Accurate and Painless GC Column Installation with Phenomenex's Cool-Lock™ Nut

Kory Kelly, Ngoc Nguyen, and Sky Countryman
Phenomenex Inc., Torrance, CA, USA

Abstract
Proper column installation is critical for precise and optimal functioning of any gas chromatography (GC) system. Yet errors in this seemingly simple process cause most of the problems associated with GC analysis. GC column installation actually involves several different processes where errors can occur. Moreover, time spent on column swapping interrupts workflow and reduces a lab's productivity. To address these issues, Phenomenex has developed the Cool-Lock Nut, a capillary GC installation tool that eliminates most problems associated with column installation.

Introduction
GC column replacement typically involves a series of steps. First, the oven needs to cool down to a temperature comfortable to the touch so the nut that holds the column in place can be loosened by hand. This step can take as long as 20 minutes. After detaching the nut, a new column is inserted through the nut and ferrule and positioned into the injector at a specified depth. The ferrule is then finger-tightened and given an extra half turn with a wrench until the column is secured.

If the oven has not cooled down sufficiently, chromatographers experience a hot, searing pain when they touch the capillary nut. A glove may be used as insulation, but the protection decreases over time because the gloves fray or stretch. Glove use also adds a time-consuming step to the process.

Another major challenge to traditional GC column installation is achieving the correct column depth. Failure to do this compromises reproducibility and produces inconsistent results from one installation to the next. Typically chromatographers use an old ferrule or correction fluid to install the column at the necessary depth. However, correction fluids can be messy because they smear and burn in the oven.

The Cool-Lock Nut's unique (patent pending) design helps simplify the column installation process. In contrast to a normal capillary installation nut, which is actually connected to the injector or detector, the mechanism to change the Cool-Lock Nut is found outside the injector or detector **(Figure 1)**. This allows easy access to the nut when detaching the column from the ports. In addition, chromatographers aren't crammed in a tight, hot space because the tightening mechanism is outside the injector or detector, which is constantly giving off heat.

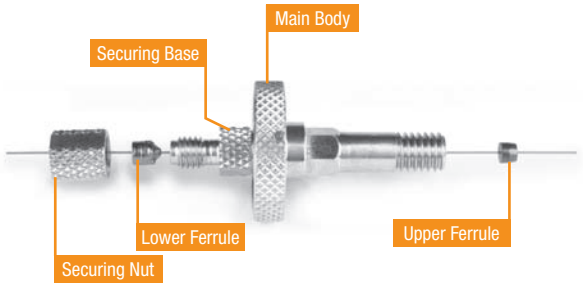

Figure 1. Cool-Lock Nut patent-pending design helps simplify the column installation process.

The Cool-Lock Nut has a knurled installation wheel and a second securing nut. The wheel is located approximately ⅛ inch below the ¼ inch hex portion of the most widely-used standard nut*, allowing fingers to stay well below and to the outside of the center of the insulator cap, which is very hot. Its low thermal mass tracks the oven temperature and makes it comfortable for chromatographers to install or manually remove without waiting for the inlet/detector to cool. The wheel also acts as a tightening device so the column can be hand-tightened into place, eliminating the need for a wrench.

Below the wheel is a second nut with a compression ferrule that holds the column at a constant length during the installation process. When used with the Cool-Lock Nut Installation Gauge, a proper and constant installation depth is achieved to assure to the accuracy and reproducibility of the analysis.

Methods
Comparison of a GC analysis using proper and improper installation depths was done on an Agilent 5980 GC system **(Figure 2)**. For the proper installation, the end of the column was installed 5 mm above the tip of the ferrule. In the improper column run, the end of the column was just above the tip of the ferrule.

The temperature measurements of the Cool-Lock Nut and a standard nut* was measured on Agilent 5980 GC system. For the experiment, the initial oven temperature was set to 360 °C then lowered to 45 °C. The oven door was then opened, exposing the nut to room temperature (25 °C). Temperature was immediately measured using a non-contact thermometer. The first experiment (a) was done with the injector temperature set at 250 °C, and the second experiment (b) at 300 °C. Please note that the oven temperature was set to zero, allowing the oven fan to stay on during all temperature readings **(Figure 3)**.

Results and Discussion
Figure 2 demonstrates how proper installation depth can affect peak height. When installed appropriately, the signal response is greater and peak shape is high **(Figure 2A)**. In contrast, improper column installation depth results in some loss of signal and response **(Figure 2B)**.

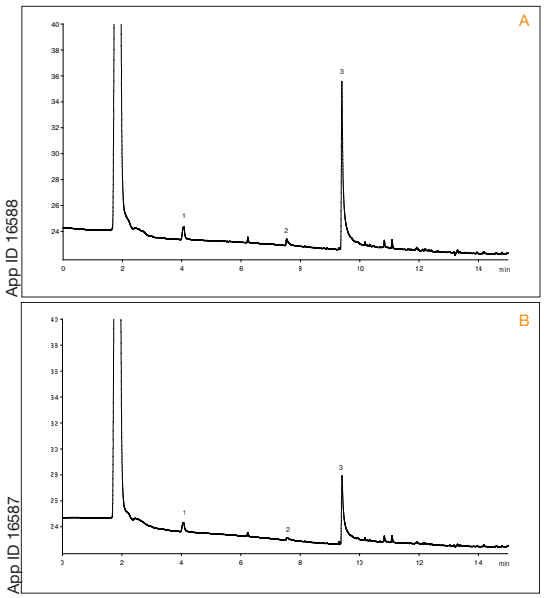

Figure 2. Comparison of a GC analysis using (A) proper and (B) improper installation depths. In analysis with the proper installation, where the end of the column was 5 mm above the tip of the ferrule, all peaks had high responses (A). In contrast, when the column was installed improperly with the end of the column just above the tip of the ferrule, the responses were greatly reduced (B).

