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5973*Network* Mass Selective Detectors

General Description

The 5973*Network* products are a family of MSDs (mass selective detectors) optimally designed for use with the industry-leading 6890 Plus Series Gas Chromatograph as capillary gas chromatography detectors. One product (G2570A) is a GC/MS system that includes a 6850 GC, a 5973N diffusion pump MSD configuration, and a data system.

The MSDs are compact (occupying less than $0.2~m^2$ on a benchtop), require no cooling water or compressed air, and operate on 120 VAC or 200–240 VAC. Each instrument includes a short GC interface (< 20 cm), an independently heated electron impact ion source, a metalized gold quadrupole mass filter, an electronics module, LAN communications, and a long-life off-axis HED (high-energy dynode) detector with a replaceable snap-in horn. Depending on the product ordered, the system comes equipped with a vapor diffusion pump, a standard turbomolecular pump, or a high-performance turbomolecular pump.

5973*Network* MSDs offer true classical EI (electron impact ionization) spectra with the standard EI source. Chemical ionization (CI) operation is available with the optional PCI/NCI (positive/negative chemical ionization) ion source.

Software

The GC/MSD System is controlled from the MSD Productivity ChemStation with the current version of MS Windows™ NT. Standard operating software includes autotune and target tune programs for EI, PCI and NCI techniques along with programs for data acquisition, data editing, reporting, quantitation, library searching, and four data analysis modes (Enhanced, EnviroQuant, Drug Analysis, Aromatics in Gasoline). Optional MS libraries include general purpose, pesticide and drug libraries. The user has full instrument control of 6890 Plus Series GCs including additional GC detectors.

Support and Training

Installation and one-year warranty are provided. A wide range of service products for both MSD hardware and software products is available. Operator training is recommended, and a good understanding of capillary gas chromatography is useful. Agilent Technologies offers standardized ISO-registered training courses in selected locations worldwide as well as onsite courses that can be tailored to specific training needs.

Technical Specifications: MSD Instruments

Mass range

1.6–800 amu in 0.1 amu steps; any subset of this range may be selected by the user.

Mass resolution

Unit mass resolution throughout the mass range.

Scan speed

Instrument provides scan rates up to 5,200 amu/second with 0.1 amu scan step size, with eight sampling rates. (Typical analyses require one scan/second, which is approximately 800 amu/second.)

Dynamic range

Total ADC (analog/digital converter) dynamic range is 10^6. Linear calibration curves for individual compounds will vary depending on sample, target analyte, experimental conditions, and chromatographic performance.

Mass axis stability

Mass axis stability is ±0.15 amu over 12 hours, assuming constant operating temperature and thermal equilibration of the instrument.

SIM (single ion monitoring) capability

Up to 50 groups of masses, with 30 masses per group, may be switched automatically within an analysis by time-programming during acquisition.

SIM dwell time

Any value between 10–9,999 msecs per mass, selectable by the user.

Ionization energy

Filament voltage is user-selectable over the range 5–240 eV. Dual filaments for EI; single filament for CI.

Ionization current

Filament emission current is user-selectable over the range 0–315 µA in all modes of operation. Some combinations of low ionization energy and high emission current are not allowed to avoid damage to the instrument.

Ion source temperature

Temperature of the independently heated ion source can be controlled up to 250°C for EI and up to 300°C for CI.

Quadrupole temperature

Temperature of the independently heated quadrupole can be controlled up to 200°C.

Interface temperature

Temperature of the interface (an auxiliary zone of the GC) can be controlled up to 350°C.

Vacuum systems

The 5973*Network* MSDs comprise a family of vacuum systems.

Product Number	High Vacuum Pump	Gas Flow Rate Entering the MSD (mL/min)	
		Optimal for Chromatography	**Maximum for Typical GC/MS**
G2570A	Diffusion	1	1.5
G2577A/ G1777A	Diffusion	1	1.5
G2578A/ G1778A	Standard Turbo	1	2.0
G2579A/ G1779A	Performance Turbo	2	4.0
G2588A/ G1788A	Standard Turbo	1	2.0
G2589A/ G1789A	Performance Turbo	2	4.0

Pump-down from atmosphere to operating pressures requires approximately 3 minutes (turbomolecular pump systems) or 15 minutes (diffusion pump version). Recommended time to reach a stable operating temperature is 2 hours. Venting the system to atmospheric pressure requires approximately 20 to 40 minutes; the exact time depends on the temperature of the mass analyzer and the type of high-vacuum pump. Pump down/vent cycle is accomplished by following a simple procedure incorporated in the software. The recommended optional ion gauge controller monitors pressure in the high vacuum chamber up to 1×10^{-3} Torr. High vacuum and typical ion source pressure (for EI operation) is 5×10^{-5} Torr (nitrogen equivalent) and depends on chromatographic column flow rate entering the MSD.

