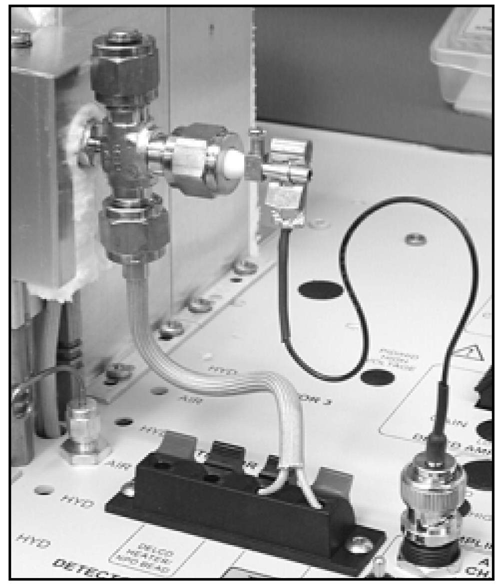
Overview

The SRI Nitrogen-Phosphorus Detector (NPD) has a linear response selective to organic compounds containing nitrogen and/or phosphorus. The NPD also responds to normal hydrocarbons, but approximately 100,000 times less than nitrogen or phosphorus containing compounds. Due to its selectivity and sensitivity, the NPD is often used to detect pesticides, herbicides, drugs of abuse, and other trace compounds. Nitrogen is the carrier gas of choice for the NPD detector, but helium is often used, especially when other detectors are installed on the same GC as the NPD.



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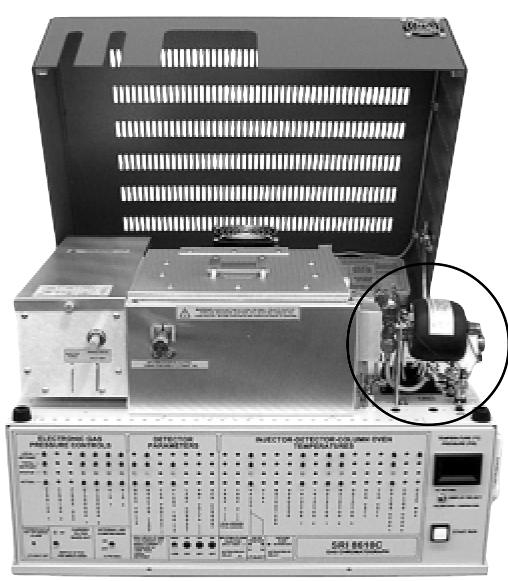
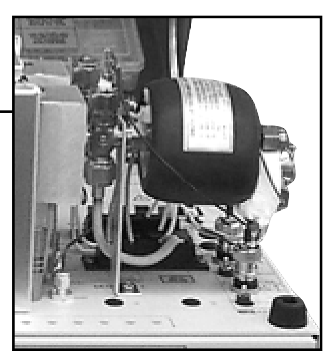
The NPD is similar in design to the FID, except it uses a thermionic NPD bead to generate ions in a hydrogen and air plasma. Like the FID, the NPD uses a stainless steel jet to deliver sample-laden carrier gas and hydrogen gas to the detector, and a positively charged collector electrode that also serves as the detector exhaust. The NPD bead is positioned between the jet and the collector electrode. The tip of the NPD jet is slightly different from that of the FID jet.

