

# **Agilent 8355 Sulfur and 8255 Nitrogen Chemiluminescence Detectors**

**User Manual**



**Agilent Technologies**

# Notices

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## Safety Notices

### CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

### WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

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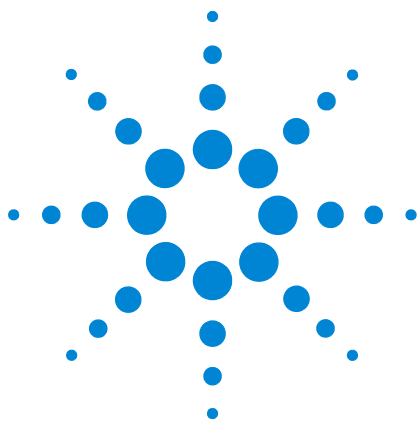
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# 1 Getting Started

Manuals, Information, Tools and Where to Find Them	8
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This chapter introduces the Agilent 8355 Sulfur Chemiluminescence Detector (SCD) and the Agilent 8255 Nitrogen Chemiluminescence Detector (NCD), and provides details about where to find helpful information and tools, such as GC manuals, flow calculators, and so forth.

## Manuals, Information, Tools and Where to Find Them

This manual describes how to operate the Agilent 8355 Sulfur Chemiluminescence Detector (SCD) and the Agilent 8255 Nitrogen Chemiluminescence Detector (NCD) as installed on an Agilent 7890B Gas Chromatograph (GC). This manual also provides operating recommendations, maintenance procedures, and troubleshooting. For installation instructions, see the Agilent 8355 SCD and 8255 NCD *Installation and First Startup Guide*. To prepare the installation site for a new SCD or NCD, see the Agilent 8355 SCD and 8255 NCD *Site Preparation Guide*.

In addition, Agilent provides other manuals, familiarization information, and help systems for self-paced learning about the 7890B GC. You will need to reference this general GC information for installation and operation of the detector. The sections below describe this information and where to find it.

### GC Manuals, Tools, and Online Help

Agilent provides several learning products that explain how to install, operate, maintain, and troubleshoot the 7890B GC system. These manuals can be found on the Agilent *GC and GC/MS User Manuals & Tools* DVDs that are included with your GC shipment.

Installing your manuals provides for a much richer user experience by providing the ability to install the manuals you want, in the language you want. Install HTML and PDF versions.





Select the Instrument Manuals icon from the GC and GC/MS User Manuals & Tools DVD and install the suite of manuals for your system.

## Available manuals

**Table 1** 7890B GC Learning Products

Learning product	Contents	When to use this documentation
Getting Started	Overview of the manuals. Where to find information. How to install the manuals. Overview of the GC.	
Safety Manual	Lists safety and regulatory information. Precautions for using hydrogen carrier (or fuel) gas. Precautions for performing maintenance tasks.	<ul style="list-style-type: none"> <li>• Before installation, to prepare for a safe installation process.</li> <li>• Before maintenance.</li> </ul>
GC, GC/MS, and ALS Site Prep Guide	Requirements for: space and weight for the lab bench, power, heat dissipation, exhaust venting, laboratory conditions (expected local environment), gas and reagent gas purity, gas supplies, gas plumbing (including filters, regulator types, and tubing needs), and cryogenic cooling supplies (if used). Recommended supplies to purchase before installation.	<ul style="list-style-type: none"> <li>• Before installation, to prepare the laboratory site.</li> <li>• Before installation, to find what supplies are needed for successful installation (such as gases, installation kits, gas purifiers, regulators, tubing, fittings, consumable parts, and so on).</li> <li>• At any time, to refer to expected requirements for gas supplies, regulators, cryogenic cooling supplies, supply pressures, and so on.</li> </ul>
Installation and First Startup	How to install the GC on the laboratory bench. Cabling pinouts.	<ul style="list-style-type: none"> <li>• During installation.</li> </ul>
Operation Manual	Common keyboard functions. Using the keyboard to start runs and sequences. Using the keyboard when connected to an Agilent data system. Methods and sequences overview. Startup and shutdown. How to check GC performance after installation. Energy conservation (sleep/wake). Early Maintenance Feedback. Configuration.	<ul style="list-style-type: none"> <li>• To learn common operating tasks (making a run, loading a method, running a series of samples).</li> <li>• To learn how to use the GC keyboard when under data system control.</li> <li>• Before a short-term or long-term shutdown.</li> <li>• When starting up the GC after a period of inactivity.</li> <li>• Whenever you need to verify performance of the instrument against factory standards, for example, after certain maintenance procedures.</li> <li>• To learn how to properly configure GC components, especially when newly installed.</li> </ul>

**Table 1** 7890B GC Learning Products

Learning product	Contents	When to use this documentation
Advanced Operation Manual	Procedures and theory of operation not normally required for daily use: programming; detailed information about methods and sequences; inlet (column) flow and pressure modes; inlet, detector, valve, oven, and other setpoint details; and output signal settings.	<ul style="list-style-type: none"> <li>• When developing methods.</li> <li>• When running the GC standalone (no data system).</li> <li>• To learn details about settings.</li> </ul>
Maintaining Your GC	Procedures to maintain the GC, including procedures for all standard inlet and detector options. Replacement parts information. Instructions for using Early Maintenance Feedback (EMF).	<ul style="list-style-type: none"> <li>• To look up a replacement part or consumable part.</li> <li>• Before performing any maintenance on the GC.</li> </ul>
Troubleshooting	Procedures for resolving GC issues. Symptoms and resolutions for resolving GC or chromatographic or hardware issues. Procedures to determine whether an issue is hardware-related, software-related, or related to other factors (such as sample preparation).	<ul style="list-style-type: none"> <li>• When trying to isolate the cause of unexpected performance issues.</li> </ul>
GC Software Familiarization	Introduction to the data system control software user interface for the GC. Introduces concepts for EMF and configuration, and other new features.	<ul style="list-style-type: none"> <li>• To locate settings in the data system user interface.</li> </ul>
Data system help	Topics and tasks for creating and editing methods for the GC.	<ul style="list-style-type: none"> <li>• To answer questions about using the software to control the GC.</li> </ul>

### Language Versions

Agilent provides the 7890B learning products in several languages. [Table 2](#) below lists the manuals and the languages available for each manual format (print, Adobe PDF, or HTML).

**Table 2** Languages available for GC manuals

Manual	Format	Spanish	English	Chinese	French	German	Italian	Japanese	Brazilian Portuguese	Russian
Getting Started	Print	✓	✓				✓	✓		
	HTML	✓	✓				✓			
	PDF	✓	✓	✓	✓	✓	✓	✓	✓	✓
Safety Manual	HTML	✓	✓				✓			
	PDF	✓	✓	✓	✓	✓	✓	✓	✓	✓
Installation and First Startup	HTML	✓	✓				✓			
	PDF	✓	✓	✓	✓	✓	✓	✓	✓	✓
GC, GC/MS, and ALS Site Prep Guide	HTML	✓	✓				✓			
	PDF	✓	✓	✓	✓	✓	✓	✓	✓	✓
Maintaining Your GC	HTML	✓	✓				✓			
	PDF	✓	✓	✓	✓	✓	✓	✓	✓	✓
Troubleshooting	HTML	✓	✓				✓			
	PDF	✓	✓	✓	✓	✓	✓	✓	✓	✓

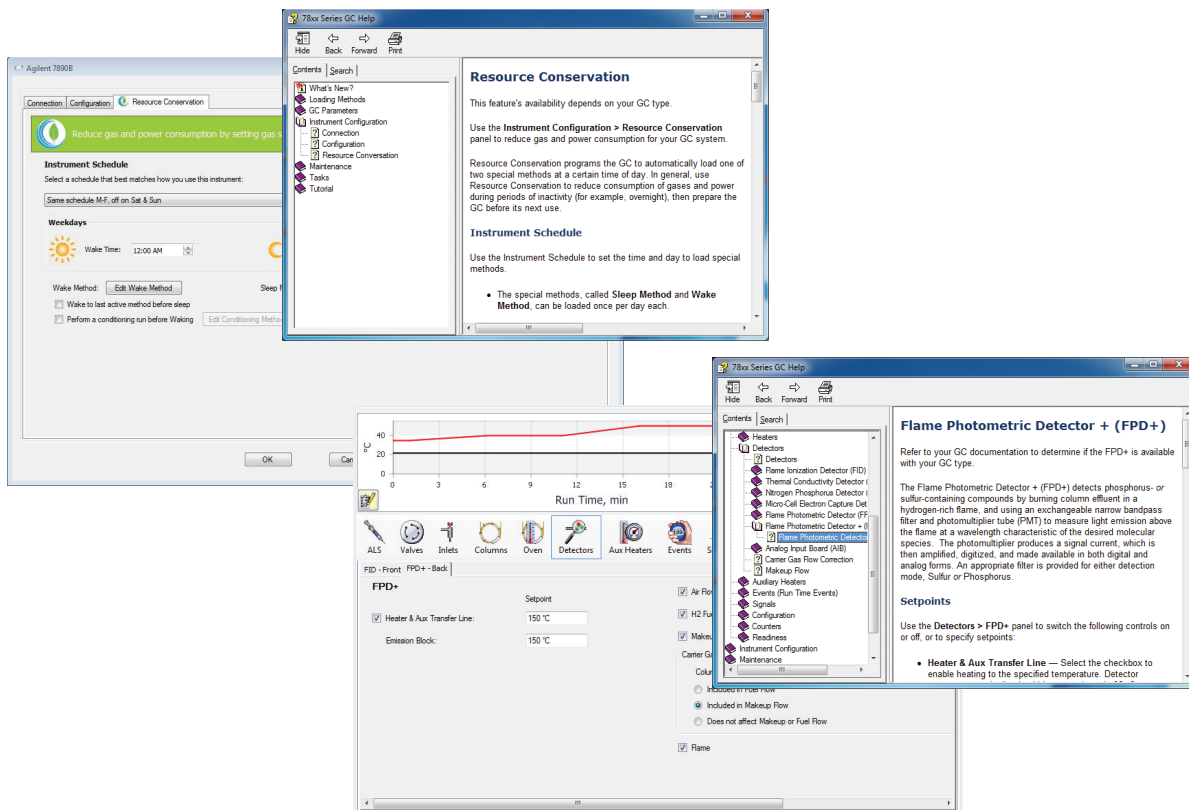
**Table 2** Languages available for GC manuals

Manual	Format	Spanish	English	Chinese	French	German	Italian	Japanese	Brazilian Portuguese	Russian
Operation Manual	HTML	✓	✓				✓			
	PDF	✓	✓	✓	✓	✓	✓	✓	✓	✓
Advanced Operation Manual	HTML	✓								
	PDF	✓								
Software Familiarization	HTML	✓	✓				✓	✓	✓	

### Online help

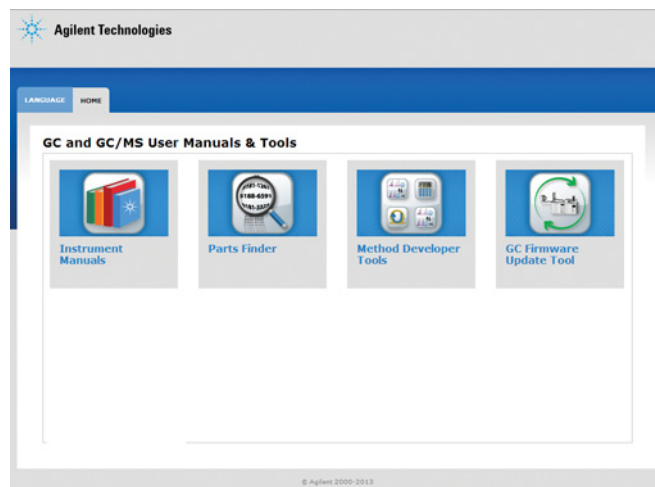
In addition to hardware manuals, your GC data system also includes an extensive online help system with detailed information, common tasks, and video tutorials on using the software.

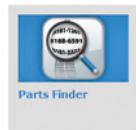
# 1 Getting Started



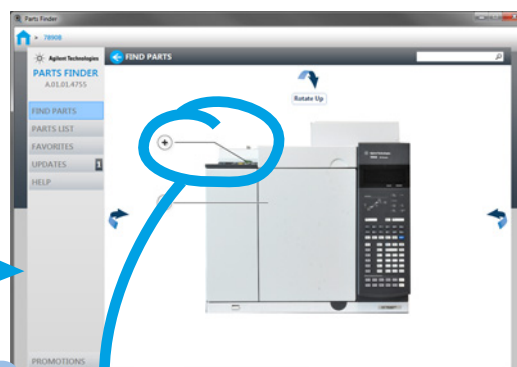
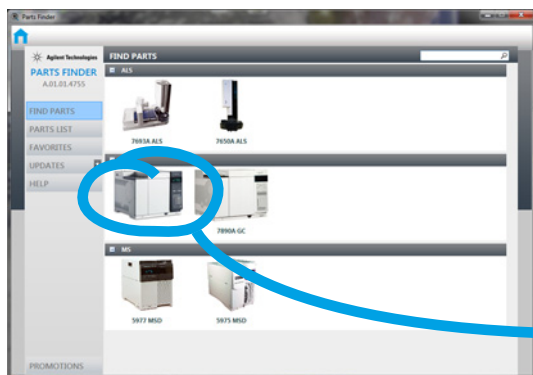
## User Apps

In addition to the Hardware Manuals, you will also find several User Apps on the Agilent GC and GC/MS User Manuals & Tools DVDs. See below for a list of available Apps, such as Parts Finder, the GC Firmware Update Tool, and a variety of Method Developer Tools.

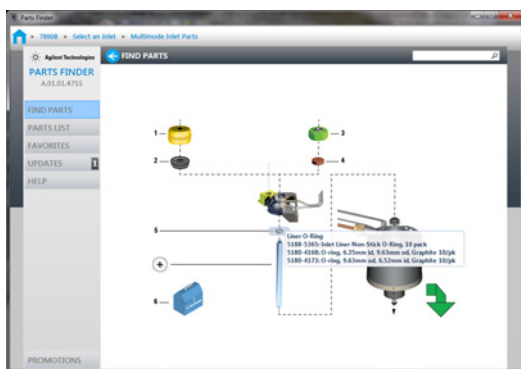
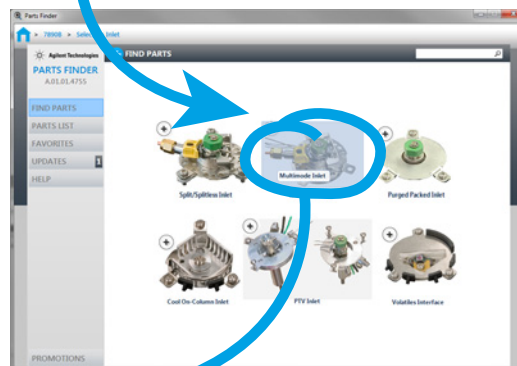




Install Parts Finder to quickly find replacement and consumable parts by clicking through images of the instrument.



Instead of thumbing through a catalog or manual, you can quickly click on photos and artwork to isolate the instrument components of interest (a specific type of inlet or detector, ion source, or sampler tray, for example), then visually browse to the parts you need.



Not only does Parts Finder save time when ordering parts, but it also updates itself from the internet so you can always access the latest parts list for all of your instruments.

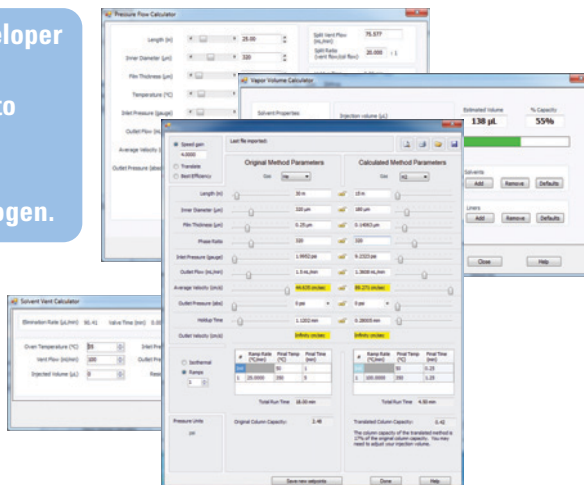
# 1 Getting Started



Install the GC Firmware Update tool to install the latest firmware onto your GC and sampler systems.



Install Method Developer Tools, such as the Method Translator, to help you convert a helium carrier gas method to use hydrogen.





## Education Opportunities



Agilent has designed customer courses to help you learn how to use your GC to maximize your productivity while learning about all of the great features of your new system:

**R1778A** – Agilent 7890 A/B GC and OpenLAB ChemStation Operation

**R1914A** – Agilent 7890 A/B GC Troubleshooting and Maintenance

**R2255A** – Agilent 7890 Series GC Operation with OpenLAB EZChrom

For course details and education opportunities, visit <http://www.agilent.com/chem/education>, or call your local Agilent sales representative.

## Overview of the 8355 SCD and 8255 NCD

Figure 1 through Figure 5 show the controls, parts, and components of the 8355 SCD and 8255 NCD used or accessed during installation, operation, and maintenance.