Local control panel

A panel with a vacuum fluorescent display and push buttons allows the user to verify system performance locally, to start a method or sequence, to vent the MSD, and to monitor the status without interacting with the MSD ChemStation.

ISO 9001

The 5973*Network* MSD products have been designed and manufactured under a quality system that has been registered to ISO 9001.

Sensitivity

With a GC that is in acceptable working order, the tables below summarize expected performance in various operating and ionization modes.

EI Scan Sensitivity

At installation, the following are the specifications:

Product Numbers	Instrument Description	Quantity of Octafluoronaphthalene Injected onto Column	Scan Rate (scans/sec)	Scan Mass Range (amu)	Shall yield an RMS signal/noise for the extracted ion signal at m/z 272.0 of at least
G2577A G1777A	Diffusion Pump, EI				20:1
G2578A G1778A	Standard Turbo, EI				20:1
G2579A G1779A	Performance Turbo, EI	1 pg	2.9	50–300	20:1
G2588A G1788A	Standard Turbo, EI/PCI				20:1
G2589A G1789A	Performance Turbo, EI/PCI/NCI				20:1
G2570A	GC/MSD System				10:1
Split/splitless or PTV injection ports on 6890 Plus GC and split/splitless injection port on 6850 GC: 1 µL aliquot of 1 pg/µL OFN in iso-octane with pulsed splitless injection; 0.25 mm × 30 m × 0.25 µm HP-5MS column or equivalent.					

EI SIM Sensitivity[a]

The following are the specifications:

Product Numbers	Instrument Description	Quantity of Octafluoronaphthalene Injected onto Column	Acquisition Rate (cycles/sec)	Dwell Time (msec)	Shall yield an RMS signal/noise for the extracted ion signal at m/z 272.0 of at least
G2577A G1777A	Diffusion Pump, EI				10:1
G2578A G1778A	Standard Turbo, EI				10:1
G2579A G1779A	Performance Turbo, EI	20 fg	1.9	500	10:1
G2588A G1788A	Standard Turbo, EI/PCI				10:1
G2589A G1789A	Performance Turbo, EI/PCI/NCI				10:1
G2570A	GC/MSD System				10:1
Split/splitless injection ports on 6890 Plus GC and 6850 GC: 1 µL aliquot of 20 fg/µL OFN in iso-octane with pulsed splitless injection; 0.25 mm × 30 m × 0.25 µm HP-5MS column or equivalent. Low resolution mode.					

[a] *Demonstration is not part of the standard installation but can be requested for additional cost.*

PCI Scan Sensitivity

At installation, with methane (CH_4) CI reagent gas, the following are the specifications:

Product Numbers	Instrument Description	Quantity of Benzophenone Injected onto Column	Scan Rate (scans/sec)	Scan Mass Range (amu)	Shall yield an RMS signal/noise for the extracted ion signal at m/z 183.1 of at least
G2588A G1788A	Standard Turbo, EI/PCI	100 pg	4.7	80–230	75:1
G2589A G1789A	Performance Turbo, EI/PCI/NCI				75:1
Split/splitless injection port on 6890 Plus GC: 1 µL aliquot of 100 pg/µL BZP in iso-octane with pulsed splitless injection; 0.25 mm × 30 m × 0.25 µm HP-5MS column or equivalent.					

PCI SIM Sensitivity[a]

With methane (CH_4) CI reagent gas, the following are the specifications:

Product Numbers	Instrument Description	Quantity of Benzophenone Injected onto Column	Acquisition Rate (cycles/sec)	Dwell Time (msec)	Shall yield an RMS signal/noise for the extracted ion signal at m/z 183.1 of at least
G2588A G1788A	Standard Turbo, EI/PCI	1 pg	3.7	250	10:1
G2589A G1789A	Performance Turbo, EI/PCI/NCI				10:1
Split/splitless injection port on 6890 Plus GC: 1 µL aliquot of 100 pg/µL BZP in iso-octane with split injection (100:1 split); 0.25 mm × 30 m × 0.25 µm HP-5MS column or equivalent. Low resolution mode.					