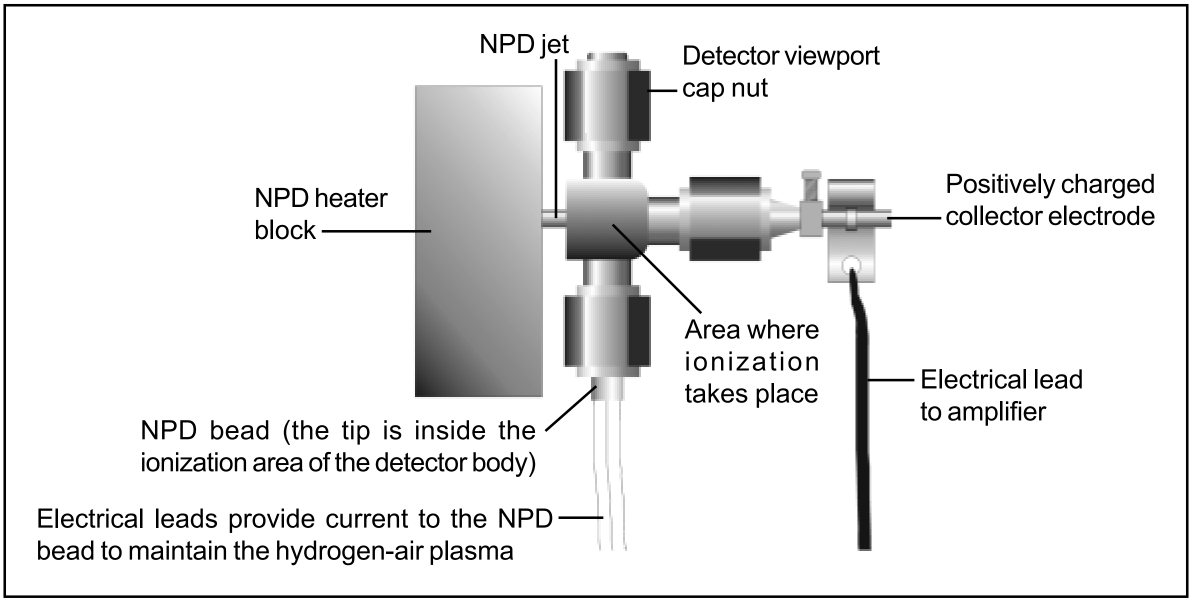
The thermionic NPD bead is coated with an alkali salt.



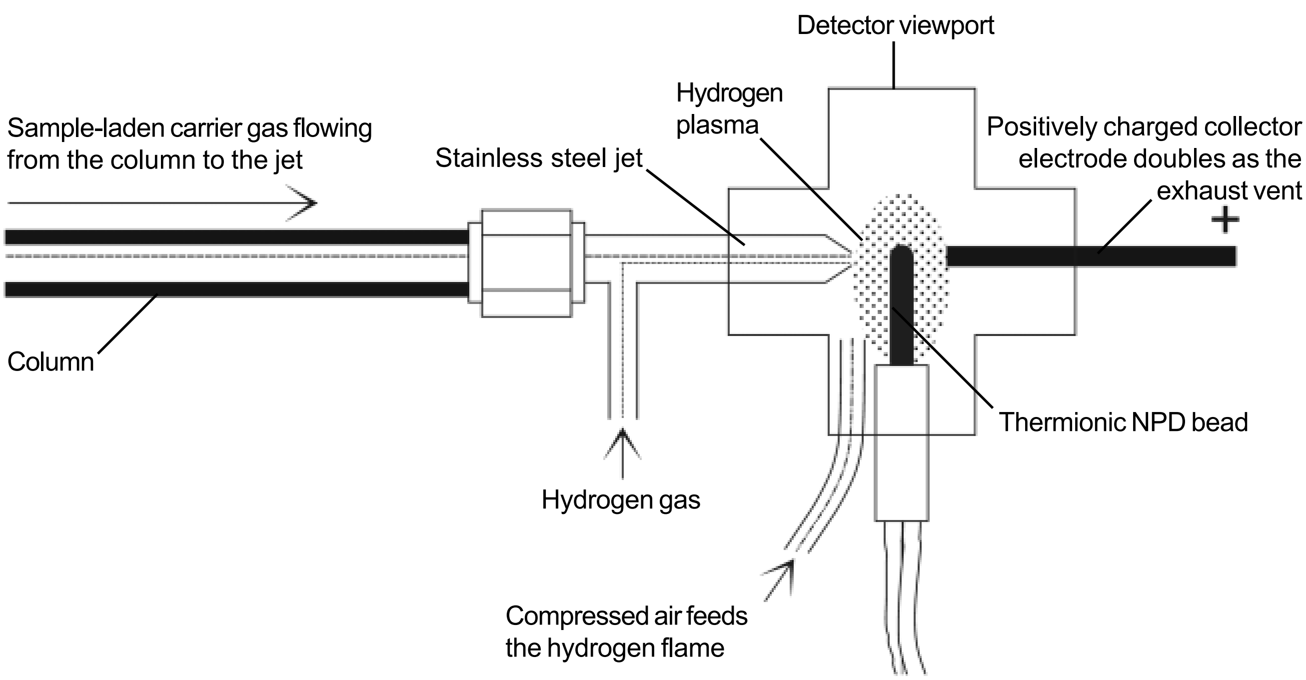
The NPD may be combined with the DELCD for pesticide screening. The NPD detects Organo-phosphate pesticides and the DELCD detects the chlorinated pesticides.