Figure 1 Front view, detector (SCD and NCD)

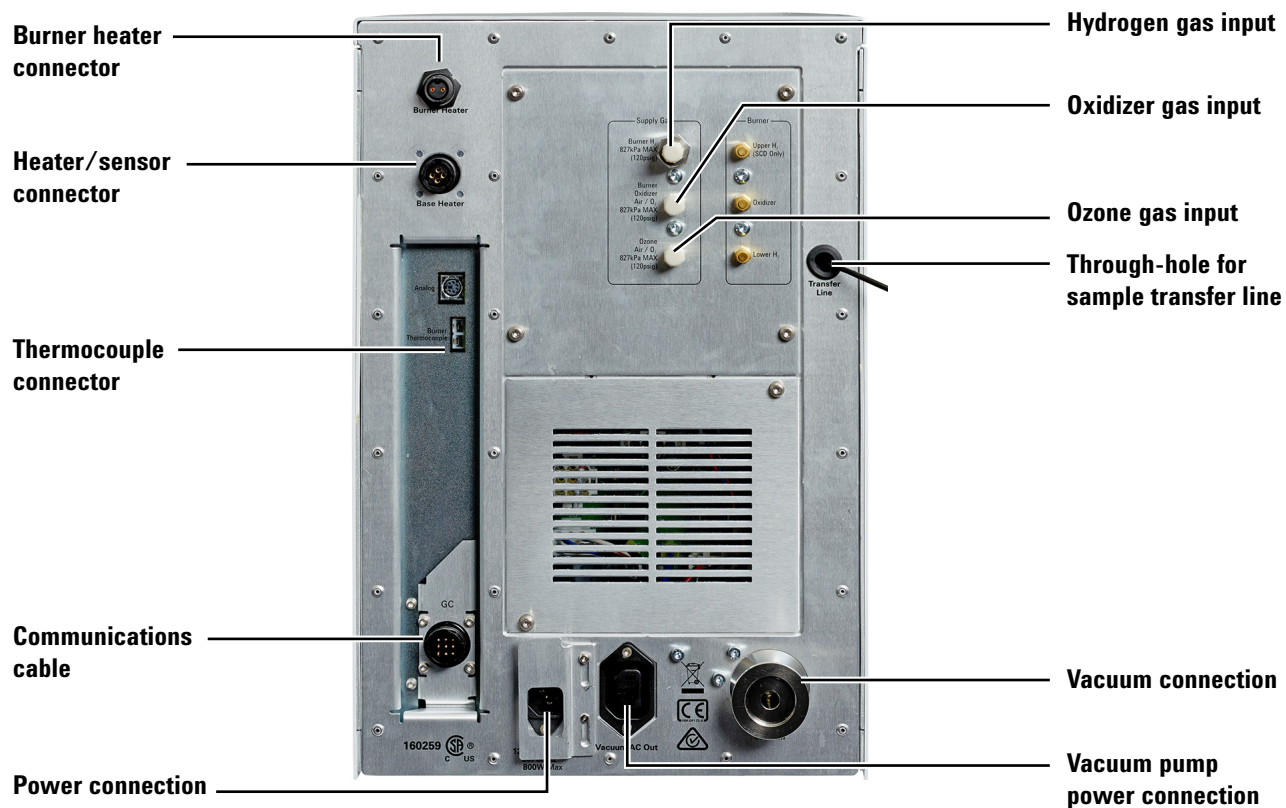
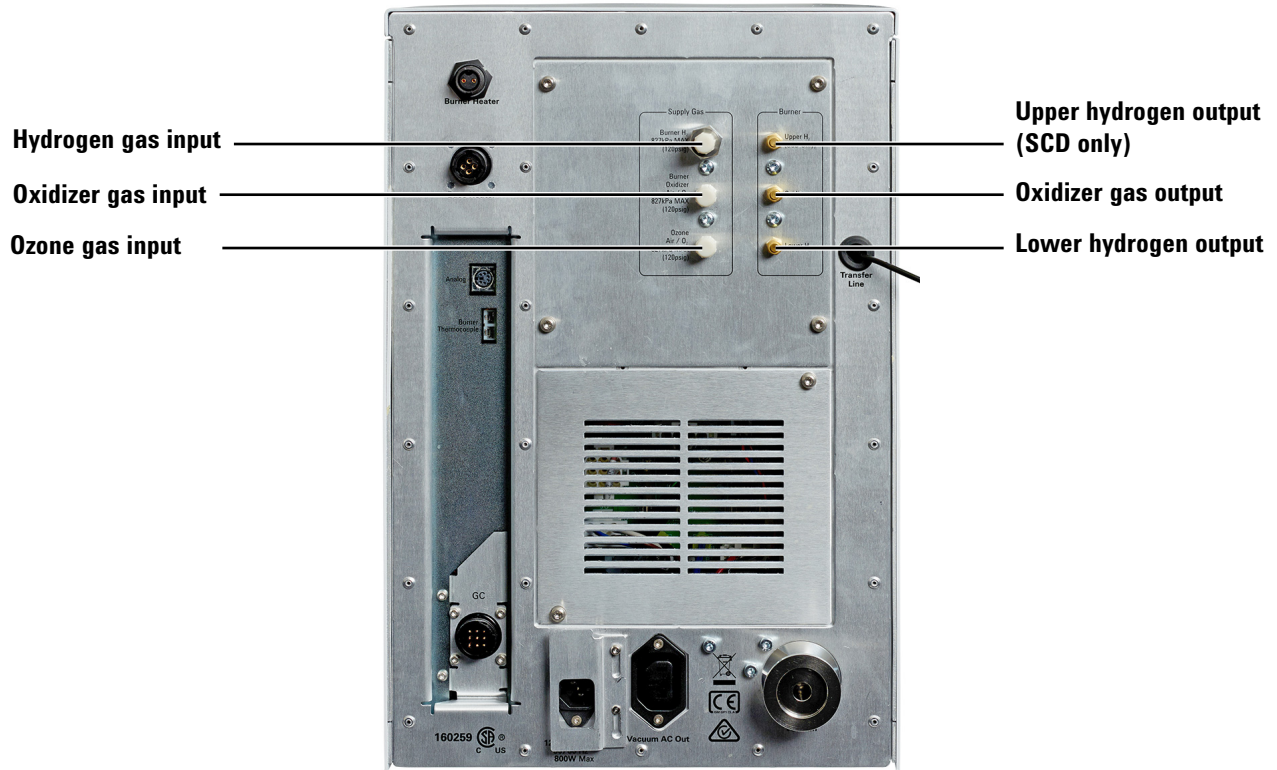
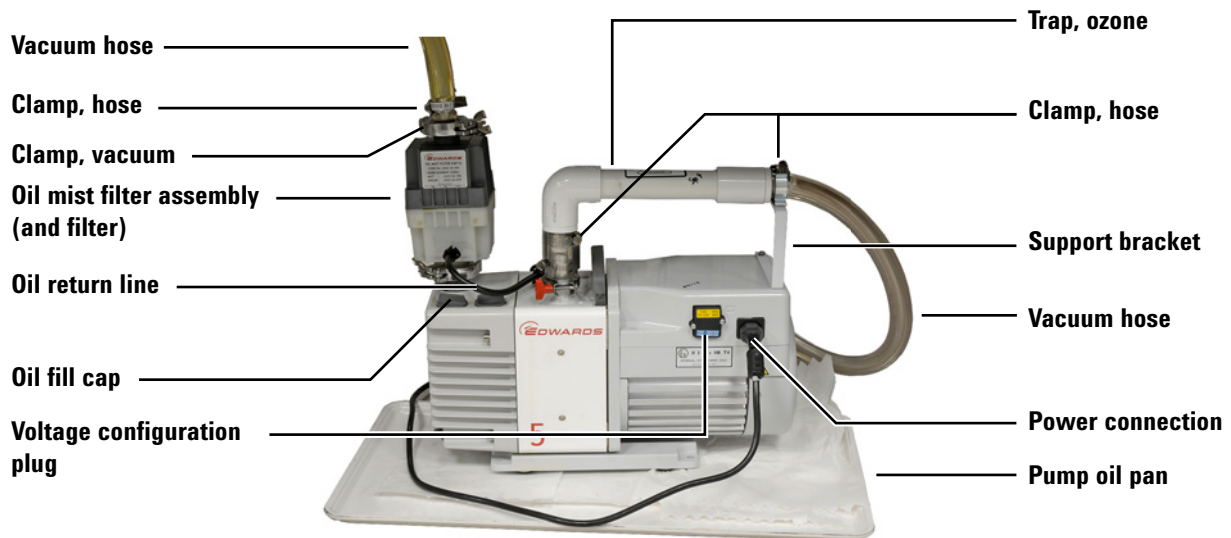


Figure 2 Detector back view

# 1 Getting Started



**Figure 3** Detector gas connections



**Figure 4** RV5 Vacuum pump

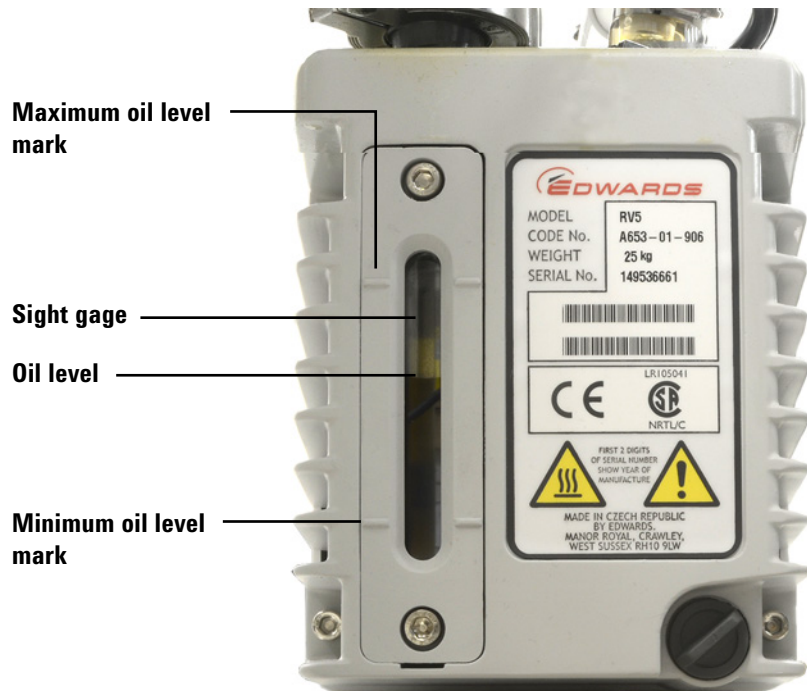
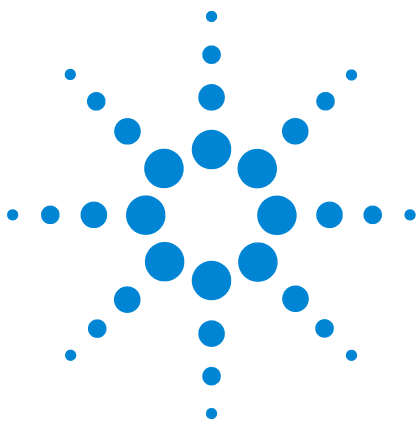


Figure 5 RV5 Vacuum pump oil sight gage

## Overview of Installation and First Startup

Below is an overview of the installation process. See the *Installation and First Startup* Guide for complete installation details.

- 1 If not already installed, install the GC and Agilent data system. (If another detector is present, verify its performance.)
- 2 Place the detector on the bench. Remove protective caps.
- 3 Prepare the GC. Cool the GC, then turn off and unplug the power cord. Remove covers.
- 4 Prepare the detector mounting location.
- 5 Unpack the vacuum pump. Remove plugs. Install oil coalescing filter and ballast.
- 6 Install the vacuum pump.
- 7 Verify the power configuration.
- 8 Install the burner assembly.
- 9 Connect the supply gases.
- 10 Connect the detector gases.
- 11 Connect the detector cables and wires.
- 12 Connect cables to the GC and detector.
- 13 Connect to power.
- 14 Install the column.
- 15 Install the GC covers.
- 16 Turn on the GC and the detector.
- 17 Configure the detector.
- 18 Create a checkout method and verify performance.



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This chapter provides important safety and regulatory information required for installation and use of the Agilent 8355 SCD and the Agilent 8255 NCD. Read and understand this information before operating the detector.



## Introduction

This manual will guide you in the operation, maintenance, and troubleshooting of the Agilent 8355 SCD and the Agilent 8255 NCD. The SCD and NCD are typically installed onto the gas chromatograph (GC) by Agilent-trained personnel. If installing the SCD or NCD, see the *Installation Guide* for instructions.

In addition to the information here, refer to the GC safety information that shipped with the GC. Find the Agilent GC manuals on the Agilent Technologies *GC and GC/MS User Manuals & Tools* DVDs.



## Important Safety Information

There are several important safety notices that you should always keep in mind when using the 8355 SCD or 8255 NCD.

### **Many internal parts of the detector carry dangerous voltages**

If the GC and detector are connected to a power source, even if the power switches are off, potentially dangerous voltages exist on the:

- Wiring between the detector power cord and the AC power supply
- AC power supply
- Wiring from the AC power supply to the power switch.

With the power switches on, potentially dangerous voltages also exist on:

- All electronics boards.
- The internal wires and cables connected to these boards.

Note that the GC supplies power to the detector electronics boards and EPC modules.

## Electrostatic discharge is a threat to GC electronics

The printed circuit (PC) boards in the detector can be damaged by electrostatic discharge. Do not touch any of the boards unless it is absolutely necessary. If you must handle them, wear a grounded wrist strap and take other antistatic precautions. Wear a grounded wrist strap any time you must remove the GC right side cover, or the right or left side detector covers.

## Many parts are dangerously hot

Many parts of the detector operate at temperatures high enough to cause serious burns. These parts include, but are not limited to:

- The dual plasma burner
- The detector interface to the GC, including the column connection

Always cool these areas of the detector to room temperature before working on them. If you must perform maintenance on hot parts, use a wrench and wear thermally protective gloves. Whenever possible, cool the part of the instrument that you will be maintaining before you begin working on it.

## Hydrogen safety

Hydrogen gas is used as a fuel gas to produce a flame in the detector.

### **WARNING**

**When using hydrogen (H<sub>2</sub>) as a fuel gas, be aware that hydrogen gas can flow into the GC oven and create an explosion hazard. Therefore, be sure that the supply is turned off until all connections are made and ensure that the detector column fittings are either connected to a column or capped at all times when hydrogen gas is supplied to the detector. Hydrogen is flammable. Leaks, when confined in an enclosed space, may create a fire or explosion hazard. In any application using hydrogen, leak test all connections, lines, and valves before operating the instrument. Always turn off the hydrogen supply at its source before working on the instrument.**

---

Hydrogen is a commonly used GC carrier gas. Hydrogen is potentially explosive and has other dangerous characteristics.

- Hydrogen is combustible over a wide range of concentrations. At atmospheric pressure, hydrogen is combustible at concentrations from 4 % to 74.2 % by volume.
- Hydrogen has the highest burning velocity of any gas.
- Hydrogen has a very low ignition energy.
- Hydrogen that is allowed to expand rapidly from high pressure into the atmosphere can self-ignite due to an electrostatic spark.
- Hydrogen burns with a nonluminous flame which can be invisible under bright light.

### Hydrogen shutdown

Hydrogen gas is used as a fuel for the SCD and NCD detectors.

When using the detector with an Agilent 7890B or 7890A+ GC, the GC monitors any hydrogen gas streams. If a stream shuts down because it is unable to reach its flow or pressure setpoint, and if that stream is configured to use hydrogen, the GC assumes that a leak has occurred and declares a hydrogen safety shutdown.

If the GC goes into hydrogen safety shutdown, the effects for the detector are:

- The detector heated zones are turned off.
- The detector hydrogen flows are shut off.
- The ozone generator is turned off.
- The vacuum pump remains on.

To recover from this state, fix the cause of the shutdown (tank valve closed, serious leak, others). Turn the instrument and detector off, then back on.

#### **WARNING**

**The GC cannot always detect leaks in detector gas streams. For this reason, it is vital that column fittings should always be either connected to a column, or have a cap or plug installed. The H<sub>2</sub> streams must be configured for hydrogen so that the GC is aware of hydrogen use.**

---

### Measuring hydrogen gas flows

**WARNING**

Do not measure hydrogen together with air or oxygen. This can create explosive mixtures that may be ignited by the automatic igniter. To avoid this hazard: 1. Turn the automatic igniter off before you begin. 2. Always measure gases separately.

---

When measuring gas flows on a detector using hydrogen for the detector flame or GC carrier gas, measure the hydrogen flow separately. Never allow an air stream to enter when hydrogen is present in the flow meter.

### Ozone

**WARNING**

Ozone is a hazardous gas and a strong oxidant. Exposure to ozone should be minimized by using the instrument in a well-ventilated area and by venting the exhaust of the vacuum pump to a fume hood. The ozone generator should be turned off when the instrument is not in use.