With ammonia (NH_3) CI reagent gas, the following are the specifications:

Product Numbers	Instrument Description	Quantity of Benzophenone Injected onto Column	Acquisition Rate (cycles/sec)	Dwell Time (msec)	Shall yield an RMS signal/noise for the extracted ion signal at m/z 183.1 of at least
G2588A G1788A	Standard Turbo, EI/PCI	1 pg	3.7	250	100:1
G2589A G1789A	Performance Turbo, EI/PCI/NCI				100:1
Split/splitless injection port on 6890 Plus GC: 1 µL aliquot of 100 pg/µL BZP in iso-octane with split injection (100:1 split); 0.25 mm × 30 m × 0.25 µm HP-5MS column or equivalent. Low resolution mode.					

[a] *Demonstration is not part of the standard installation but can be requested for additional cost.*

NCI Scan Sensitivity

At installation, with methane (CH_4) CI buffer gas, the following are the specifications:

Product Numbers	Instrument Description	Quantity of Octafluoronaphthalene Injected onto Column	Scan Rate (scans/sec)	Scan Mass Range (amu)	Shall yield an RMS signal/noise for the extracted ion signal at m/z 272.0 of at least
G2589A G1789A	Performance Turbo, EI/PCI/NCI	1 pg	2.9	50–300	500:1
Split/splitless injection port on 6890 Plus GC: 1 µL aliquot of 1 pg/µL OFN in iso-octane with pulsed splitless injection; 0.25 mm × 30 m × 0.25 µm HP-5MS column or equivalent.					

NCI SIM Sensitivity[a]

With methane (CH_4) CI buffer gas, the following are the specifications:

Product Numbers	Instrument Description	Quantity of Octafluoronaphthalene Injected onto Column	Acquisition Rate (cycles/sec)	Dwell Time (msec)	Shall yield an RMS signal/noise for the extracted ion signal at m/z 272.0 of at least
G2589A G1789A	Performance Turbo, EI/PCI/NCI	1 fg	1.9	500	10:1
Split/splitless injection port on 6890 Plus GC: 1 µL aliquot of 1 fg/µL OFN in iso-octane with pulsed splitless injection; 0.25 mm × 30 m × 0.25 µm HP-5MS column or equivalent. Low resolution mode.					

[a] *Demonstration is not part of the standard installation but can be requested for additional cost.*

Physical Specifications

MSD Instruments[a,c,d,e]

Product Numbers	Instrument Description	Height	Width	Depth	Maximum Power	Weight
G2577A G1777A	Diffusion Pump, EI	40.6 cm 16 in	29.8 cm 11.8 in	56 cm 22 in	900VA	36.3 kg 80 lb
G2578A G1778A	Standard Turbo, EI	40.6 cm 16 in	29.8 cm 11.8 in	56 cm 22 in	900 VA	38.9 kg 86 lb
G2579A G1779A	Performance Turbo, EI	40.6 cm 16 in	29.8 cm 11.8 in	56 cm 22 in	900 VA	43.9 kg 97 lb
G2588A G1788A	Standard Turbo, EI/PCI	40.6 cm 16 in	29.8 cm 11.8 in	56 cm 22 in	900 VA	40.9 kg 90 lb
G2589A G1789A	Performance Turbo, EI/PCI/NCI	40.6 cm 16 in	29.8 cm 11.8 in	56 cm 22 in	900 VA	45.9 kg 101 lb

GC/MSD System[b,c,d]

Product Numbers	Instrument Description	Height	Width	Depth	Maximum Power[f]	Weight
G2570A	GC/MSD System	50 cm 20 in	58.8 cm 23.2 in	56 cm 22 in	2340 to 2900 VA	59.3 kg 131 lb

[a] *Measurements for MSD instruments alone.*

[b] *Measurements include MSD instrument and 6850 GC.*

[c] *Measurements include mechanical pump weight and mechanical pump positioned within pump compartment within MSD. Mechanical pump weighs 11.4 kg (25 lb).*

[d] *For products with ChemStations (G17xxA, G2570A) with printers, reserve bench space of at least 100 cm (39 in) long by 54 cm (21 in) deep. A typical data system weight is 34 kg (75 lb).*