Theory of Operation



Inside the NPD detector body, an electrically heated thermionic bead (NPD bead) is positioned between the jet orifice and the collector electrode. The bead is coated with an alkali metal which promotes the ionization of compounds that contain nitrogen or phosphorus. Hydrogen and air flows create a hydrogen plasma around the hot NPD bead. When molecules containing nitrogen or phosphorus enter the plasma from the column and jet orifice, they undergo a catalytic surface chemistry reaction, producing thermionic electrons. The resulting ions are attracted to a positively charged collector electrode, then amplified and output to the data system. The hydrogen to air ratio is too lean to sustain a flame, therefore minimizing hydrocarbon ionization and contributing to the NPD detector's selectivity.



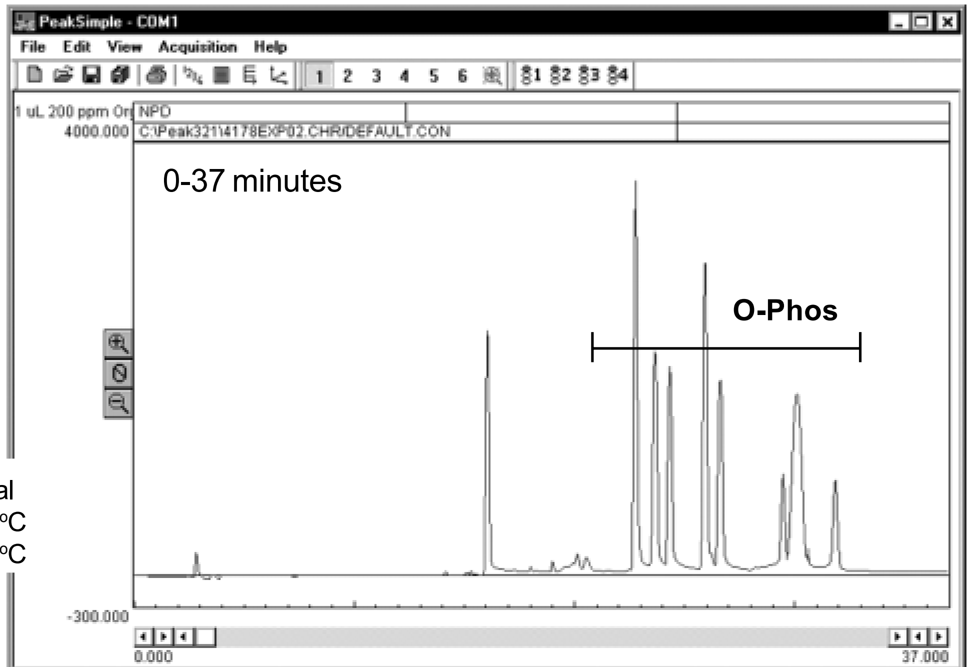
Expected Performance

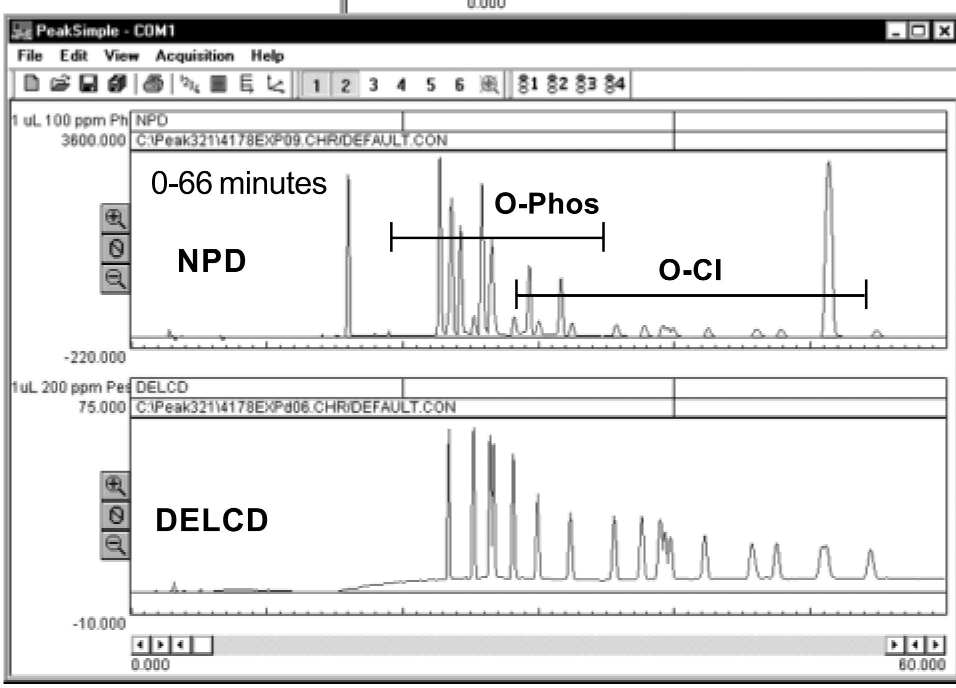
The following chromatograms are from an SRI GC equipped with NPD, DELCD and FID detectors. Since the NPD is not the only detector, helium carrier gas was used instead of nitrogen. The first chromatogram shows a separation of 200ppm Organophosphorus pesticide standard, Mix 8270. The second chromatogram shows both the NPD and DELCD responses to a mixture of 100ppm Mix 8270 and 100ppm Organochlorine pesticide standard, Mix 8081. Other than the sample and length of time, the analytical parameters were the same for both runs. The NPD has a much smaller response to the Organochlorine standard (Mix 8081). Since the DELCD is selective to chlorinated molecules, its response to Mix 8081 supplements the NPD response for better identification. and quantification.

Sample: 1µL 200ppm Organophophorus standard mix 8270
Method: direct injection
Column: 60-meter MXT-VOL
Carrier: helium at 10mL/min
NPD gain: HIGH
NPD temperature: 250°C
NPD bead current: -370
Injector temperature: 150°C

Temperature program:

Initial	Hold	Ramp	Final
100°C	6.00	15.00	280°C
280°C	20.00	0.00	280°C

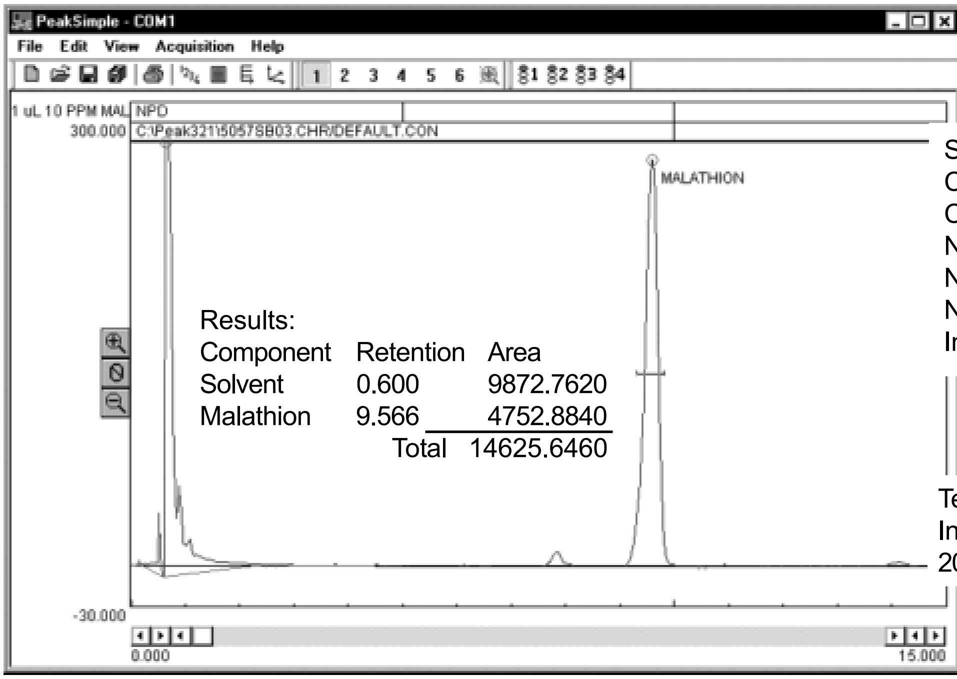




Sample: 1µL 100ppm Organophophorus pesticide standard mix 8270 + 100ppm Organochlorine pesticide standard mix 8081
Method: direct injection
Injector temperature: 150°C
Column: 60-meter MXT-VOL
Carrier: helium at 10mL/min
NPD gain: HIGH
NPD temperature: 250°C
NPD bead current: -370
DELCD gain: LOW
DELCD reactor: 260
DELCD temp: 300°C

Expected Performance

This chromatogram shows the NPD response to an isothermal analysis of a 10ppm malathion sample. Compare the NPD response to the 100% hydrocarbon solvent with the response to the 10ppm malathion sample.

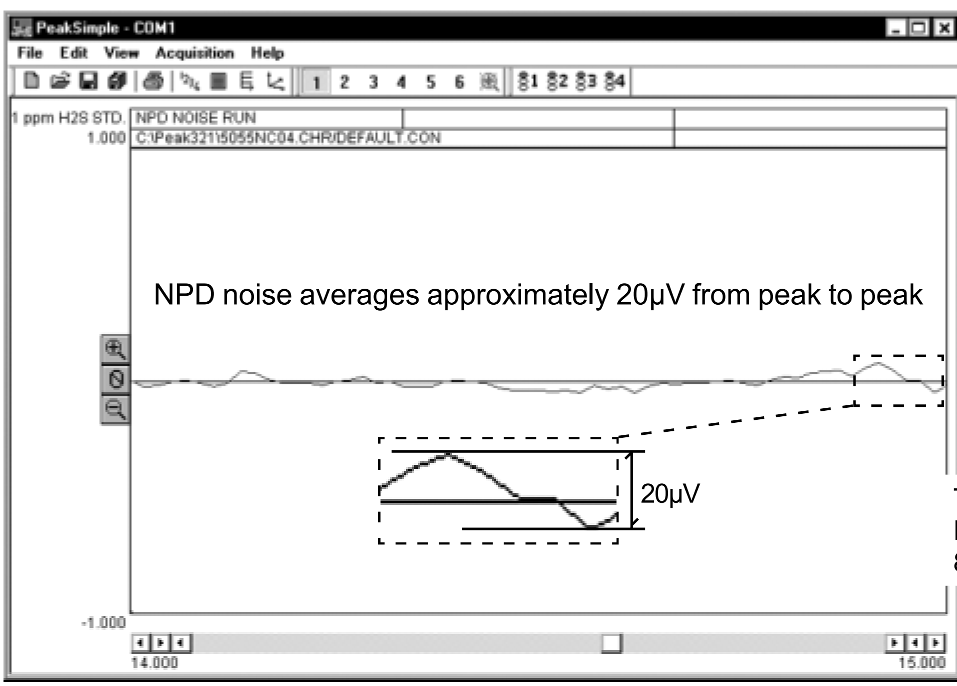


Sample: 1 µL 10ppm malathion
Column: 15-meter MXT-5
Carrier: helium at 10mL/min
NPD gain: HIGH
NPD temperature: 250°C
NPD bead current: -380
Injector temperature: 200°C

Temperature program:

Initial	Hold	Ramp	Final
200°C	100.00	0.00	200°C

The following chromatogram shows an NPD noise run using helium carrier gas and an 80 degree isothermal temperature program.