---

### Oxygen environments

**WARNING**

Oxygen rich environments can promote combustion, and even result in spontaneous combustion under conditions of high pressure and exposure to contamination. Use only oxygen-rated components, and ensure that components are oxygen clean prior to use with pure oxygen.

---

## Symbols

Warnings in the manual or on the instrument must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions violates safety standards of design and the intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

See accompanying instructions for more information.



Indicates a hot surface.



Indicates hazardous voltages.



Indicates protective conductor terminal.



Indicates potential explosion hazard.



Indicates electrostatic discharge hazard.



Indicates a hazard. See the Agilent user documentation for the item labeled.



Indicates that you must not discard this electrical/electronic product in domestic household waste



## Fuses

The 8355 SCD and 8255 NCD require fuses for proper operation. **These must only be accessed by Agilent trained service personnel.**

**WARNING**

**For continued protection against fire hazard, replace fuses only with fuses of the same type and rating.**

---

**WARNING**

**Electrical shock hazard. Disconnect the instrument from the mains supply before replacing fuses.**

---

**Table 3** AC board fuses

<b>Fuse designation</b>	<b>Line voltage</b>	<b>Fuse rating and type</b>
F1/F2	All	15 A, 250 VAC, IEC type F (non-time delay), ceramic body
F6/F5	All	0.75 A, 250 VAC, IEC type F (non-time delay), glass body
F4/F3	All	10 A, 250 VAC, IEC type F (non-time delay), glass body

## Safety and Regulatory Information

This instrument has been designed and tested in accordance with IEC Publication 61010-1 Safety Requirements for Electrical equipment for Measurement, Control, & Laboratory Use, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

Refer to the 7890B GC Safety Manual, available on the GC and GC/MS User Manuals & Tools DVD, for general safety and regulatory information for the 7890B GC. The sections below provide information specific to the 8355 SCD and 8255 NCD.


The Agilent 8355 SCD and 8255 NCD conform to the following safety standards:

- Canadian Standards Association (CSA): C22.2 No. 61010-1
- CSA/Nationally Recognized Test Laboratory (NRTL): ANSI/UL 61010-1
- International Electrotechnical Commission (IEC): 61010-1, 61010-2-010
- EuroNorm (EN): 61010-1

This is a safety Class I, Pollution Degree 2, Installation Category II product. It must be wired to a mains supply with a protective earthing ground incorporated into the power cord. Any interruption of the protective conductor, inside or outside the equipment, is likely to make the instrument dangerous. Intentional interruption is prohibited.

If this instrument is used in a manner not specified by Agilent, the protection provided by the instrument may be impaired.

The Agilent 8355 SCD and 8255 NCD conform to the following regulations on Electromagnetic Compatibility (EMC) and Radio Frequency Interference (RFI):

- CISPR 11/EN 55011: Group 1, Class A
- IEC/EN 61326
- AUS/NZ 

This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.



The Agilent 8355 SCD and 8255 NCD are designed and manufactured under a quality system registered to ISO 9001. Declaration of Conformity available.



*Instructions for Disposal of Waste Equipment by Users in the European Union:* This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city recycling office or the dealer from whom you originally purchased the product.

### Sound Emission Certification for Federal Republic of Germany

Sound pressure  $L_p < 68$  dB(A) operator and  $L_p < 72$  dB(A) bystander according to DIN-EN 27779 (Type test).

### Schalldruckpegel

Schalldruckpegel  $L_p < 68$  dB(A) Operator and  $L_p < 72$  dB(A) Bystander nach DIN-EN 27779 (Typprüfung).

### Electromagnetic compatibility

This device complies with the requirements of CISPR 11. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the



equipment off and on, the user is encouraged to try one or more of the following measures:

- 1 Relocate the radio or antenna.
- 2 Move the device away from the radio or television.
- 3 Plug the device into a different electrical outlet, so that the device and the radio or television are on separate electrical circuits.
- 4 Make sure that all peripheral devices are also certified.
- 5 Make sure that appropriate cables are used to connect the device to peripheral equipment.
- 6 Consult your equipment dealer, Agilent Technologies, or an experienced technician for assistance.
- 7 Changes or modifications not expressly approved by Agilent Technologies could void the user's authority to operate the equipment.

## Intended Use

Agilent products must only be used in the manner described in the Agilent product user guides. Any other use may result in damage to the product or personal injury. Agilent is not responsible for any damages caused, in whole or in part, by improper use of the products, unauthorized alterations, adjustments or modifications to the products, failure to comply with procedures in Agilent product user guides, or use of the products in violation of applicable laws, rules or regulations.

## Cleaning

To clean the unit, disconnect the power and wipe down with a damp, lint-free cloth.

## Recycling the Product



For recycling, contact your local Agilent sales office.

## Technical Assistance

This instrument ships with documentation for operation, routine maintenance, and troubleshooting. To obtain additional technical assistance, visit the technical support pages available on the Agilent web site at <http://www.agilent.com>, or contact your local Agilent sales office. For the most up-to-date contact information, visit the Agilent website at: <http://www.chem.agilent.com/en-US/Contact-US/Pages/ContactUs.aspx>.



## 3 System Description

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This chapter provides typical performance specifications, and describes the theory of operation for the 8355 SCD and 8255 NCD.



## Specifications

This section lists the published specifications for a new detector, installed on a new Agilent 7890B GC, when used in a typical laboratory environment.

### 8355 SCD

Specification	
Minimum Detection Limit (MDL), typical	< 0.5 pg (S)/s (2x Agilent data system ASTM noise)
Linearity	> 10 <sup>4</sup>
Selectivity	> 2 x 10 <sup>7</sup> response S/response C <sup>2</sup>
Precision* and stability	< 2 % RSD over 2 hours < 5 % RSD over 24 hours
Typical time to reach 800 °C from ambient	10 min

\* Typically, based on one run per 30 minutes, collected over 24 hours. For example, a 24 hour time span will contain approximately 48 replicate runs.

### 8255 NCD

Specification	
Minimum Detection Limit, typical	< 3 pg (N)/s (2x Agilent data system ASTM noise)
Linearity	> 10 <sup>4</sup>
Selectivity	> 2 x 10 <sup>7</sup> response N/response C
Area repeatability	< 1.5 % RSD over 8 hours < 2 % RSD over 18 hours
Typical time to reach 800 °C from ambient	10 min

## Theory of Operation

The Agilent 8255 and 8355 chemiluminescence detectors detect target molecules by chemically transforming them in several steps to an excited species that emits light. The light from this emission is converted to an electrical signal by a photomultiplier tube (PMT). For each detector, samples undergo preliminary reaction(s) with an oxidizer (air for SCD, oxygen for NCD) and hydrogen in a very hot reaction zone (the burner) at reduced pressure to form either SO or NO in addition to other products such as H<sub>2</sub>O and CO<sub>2</sub>. The reaction products then flow to a reaction cell in a separate detector module. In this cell, they mix with ozone (O<sub>3</sub>) produced from oxygen using an ozone generator. The O<sub>3</sub> reacts with SO or NO to generate SO<sub>2</sub>\* and NO<sub>2</sub>\* respectively. This reaction cell operates at a pressure of about 4-7 Torr. These high energy species return to ground state by chemiluminescence. The emitted light is filtered and then is detected by a PMT. The electrical signal produced is proportional to the amount of SO<sub>2</sub>\* or NO<sub>2</sub>\* formed in the reaction cell. The sample exits the reaction cell, passes through an ozone destruction trap, and then passes through a vacuum pump and out to vent.

### SCD

The SCD uses the chemiluminescence (light-producing reaction) from the reaction of ozone with sulfur monoxide (SO) produced from combustion of the analyte:

**Sulfur compound (analyte) → SO + H<sub>2</sub>O + other products**

**SO + O<sub>3</sub> → SO<sub>2</sub> + O<sub>2</sub> + hν (< 300-400 nm)**

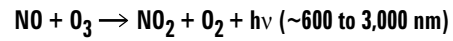
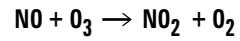
The pressure differential produced by a vacuum pump transfers the combustion products into a reaction cell, where excess ozone is added. Light (hν) produced from the subsequent reaction is optically filtered and detected with a blue-sensitive photomultiplier tube, and the signal is amplified for display or output to a data system.

### NCD

The NCD uses the chemiluminescence of ozone with nitric oxide formed from combustion. Reacting nitric oxide with ozone results in the formation of electronically excited nitrogen dioxide. The excited nitrogen dioxide emits light, a chemiluminescence reaction, in the red and infrared region of

### 3 System Description

the spectrum. The light emitted is directly proportionally to the amount of nitrogen in the sample:



The light ( $h\nu$ ) emitted by the chemical reaction is optically filtered and detected by a PMT. A chiller cools the PMT to reduce thermal noise and help measure infrared light. The signal from the PMT is amplified for display or output to a data system.

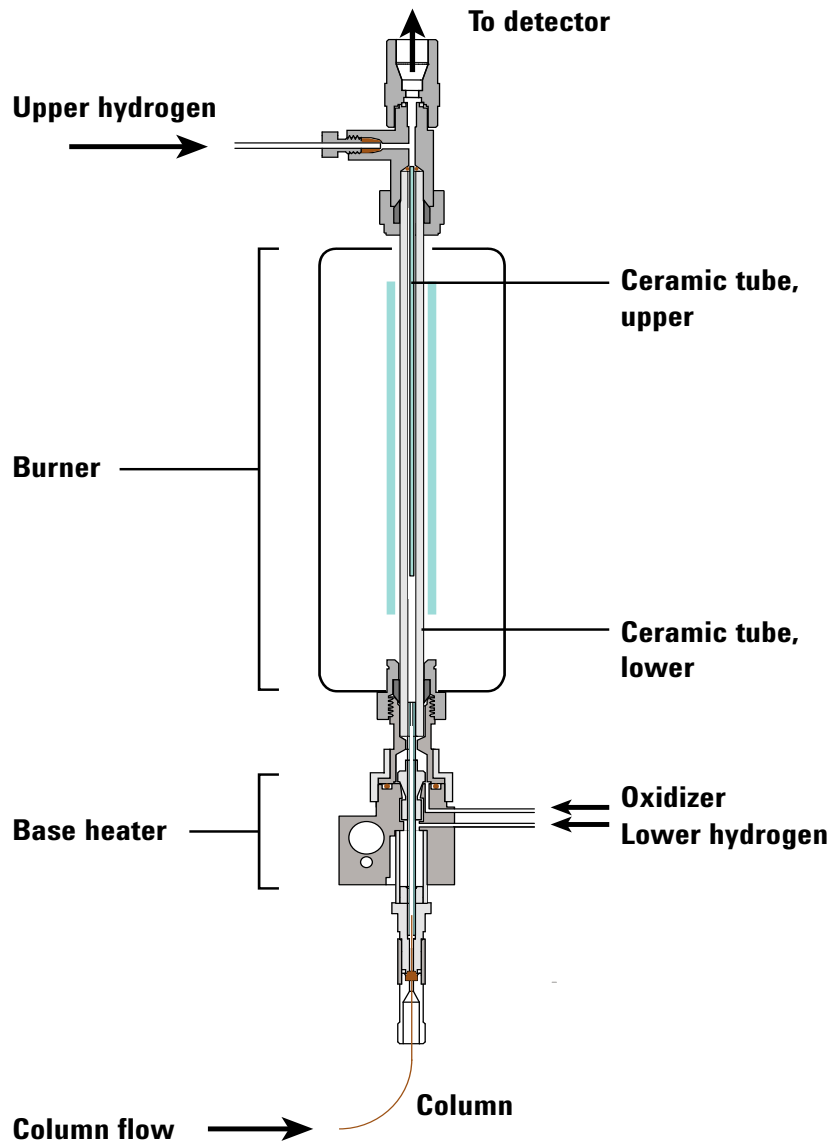
## Description of Major Components

### Burner assembly

The burner assembly mounts on top of the GC in a detector location, and contains the column connection.

For the SCD, the burner provides two heated zones, one at the base and one farther up the assembly. In the burner base region, the column effluent mixes with the lower hydrogen flow and air at high temperature. The resulting hydrogen flame combusts the effluent. Low concentration components burn to form the usual combustion products, including  $\text{SO}_2$  for compounds containing sulfur. The products are drawn upward through a ceramic tube, where at even higher temperature the upper hydrogen flow mixes with the combustion products, causing the  $\text{SO}_2$  to reduce into SO.

Figure 6 shows the flow paths for the SCD burner assembly.



**Figure 6** SCD flows

For the NCD, the burner provides two heated zones, one at the base and one farther up the assembly. In the burner base region, the column effluent mixes with hydrogen and air at high temperature. The resulting hydrogen flame combusts the effluent. Low concentration components will burn to form the usual combustion products, including  $\text{NO}_2$  for compounds containing nitrogen. The products are drawn upward through a quartz tube and catalyst, where a high temperature will convert  $\text{NO}_2$  into  $\text{NO}$ .

Figure 7 shows the flow paths for the NCD burner assembly.



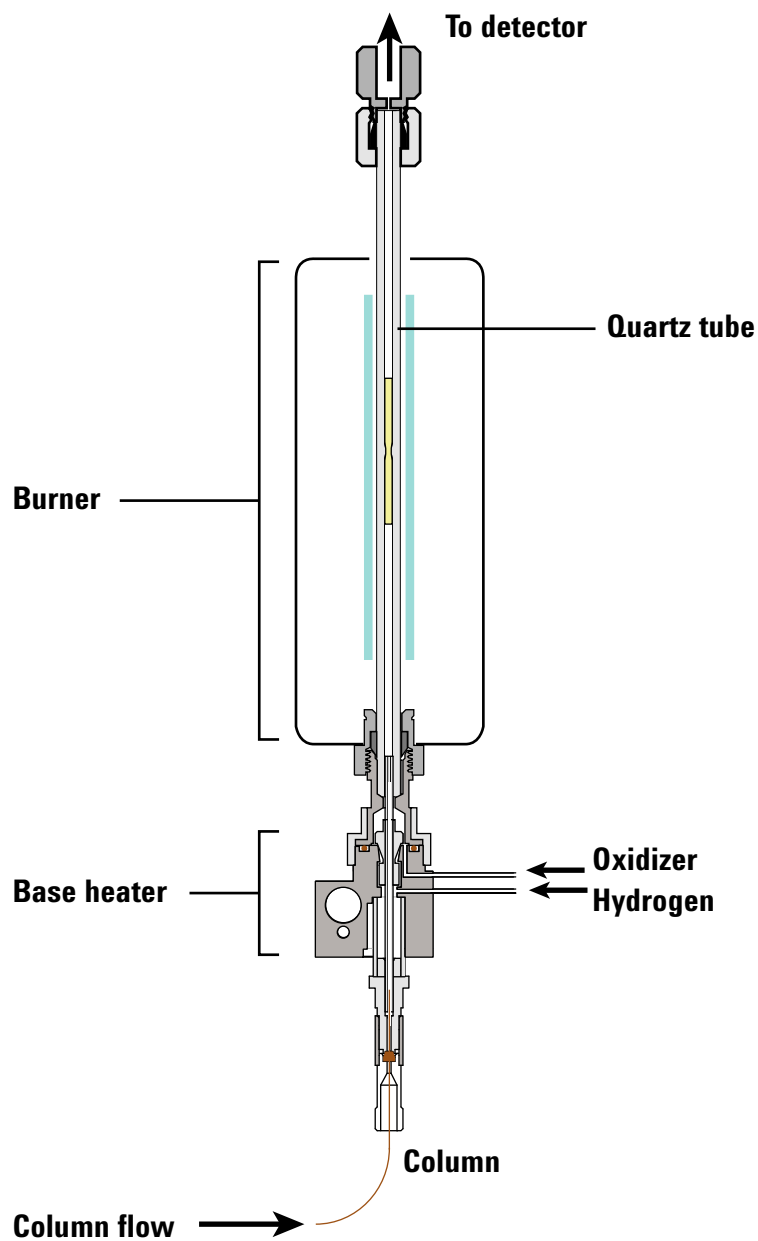


Figure 7 NCD Flows

### Ozone generator

The ozone generator provides ozone that reacts with any SO or NO in the reaction cell to generate  $\text{SO}_2^*$  and  $\text{NO}_2^*$  respectively. These high energy species return to ground state by chemiluminescence.

#### **Reaction cell and photomultiplier tube (PMT)**

The ozone generator discharges ozone into the reaction cell. This ozone reacts with any SO or NO to generate SO<sub>2</sub>\* and NO<sub>2</sub>\* respectively. As the species return to ground state through chemiluminescence, the photomultiplier tube produces a current proportional to the intensity of emitted light. A bandpass filter is used to optimize the detector for either sulfur or nitrogen detection.

#### **EPC modules**

The detector controls hydrogen, oxidizer (air or oxygen), and ozone supply (oxygen) gas flows using two electronic pressure control modules.

#### **Vacuum pump**

A two-stage, oil-sealed rotary vacuum pump provides an operating pressure between 3 and 10 Torr in the reaction cell. This vacuum helps transfer combustion gases from the burner to the reaction cell, as well as transferring the ozone from the ozone generator into the reaction cell. The vacuum pump also reduces non-radiative collisional quenching of the emitting species in the reaction cell.

