

Simplifying Column Selection

WHICH COLUMN DO I NEED?

Successful separations depend on choosing the right column, but with so many options available how do you know which is best? Understanding the basic elements of the resolution equation and how they relate to column characteristics is the key to getting the best separation in the shortest possible time!

$$R = \frac{1}{4} \sqrt{N} \times \left(\frac{k}{k+1} \right) \times (\alpha - 1)$$

A measure of Efficiency.
This term is affected by:

- Length
- Inner diameter
- Carrier gas type and linear velocity

A measure of Retention.
This term is affected by:

- Inner diameter
- Film thickness
- Temperature

A measure of Peak Separation.
This term is affected by:

- Stationary phase composition
- Temperature

N = L/H = Effective theoretical plate number
L = Column length
H = HETP = Height equivalent to a theoretical plate

k = Retention factor
α = Separation factor
Baseline resolution (R = 1.5) is the goal.

For an in-depth discussion on how to choose the right column and improve your chromatographic results, as well as helpful troubleshooting information, visit www.restek.com

- Download our *Guide to GC Column Selection and Optimizing Separations* (lit. cat.# GNBR1724-UNV)
- Request our *GC Troubleshooting Tips poster* (GNWC1723-UNV)

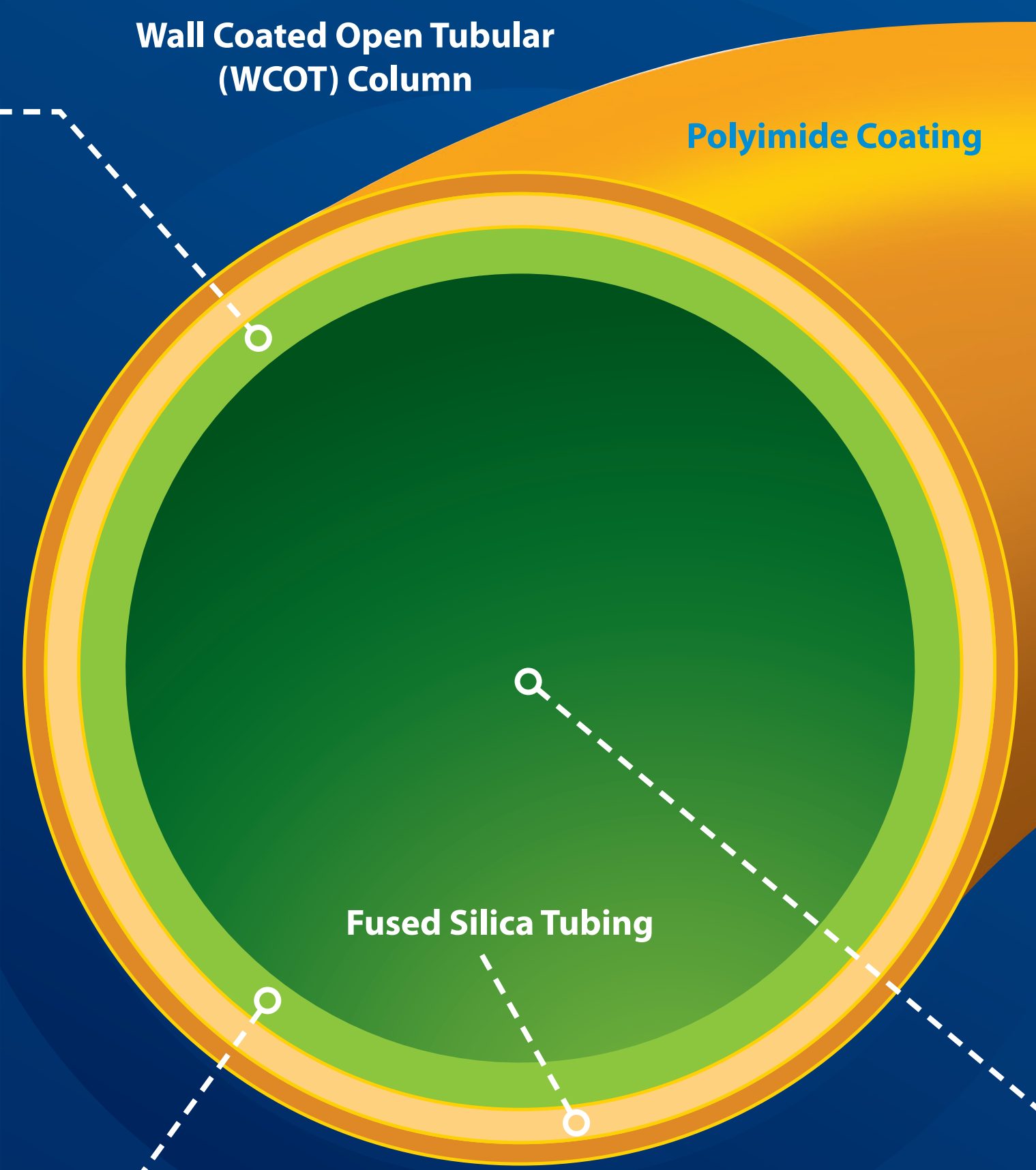
STATIONARY PHASE

Choosing the right stationary phase is the first step toward optimizing your separation. Resolution is most influenced by separation factor, which is affected by polarity and selectivity. When making your choice, consider:

- Target analyte and stationary phase interactions—resolution generally increases as solubility, molecular interactions, and retention increase.
- Expected maximum temperatures.
- Method requirements.

Nonpolar		Polar			
Proprietary (Silylene) Rxi®-55il MS	20% Diphenyl Rtx®-20	50% Phenyl Rtx®-50	65% Diphenyl Rtx®-65	Polyethylene Glycol Rtx®-Wax Stabilwax*	
5% Diphenyl Rxi®-5ms Rxi®-SHT Rtx®-5	Proprietary (Silylene) Rxi®-624SII MS	Proprietary (Silylene) Rxi®-35SII MS	Proprietary (Silylene) Rxi®-17SII MS	90% + Bis-Cyano Rtx®-2330	
100% Dimethyl Rxi®-1ms Rxi®-1HT Rtx®-1	Proprietary Rxi®-XLB	6% Cyano Rtx®-624 Rtx®-1301	35% Diphenyl Rtx®-35	50% Diphenyl Rxi®-17	
	Proprietary Rtx®-440	Trifluoropropyl Rtx®-200 Rtx®-200MS	14% Cyano Rtx®-1701	50% Cyano Rtx®-225	

In general, maximum operating temperature decreases as polarity increases.
Note that silylene columns typically differ in selectivity and have higher temperature limits than their conventional counterparts.



LENGTH

Short Length		Long Length
5 m–15 m	20 m–30 m	50 m–150 m
