



INDUCTIVELY COUPLED PLASMA – MASS SPECTROMETERS OPERATIONAL QUALIFICATION

Standard OQ Test Suite

This document describes tests for qualifying the ICP-MS systems.

Extra: The Injection Precision test is NOT INCLUDED in the standard OQ for ICP-MS but can be ordered at an EXTRA COST.

Test /Mode (if applicable)	Setpoints and Parameters	Limits (Allowable Range)
Autosampler Check	Configuration check	Qualitative
Integrated Sample Introduction System (ISIS) Check	Configuration check	Qualitative
Autotune	Model specific	See tables below
Background (No Gas Mode)	Model specific	See tables below
Background (Gas Modes)	Model specific	See tables below
20-minute Stability (No Gas Mode)	Model-specific acquisition parameters	See tables below
Injection Precision (No Gas Mode)	Functional connection between ICP-MS and HPLC	Precision RSD \leq 10.00% (1.00 – 15.00)

Test Details, Design, and Rationale

Overview

Many GMP/GLP enforcement agency inspectors now ask firms to provide a risk assessment of their equipment and computer systems plus a science-based rationale for subsequent validation and qualification testing.

GENERAL RISK STATEMENT: Any laboratory chemical system used for raw material testing or final drug product / medical device testing in GMP or used in formal GLP studies will likely fall into a HIGH RISK category. This risk assessment will imply the need for IQ & OQ & on-going qualification. ANY USER SPECIFIC RISK ANALYSIS SUPERCEDES THIS GENERAL RISK STATEMENT.

The rest of this section outlines the science-based rationale for each test in the Agilent hardware OQ plus a brief test design and procedure description.

The recommended set of hardware OQ tests described in this EQP derives from Agilent's interpretation of FDA, USP, and GAMP guidelines and other authoritative expert literature.

OQ test design incorporates both modular and holistic testing, which is a proven and regulatory acceptable approach. When applicable, direct metrology is used to test pump flow rates and thermal-controlled column compartments, for example. Holistic chemical testing is used to evaluate critical instrument characteristics

When applicable, certified reference standards and calibrated equipment are used.

Considering the number of setpoints, parameters, and conditions of each recommended OQ test, the proven concepts of worst case, range, and representative have been applied. If a property or characteristic is known to have its worst performance at one end of a range of use, this is the setpoint that should be tested and other setpoints are not required. If a property or characteristic has no known worst case, testing at the high and low points of the range of use is required. If there are too many possible use cases and conditions to realistically test (and none is a worst case), a representative sample for test is the best approach.

The OQ procedure is intended to ensure that the ICP-MS equipment performs in accordance with recently published standards. The procedure is a standardized test protocol designed to ensure the ICP-MS system functions as intended by the manufacturer and as required by the end user. Only certified reference standards are used.

Autosampler Check

This test is only scheduled when an autosampler is part of the configuration. It demonstrates that the module is correctly installed and connected; it does not test instrument performance. The instrument is power cycled, and the self-test results are observed and recorded according to the table below.

Test	Parameter
Self-Test	Probe moves to home position.
Probe Positioning	Positioned at vial 2

Integrated Sample Introduction System (ISIS) Check

This test is only scheduled when an ISIS is part of the configuration. It demonstrates that the module is correctly installed and connected; it does not test instrument performance. The peristaltic pump speed is set to 0.1 RPS for the installed pumps; results are observed and recorded according to the table below.

Test	Parameter
Pump rotation	Rotate on request.
Valve function (if present)	Open and close on request

Autotune

This test uses traceable checkout standards to run a software-executed autotune in all modes that generates a tune report. The tune report provides values for the peak width, mass axis, sensitivity, oxide species, and doubly-charged species sub-tests.

The following table identifies the model specific limits for each setpoint within the autotune test.