#### **Ozone destruction trap**

A chemical trap between the detector exhaust and the vacuum pump destroys ozone, converting it to diatomic oxygen. Unconverted ozone reduces pump life.

#### **Oil coalescing filter**

The oil-sealed rotary vacuum pump uses a partially-open gas ballast to aid in the elimination of water produced in the burner and transferred to the pump. As a result of the open gas ballast and the relatively high flow rates of gases, oil vaporized in the pump can escape through the pump exhaust. To minimize oil loss, the pump includes an oil coalescing filter on the pump exhaust to trap vaporized oil and to return this oil to the vacuum pump oil reservoir.

#### **FID adapter (optional)**

The SCD burner normally mounts onto the GC oven directly as a stand-alone detector. However, some applications also require

simultaneous detection of hydrocarbon components using a single column without splitting. For this reason, Agilent offers an optional FID adapter to mount the burner assembly onto an FID for the simultaneous collection of FID and SCD chromatograms. During dedicated SCD operation, 100 % of the column effluent passes through the burner to the detector. During simultaneous detection, approximately 10 % of the FID exhaust gases are drawn into the burner through a restrictor, which reduces SCD sensitivity to approximately 1/10 of the signal observed in a dedicated SCD burner.

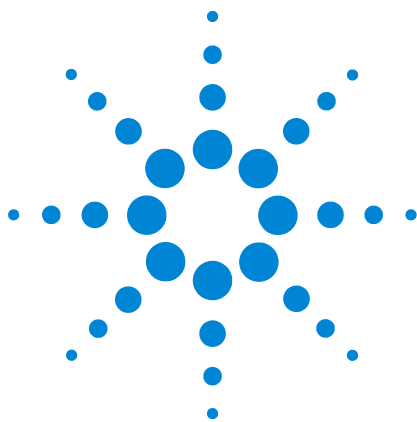
## NCD chiller

For NCD, the detector uses a Peltier cooler to lower the PMT temperature, which in turn reduces noise. This chiller cools the PMT relative to the current ambient temperature. Higher laboratory ambient temperatures may result in higher PMT temperatures. Fluctuations in ambient temperature may result in fluctuations in PMT temperature.

Since noise and response determine the MDL, the efficiency of the chiller can influence the MDL. Depending on the ambient temperature, the chiller may not be able to maintain a sufficiently cool temperature in the PMT, and XCD noise will increase, therefore increasing the MDL.

Because chiller efficiency depends on the ambient temperature inside the detector and in the laboratory, the chiller setpoint does not impact detector readiness. A GC run can start regardless of whether or not the chiller has cooled the GC to setpoint.

### **3 System Description**



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This chapter describes the how to use the 8355 SCD and 8255 NCD. This chapter assumes familiarity with using the data system, if used, and the GC front panel keyboard and display. For more information, please see the data system online help and the instrument documentation available on the Agilent *GC and GC/MS User Manuals and Tools* DVDs.



## Introduction

### Integrated version

When installed on an Agilent 7890B or 7890A+ GC, program and operate the SCD and NCD as you would any other detector on the GC. For Agilent data system users, use the integrated GC driver to access the operating parameters. For standalone GC users, access these parameters from the GC front panel and keyboard. The settings and information provided by the driver and GC keyboard include:

- Settings for temperatures, flows, and gas types
- Sequence integration
- Method storage
- Early Maintenance Feedback (EMF) settings, data rate settings, error logging, maintenance logging, and status information

## Setting Parameters

This section lists the parameter ranges for the SCD and NCD. The available setpoints provide a wide range suitable for a large variety of applications as well as for method development. See “Adjusting the Operating Conditions” on page 53 for important details about the relationships between the setpoints.

### Parameters and ranges

The table below lists the available parameters for the detector.

**Table 4** 8355 SCD and 8255 NCD parameters and ranges

Parameter	Range, SCD	Range, FID-SCD	Range, NCD
<b>Method</b>			
Base temperature	125 – 400 °C	125 – 400 °C	125 – 400 °C
Burner temperature	100 – 1000 °C	100 – 1000 °C	100 – 1000 °C
Chiller temperature (NCD only)*	On/Off	On/Off	On/Off
Lower hydrogen flow	5 – 25 mL/min	—	1 – 25 mL/min
Upper hydrogen flow (SCD only)	25 – 100 mL/min	25 – 100 mL/min	—
Oxidizer flow	25 – 150 mL/min	5 – 100 mL/min	4 – 80 mL/min
O3 Generator flow	On/Off	On/Off	On/Off
O3 Generator high voltage	On/Off	On/Off	On/Off
Vacuum pump	On/Off	On/Off	On/Off
<b>Configuration</b>			
Oxidizer gas type	Air	Air	Oxygen
O3 Generator gas type	Oxygen	Oxygen	Oxygen
Ignore Ready	See the GC <i>Operating Manual</i> .		
Signal	XCD. See the GC <i>Advanced Operation Manual</i> .		

\* Chiller (PMT cooler) operation depends on the current detector ambient temperature. The actual chiller temperature does not impact detector readiness. See “NCD chiller” on page 43.

Note that PMT voltage is fixed at 800 V.

## Software control

When using an Agilent data system, open an online session and edit the instrument acquisition parameters to change method settings. Select the detector from the method editor, typically **Detectors > Front Detector** (or **Back Detector** or **Aux Detector**, as appropriate for your setup). See [Figure 8](#), [Figure 9](#), and [Table 5](#).

SCD		
	Setpoint	Actual
<input checked="" type="checkbox"/> Base Temperature:	280 °C	280 °C
<input checked="" type="checkbox"/> Burner Temperature:	800 °C	800 °C
<input checked="" type="checkbox"/> Upper H2 Flow:	38 mL/min	38 mL/min
<input checked="" type="checkbox"/> Lower H2 Flow:	8 mL/min	8 mL/min
<input checked="" type="checkbox"/> Oxidizer Flow (Air):	50 mL/min	50 mL/min
<input checked="" type="checkbox"/> O3 Generator Flow		46.4 mL/min
<input checked="" type="checkbox"/> O3 Generator Power		
<input checked="" type="checkbox"/> Vacuum Pump		
Burner Pressure:		363.2 Torr
Reaction Cell Pressure:		4.2 Torr
Signal Output:		681.9 pA
SCD Subtract from Signal: <input type="radio"/> (Nothing) <input type="radio"/> Column Compensation Curve #1 <input checked="" type="radio"/> Column Compensation Curve #2		

**Figure 8** Example SCD parameters in a data system



NCD		
	Setpoint	Actual
<input checked="" type="checkbox"/> Base Temperature:	280 °C	280 °C
<input checked="" type="checkbox"/> Burner Temperature:	900 °C	900 °C
<input checked="" type="checkbox"/> Chiller Temperature		-10 °C
<input checked="" type="checkbox"/> H2 Flow:	3 mL/min	3 mL/min
<input checked="" type="checkbox"/> Oxidizer Flow (O2):	10 mL/min	10 mL/min
<input checked="" type="checkbox"/> O3 Generator Flow		35.9 mL/min
<input checked="" type="checkbox"/> O3 Generator Power		
<input checked="" type="checkbox"/> Vacuum Pump		
Burner Pressure:		110.1 Torr
Reaction Cell Pressure:		1.7 Torr
Signal Output:		52.8 pA

NCD	
Subtract from Signal:	
<input type="radio"/> (Nothing)	
<input type="radio"/> Column Compensation Curve #1	
<input checked="" type="radio"/> Column Compensation Curve #2	

**Figure 9** Example NCD parameters in a data system

For tandem configurations, for example a front FID-SCD, the FID will be the front detector, and the XCD will be an Aux detector.

To access configuration parameters using data system control, select **Configuration > Modules**. See [Figure 10](#) for an example.

<b>Front Detector</b>	
SCD	
Oxidizer Gas	Air
O3 Generator Gas	O2
<b>Back Detector</b>	
NCD	
Oxidizer Gas	O2
O3 Generator Gas	O2

**Figure 10** Example of SCD and NCD configuration parameters

See “[Configure the Detector](#)” on page 58 for more information.

## GC keyboard control

To access the method parameters for an SCD or NCD, press the [**Front Det**], [**Back Det**], or [**Aux Det #**] (tandem FID-XCD configuration only) key. See [Table 5](#).

To turn on the PMT voltage, press [**Config**], then press the key for the detector ([**Front Det**], [**Back Det**], or [**Aux Det #**]). The PMT voltage can be turned on or off. The PMT operates at a constant voltage (800 V).

## Identifying the detector

[Table 5](#) lists the expected configurations for an XCD.

**Table 5** Connections to the GC wiring harnesses

<b>XCD Installation</b>	<b>Which detector is the XCD?</b>
Front XCD	Front
Back XCD	Back
Single front FID-XCD (front tandem FID-XCD)	Front: Front FID Aux detector 2: XCD
Single back FID-XCD (back tandem FID-XCD)	Back: Back FID Aux detector 2: XCD
Dual front FID-XCD and back FID-XCD (Dual tandem FID-XCD)	Front: Front FID Aux detector 1: front XCD Back: Back FID Aux detector 2: back XCD

## Detector Stability and Response

The time required for system stabilization varies depending on the application, system cleanliness, the presence of active sites, and other factors.

- When starting an existing system, typically wait at least 10 minutes before using the system to collect data.
- A new burner or a new set of ceramic tubes may take up to 24 hours to condition. Set the detector to the operating conditions, and monitor the baseline until the baseline becomes stable enough for your application.

## Typical Operating Conditions

Table 6 lists the recommended starting conditions for SCD and NCD methods. These conditions should provide acceptable results for a wide variety of applications. However, optimize these conditions as needed to improve the performance of the specific application.

**Table 6** Typical operating conditions, SCD and NCD

Parameter	SCD	NCD
Base temperature, °C	250	250
Burner temperature, °C	800	900
Chiller temperature	N/A	On
Upper H <sub>2</sub> flow, mL/min	40	N/A
Lower H <sub>2</sub> flow, mL/min	10	3
Oxidizer flow, mL/min	50, Air	8, Oxygen
O3 Generator flow, mL/min	On	On
O3 Generator high voltage	On	On
Vacuum pump	On	On
Burner pressure, Torr, typical reading	< 425 Torr	< 120 Torr
Reactor pressure, Torr (read only)	Should be below 7 Torr	Should be below 5 Torr

The checkout methods for the SCD and NCD also provide example parameters for balancing good detection limit, good selectivity, and reasonable ceramic tube life. In any XCD method:

- Always keep oxidizer gas flowing through the burner.
- The firmware will not allow hydrogen to flow into the burner while there is no oxidizer to protect the system.

During startup and shutdown, always turn on the pump first and turn off the pump last to prevent contamination or damage.

## Adjusting the Operating Conditions

Table 4 on page 47 lists the range of values for each parameter, as limited by the GC firmware. To provide flexibility during method development for particular application, the range is wider than needed for most applications.

However, hydrogen flows in the SCD need particular attention. Using very high hydrogen flows (both upper and lower), relative to the oxidizer flow, can permanently damage the ceramic tubes. This condition may not be recoverable. See “Hydrogen Poisoning” on page 103.

**SCD lower hydrogen flow:** Very high flow can damage the ceramic tubes.

**NCD lower hydrogen flow:** The NCD can operate without hydrogen flow, although this is not recommended. The hydrogen flame/plasma can help burn off solvent and heavy molecules. If operating an NCD without hydrogen flow, plumb the 1/16-inch tubing for the lower hydrogen flow to the oxygen supply. Otherwise, residual hydrogen in the tubing will continue diffuse into the burner and affect stability.

- 1 Disconnect the **Lower H2** line from the back of the detector and cap off the detector fitting.
- 2 Install a 1/16-inch Swagelok Tee fitting in the **Oxidizer** output from the detector body.
- 3 Connect the **Oxidizer** and **Lower H2** lines to the Tee fitting.

You will typically need to adjust the recommended starting conditions to create an optimized method for your application. When optimizing SCD or NCD method parameters, consider the following:

- A higher hydrogen to oxidant ratio may initially show higher response, but later yield a reduced response because of the accumulation of contaminants that reduce detector response, such as soot or other active species.
- Operating the burner at higher temperatures may shorten the useful lifetimes of the heater, thermocouple, and seal materials.

In general, when making any parameter change, allow sufficient time for the system to reach equilibrium. Monitor the baseline until it stabilizes at its new value.

## Start-up

How to start the detector depends on whether or not you have created a method for the detector.

**If a valid method exists:** After you have used the SCD/NCD (at least one valid method exists), start the detector by loading the method. As soon as the method loads, the GC will turn on the vacuum pump and oxidizer flows, and also turn on all other parameters except hydrogen flow. The GC will monitor the temperatures and prevent hydrogen flow until the base temperature reaches 150 °C and the burner temperature reaches 200 °C. Once the detector temperatures reach these minimum limits, the GC turns on the hydrogen flow.

**During initial startup,** or whenever there are no method parameters set for the SCD or NCD, start the detector as follows:

- 1 Access the method parameters.
  - At the GC front panel, press **[Front Det]**, **[Back Det]**, or **[Aux Det #]**.
  - In the data system, select the detector in the method editor.
- 2 Turn on the vacuum pump.
- 3 Set the oxidizer flow rate and turn on the oxidizer flow.
- 4 Wait 1–2 minutes for the vacuum pump to purge the system using the oxidizer flow.
- 5 Set the base temperature and turn it on.
- 6 Set the burner temperature and turn it on.
- 7 For NCD only: Set the chiller temperature and turn it on.
- 8 Set the hydrogen flow and turn it on.
- 9 Set the ozone supply gas flow and turn it on.
- 10 Turn on the ozone supply gas high voltage.

The GC will monitor the temperatures and prevent hydrogen flow until the base temperature reaches 150 °C and the burner temperature reaches 200 °C. Once the detector temperatures reach these minimum limits, the GC turns on the hydrogen flow.

If needed, also turn on the PMT voltage. See “[Configure the Detector](#)” on page 58.

## Resource Conservation

To conserve resources during periods of inactivity, for example, overnight or over a weekend, use the 7890B GC's resource conservation features to load a sleep method. (See the GC *Operation Manual* for details on using sleep and wake methods.)

A sleep method for an SCD or NCD should do the following:

- Turn off all hydrogen flows
- Maintain base temperature of 125 °C to prevent condensation
- Maintain burner temperature of at least 200 °C to prevent condensation
- Set an oven temperature of 30°C to minimize column bleed

In addition, a sleep method can also:

- Turn on gas saver mode to reduce column flow
- Turn off the ozone generator and ozone supply gas flow
- Turn off the chiller (NCD only)
- Turn off the vacuum pump if carrier gas and the oven are turned off. (If the carrier gas flow is on, do not turn off the vacuum pump. With the vacuum pump off, any carrier gas flow will eventually cause a flow shutdown.)

It is good practice to leave on the oxidizer flow if the vacuum pump is on.

## Shutdown

When turning off the detector for a long period of time, or to perform maintenance on the GC or detector, shut down the detector as follows:

- 1 Access the method parameters.
  - At the GC front panel, press [**Front Det**] or [**Back Det**], or [**Aux Det #**].
  - In the data system, select the detector in the method editor.
- 2 Turn off the ozone supply gas high voltage.
- 3 Turn off the ozone supply gas flow.
- 4 Turn off the hydrogen flow.
- 5 For NCD only: Turn off the chiller.
- 6 Turn off the burner heater.
- 7 Turn off the base heater.

### NOTE

When shutting down, the GC will keep the vacuum pump and oxidizer flow running until approximately 100 mL of oxidizer gas has purged the system after the hydrogen flow is turned off. This action prevents moisture residual contamination.

- 8 Turn off the oxidizer flow.
- 9 Turn off the vacuum pump.
- 10 Turn off the detector power.
- 11 If shutting down the GC, turn off the GC.

### WARNING

**Burn hazard. Many parts of the GC can be dangerously hot. If performing GC or detector maintenance, turn off all heated zones and monitor them until they reach a safe handling temperature before turning off the GC.**

Alternately, create a method that turns off all detector components, and load that method to shut down the detector.



## Configure Auto Flow Zero on the GC

Agilent recommends setting the GC to automatically zero flow sensors to reduce drift. See the GC *Operation Manual* for details.

- 1 On the GC keypad, press [**Options**].
- 2 Scroll to **Calibration** and press [**Enter**].
- 3 Scroll to select the appropriate detector (front, back, aux 2, or aux 1) and press [**Enter**].
- 4 Scroll to **Autoflow zero (H2 Lower)** and press [**On/Yes**]. (To turn off autozero, instead press [**Off/No**].)
- 5 For SCD, repeat for **Autoflow zero (H2 Upper)**.

## Configure the Detector

For an SCD or NCD, gas types are usually set once. The SCD uses oxygen for the ozone supply gas and air for the oxidizer gas, while the NCD uses oxygen for both.