Column: Zebron ZB-XLB
Dimensions: 30 meter x 0.25 mm x 0.25 µm
Part No. : 7HG-G019-11
Injection : Splitless @ 250 °C, 1 µL
Carrier Gas: Helium @ 30 cm/sec (constant flow)
Oven Program: 110 °C to 320 °C @ 15 °C/min for 5 min
Detector: ECD @ 350 °C
Samples:
1. 4-Chlorophenol
2. Chlorobenzene
3. Pentachlorophenol

The Cool-Lock Nut significantly also decreases the time that chromatographers have to wait before they start to change a column. It cools down in just five minutes to a temperature comfortable to the touch **(Figure 3)** in contrast to the widely used standard installation nut*, which takes over 15 minutes to get to that level (data not shown).

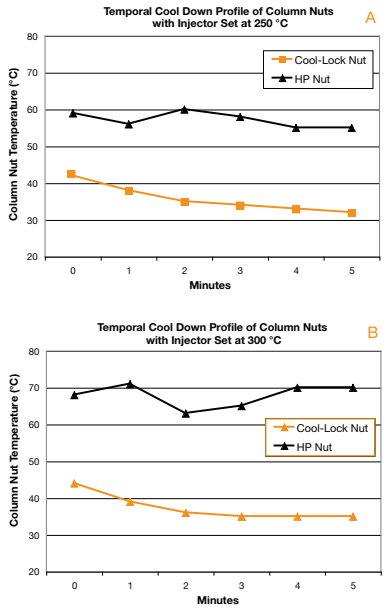

Figure 3. Temperature measurements of the Cool-Lock Nut and a standard nut* over time on Agilent 5980 GC system. For the experiments, the initial oven temperature was set to 360 °C then lowered to 45 °C. The oven door was then opened, exposing the nut to room temperature (25 °C). Temperature was immediately measured using a non-contact thermometer. Note: Oven temperature was set to zero, allowing the oven fan to stay on during all temperature readings. The first experiment (A) was done with the injector temperature set at 250 °C, and the second experiment (B) at 300 °C.

**The capillary column nut from Agilent.*

Even the most expert GC users have experienced column installation challenges and many have found that the Cool-Lock Nut brings significant improvements to their processes. "I have been doing GC work for about 20 years and have seen just about everything when it comes to GC analysis," comments Andy Still, of Albemarle Corporation. "We have about 20 functional GCs in our laboratory and literally hundreds of methods. Despite the number of GCs, we sometimes have to change a column 'on the run' and don't always have time to allow the inlet to cool down. This Cool-Lock Nut is a welcome tool for those of us cursed with the task of quick column replacement."

Kurt Weiss, a lab manager, comments, "Using [the Cool-Lock Nut] did speed up the process because we didn't have to wait as long to allow the inlet and detector connections to sufficiently cool down. Time is always critical in a manufacturing environment, so any tools that can help speed tasks up are invaluable. Because a technician may, in the interest of time, try to manipulate a column connection before it is cooled down, safety is improved because the nuts cool down faster. The installation guides also help as a constant tool with which to measure the depth of the column into the inlet and detector. This is much easier than trying to guess or use a septum to mark the correct spot."

Conclusion

The Cool-Lock Nut delivers a seemingly simple solution to an age-old problem in gas chromatography. It provides a combination of time savings and accuracy advantages that help the laboratories maintain optimal productivity.

ORDERING INFORMATION

Cool-Lock GC Capillary Nut		
Part No.	**Description**	**Unit**
AG0-8319-TN	Cool-Lock GC Capillary Nut For Use With Short-Style Ferrules	ea
AG0-8320-TN	Cool-Lock GC Capillary Nut For Use With Long-Style Ferrules	ea
AG0-8349-TN	Cool-Lock Nut Installation Gauge	ea
Replacement		
AG0-4701-TN	GC Capillary Ferrules Graphite 1/16 in. to 0.5 mm ID	10/pk
AG0-4704-TN	GC Capillary Ferrules Graphite 1/16 in. to 0.8 mm ID	10/pk

Caution: For safety, please use common sense when handling metal surfaces within the GC oven, including the Cool-Lock Nut. The Cool-Lock Nut is designed to track the GC oven temperature as close as possible, therefore, when you cool down your GC oven, the Cool-Lock Nut will follow suit because it is related to oven temperature with the fan on. So if the oven is hot enough to cause severe burns, the Cool-Lock Nut will also be hot enough to cause severe burns. If the GC oven fan has turned off and the injection port temperature is still hot, the Cool-Lock Nut will begin to heat up causing it to be too hot to touch with the bare hand. For any questions regarding use of the Cool-Lock Nut, please contact your local Phenomenex representative.

5573_L