Column: 15-meter MXT-5
Carrier: helium at 10mL/min
NPD gain: HIGH
NPD temperature: 250°C
NPD bead current: -380

Temperature program:

Initial	Hold	Ramp	Final
80°C	24.00	0.00	80°C

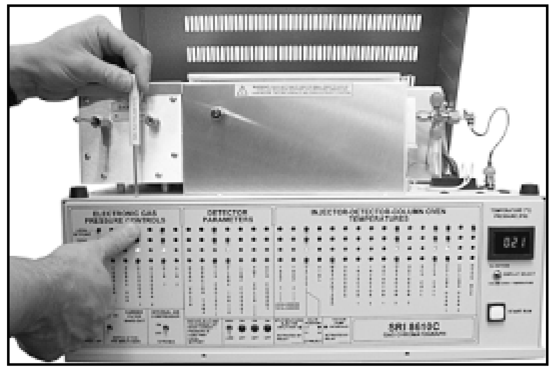
Note: Most SRI NPDs are installed on a GC with one or more other detectors. Therefore, SRI tests its NPD detectors with helium carrier gas.

General Operating Procedures

NPD Detector

1. Set the NPD amplifier gain switch to HIGH for most applications.

2. The approximate pressures required for the correct hydrogen and air flows are labeled on the right-hand side of the GC chassis under "GAS FLOW RATES." Set the hydrogen flow to 3mL/minute and the air flow to 100mL/minute using the trimpots on the top edge of the GC's front control panel. To adjust a pressure setting, hold down the SETPOINT button while turning the corresponding trimpot until you can read the desired pressure setting in the LED display (make sure the LED "DISPLAY SELECT" switch is on "ALL BUTTONS").



3. Set the NPD detector temperature to 250°C: hold down the SETPOINT button while turning the detector heat trimpot until the desired setpoint is visible in the LED display.

4. Set the NPD bead current to -360. Higher current settings may be used, but the life and subsequent sensitivity of the NPD bead will be reduced.

5. Press the ACTUAL button to observe the temperature of the NPD in the LED display. When the detector has reached the set temperature and the signal appears stable, the NPD is ready for use.

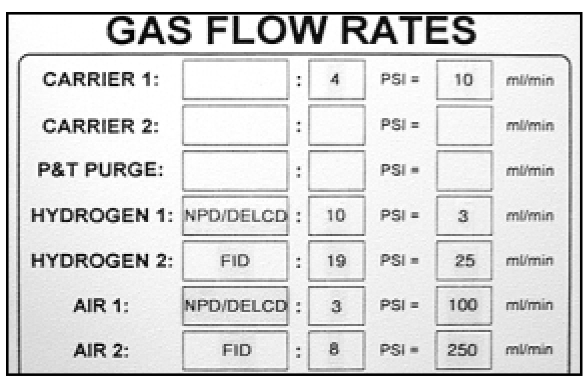
NPD/DELCD Combination Detector

1. Set the DELCD amplifier gain switch to LOW, and the NPD gain to HIGH.

2. Set the NPD/DELCD hydrogen to 3mL/minute and the air to 100mL/min using the correlating pressure labeled on the right-hand side of the GC.

3. Set the NPD/DELCD detector heat to 150°C.

4. Set the DELCD reactor temeprature to 260. The number 260 represents 1000°C; the DELCD will heat to about 254 and stabilize. The visible end of the reactor tube will glow bright red with the high temperature.



GAS FLOW RATES

CARRIER 1:		4	PSI =	10	ml/min
CARRIER 2:			PSI =		ml/min
P&T PURGE:			PSI =		ml/min
HYDROGEN 1:	NPD/DELCD	10	PSI =	3	ml/min
HYDROGEN 2:	FID	19	PSI =	25	ml/min
AIR 1:	NPD/DELCD	3	PSI =	100	ml/min
AIR 2:	FID	8	PSI =	250	ml/min

Example Gas Flow Rates table: this particular GC is equipped with NPD/DELCD and FID detectors.

5. Inject sample when the combination detector has reached the set temperatures and their signals appear stable.