To configure the gas types for an SCD or NCD by using the GC keyboard:

- 1 At the GC keyboard, press the keys to access the detector, for example [**Config**][**Front Det**].
- 2 Scroll to **Oxidizer Gas** and press [**Mode/Type**].
- 3 Scroll to the correct gas type, **Air** (SCD) or **Oxygen** (NCD), and press [**Enter**].

If using data system control, you can set the gas types through the data system.

- 1 From the data system, open the GC parameters user interface. For example, in Agilent OpenLAB select **Home > Method > Instrument Setup > Configuration > Modules**.
- 2 Select the gas types for the method.

The screenshot shows a configuration window with two sections. The first section is titled 'Front Detector' and 'SCD'. It contains two dropdown menus: 'Oxidizer Gas' set to 'Air' and 'O3 Generator Gas' set to 'O2'. The second section is titled 'Back Detector' and 'NCD'. It also contains two dropdown menus: 'Oxidizer Gas' set to 'O2' and 'O3 Generator Gas' set to 'O2'.

**Figure 11** Example of SCD and NCD configuration parameters

- 3 Click **OK** and save the method changes.

The PMT voltage can be turned on or off only at the GC front panel. To enable or disable the PMT voltage:

- 1 At the GC keyboard, press the keys to access the detector, for example, press [**Config**][**Front Det**] for an XCD mounted in the front position, or press [**Config**][**Back Det**] for an XCD mounted in the back position.
- 2 Scroll to **PMT Voltage**.
- 3 Press **On/Yes** to turn on the voltage, or **Off/No** to turn it off. Press [**Enter**].

## 4 Operation



## 5 Maintenance

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This chapter describes the routine maintenance procedures needed for normal use of the SCD and NCD.



## Maintenance Log and Early Maintenance Feedback (EMF)

When using the detector with an Agilent 7890B GC, use the Early Maintenance Feedback (EMF) feature to track routine maintenance. The EMF feature is available at the GC front panel and in any Agilent data system, and can help you replace the filters and oil before contamination becomes a problem.

The Agilent 7890B GC provides the following counters for the SCD, NCD, and vacuum pump:

Component	Part with a counter	Counter type	Default value
Detector	Detector	Number of injections	
	Outer tube (SCD only)	Number of injections	
	Inner tube (SCD only)	Number of injections	
	Quartz tube (NCD only)	Number of injections	
	Gas filters	Time (days)	
Vacuum pump	Pump oil	Time (days)	3 months
	Oil mist filter	Time (days)	

If not using the GC EMF feature, manually keep a maintenance log that tracks:

- Dates of maintenance and type of maintenance performed
- Operational changes that might impact performance, such as changes in temperature settings and hydrogen flows
- Pressures during normal method runs
- Background signal (the difference between ozone “on” and ozone “off”)

## Maintenance Schedule

To maintain optimum performance of the Agilent 8355 SCD and 8255 NCD, routinely replace the ozone trap, oil coalescing filter, and vacuum pump oil. Refer to [Table 7](#) for the expected life span of each item.

**Table 7** Recommended Edwards RV5 vacuum pump maintenance schedule

Component	Operating life*
Chemical trap (converts O <sub>3</sub> to O <sub>2</sub> )	~ 6 months
Oil coalescing filter	~ 3 months
Oil odor filter	~ 3 months if needed
Pump oil†	~ 3 months
Oil level	Check weekly

\* The operating life is based on the total time logged during operation of the detector with the burner and the ozone generator On.

† Pump oil can be purchased from a supplier or directly from Agilent: SAE 10W-30, Multiviscosity Synthetic Motor Oil such as, MOBIL 1 or AMSOIL.

## Tracking Detector Sensitivity

In addition to using the EMF features of the GC and detector, also track detector sensitivity. Sensitivity reflects the performance characteristics of a given system, and decreased sensitivity may indicate the need for routine detector maintenance. Sensitivity is typically reported as:

$$\text{Sensitivity} = \frac{\text{peak area}}{\text{amount}}$$

Calculate a minimum detection limit (MDL) from the following formula:

$$\text{MDL} = \frac{2 \times \text{noise}}{\text{sensitivity}}$$

where the noise is the ASTM noise reported by the Agilent data system.



## Consumables and Replacement Parts

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (<http://www.chem.agilent.com/store>).

**Table 8** Consumables and parts for the SCD and NCD

Description/quantity	Part number
<b>Detector parts</b>	
Ceramic tube, inner, small (SCD)	G6602-45005
Quartz tube (NCD)	G6600-80063
Ferrule, 1/4-inch, graphite, straight, 10/pk for SCD outer ceramic tube and NCD quartz tube	0100-1324
Column installation tool	G3488-81302
Sulfur chemiluminescence test sample	
Nitrogen chemiluminescence test sample	
<b>Vacuum pump parts</b>	
RV5 pump – 230 V – Inland	G6600-64042
Pump tray, RV5 pump	G1946-00034
PM Kit, RV5 oil pump	G6600-67007
Oil mist filter for RV5 pump, for SCD/NCD	G6600-80043
Replacement oil coalescing filter, RV5 pump	G6600-80044
Replacement odor filtration element	G6600-80045
Ozone destruction trap	G6600-85000
Oil return line, RV5 pump	3162-1057
Oil, synthetic, Mobil 1	G6600-85001
NW 20/25 clamping ring (for oil mist filter)	0100-0549
NW 20/25 clamping ring (for exhaust hose)	0100-1398
<b>Tools</b>	
Funnel	9301-6461
Wrench, Allen, 5-mm	8710-1838
Screwdriver, flat-bladed	8710-1020
Gloves, chemical resistant, lint-free	9300-1751

**Table 9** Filters for the SCD and NCD

Description/quantity	Part number
Gas Clean filter, sulfur (filters sulfur and moisture)	CP17989
Gas Clean Filter SCD Kit, for sulfur chemiluminescence detectors	CP17990

**Table 10** Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.53	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Ferrule, graphite, 0.8-mm id	0.53-mm capillary columns	500-2118 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.45	Ferrule, graphite, 0.8-mm id	0.45-mm capillary columns	500-2118 (10/pk)
.32	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.1 – .25	Ferrule, graphite, 0.4-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	500-2114 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing—use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)
	Ferrule tool kit	Ferrule installation	440-1000

## Exploded Parts View of the SCD

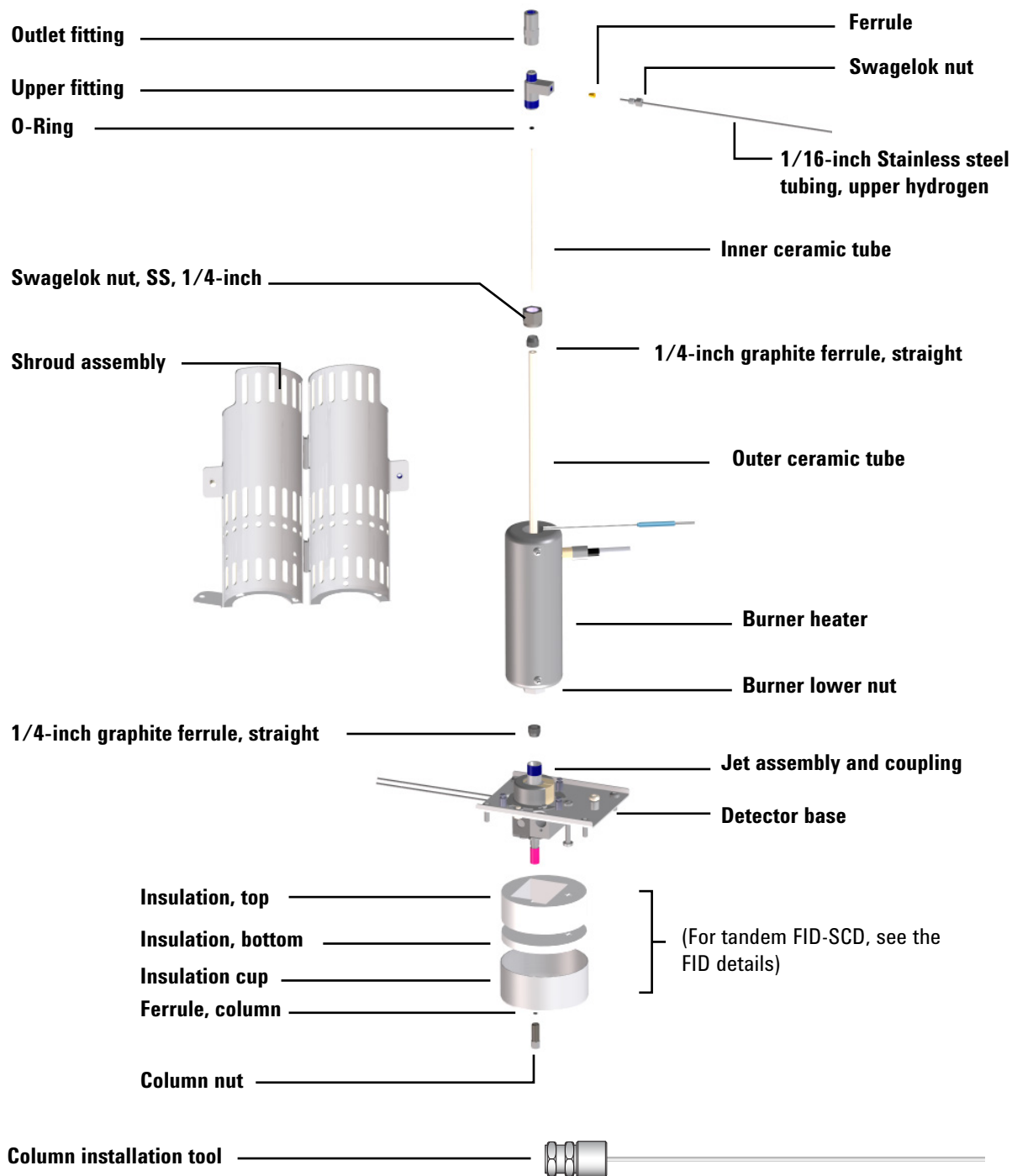


Figure 12 SCD Exploded parts view

## Exploded Parts View of the NCD

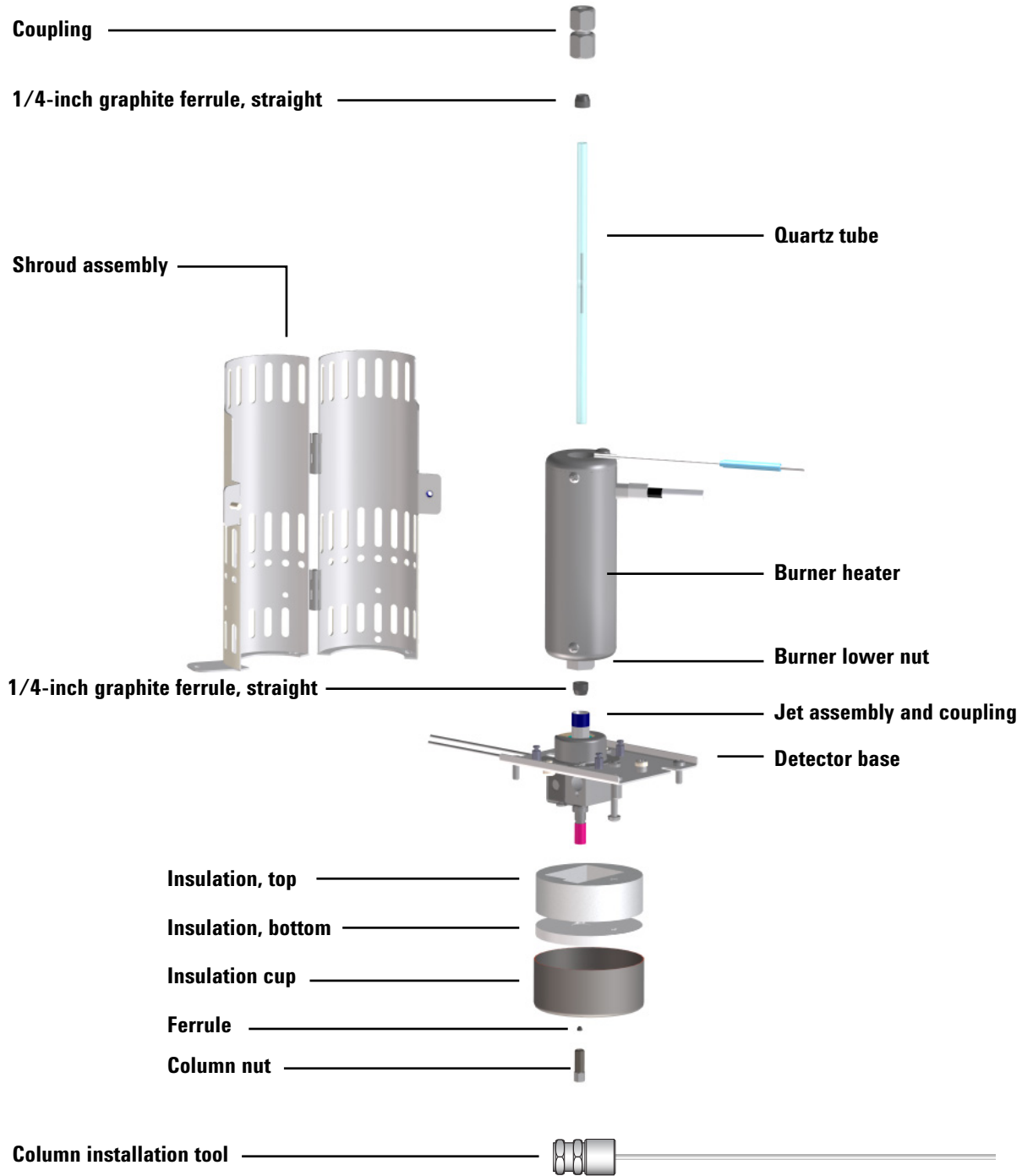


Figure 13 NCD exploded parts view

## Detector Maintenance Method

It is good practice to create a maintenance method for the GC that prepares the GC and detector for maintenance. Load this method before performing maintenance.

A maintenance method for the SCD should do the following:

- 1 Turn off the heater and burner to allow them to cool.
- 2 Turn off all hydrogen flows.
- 3 Leave on the oxidizer and ozone supply gases.
- 4 Turn off the ozone generator.
- 5 Leave on the vacuum pump.
- 6 Keep (helium) carrier gas flowing.
- 7 Set the oven to 30 °C to minimize column bleed.
- 8 Cool any other parts of the GC (oven, inlet, and so forth) as needed.

A maintenance method for the NCD should do the following:

- 1 Turn off the heater and burner to allow them to cool.
- 2 Turn off the hydrogen flow.
- 3 Leave on the oxidizer and ozone supply gases.
- 4 Turn off the ozone generator.
- 5 Leave on the vacuum pump.
- 6 Keep (helium) carrier gas flowing.
- 7 Set the oven to 30 °C to minimize column bleed.
- 8 Cool any other parts of the GC (oven, inlet, and so forth) as needed.

Allow heated zones to cool to < 40 °C for safe handling.

## Attach a Column to the Detector

### NOTE

This procedure describes how to attach a column directly to an XCD. In a tandem FID-XCD installation, install the column into the FID as described in the FID instructions. See the GC documentation.

---

- 1 Gather the following materials (see “Consumables and parts for the SCD and NCD” on page 65):
  - Column installation tool for SCD/NCD (G3488-81302)
  - Column
  - Ferrule (for column)
  - Column nut
  - Column cutter
  - 1/4-inch open-end wrench
  - Septum
  - Isopropanol
  - Lab tissue
  - Lint-free gloves
  - Magnifying loupe

### WARNING

**The oven, inlet, or detector may be hot enough to cause burns. If the oven, inlet, or detector is hot, wear heat-resistant gloves to protect your hands.**

---

### WARNING

**Wear safety glasses to protect your eyes from flying particles while handling, cutting, or installing glass or fused silica capillary columns. Use care in handling these columns to prevent puncture wounds.**

---

### CAUTION

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

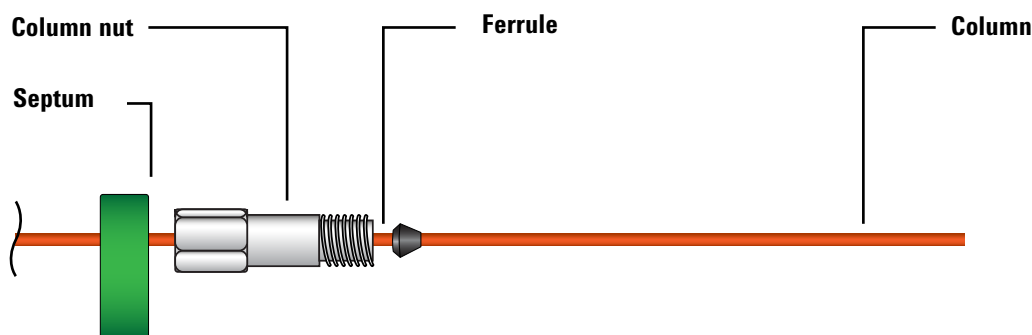
---

- 2 Prepare the detector for maintenance.
  - a Load the GC maintenance method and wait for the GC to become ready. (See “Detector Maintenance Method” on page 69.) Wait until the inlets, oven, detectors, valve box, burner assembly, and detector base cool to a safe handling temperature ( $< 40\text{ }^{\circ}\text{C}$ ).
  - b Turn off all hydrogen flows. (Leave on the oxidizer and ozone supply gases.)
  - c Turn off the ozone generator.