Setpoint/Mode	Unit	massIon	SQ Limit(s)					
			7700e	7700s	7700x	7800	7900#100	7900#200
Peak Width/No Gas	Amu range @10% height	⁷ Li, ⁸⁹ Y, ²⁰⁵ Tl	0.65 to 0.80			0.65 to 0.80	0.65 to 0.80	
Mass Axis/No Gas	Amu range	⁷ Li, ⁸⁹ Y, ²⁰⁵ Tl	± 0.1			± 0.1	± 0.1	
Doubly-charged Species/No Gas	%	⁷⁰ Ce ²⁺ / ¹⁴⁰ Ce ⁺	≤ 3.45	≤ 6.9	≤ 2.3	≤ 2.3	≤ 2.3	≤ 6.9
Oxide Species/No Gas	%	¹⁵⁶ CeO ⁺ / ¹⁴⁰ Ce ⁺	≤ 2.3	≤ 3.45	≤ 1.38	≤ 1.38	≤ 1.38	≤ 3.45
Sensitivity/No Gas	Mcps/ppm	⁷ Li	≥ 17	≥ 42.5	≥ 25.5	≥ 25.5	≥ 25.5	≥ 42.5
		⁸⁹ Y	≥ 68	≥ 204	≥ 85	≥ 85	≥ 127.5	≥ 297.5
		²⁰⁵ Tl	≥ 34	≥ 102	≥ 51	≥ 51	≥ 76.5	≥ 110.5
Sensitivity/He	Mcps/ppm	⁵⁹ Co	≥ 20.4	≥ 34	≥ 20.4	≥ 20.4	≥ 23.8	≥ 34
Sensitivity/H ₂	Mcps/ppm	⁸⁹ Y	N/A	≥ 85	≥ 51*	≥ 51*	≥ 68*	≥ 85

* Hydrogen option only

Setpoint/Mode	Unit	massIon	QQQ Limit(s)				
			8800 #100	8800#200	8900#080	8900#100	8900#200
Q1 - Peak Width/No Gas	Amu range @10% height	⁷ Li, ⁸⁹ Y, ²⁰⁵ Tl	0.60 to 0.80			0.60 to 0.80	
Q2 - Peak Width/No Gas	Amu range @10% height	⁷ Li, ⁸⁹ Y, ²⁰⁵ Tl	0.60 to 0.80			0.60 to 0.80	
Q1 - Mass Axis/No Gas	Amu range	⁷ Li, ⁸⁹ Y, ²⁰⁵ Tl	± 0.15			± 0.15	
Q2 - Mass Axis/No Gas	Amu range	⁷ Li, ⁸⁹ Y, ²⁰⁵ Tl	± 0.16			± 0.16	
Doubly-charged Species/No Gas	%	⁷⁰ Ce ²⁺ / ¹⁴⁰ Ce ⁺	≤ 2.3	≤ 6.9	≤ 3.45	≤ 3.45	≤ 9.2
Oxide Species/No Gas	%	¹⁵⁶ CeO ⁺ / ¹⁴⁰ Ce ⁺	≤ 1.38	≤ 3.45	≤ 1.38	≤ 1.38	≤ 3.45
Sensitivity/No Gas	Mcps/ppm	⁷ Li	≥ 28.9	≥ 85	≥ 32.3	≥ 42.5	≥ 170
		⁸⁹ Y	≥ 110.5	≥ 595	≥ 119	≥ 161.5	≥ 1020
		²⁰⁵ Tl	≥ 40.8	≥ 212.5	≥ 45.05	≥ 59.5	≥ 382.5
Sensitivity/He	Mcps/ppm	⁵⁹ Co	≥ 12.75	≥ 46.75	≥ 18.7	≥ 25.5	≥ 76.5
Sensitivity/H ₂	Mcps/ppm	⁸⁹ Y	≥ 76.5	≥ 127.5	≥ 85	≥ 119	≥ 136
Sensitivity/O ₂	Mcps/ppm	⁸⁹ Y (¹⁰⁵ YO)	≥ 59.5	≥ 297.5	≥ 68	≥ 136	≥ 408

Background (No Gas Mode)

This test examines the background of the ICP-MS in no gas mode by monitoring ions during a blank run. Background ions must be below the thresholds detailed in the table below. The data is directly compared to the limit to determine pass/fail.

