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Validating a Refrigerator-Freezer

In QC laboratories, refrigerator-freezers are used to store in-process product samples for ongoing quality control studies. As equipment, they must be validated.

Of the three types of devices — utensils, instruments, and equipment — the refrigerator-freezer falls under the definition of equipment. Therefore, it must be validated.

Utensils have no control specifications and no measurements. Often, such devices replace what an operator would do by hand. They include stir plates, stir rods, and spatulas. Utensils do not need to be validated. Glassware used to measure a volume is certified by the vendor.

Instruments take physical measurements and display their values but have no control or analytical function. Such devices include stopwatches, timers, and thermometers. Instruments do not need to be validated, but they do require initial and ongoing calibration programs.

Equipment performs a process to produce a result, producing an environment or performing an action on something. Whether a simple device or a collection of components, equipment must be validated.

This article explains how to validate a refrigerator-freezer that is used for storing in-process product samples. The materials are environmentally controlled at 2–8 °C in the refrigerator.

The Validation Protocol

Following are the major elements of a validation protocol for a refrigerator-freezer. The protocol example can be used as a GMP compliance guide, but it should be tailored to meet individual company requirements.

The equipment validation method described here is designed to support current good manufacturing practices (CGMPs) in a biopharmaceutical manufacturing environment. Examples are provided of installation, operational, and performance qualifications. A validation protocol is an industry tool used to document the validation testing process.

A validation protocol was developed and approved before equipment testing began. During validation testing, the performer and reviewer signed the protocol at the bottom of each page where entries were made. The validation was complete when all acceptance criteria had been met.

Definitions. *Validation* is the overall term used for establishing documented evidence through defined testing that a system or piece of equipment meets design criteria and that adequate provisions have been established to keep it controlled. *Qualification* (generally referring to equipment) is used to determine whether equipment operates as it was designed and in a reproducible manner. Qualification procedures are determined by written protocol and testing of the equipment.

Installation Qualification

The installation qualification (IQ) evaluation established confidence that the refrigerator-freezer equipment was properly installed. The installation met manufacturer-specified guidelines, as did design changes at installation. Also, the supporting electrical utilities met all electrical codes. An IQ evaluation requires information on equipment identification, required documentation, equipment utility requirements, major component specifications, materials of construction, refrigerants, and equipment safety features.

Equipment identification. Table 1 lists equipment identification numbers; the equipment manufacturer's purchase order number, model number, serial number, company-assigned equipment number; and equipment location. Some of that information was found on the nameplate attached to the equipment.

Table 1. Equipment identification.

Required Information	As-Found Conditions
Manufacturer	Any Refrigerator Co.
Purchase order number	066231
Model number	2-SR03TB
Serial number	81187045
Equipment number	4233
Location	QC Lab, Room 455

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Table 2. Manufacturer's manuals and drawings.

Number	Description	Date
None	Refrigerator-freezer operating instruction manual	None

Table 3. Standard operating procedures.

Number	Description	Release Date
LAB120	Refrigerator-freezer operation of microbiology	03/01/96
LAB121	Refrigerator-freezer cleaning procedure	09/26/97

Required documentation. Table 2 provides the equipment manufacturer's operation and maintenance manual and drawings. Table 3 lists the standard operating procedures that cover the set-up, operation, and cleaning of the refrigerator-freezer.

Equipment utility requirements. Table 4 shows the results of a comparison between the manufacturer's specified volt (V) and ampere (A) requirements and their as-found condition at the time of qualification testing. The volt measurement was taken where the incubator's power cord plugged into a receptacle, and the location of the power supply source was recorded. Table 5 gives the instrument used to measure the volts and amps.

Volts are calculated as follows:

Volt specification = 115 V ±10%

±10% of 115 = ±11.5

120 + 11.5 = 126.5

120 − 11.5 = 103.5

The measured volts of 114 falls within ±10%.

Amps are calculated as follows:

Circuit rating = 20 A

Equipment current draw = 2.5 A

The circuit rating of 20 amps is greater than the maximum current draw of the equipment.