**WARNING**

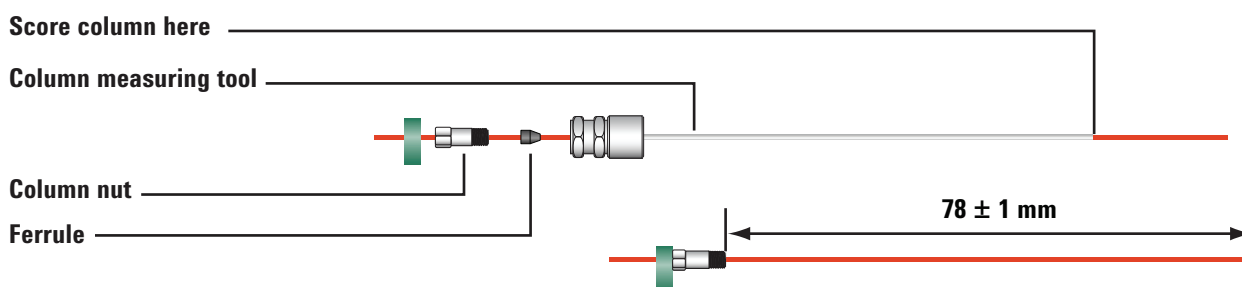
Hydrogen gas is flammable. Turn off all detector (and column) hydrogen gas flows before performing maintenance on the detector.

- 3 Place a septum, capillary column nut, and ferrule on the column.



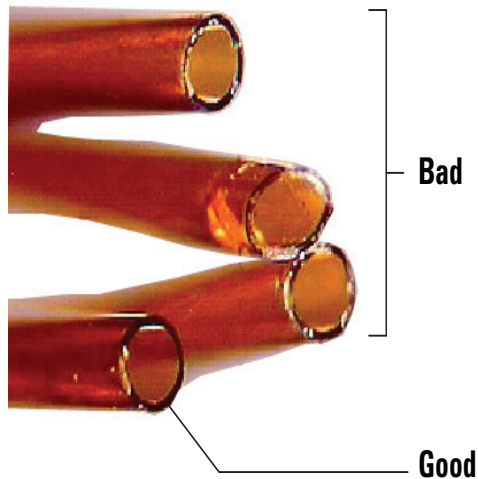
**Figure 14** Place septum, column nut, and ferrule on the column

- 4 Insert the end of the column through the column measuring tool so that the end protrudes beyond the tool.



**Figure 15** Set column length and swage ferrule using column measuring tool

- 5 Tighten the column nut into the column measuring tool until the column nut grips the column. Tighten the nut an additional 1/8- to 1/4-turn with a pair of wrenches. Snug the septum against the base of the column nut.
- 6 Use a column cutting wafer at 45° to score the column.
- 7 Snap off the column end. The column may protrude about 1 mm beyond the end of the tool. Inspect the end with a magnifying loupe to make certain that there are no burrs or jagged edges.



- 8 Remove the column, nut, and swaged ferrule from the tool.
- 9 Wipe the column walls with a tissue dampened with isopropanol to remove fingerprints and dust.
- 10 Carefully thread the swaged column into the detector fitting. Finger-tighten the column nut, then use a wrench to tighten an additional 1/8 turn.



## Replace the Inner Ceramic Tube (SCD)

To replace the inner ceramic tube:

**WARNING**

**The oven, inlets, and detectors can be hot enough to cause burns. Cool these areas to a safe handling temperature before beginning.**

---

**CAUTION**

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

---

**CAUTION**

Most steps in this procedure require the use of two wrenches, one to hold the burner steady and the other to loosen a part. Always use two wrenches to avoid over-torquing or bending the burner assembly.

---

- 1 Gather the following:
  - Two 7/16-inch open-end wrenches
  - 3/8-inch open-end wrench
  - New O-ring
  - New ceramic tube
  - Tweezers
  - 1/8-inch cap for transfer line
  - T20 Torx driver
- 2 Prepare the detector for maintenance.
  - a Load the GC maintenance method and wait for the GC to become ready. (See “[Detector Maintenance Method](#)” on page 69.) Wait until the inlets, oven, detectors, valve box, burner assembly, and detector base cool to a safe handling temperature (< 40 °C).
  - b Turn off all hydrogen flows. (Leave on the oxidizer and ozone supply gases.)
  - c Turn off the ozone generator.

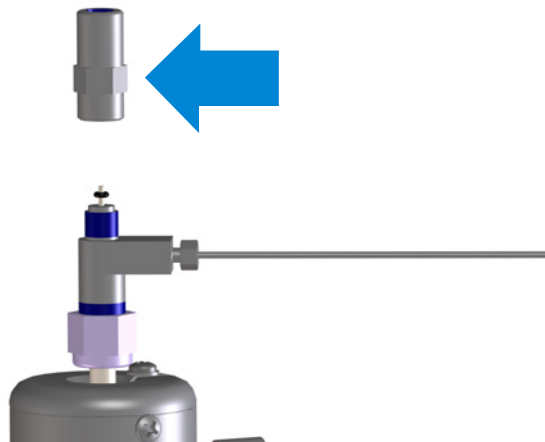
**WARNING**

**Hydrogen gas is flammable. Turn off all detector (and column) hydrogen gas flows before performing maintenance on the detector.**

- 3 Disconnect the transfer line and quickly cover the open end with the 1/8-inch cap. Use a 3/8-inch wrench on the transfer line and a 7/16-inch wrench on the upper fitting to hold the burner assembly steady.
- 4 Using two 7/16-inch wrenches, remove the outlet fitting from the upper fitting.
- 5 If the old O-ring is stuck to the bottom of the outlet fitting, use tweezers or similar to gently pry it loose from the fitting.
- 6 Remove the old inner ceramic tube.
- 7 Place a new O-ring over the end of the new inner ceramic tube, and slide the O-ring about 7 mm down the tube. (This dimension is not critical.)



- 8 Gently insert the tube and O-ring assembly into the burner until it rests on the O-ring.
- 9 Orient the outlet fitting so the hex flats are closer to the upper fitting, as shown, and install over the ceramic tube. Tightening the outlet fitting will automatically adjust the O-ring and ceramic tube positions. Tighten until snug (finger-tight). Do not overtighten.



- 10 Reinstall the transfer line onto the outlet fitting. Tighten until snug (finger-tight). Do not overtighten.
- 11 Restore the detector gas flows.
- 12 Check for leaks at the upper hydrogen fitting. Correct a leak as needed.
- 13 Restore the remaining detector operating conditions.
- 14 Reset the EMF counter.

## Replace the Quartz Tube (NCD)

To replace the NCD quartz tube:

**WARNING**

**The oven, inlets, and detectors can be hot enough to cause burns. Cool these areas to a safe handling temperature before beginning.**

---

**CAUTION**

Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

---

**CAUTION**

Most steps in this procedure require the use of two wrenches, one to hold the burner steady and the other to loosen a part. Always use two wrenches to avoid over-torquing or bending the burner assembly.

---

- 1 Gather the following:
  - Two 7/16-inch open-end wrenches
  - 3/8-inch open-end wrench
  - 5/8-inch open-end wrench
  - New quartz tube
  - Tweezers
  - 1/8-inch cap for transfer line
  - T20 Torx driver
  - Dental tool or similar tool for graphite ferrule removal
  - 2 New graphite ferrules
- 2 Prepare the detector for maintenance.
  - a Load the GC maintenance method and wait for the GC to become ready. (See “[Detector Maintenance Method](#)” on page 69.) Wait until the inlets, oven, detectors, valve box, burner assembly, and detector base cool to a safe handling temperature (< 40 °C).
  - b Turn off all hydrogen flows. (Leave on the oxidizer and ozone supply gases.)
  - c Turn off the ozone generator.

**WARNING**

**Hydrogen gas is flammable. Turn off all detector (and column) hydrogen gas flows before performing maintenance on the detector.**

---

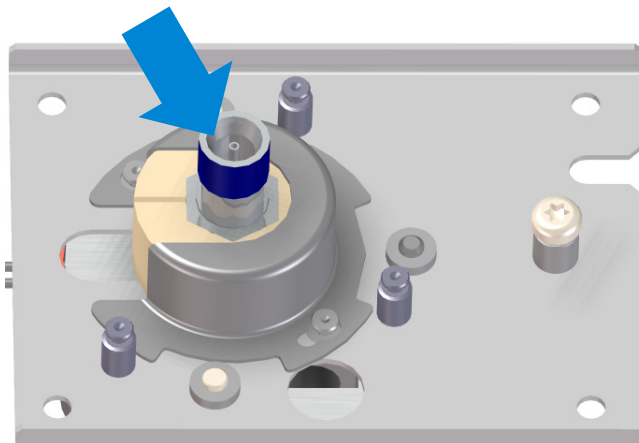
- 3 Remove the protective shroud. Remove the two T20 Torx screws, twist the shroud counter-clockwise to remove it from the mounting posts, then lift. Set the shroud and screws aside for later use.
- 4 Disconnect the transfer line and quickly cover the open end with the 1/8-inch cap. Use a 3/8-inch wrench on the transfer line and a 7/16-inch wrench of the upper fitting to hold the burner assembly steady.
- 5 Using two 7/16-inch wrenches, remove the outlet fitting from the nut on the top of the quartz tube.
- 6 Gently slide the nut and its ferrule up and off of the quartz tube.

**CAUTION**

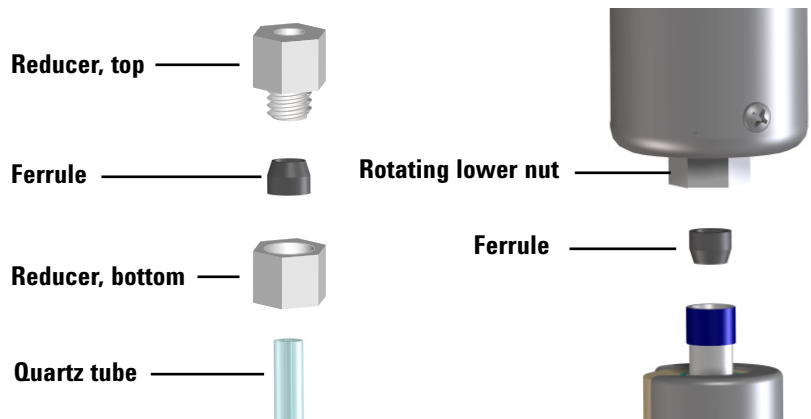
The quartz tube is fragile and can be chipped or cracked. To avoid damaging the quartz tubes, handle carefully.

---

- 7 Using 5/8-inch and 9/16-inch wrenches, remove the burner assembly and tube from the coupling in the detector base assembly.
- 8 Inspect the area around the jet in the coupling. If there are broken bits of tube present, remove with tweezers or similar tool.



- 9 Gently pull the quartz tube up through the burner assembly to remove. The graphite ferrule should remain in the rotating nut in the burner base.
- 10 Use a dental tool or similar to remove the old graphite ferrule from the rotating nut in the burner base.
- 11 Use two wrenches to disassemble the reducer, then remove the old ferrule.
- 12 Install new graphite ferrules. In both cases, the tapered end of the ferrule faces out, away from the burner.



- 13 Reassemble the reducer. Tighten with two wrenches until snug.
- 14 Slide the new quartz tube down through the burner assembly until it protrudes from the base about 1 cm. (This dimension is not critical. The tube position will adjust as you tighten the lower nut onto the coupling.)

**CAUTION**

When tightening the graphite ferrules onto a quartz tube, tighten only until snug. Overtightening can damage the ferrules or quartz tubes.

- 15 Carefully lower the burner assembly onto the detector base and thread the nut onto the detector base assembly by hand. Tighten finger-tight, then snug in place using a wrench. Do not overtighten.
- 16 Place the nut and ferrule over the open end of the quartz tube so that the open end of the nut faces up.
- 17 Install the nut into the outlet fitting and tighten with two wrenches just until snug.
- 18 Reinstall the transfer line onto the outlet fitting. Tighten until snug (finger-tight). Do not overtighten.

- 19 Reinstall the protective shroud.
- 20 Restore the detector operating conditions.
- 21 Reset the EMF counter.

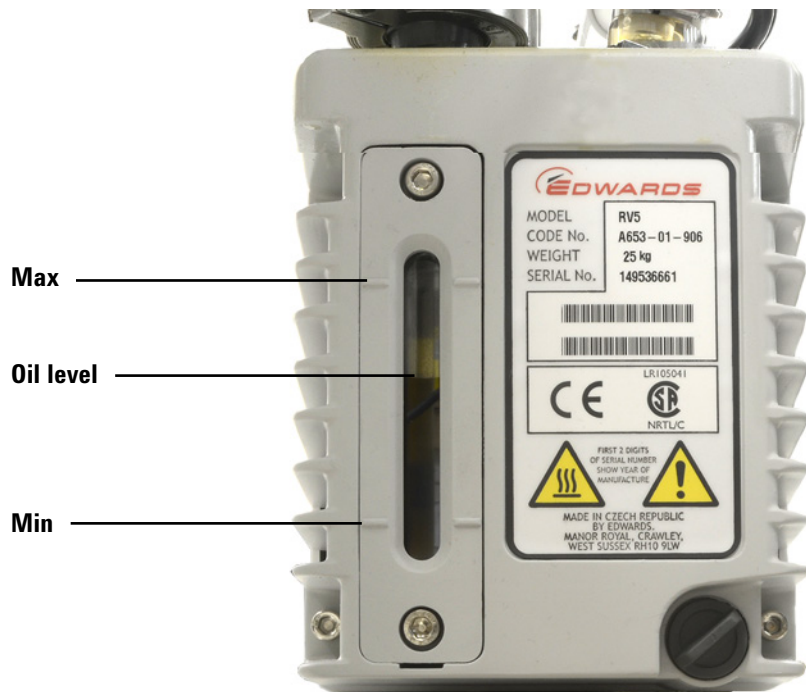
## Check the Vacuum Pump Oil

**CAUTION**

Never add or replace the foreline pump oil while the pump is on.

Check the level and color of the pump oil weekly.

- 1 Check the oil level in the window of the foreline pump. The oil level should be between the marks for Max and Min.



**Figure 16** Checking the oil level

- 2 Check that the color of the pump oil is clear or almost clear with few suspended particles. If the pump oil is dark or full of suspended particles, replace it.
- 3 Record the maintenance in the maintenance logbook. If applicable, reset the EMF counter.



## Add Vacuum Pump Oil

Add pump oil when the pump oil level is low.

### Materials needed

- Funnel (9301-6461)
- 5-mm Allen wrench (8710-1838)
- Gloves, chemical resistant, clean, lint free (9300-1751)
- Oil, synthetic, Mobile 1 (G6600-85001)
- Safety glasses (goggles)

---

**WARNING**

**Never add pump oil while the pump is on.**

---

**WARNING**

**The fill cap and pump may be dangerously hot. Check that the fill cup and pump are cool before you touch them.**

---

**CAUTION**

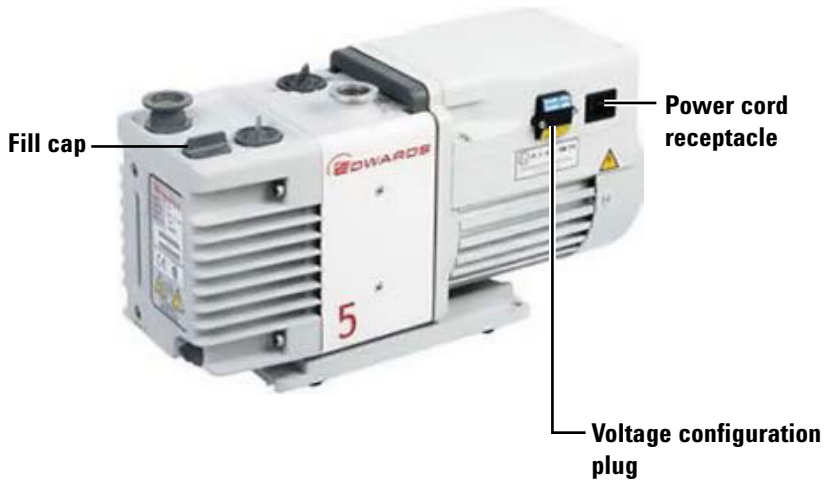
Use only synthetic 10W30 oil, such as Mobil 1. Any other oil can substantially reduce pump life and invalidates the pump warranty.

---

### Procedure

- 1 Shut down the detector and wait for the pump to turn off. See “[Shutdown](#)” on page 56.
- 2 Turn off the detector and unplug the pump power cord at the pump.

- 3 Remove the fill cap on the vacuum pump.



