (Deg C)	23	23		
Rel Humidity (%)	54	54		
Technician	Peter Chen	Peter Chen		
mOhm values	Actual	Delta	Delta	Delta
	Initial	Therm Shck		Humidity
Pin Type: Signal 1				
Average	11.19	0.08		
St. Dev.	0.07	0.05		
Min	11.08	0.01		
Max	11.25	0.15		
Summary Count	4	4		
Total Count	4	4		
Pin Type: GND 1				
Average	6.76	0.13		
St. Dev.	0.32	0.06		
Min	6.42	0.06		
Max	7.28	0.23		
Summary Count	4	4		
Total Count	4	4		

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	$>5 \ \& \ \leq 10$	$>10 \ \& \ \leq 15$	$>15 \ \& \ \leq 50$	$>50 \ \& \ \leq 1000$	>1000
Therm Shck	8	0	0	0	0	0

DATA SUMMARIES Continued

LLCR Cable Pull:

- 1) A total of 4 signal and 4 ground points were measured.
- 2) EIA-364-23, *Low Level Contact Resistance Test Procedure for Electrical Connectors and Sockets*.
- 3) A computer program, *LLCR 221.exe*, ensures repeatability for data acquisition.
- 4) The following guidelines are used to categorize the changes in LLCR as a result from stressing.
 - a. $\leq +5.0$ mOhms: -----Stable
 - b. $+5.1$ to $+10.0$ mOhms: -----Minor
 - c. $+10.1$ to $+15.0$ mOhms: -----Acceptable
 - d. $+15.1$ to $+50.0$ mOhms: -----Marginal
 - e. $+50.1$ to $+1000$ mOhms: -----Unstable
 - f. $>+1000$ mOhms: -----Open Failure

LLCR Measurement Summaries by Pin Type			
Date	8/12/2024	8/14/2024	
Room Temp (Deg C)	22	23	
Rel Humidity (%)	50	54	
Technician	Peter Chen	Peter Chen	
mOhm values	Actual	Delta	
	Initial	PULL	
Pin Type: Signal 1			
Average	11.13	0.15	
St. Dev.	0.09	0.07	
Min	11.04	0.04	
Max	11.26	0.2	
Summary Count	4	4	
Total Count	4	4	
Pin Type: GND 1			
Average	6.21	1.83	
St. Dev.	1.14	1.14	
Min	4.53	0.72	
Max	7.04	3.14	
Summary Count	4	4	
Total Count	4	4	

LLCR Delta Count by Category						
	Stable	Minor	Acceptable	Marginal	Unstable	Open
mOhms	≤ 5	$>5 \ \& \ \leq 10$	$>10 \ \& \ \leq 15$	$>15 \ \& \ \leq 50$	$>50 \ \& \ \leq 1000$	>1000
PULL	8	0	0	0	0	0

EQUIPMENT AND CALIBRATION SCHEDULES**Equipment #:** HZ-TCT-04**Description:** Dillon Quantrol TC21 25-1000 mm/min series test stand**Manufacturer:** Dillon Quantrol**Model:** TC2 I series test stand**Serial #:** 04-1041-04**Accuracy:** Speed Accuracy: +/- 5% of indicated speed; Speed Accuracy: +/- 5% of indicated speed;

... Last Cal: 05/29/2024, Next Cal: 05/29/2025

Equipment #: HZ-MO-11**Description:** Switch/Multimeter**Manufacturer:** Keithley**Model:** 3706**Serial #:** 120169**Accuracy:** See Manual

... Last Cal: 09/11/2023, Next Cal: 09/11/2024

Equipment #: HZ-TSC-01**Description:** Vertical Thermal Shock Chamber**Manufacturer:** Cincinnati Sub Zero**Model:** VTS-3-6-6-SC/AC**Serial #:** 10-VT14993**Accuracy:** See Manual

... Last Cal: 06/30/2024, Next Cal: 06/30/2025

Equipment #: HZ-HPT-01**Description:** Hipot Safety Tester**Manufacturer:** Vitrek**Model:** V73**Serial #:** 019808**Accuracy:**

... Last Cal: 05/15/2024, Next Cal: 05/15/2025