Major component specifications verify that the refrigerator-freezer components purchased were delivered and installed. The equipment manufacturer's operations manual provided the component specifications listed in Table 6. That list establishes a baseline of information for change control purposes.

Component materials. Table 7 gives the materials of construction for the component that makes contact with the product.

Refrigerants. Table 8 details the refrigerant used in the refrigerator-freezer. A preventive maintenance procedure was on file.

Equipment safety features. There are no safety features on the refrigerator-freezer equipment.

Operational Qualification

The operational qualification (OQ) evaluation established that the equipment can operate within specified tolerances and limits. QA personnel challenged the mechanical ranges of the refrigerator-freezer along with the basic refrigerator-freezer operations used by the operator. The refrigerator-freezer was validated for its operating ability, not for how well it refrigerates. The OQ evaluation requires information on calibration of the instruments used with the refrigerator-freezer, equipment control functions (pushbuttons, switches, and indicators), and general operation (temperature distribution).

Calibration requirements. The critical instrument used with the equipment was logged into the calibration department system software. A calibration procedure was in place and was in current calibration at the time of qualification testing. Tables 9 and 10 show the necessary information for the calibrated instrument. There were no noncalibrated instruments on the refrigerator-freezer.

Equipment Control Functions

Switch test. The objective of the switch test was to verify that the switches, pushbuttons, and indicators on the refrigerator-freezer operated according to the manufacturer's specifications. QA personnel set the refrigerator to 5 and the freezer to 3, then operated each control listed in Table 11 to verify their proper operation.

Table 4. Utilities.

Utility	Specified	Measured Results	Acceptable (Yes/No)
Volts	115±10%	114	Yes
Amps	2.5	20	Yes
Power supply source: breaker box BB28, wire number 23.			

Table 5. Instrument used to measure volts and amps.

Test Instrument	Identification Number	Calibration Due
Multimeter	MU-025	04/19/97

Table 6. Major component specifications.

Component	As-Found Conditions
Refrigerator-freezer	Manufacturer: Any Refrigerator Co. Volts: 115 Amps: 2.5 Phases: 1 Cycles: 60 Hz Temperature range: −15 to +15 °C Size: 26 inches wide × 27.5 inches deep × 60 inches high (8 ft^3)

Table 7. Materials of construction.

Component	Material
Refrigerator-freezer chamber	Plastic

General Equipment Operation

Temperature distribution test. The objective of the temperature distribution test was to perform temperature mapping of the refrigerator-freezer with its chamber empty. Sixteen thermocouple wires (TCWs) were calibrated in a range above and below the refrigerator-freezer set point temperature of 5 °C. Three TCWs were placed on each of the five shelves in the chamber (one in each corner

Table 8. Refrigerants used.

Where Used	Type	Manufacturer	Product Contact (Yes/No)
Refrigerant	R-22 44-oz Charge	Any Refrigerant Co.	No

Table 9. Calibrated instrument — temperature gauge.

Calibrated Instrument	As-Found Conditions
Identification number	100-TID
Type	Temperature gauge, digital
Manufacturer	Any Refrigerator Co.
Model number	0008-296
Serial number	13311970
Range	−15 to +15 °C
Scale division	1 °C
Location	On top of refrigerator
Use	Displays chamber temperature
Calibration due	08/28/97
Critical/not critical	Critical to refrigerator operation

Table 10. Calibrated instrument — chart recorder.

Calibrated Instrument	As-Found Conditions
Identification number	210-CR
Type	Chart recorder, analog
Manufacturer	Any Chart Recorder Co.
Model number	L-136-302-LA
Serial number	149152
Range	−40 to +40 °F
Scale division	1 °F
Location	Control panel
Use	Records the chamber temperature
Calibration due	02/27/97
Critical/not critical	Critical to refrigerator operation

Table 11. Equipment control function test results.