- 4 Add new pump oil until the oil level is near, but not over the maximum mark beside the oil level window. See [Figure 16](#) on page 80.
- 5 Reinstall the fill cap.
- 6 Wipe off all excess oil around and underneath the pump.
- 7 Reconnect the pump power cord.
- 8 Turn on the detector and restore operating conditions. See [“Start-up”](#) on page 54.
- 9 Record the maintenance in the maintenance logbook. If applicable, reset the EMF counter.

## Replace the Vacuum Pump Oil

Replace the pump oil every three months or sooner if the oil appears dark or cloudy.

### Materials needed

- Container for catching used pump oil
- Funnel (9301-6461), 5-mm Allen wrench (8710-1838)
- Gloves, chemical resistant, clean, lint free (9300-1751)
- Oil, synthetic, Mobil 1 (G6600-85001)
- Safety glasses (goggles)
- Screwdriver, flat-bladed, large (8710-1029)

**WARNING**

**Never add pump oil while the pump is on.**

---

**WARNING**

**The fill cap and pump may be dangerously hot. Check that the fill cup and pump are cool before you touch them.**

---

**WARNING**

**Do not touch the oil. The residues from some samples are toxic. Properly dispose of the oil.**

---

**CAUTION**

Use only synthetic 10W30 oil, such as Mobil 1. Any other oil can substantially reduce pump life and invalidates the pump warranty.

---

### Procedure

- 1 Shut down the detector and wait for the pump to turn off. See “[Shutdown](#)” on page 56.
- 2 Turn off the detector and unplug the pump power cord at the pump.

- 3 Place a container under the drain plug of the vacuum pump.

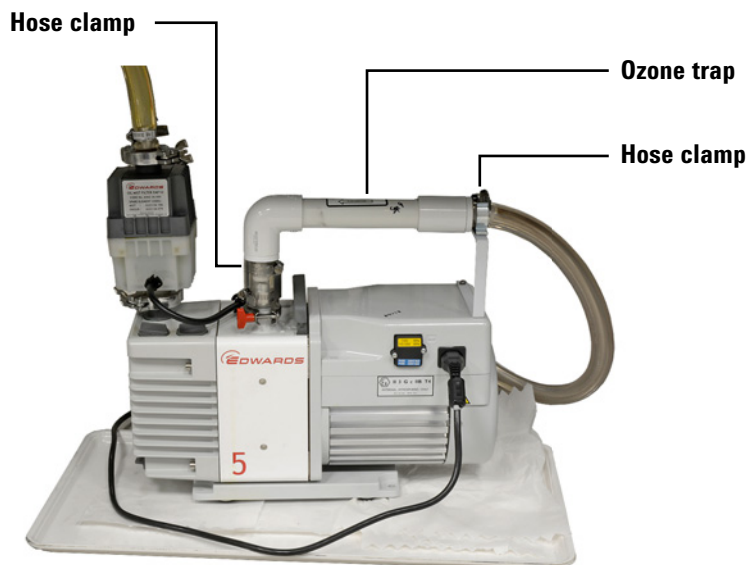


- 4 Remove the fill cap, then open the drain plug. Drain the oil completely by raising the motor end of the pump.
- 5 Reinstall the drain plug.
- 6 Add new pump oil until the oil level is near, but not over the maximum mark beside the oil level window. See [Figure 16](#) on page 80.
- 7 Reinstall the fill cap.
- 8 Wipe off all excess oil around and underneath the pump.
- 9 Reconnect the pump power cord.
- 10 Turn on the detector and restore operating conditions. See [“Start-up”](#) on page 54.
- 11 Record the maintenance in the maintenance logbook. If applicable, reset the EMF counter.
- 12 Check the pump for leaks after about 30 minutes, and check again after 24 hours.

## Replace the Ozone Trap

To replace the ozone trap:

- 1 Load a method to cool the detector, turn off the heaters, and turn off the hydrogen flow.
  - Turn off the heaters and allow the burner to cool.
  - Leave the oxidizer flow on.
  - Turn off the hydrogen flow.
  - Turn off the vacuum pump.
  - Set the GC oven to 30 °C (or off) to minimize column bleed.
  - Leave (helium) carrier gas flowing.
- 2 Allow the vacuum pump to cool to a safe handling temperature.
- 3 Remove the trap assembly and vacuum hose from the support bracket.
- 4 Loosen the two hose clamps that secure the old ozone trap in place.



- 5 Remove the trap from the pump intake hose. (If needed, loosen the clamp at the pump intake.)
- 6 Lift the old trap from the support bracket, then remove the detector vacuum hose from the barbed fitting on the old trap.
- 7 Install the new trap. Make sure that the flow direction arrow on the new trap points towards the intake fitting. (The trap

elbow must be nearest the pump intake.) If you removed the short connector hose from the pump intake, reinstall it.

## Change the Oil Mist Filter

The oil mist filter on the RV5 pump has two components: the charcoal odor filter and the oil coalescing filter element. To replace the filters, disassemble the oil mist filter assembly with the 4 mm long-handled hex wrench (provided). The smaller charcoal odor filter sits on top of the larger oil coalescing filter element. While it is recommended to replace the oil coalescing filter element after 90 days of continuous use, replacement of the charcoal odor filter is optional. After replacing the filter, re-assemble the filter assembly and attach it to the pump flange. Reset the EMF counter.

## Clean the Detector Exterior

**WARNING**

**Burn hazard. The burner assembly can be hot enough to cause burns. Before touching, cool to a safe handling temperature (< 40 °C).**

---

**WARNING**

**Shock hazard. Before cleaning the detector, turn it off and unplug its power cord.**

---

Before cleaning the detector, shut it down, turn it off, and unplug the detector power cord. Clean the detector with a **damp** cloth using water. Do not spray liquids directly onto the detector. Wipe dry with a clean, soft cloth. Do not allow cleaning fluids to drip into the detector or GC because liquids can damage the detector or GC electronics.

Do not use cleaning agents on the burner assembly that could cause a hazard on the burner.



## Calibrate the Flow and Pressure Sensors

The 8355 SCD and 8255 NCD use electronic pressure control modules. Typically, set the 7890B GC to use automatic flow zeroing. Calibration is generally not required. However, if needed the flow and pressure sensors can be manually zeroed. See the GC *Operation Manual* for details.

## Updating Firmware

The GC firmware controls the detector. Any updates for the detector will be applied through the GC firmware. See the GC Firmware Update Tool on the Agilent *GC and GC/MS User Manuals & Tools* DVDs, or download the tool from the Agilent web site GC support pages.



## 6 Troubleshooting

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This chapter describes how to troubleshoot and resolve typical issues encountered while using an Agilent SCD or NCD.



## Solving Detector Problems

A basic understanding of the detector helps to diagnose and solve detector problems. Review the basic detector theory found in “[Theory of Operation](#)” on page 37. Also, please note that this section is intended to troubleshoot problems in a detector that has previously been performing acceptably. If trying to optimize a new detector application, see “[Adjusting the Operating Conditions](#)” on page 53 for recommendations on adjusting method setpoints to obtain better results.

Many symptoms may be caused by more than one problem or by poor chromatographic technique. Analysis of sulfur or nitrogen compounds has traditionally been very difficult because of the inherent reactivity and instability of the compounds themselves. Often, problems initially blamed on the detector actually originate from either poor chromatographic technique or other system failures (for example, a leak at the column inlet fitting). Therefore, the first step in troubleshooting is to isolate the problem to the GC (inlet, injector, or column), to the burner assembly, or to the detector (ozone generator, vacuum pump, photomultiplier tube, or electronics). When diagnosing a problem in a system that had been working, a good first step is to restore the default typical operating conditions. The response under these conditions can help determine whether or not the method settings are causing the problem.

As a good practice, use the GC’s maintenance log and Early Maintenance Feedback (EMF) features for the detector. This feature helps you maintain the detector in good working order before problems can arise. See the *GC Operation Manual* for more information.

Also keep a maintenance log to track detector pressure readings and background signal (the difference between ozone “on” and ozone “off”). Changes over time in these values may indicate maintenance due.

[Table 11](#) in the next section lists many common problems, their most probable causes, and corrective action that should be taken.

## Troubleshooting Table

**Table 11** Troubleshooting Detector Issues

<b>Problem</b>	<b>Possible cause</b>	<b>Diagnosis</b>	<b>Corrective action</b>
<b>Detector problems</b>			
No response	No ozone	Little or no difference in output signal between ozone On and Off.	See “No ozone”.
No ozone	High voltage transformer and/or ozone generator inoperative.	No difference in output signal between ozone On and Off even though flow through the ozone generator is normal.	Contact Agilent for service.
	Restriction in ozone supply to the reactor cell.		Contact Agilent for service.
No Response	Broken ceramic or quartz tube.		Replace the ceramic tube. See “Replace the Inner Ceramic Tube (SCD)” on page 73 or “Replace the Quartz Tube (NCD)” on page 76.
Low Response	Inappropriate hydrogen and oxidizer flow rates.	Check flow rates.	Adjust flow rates.
	Leak in the detector.		Check for leaks in the detector and repair any leaks. See “Leaks” on page 98.
	Contaminated ceramic or quartz tubes.	If there does not appear to be a leak, then inspect the ceramic tube. Contamination can result from column bleed, samples which contain volatile metal complexes, and large injections of coke-forming hydrocarbons.	Replace the ceramic tube. See “Replace the Inner Ceramic Tube (SCD)” on page 73 or “Replace the Quartz Tube (NCD)” on page 76.
Wandering Baseline	Contamination in one of the detector gases.	Check the difference in the output signal between ozone On and Off.	Check inline supply traps and replace. Change detector gases.
	Leak in the oxidizer lines.		Check for leaks in the detector and repair any leaks. See “Leaks” on page 98.

**Table 11** Troubleshooting Detector Issues

<b>Problem</b>	<b>Possible cause</b>	<b>Diagnosis</b>	<b>Corrective action</b>
	Leak in the hydrogen supply lines.		Check for leaks in the detector and repair any leaks. See “Leaks” on page 98.
Tailing peaks with non-equimolar response	Severe contamination of detector gases.	High background signal compared against ozone Off.	Check inline supply traps and replace. Change detector gases.
Tailing peaks	Poor column connection.	Verify column position at inlet and outlet. Look for discoloration of column at detector fitting which indicates column in combustion zone.	Reinstall column. See “Attach a Column to the Detector” on page 70.
	Cracked tubes.	Confirm pressure and vacuum ranges. Inspect columns and ferrules.	Replace the ceramic tube. See “Replace the Inner Ceramic Tube (SCD)” on page 73 or “Replace the Quartz Tube (NCD)” on page 76.
Detector thermal shutdown	Thermocouple open.		Contact Agilent for service.
Burner pressure excessively high.	Cracked quartz or outer ceramic tube. Leaking or disconnected 1/16-inch stainless steel hydrogen or oxidizer line.		Replace the ceramic tube. See “Replace the Inner Ceramic Tube (SCD)” on page 73 or “Replace the Quartz Tube (NCD)” on page 76. Check connection. Check line for leaks. Contact Agilent for service if the line is cracked.
	Leak in burner.		Check for leaks in the detector and repair any leaks. See “Leaks” on page 98.
Burner pressure lower than expected and poor response	Cracked inner ceramic tube.		See “Replace the Inner Ceramic Tube (SCD)” on page 73.

**Table 12** Troubleshooting Pump Issues

<b>Problem</b>	<b>Possible Cause</b>	<b>Diagnosis</b>	<b>Corrective Action</b>
<b>Vacuum pump problems</b>			
Pump does not start	Pump switch off or power cord disconnected.		Turn On pump power switch. Check pump power cord.
Fuses blow on startup	Emulsified oil.	Inspect oil for integrity.	Change pump oil, and plug unit into wall to run for 10–15 minutes. Contact Agilent to replace blown fuses.
Water in pump	Cracked coalescing filter.	Milky yellow oil in the pump window.	Change coalescing filter and pump oil.
Reaction cell pressure high	Ozone destruction trap clogged.	Remove ozone destruction trap from the vacuum line and re-check expected pressure readings.	Change chemical trap.
	Burner disconnected from reaction cell.	Check connections.	
	Vacuum pump defective.		Replace vacuum pump.
Pump loses oil gurgle sound	Ballast open.	Oil level drops.	Reset ballast. See pump-specific sections.
High level of oil in coalescing filter	Plugged oil return restrictor.	No visible movement of oil in the return line.	Change filter and clear restrictor.

## Status Indicator LED

Use the detector status LED to quickly determine the status and readiness of the detector. The LED changes color depending on the current state of the detector.

- **Green:** Indicates that power is available for the heaters, chiller (NCD), vacuum pump, and ozone generator. Note that the GC supplies power to the detector electronics independently of the power controlled by the switch on the front of the detector.
- **Yellow:** Indicates that the detector is not ready for operation. Power is on and available, but not all parameters have reached operating setpoints. A warning or other message may exist. Check the GC display.
- **Red:** Indicates a fault or other serious condition. A fault or other message may exist. Check the GC display. The detector cannot be used until the fault condition is resolved.



## Detector Messages

Check the GC status display for detector messages. The GC will display and status and error messages that occur during operation, as well as log detector maintenance and error messages in the GC log files. See the GC operating manuals for details.

## Leaks

### Ozone leaks

**WARNING**

**Ozone is a hazardous gas and a strong oxidant. Exposure to ozone should be minimized by using the instrument in a well-ventilated area and by venting the exhaust of the vacuum pump to a fume hood. The ozone generator should be turned off when the instrument is not in use.**

---

If you suspect an ozone leak, shut down the detector. Do not open the detector mainframe. Contact Agilent for service.

### Hydrogen leaks

**WARNING**

**Do not measure hydrogen together with air or oxygen. This can create explosive mixtures that may be ignited by the high burner temperature. To avoid this hazard: 1. Cool the burner before you begin. 2. Always measure gases separately.**

---

Check all external connections for leaks. See [“Checking for hydrogen and oxidizer leaks”](#) on page 99. Check the supply connections to the detector mainframe and between the detector mainframe and the burner assembly. If you suspect a leak inside the detector mainframe, contact Agilent for service. Do not open the detector mainframe.

### Oxidizer leaks

**WARNING**

**Oxygen rich environments can promote combustion and even result in spontaneous combustion under conditions of high pressure and exposure to contamination. Use only oxygen rated components and ensure that components are oxygen clean prior to use with pure oxygen.**

---

Check the oxidizer supply connections to the detector mainframe and between the detector mainframe and the burner assembly. See [“Checking for hydrogen and oxidizer leaks”](#) on

page 99. If you suspect a leak inside the detector mainframe, contact Agilent for service. Do not open the detector mainframe.

## Checking for hydrogen and oxidizer leaks

To check for a leak in the hydrogen or oxidizer flow paths, do the following:

- 1 Check all external fittings for leaks. Correct any leaks (tighten or remake connections as appropriate).
- 2 If you still suspect a leak, establish the typical flow checkout conditions (see [Table 14](#) on page 110 for SCD or [Table 15](#) on page 115 for NCD).
- 3 Maintain these conditions for several minutes. If the detector cannot maintain these flow rates, contact Agilent for service.
- 4 If the detector was able to maintain the flow rates, turn off all gas flows using the GC keyboard or the control software.
- 5 Monitor the pressure readings on the GC display. (Press [**Front Det**] or [**Back Det**] or [**MS/Aux Det**].) With the vacuum pump running, the reaction cell pressure should fall to approximately 0 (zero). The burner pressure should fall to a value considerably lower than the typical operating pressure. This process will take time due to the internal configuration of the burner assembly. If the burner pressure remains high or at normal pressures, contact Agilent for service.

## Power Problems

When troubleshooting power problems on an SCD or NCD, remember that the power supplied to the detector electronics and flow modules comes from the GC and is controlled by the GC power switch. The power supplied to the SCD/NCD heaters, NCD chiller, vacuum pump, and ozone generator comes from the detector mainframe and is controlled by the detector power switch.

### No power

If the detector does not appear to have power—if the vacuum pump does not run and the heaters will not turn on—check the following:

- Check that the power switch is on.
- Check that the power cord is properly connected.
- Check the building power supply.

If the cord is connected properly, and the building circuit for the detector is operating normally, contact Agilent.

## Ozone Generation Problems

Before troubleshooting the ozone generator, first verify that the other components of the system operate normally. For example, check for leaks in the detector external connections, check for leaks in the inlet and inlet column fitting, check that the vacuum pump operates normally, check that the inlet and ALS are operating normally, and so on.

Troubleshoot ozone generation as follows:

- 1 On the GC display, note the detector output signal.
- 2 Leave the vacuum pump on and ozone supply gas flowing.
- 3 Turn off the ozone generator.
- 4 Observe the detector output signal.
- 5 Turn on the ozone generator and check the detector output signal again.

A properly operating detector will typically display a difference in background signal between ozone supply gas voltage on and off. If no change is observed, contact Agilent service.

## Coking

Contamination from some sample matrices can reduce sensitivity. For example, crude oils containing volatile metal complexes may contaminate the ceramic tubes. In addition, incomplete combustion of certain hydrocarbon-containing compounds leaves behind coke deposits on the ceramic tubes. Coke deposits may be removed from the burner by reducing the hydrogen flow rate.