[e] *The following are the dimensions of a 6890 Plus GC: 50.0 cm (20 in) high × 58.5 cm (23 in) wide × 50.0 cm (20 in) deep and 50 kg (110 lb) weight.*

[f] *Total power for MSD plus 6850 GC: for 120 V, 2340 VA; for 230 V, 2900 VA. Requires separate outlets.*

Environmental Description

The 5973N MSDs meet all the following regulatory requirements:

Product safety

EN 61010-1, IEC 61010-1 *(including amendments 1 and 2),* CSA C22.2 No. 1010.1, UL 3101-1

Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

Safety class 1; pollution degree 2; installation category II.

93/23/EEC *(as amended by 93/68/EEC)*

European Low Voltage Directive

Electromagnetic interference (EMI)

EN 55011, CISPR 11

Limits and Methods of Measurement of RFI Characteristics of Industrial, Scientific and Medical Apparatus

Interference limits as specified for equipment group 1, class A.

Electromagnetic compatibility (EMC)

IEC/EN 61326-1: 1997

Electrical Equipment for Measurement, Control, and Laboratory Use—EMC Requirements

Sound emission

ISO 7779:1988, EN 27779:1991

Acoustics-Measurement of Air-Borne Noise Emitted by Computer and Business Equipment

The 5973N sound pressure level at the operator's position is less than 70 db (A).

Electrical characteristics

The MSD will operate on 120V or 200–240 VAC power. Site wiring must meet applicable codes.

Nominal Voltage	Voltage Range
200–240V 50 Hz	±10%
120V 60 Hz	±10%

Environmental conditions

Temperature

    Operating environment: 15 to 35°C at constant temperature (constant temperature: ±2°C per hour)

    Non-operating storage temperature: –20 to 70°C

Humidity

    Operating: 25% to 50% RH

    Non-operating: 10% to 95% RH, (non-condensing)

Precautions to minimize electrostatic discharge should be observed. Exhaust from the mechanical pump MUST be suitably vented external to the lab in conformance with all local environmental and safety codes. Failure to vent exhaust could interfere with air quality. The exhaust vent needs to have a negative draw to remove the exhaust.

Technical Specifications: MSD Software

The software is a Win32 application consisting of modules for configuration, sequencing, instrument control and data analysis. When used with 6890 Plus GCs, the following describe the attributes of the MSD Productivity ChemStation software.

Operating System

Microsoft Windows NT.

Control

When used with 6890 Plus GCs, create, edit, save, execute complete system methods and sequences of samples. System control and acquisition parameters include set-points for 6890 and 6890 Plus GCs; 5972, 5973, 5973N MSDs; and 7673B ALS, G1512A, and G2612A controller.

Tuning

Includes a variety of autotune algorithms to tune the instrument for maximum sensitivity or for specific target compounds (i.e., BFB, DFTPP). For chemical ionization, automated tuning procedures facilitate the adjustment of reagent gas and mass analyzer parameters. All mass spectrometric parameters may be individually controlled by a highly interactive manual tune program. Automatic archival for GLP.

Data acquisition

When used with 6890 Plus GCs, acquisition of up to 4 system detectors: GC, MSD, and combined GC/MSD. Any one MSD ChemStation may control a maximum of two MSDs.

Data display

When used with 6890 Plus GCs, real-time display of MS and GC signals and MS spectra; off-line display of multiple signals (TIC, SIM, spectra); capabilities for overlay, subtraction, zoom, user-definable attributes (axes, baselines, compound names, fonts, scaling).

Warning/alarm levels

When used with 6890 Plus GCs, user-settable limits for Signal Monitors that monitor MS and chromatographic signals and instrument parameters; can be edited and saved for specific applications.

GC instrument parameters

When used with 6890 Plus GCs, complete electronic pneumatic control of all gas pressures and flow rates, Cryo-Blast, time-programming, heated zones, oven temperatures (including ramp rates), cryogenic cooling, valves, and signals.

Integration

Two chromatographic integrators (one optimized for GC detector data and one optimized for mass spectrometric data); manual and automatic integration for area or height. Integration parameter files allow setting the area rejection, peak width, noise threshold, baseline control parameters, negative peak tangent skim, area sum. Custom integration parameter files are saved with methods.