Test Function (operation)	Expected Results	Acceptable (Yes/No)
Refrigerator control knob	When the refrigerator control knob is rotated to a higher number, the refrigerator temperature goes down.	Yes
	When the refrigerator control knob is rotated to a lower number, the refrigerator temperature goes up.	Yes
Freezer control knob	When the freezer control knob is rotated to a higher number, the freezer temperature goes down.	Yes
	When the freezer control knob is rotated to a lower number, the freezer temperature goes up.	Yes

Table 12. Temperature mapping results.

Time hr.:min.	Chart Recorder Temp. (°C)	TCW 16 Temp. (°C)	Average Chamber Temp. (°C)	Acceptable (Yes/No)
17:20	5 °C	2.6 °C	2.8 °C	Yes
18:30	6 °C	5.6 °C	5.7 °C	Yes
07:40	4 °C	2.9 °C	3.2 °C	Yes
08:40	6 °C	7.4 °C	7.4 °C	Yes
11:50	3 °C	2.1 °C	2.4 °C	Yes
12:50	7 °C	6.9 °C	6.9 °C	Yes
14:00	6 °C	6.7 °C	6.7 °C	Yes
15:40	6 °C	6.0 °C	5.9 °C	Yes
17:00	7 °C	7.7 °C	7.7 °C	Yes

at least one inch from the side of the chamber and one in the center). One TCW was placed next to the data recorder probe. Table 12 shows the data recorder used for the test.

A chart was installed in the chart recorder. The data recorder was programmed to print the minimum, maximum, and average temperatures for all 16 TCWs every 10 minutes. When TCW number 16 registered 2–8 °C, the temperature recording was started and continuously monitored for 24 hours. Table 12 shows the results of the test.

Performance Qualification

Once QA established that the equipment was properly installed and functioning within specified operating parameters, they showed that the incubator performed reliably under routine operating conditions in a performance qualification (PQ) evaluation.

Temperature distribution test. The objective of this test was to perform temperature mapping of the refrigerator-freezer with in-process product samples in the chamber. Sixteen TCWs were calibrated in a range above and below the refrigerator-freezer set point temperature of 5 °C. Three TCWs were placed on each of the five shelves in the chamber (one in each corner at least one inch from the side of the chamber and one in the center). One TCW was placed next to the data recorder probe. Table 13 shows the data recorder used for the test.

A chart was installed in the chart recorder. The data recorder was programmed to print the minimum, maximum, and average temperatures for all 16 TCWs every 10 minutes. When TCW number 16 registered between 2 and 8 °C, the temperature recording was started and continuously monitored for 24 hours. Table 14 shows the results of the test.

The temperature distribution test with the chamber empty was intended to provide a preliminary temperature distribution baseline for information purposes only. The empty chamber test was compared with the

Table 13. Instrument used for temperature

Test Instrument	Identification Number	Calibration Due
Data recorder	DL-066	03/26/97

Table 14. Temperature mapping results.

Time hr.:min.	Chart Recorder Temp. (°C)	TCW 16 Temp. (°C)	Average Chamber Temp. (°C)	Acceptable (Yes/No)
13:20	4 °C	6.6 °C	5.4 °C	Yes
14:30	5 °C	3.3 °C	4.6 °C	Yes
15:50	3 °C	4.9 °C	2.7 °C	Yes
16:30	5 °C	1.8 °C	5.3 °C	Yes
17:40	6 °C	6.7 °C	5.2 °C	Yes
19:00	7 °C	5.9 °C	4.8 °C	Yes
08:20	6 °C	3.1 °C	4.9 °C	Yes
10:50	6 °C	4.4 °C	6.0 °C	Yes
13:10	5 °C	5.2 °C	4.7 °C	Yes

full chamber test, and there was no significant difference between the two. Therefore, the tests were successful. During the temperature distribution test with the chamber full, all thermocouple wires were 2–8 °C after stabilization and remained within that range during the 24-hour test period.

All thermocouple wires verified within ±0.3 °C of the temperature standard after the empty- and full-chamber tests were completed. So the equipment qualification for the refrigerator-freezer met required acceptance criteria as stated in our protocol. **BP**

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