## Hydrogen Poisoning

Hydrogen poisoning of the SCD ceramic tubes can occur when the relative oxidizer flow is very much lower than the hydrogen flow. Whether this state occurs due to inappropriate method setpoints or due to a problem with the oxidizer flow, this condition results in extremely reduced or no response. If you suspect hydrogen poisoning:

- Check for and resolve any flow shutdown.
- Check for restrictions in the oxidizer supply line to the burner assembly.
- Load the checkout method or other method that uses more balanced relative flow rates.

If the response does not recover, replace the inner ceramic tube. If response still does not recover, replace the outer ceramic tube. The ceramic tubes cannot be reconditioned.

## Contaminated Gases

Agilent recommends the use of clean gases that meet the requirements in the *Site Preparation Guide*. In addition, Agilent highly recommends the use of high quality traps to eliminate as much possible contamination as possible. The use of clean gases is essential for optimal performance. Otherwise, sulfur and other contaminants from gases may accumulate in the column and bleed out over time, desensitizing the ceramic tubes and causing elevated baselines.

Moisture in the ozone generator supply line can lead to the formation of acids that can damage or destroy the ozone generator and other detector components. Agilent highly recommends the use of a high-quality moisture trap, such as the Gas Clean Filter System with a moisture trap, for the ozone supply gas. See “[Consumables and Replacement Parts](#)” on page 65.





## 7 Performance Verification

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This chapter describes how to verify that the detector is operating normally.



## About Chromatographic Checkout

The tests described in this section provide basic confirmation that the GC and detector can perform comparably to factory condition. However, as detectors and the other parts of the GC age, detector performance can change. The results presented here represent typical outputs for typical operating conditions and are not specifications.

The tests assume the following:

- Use of an automatic liquid sampler. If not available, use a suitable manual syringe instead of the syringe listed.
- Use of a 10- $\mu$ L syringe in most cases. However, a 5- $\mu$ L syringe is an acceptable substitute.
- Use of the septa and other hardware (liners, adapters, and so forth) described. If you substitute other hardware, performance can vary.

## Prepare for Chromatographic Checkout

Because of the differences in chromatographic performance associated with different consumables, Agilent strongly recommends using the parts listed here for all checkout tests. Agilent also recommends installing new consumable parts whenever the quality of the installed ones is not known. For example, installing a new liner and septum ensures that they will not contribute any contamination to the results.

When the GC is delivered from the factory, these consumable parts are new and do not need replacement.

### NOTE

For a new GC, check the installed inlet liner. The liner shipped in the inlet may not be the liner recommended for checkout.

- 1 Check the indicators/dates on the gas supply traps. Replace expended traps.
- 2 Install new consumable parts for the inlet and prepare the correct injector syringe (and needle, as needed).

**Table 13** Recommended parts for checkout by inlet type

Recommended part for checkout	Part number
<b>Split splitless inlet</b>	
Syringe, 10- $\mu$ L	5181-1267
Liner O-ring	5188-5365
Septum	5183-4757
Liner	5190-2295
Gold plated inlet seal, with washer	5188-5367
<b>Multimode inlet</b>	
Syringe, 10- $\mu$ L	5181-1267
Liner O-ring	5188-5365
Septum	5183-4757
Liner	5190-2295
<b>Cool On-column inlet</b>	
Septum	5183-4758
Septum nut	19245-80521

**Table 13** Recommended parts for checkout by inlet type (continued)

Recommended part for checkout	Part number
Syringe, 5- $\mu$ L on-column	5182-0836
0.32-mm needle for 5- $\mu$ L syringe	5182-0831
7693A ALS: Needle support insert, COC	G4513-40529
7683B ALS: Needle support assembly for 0.25/0.32 mm injections	G2913-60977
Insert, fused silica, 0.32-mm id	19245-20525

### Prepare sample vials

Performance verification requires a 1  $\mu$ L injection. The checkout standards for SCD and NCD come with 3 ampoules.

#### **WARNING**

**When handling checkout standards, always follow the handling precautions recommended with its packaging.**

- 1 Open the sample box.
- 2 Snap the top off of one checkout sample ampoule.
- 3 Transfer the contents to a 2-mL ALS sample vial and cap the vial.

## Check SCD Performance

- 1 Gather the following:
  - Evaluation column, DB-1 30 m × 0.32 mm × 1.0 μm (part number 123-1033)
  - SCD performance evaluation (checkout) sample (5190-7003): 0.7 ± 0.002 mg/L diethyl disulfide and 1.0 ± 0.003 mg/L tert-butyl disulfide in isooctane.
  - Chromatographic-grade isooctane
  - 4-mL solvent and waste bottles or equivalent for autoinjector
  - 2-mL sample vials or equivalent for sample
  - Inlet and injector hardware (See “Prepare for Chromatographic Checkout” on page 107.)
- 2 Verify the following:
  - Chromatographic-grade gases plumbed and configured: helium as carrier gas, air as oxidizer, and oxygen as ozone supply gas.
  - Ozone supply gas moisture trap and other traps are in date.
  - Empty waste vials loaded in sample turret.
  - 4-mL solvent vial with diffusion cap filled with isooctane and inserted in Solvent A injector position.
  - 4-mL solvent vial with diffusion cap filled with isooctane and inserted in Solvent B injector position.
- 3 Replace consumable parts (liner, septum, traps, syringe, and so forth) as needed for the checkout. See “Prepare for Chromatographic Checkout” on page 107.
- 4 Install the evaluation column. (See the procedure for in the *GC Maintaining Your GC* manual.)
  - Bake out the evaluation column for at least 30 minutes at 180 °C. (See the procedure for in the *GC Maintaining Your GC* manual.)
  - Configure the column.
- 5 Check the detector baseline output. The output should be below 150 pA and relatively stable, assuming a well-stabilized system with the column oven at 50 °C.

However, a new burner (or a burner with a new ceramic tube) can have a very high baseline after first ignition. In this case, the baseline should gradually decrease, depending on

burner cleanliness. Noise will also greatly decrease over time. For a well-stabilized system, noise measured by Agilent OpenLAB CDS should be approximately 5 display units or less.

Checkout can continue before the baseline becomes completely stable.

- 6 Create or load a method with the parameter values listed in Table 14.

**Table 14** SCD Checkout conditions

<b>Column and sample</b>	
Type	DB-1, 30 m × 0.32 mm × 1 μm (123-1033)
Sample	SCD checkout 5190-7003
Column flow	3.5 mL/min helium
Column mode	Constant flow
<b>Split/splitless inlet</b>	
Temperature	250 °C
Mode	Splitless
Purge flow	80 mL/min
Purge time	0.7 min
Septum purge	3 mL/min
Gas saver	Off
<b>Multimode inlet</b>	
Mode	Splitless
Inlet temperature	250 °C
Purge time	0.7 min
Purge flow	80 mL/min
Septum purge	3 mL/min
Gas saver	Off
<b>Cool on-column inlet</b>	
Temperature	Oven Track
Septum purge	15 mL/min
<b>Detector</b>	
Base temperature	280°C

**Table 14** SCD Checkout conditions (continued)

Burner temperature	800 °C
Upper H <sub>2</sub> flow	38 mL/min
Lower H <sub>2</sub> flow	8 mL/min
Oxidizer flow	50 mL/min, Air
O <sub>3</sub> Generator	On
O <sub>3</sub> Generator flow	On
Vacuum pump	On
<b>FID-SCD Tandem settings</b>	
FID temp	350 °C
FID hydrogen flow	35 mL/min
FID air flow	500 mL/min
FID N <sub>2</sub> makeup flow	20 mL/min
SCD oxidizer flow	0
SCD upper H <sub>2</sub> flow	40 mL/min
Lower H <sub>2</sub> flow	Not applicable for FID-SCD
<b>Oven</b>	
Initial temp	50 °C
Initial time	3.0 min
Rate 1	25 °C/min
Ramp 1 temp	160 °C
Ramp 1 hold time	2 min
Post run temp	50 °C
<b>ALS settings (if installed)</b>	
Sample washes	2
Sample pumps	6
Sample wash volume	8 µL (maximum)
Injection volume	1 µL
Syringe size	10 µL
Solvent A pre washes	0
Solvent A post washes	3
Solvent A wash volume	8 µL (maximum)
Solvent B pre washes	0

**Table 14** SCD Checkout conditions (continued)

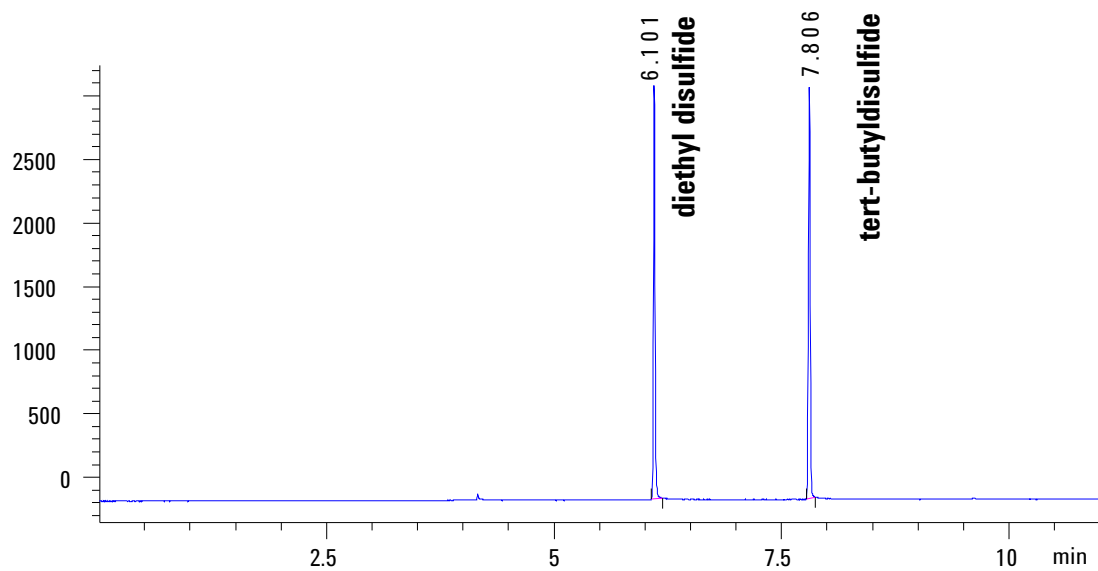
Solvent B post washes	3
Solvent B wash volume	8 $\mu$ L (maximum)
Injection mode (7693A)	Normal
Airgap Volume (7693A)	0
Viscosity delay	0
Solvent Wash Draw Speed (7693A)	150
Solvent Wash Dispense Speed (7693A)	1500
Sample Wash Draw Speed (7693A)	150
Sample Wash Dispense Speed (7693A)	1500
Inject Dispense Speed (7693A)	3000
Plunger speed (7683)	Fast, for all inlets except COC.
PreInjection dwell	0
PostInjection dwell	0
<b>Manual injection</b>	
Injection volume	1 $\mu$ L
<b>Data system</b>	
Data rate	5 Hz (Front detector, SCD)

- 7 If using a data system, prepare the data system to perform one run using the loaded checkout method. Make sure that the data system will output a chromatogram. If not using a data system, create a one sample sequence using the GC keypad.
- 8 Start the run. If performing an injection using an autosampler, start the run using the data system or press **[Start]** on the GC. If performing a manual injection (with or without a data system):
  - a Press **[Prep Run]** to prepare the inlet for splitless injection.
  - b When the GC becomes ready, inject 1  $\mu$ L of the checkout sample and press **[Start]** on the GC.



The following chromatogram shows typical results for a new detector with new consumable parts installed. Note that the response for a tandem FID-SCD installation will be approximately 1/10 of the response shown in this example due to the reduced amount of sample that reaches the SCD.

SCD1 A, Front Signal (C:\CHEM32\2\DATA\XCD-DATA-FEB2015\SCD\EXAMPLE.D)



## Check NCD Performance

- 1 Gather the following:
  - Evaluation column, HP-5 30 m × 0.32 mm × 0.25 μm (part number 19091J-413)
  - NCD performance evaluation (checkout) sample (5190-7002): 3-methylindole 10.0 ± 0.1 mg/L, 9-methylcarbazole 14.1 ± 0.1 mg/L, and nitrobenzene 9.51 ± 0.05 mg/L in isooctane.
  - Chromatographic-grade isooctane
  - 4-mL solvent and waste bottles or equivalent for autoinjector
  - 2-mL sample vials or equivalent for sample
  - Inlet and injector hardware (See “Prepare for Chromatographic Checkout” on page 107.)
- 2 Verify the following:
  - Chromatographic-grade gases plumbed and configured: helium as carrier gas, oxygen as oxidizer and ozone supply gas.
  - Ozone supply gas moisture trap and other traps are in date.
  - Empty waste vials loaded in sample turret.
  - 4-mL solvent vial with diffusion cap filled with isooctane and inserted in Solvent A injector position.
  - 4-mL solvent vial with diffusion cap filled with isooctane and inserted in Solvent B injector position.
- 3 Replace consumable parts (liner, septum, traps, syringe, and so forth) as needed for the checkout. See “Prepare for Chromatographic Checkout” on page 107.
- 4 Install the evaluation column. (See the procedure for in the *GC Maintaining Your GC* manual.)
  - Bake out the evaluation column for at least 30 minutes at 270 °C. (See the procedure for in the *GC Maintaining Your GC* manual.)
  - Configure the column.
- 5 Check the detector baseline output. The output should be below 150 pA and relatively stable, assuming a well-stabilized system with the column oven at 50 °C. (A negative baseline can be acceptable.).

However, a new burner (or a burner with a new quartz tube) can have a very high baseline after first ignition. In this case, the baseline should gradually decrease, depending on burner cleanliness. Noise will also greatly decrease over time. For a well-stabilized system, noise measured by Agilent OpenLAB CDS should be approximately 4 display units or less.

Checkout can continue before the baseline becomes completely stable.

- 6 Create or load a method with the parameter values listed in Table 15.

**Table 15** NCD Checkout conditions

<b>Column and sample</b>	
Type	HP-5, 30 m × 0.32 mm × 0.25 μm (19091J-413)
Sample	NCD checkout 5190-7002
Column flow	2.2 mL/min
Column mode	Constant flow
<b>Split/splitless inlet</b>	
Temperature	250 °C
Mode	Splitless
Purge flow	80 mL/min
Purge time	0.8 min
Septum purge	3 mL/min
Gas saver	Off
<b>Multimode inlet</b>	
Mode	Splitless
Inlet temperature	250 °C
Initial time	0 min
Purge time	0.8 min
Purge flow	80 mL/min
Septum purge	3 mL/min
Gas saver	Off
<b>Cool on-column inlet</b>	
Temperature	Oven Track

**Table 15** NCD Checkout conditions (continued)

Septum purge	15 mL/min
<b>Detector</b>	
Base temperature	280°C
Burner temperature	900 °C
Chiller temperature	On
H <sub>2</sub> flow	3 mL/min
Oxidizer flow	8 mL/min, Oxygen
O3 Generator	On
O3 Generator flow	On
Vacuum pump	On
<b>Oven</b>	
Initial temp	50 °C
Initial time	3.0 min
Rate 1	25 °C/min
Ramp 1 temp	250 °C
Ramp 1 hold time	2 min
Post run temp	50 °C
<b>ALS settings (if installed)</b>	
Sample washes	2
Sample pumps	6
Sample wash volume	8 µL (maximum)
Injection volume	1 µL
Syringe size	10 µL
Solvent A pre washes	0
Solvent A post washes	3
Solvent A wash volume	8 µL (maximum)
Solvent B pre washes	0
Solvent B post washes	3
Solvent B wash volume	8 µL (maximum)
Injection mode (7693A)	Normal
Airgap Volume (7693A)	0
Viscosity delay	0

**Table 15** NCD Checkout conditions (continued)

Solvent Wash Draw Speed (7693A)	150
Solvent Wash Dispense Speed (7693A)	1500
Sample Wash Draw Speed (7693A)	150
Sample Wash Dispense Speed (7693A)	1500
Inject Dispense Speed (7693A)	3000
Plunger speed (7683)	Fast, for all inlets except COC.
PreInjection dwell	0
PostInjection dwell	0
<b>Manual injection</b>	
Injection volume	1 $\mu$ L
<b>Data system</b>	
Data rate	5 Hz (Front detector, NCD)

- 7 If using a data system, prepare the data system to perform one run using the loaded checkout method. Make sure that the data system will output a chromatogram. If not using a data system, create a one sample sequence using the GC keypad.
- 8 Start the run. If performing an injection using an autosampler, start the run using the data system or press **[Start]** on the GC. If performing a manual injection (with or without a data system):
  - a Press **[Prep Run]** to prepare the inlet for splitless injection.
  - b When the GC becomes ready, inject 1  $\mu$ L of the checkout sample and press **[Start]** on the GC.



The following chromatogram shows typical results for a new detector with new consumable parts installed.