Characteristics • Good efficiency • Short analysis times	Characteristics • Better efficiency • Moderate analysis times	Characteristics • Best efficiency • Longer analysis times
Applications Samples with few compounds	Applications More complex samples	Applications Very complex samples

Longer Columns Can Increase Resolution...
Doubling the column length only increases resolution by approximately 41% because the column length is under the square root function in the efficiency term of the resolution equation.

But, Longer Columns Increase Cost and Analysis Time
On longer columns, analysis time is increased by as much as a factor of two. Longer columns are also more expensive.

FILM THICKNESS

Stationary phase film thickness (µm) directly affects retention, resolution, and elution temperature for each sample component. When changing either film thickness or the temperature program, you must reconfirm peak identifications as elution order changes can occur.

Thin Film	Thick Film
0.10 µm–0.50 µm	1.0 µm–10.0 µm
Characteristics • Shorter retention times • Lower bleed • Higher maximum temperatures • Lower sample loading capacity • High resolution for high molecular weight compounds	Characteristics • Longer retention times • Higher bleed • Lower maximum temperatures • Higher sample loading capacity • High resolution for volatiles and low molecular weight compounds
Applications Medium and high molecular weight compounds	Applications • Volatile, low molecular weight compounds • High concentration samples (e.g., purity testing)

As film thickness increases, retention, sample loading capacity, and column bleed increase; whereas, maximum temperature decreases.

ID INNER DIAMETER

Small ID		Large ID
0.15 mm–0.18 mm	0.25 mm–0.32 mm	0.53 mm
Characteristics • Highest efficiency • Shorter analysis time • Lower sample loading capacity	Characteristics • High efficiency • Good performance for analysis time and sample loading capacity	Characteristics • Good efficiency • Longer analysis time • Higher sample loading capacity • May require higher flow rates than MS detectors can tolerate
Applications • Highly complex samples • Fast GC • GC-MS • Split injection	Applications • Complex samples • Wide concentration range • Split, splitless, direct, headspace, and on-column injection	Applications • Packed column replacement • Purity analysis • Split, splitless, direct, headspace, and on-column injection

As inner diameter increases, efficiency decreases, sample loading capacity increases, optimal flow rate increases, and analysis time increases.

Visit www.restek.com for our complete line of general-purpose and application-specific GC columns.