- For the single quadrupole (SQ) instruments, the no gas mode background signals (^7Li , ^{89}Y , and ^{205}Tl) are pulled directly from the tune report produced during the autotune test and recorded. AMU offset is increased by 100 to allow random background noise measurement and integration time is set to 1.0 second. Data is collected for 20 cycles and average counts are recorded.
- For the triple quadrupole (QQQ) instruments, the no gas mode background signals (^9Be and ^{238}U) are collected using a unique run. Briefly, DI water is infused into the instrument while both quadrupoles are set to the signal masses. Data is collected for 20 cycles and average counts are recorded.

Setpoint	Unit	massIon	Limit(s) (* All installed options)					
			7700e	7700s	7700x	7800	7900 #100	7900#200
Background	cps	^7Li	≤ 10			≤ 6.9	≤ 5.2	N/A
		^{89}Y	≤ 10			≤ 4.6	≤ 3.5	N/A
		^{205}Tl	≤ 30			≤ 11.5	≤ 11.5	N/A
		^9Be	N/A			N/A		≤ 1.0
		^{238}U	N/A			N/A		≤ 1.0

Background (Gas Modes)

This test examines the background of the ICP-MS in the relevant gas modes by monitoring ions during a blank run. For both the He gas mode and the H₂ gas mode, the background signal (^{78}Se) is collected using a unique run. DI water is infused into the instrument and data is collected for 20 cycles and the average counts recorded. The ions must be below the threshold(s) detailed in the table below. The data is directly compared to the limit to determine pass/fail.

Setpoint/Gas	Unit	massIon	SQ Limit(s)							
			7700e	7700s	7700x	7800	7900#100	7900#200	8800#100	8800#200
Background/He	cps	^{78}Se	≤ 115	≤ 230	≤ 460	≤ 115	≤ 115	≤ 230	≤ 13.8	≤ 345
Background/H ₂	cps	^{78}Se	N/A	≤ 11.5	≤ 4.6*	≤ 4.6*	≤ 4.6*	≤ 11.5	N/A	N/A

*For hydrogen option only

Setpoint/Gas	Unit	massIon	QQQ Limit(s)				
			8800#100	8800#200	8900#080	8900#100	8900#200
Background/He	cps	^{78}Se	≤ 13.8	≤ 345	≤ 460	≤ 460	≤ 920

20-Minute Stability (No Gas Mode)

This test monitors the abundance of ions present in the checkout standard over a 20-minute period using the acquisition parameters specified below.

Parameters	SQ	QQQ
Mode	Spectrum	Spectrum
Masses	^7Li , ^9Be , ^{59}Co , ^{89}Y , ^{140}Ce , ^{205}Tl	^7Li , ^{56}ArO , ^{59}Co , ^{89}Y , ^{140}Ce , ^{205}Tl
Integration Time	9.99 seconds	9.99 seconds
Peak Pattern	3 points/peak	3 points/peak
Replicates	20	20
Sweeps/Replicate	100	100

The average spectrum/mass is calculated by the instrument and recorded. The table below details the %RSD limit(s) for the test. The recorded values are compared directly to the limit.

Setpoint/Mode	Unit	massIon	Limits	
			7800 and 7900#100	All other models
20-Minute Stability/No Gas	%RSD	^7Li , ^{89}Y , ^{205}Tl	≤ 2.3	≤ 3.45

Injection Precision (No Gas Mode)

This test uses a series of constant volume injections of an Agilent ICP-MS calibration solution to prove a functional connection between the HPLC and the ICP-MS. The test is unique to the hyphenated LC/ICP-MS configuration and is not equivalent to the LC injection precision test, nor does it constitute a full OQ of the LC modules. It is to be scheduled as the last test present of all the hardware OQ protocols, but it is an optional test.

Data is acquired with the systems using MassHunter software for ICP-MS. The injection precision test uses direct data importing of data files into the Data Manager within ACE. ACE will then integrate the traces and report the peak areas only. Manual data entry of pre-integrated peak areas will also be possible. The mean peak area for the six runs will be calculated, as well as the standard deviation and %RSD of the peak areas for the sequence. Limits for the %RSD have been determined to be $\leq 10.0\%$ for all Agilent ICP-MS series.

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www.agilent.com/crosslab/compliance-steps

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