Calibration

Up to 1,000 compounds may be individually calibrated with up to 20 levels by using peak area or height, and a choice of five curve fits: linear, linear with forced zero intercept, quadratic, quadratic with forced zero intercept, and average response factors. Allows weighted calibration for the inverse of concentration or the inverse squared of the concentration. Calibration information for each compound is viewable and includes target and qualifier ions, retention-time windows, response factors, calibration curve plots, and coefficient of determination (r^2).

Quantitation

Percent, normalized %, external standard %, internal standard %, peak area, peak height, multilevel calibrations (up to 20 levels).

Data analysis modes

Four data analysis modes: Enhanced, Enviroquant, Drug Analysis, Aromatics in Gasoline.

User interface

Graphical and customizable, with simultaneous on-line and off-line sessions supported.

On-Line Help

Extensive HELP is accessible from all screens and accompanies messaging; more than 1000 topics, glossary, and index.

Training materials

Extensive electronic materials are accessible from the software application; CD-ROM media include filmed technical lectures from experts, filmed maintenance procedures, and detailed user-paced tutorials.

Mass spectral data base searching

Automated; user-created or a range of commercial mass spectral libraries (general purpose and application specific) using a Probability Based matching algorithm as the default algorithm; compatible with other search algorithms that are used with the commercial libraries.

Reporting

Default reports; area %; Quant (summary and detailed); library search (summary and detailed).

Custom report templates

Custom reporting utilizes a report Wizard to simplify creation of reports with a broad selection of graphical data types. Associated with specific methods and automatically executed at the end of an analysis on a sample-to-sample basis; up to 240 graphics allowable; spreadsheet functionality; MDL reporting. Supports setting up user-created databases of results from multiple samples, with automatic updating of data base whenever a method is run (and can be used for control charting). Custom report templates may be exported directly into Excel™.
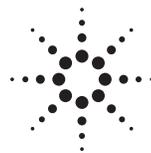
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Customization
Command set may be grouped in "macros" that perform predefined functions that users select to automate a series of keyboard entries. Macros can be initiated in pre-run, post-run, and sequence state.

File formats
Industry standard GC/MS AIA file formats may be imported/exported. Data files and reports can be exported as ".csv" files to third-party applications such as Excel™.

Networking
The 5973N MSD and 6890 Plus GC are controlled by the software by industry-standard LAN (local area network) protocol communications. TCP/IP services on 10BaseT network MSD-based systems include a network hub and all associated cabling.

Security
Secured control that allows the system manager to define multiple levels of security for methods and data files, integration, quantitation and reporting, total system accessibility, method-specific accessibility, and equilibration/stand-by methods. Analysis approval for operators may be based on Method or Sample names.

Processing tools
Real-time update of concentration, peak integration, retention times; screening for false negatives; QA check reporting; batch processing of samples or spectra.

Automation
Pre-method and post-method routines (including for sequences), recalibrations, bracketing, pause for priority samples, additional samples can be added while online, reevaluation via data analysis.

Library search tools
Peak purity and parametric retrieval.

Libraries
Range of optional commercial libraries: general purpose—NIST98 and Wiley 6th Edition; application specific—Pfleger MS Drug, Stan Pesticides, and Agilent Technologies RTL Pesticide MS Library. Users can create custom libraries from other libraries or from mass spectra acquired experimentally (including acquisition with other instruments). Agilent Technologies pesticides library is used in conjunction with retention time locking to screen specifically for pesticides.

Chromatographic repeatability tool
Closed-loop retention time locking (RTL) provides an automated process for both acquiring RTL calibration information about retention time changes resulting from normal chromatographic operation and subsequently adjusting the chromatographic pressure automatically to correct for retention time deviations as appropriate.

Early maintenance feedback
Monitoring of system components that require routine maintenance for appropriate performance, with messaging to the operator if user-defined limits are exceeded: mechanical pump fluid changes, detector change based on EM counts, injections per septum, injections per inlet liner, and tune-time limits.

ISO 9001
The MSD Productivity ChemStation and Data Analysis software have been designed and manufactured under a quality system that has been registered to ISO 9001.

Year-2000 compliance
Certifiable Year-2000 compliance.

Software validation
Data files and methods are provided for validating the calculations and algorithms that are used by the software in producing results (area percent, summary library search, summary quantitation reports).

GLP tools
Certificate of Validation, password protection, runtime logbook, revision log history.