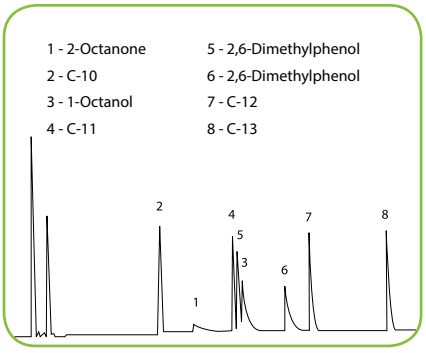
ERA-Chrom CAPILLARY COLUMNS

All of ERA-Chrom columns are manufactured according to a strict established protocol, and within the ISO 9001:2008 quality rules.

- Step 1: Hydrothermal treatment
- Step 2: Deactivation process
- Step 3: Wetting, bonding and crosslinking
- Step 4: Quality control

Step 1: Hydrothermal Treatment

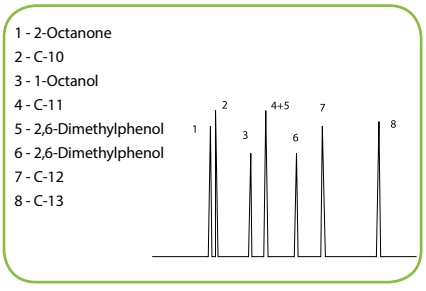
ERA-Chrom starts its manufacturing process with the selection of the best possible fused silica tubing. This tube presents an extremely reduced tolerance of internal diameters and has a polyimide outer coating capable of withstanding the highest temperatures without loss of its flexible mechanical characteristics. Each one of the batches of silica used in the process is conveniently characterized as an essential step to set the Hydrothermal Treatment conditions (Fig. 1) that will give rise to a surface containing a high and constant density of silanol groups, which will later be properly deactivated.
This treatment is indispensable, as the different capillary tubing manufactured batches present a very low and irregularly distributed silanol group density due to the high temperature manufacturing process (~2000ºC).



Verification of Hydrothermal Treatment

Step 2: Deactivation Process

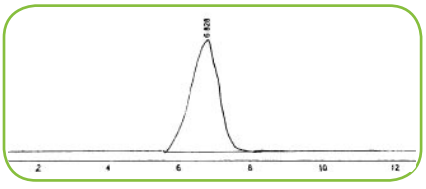
The deactivation process, which is different for each type of stationary phase, is carefully controlled (Fig. 2), ensuring that the tubing surface has acquired the necessary chemical inertness and surface tension in order to be able to proceed with the second stage of stationary phase deposition. This step also facilitates the introduction of specific functional groups on the tubing wall which are very useful for the later binding of the stationary phase or to give the columns a given end point characteristics.



Deactivation Stage (Intermediate Test)

Step 3: Wetting, bonding and crosslinking

Stationary phase selection for optimum wetting of the column is a critical point in regards to column quality. The column manufacturer uses extremely pure polymers for its phases, in order to guarantee that our columns will respond to the requirements that our customers expect in terms of efficiency, reproducibility, stability and minimal bleeding.
The polymers used are carefully fractionated to eliminate the low molecular weight components and trace catalyst. This results in a higher thermal stability and lower bleeding. Then, these polymers are tested by means of spectroscopic (FTIR, UV, NMR), chromatographic (GPC) techniques and by differential thermal analysis.
Fig. 3 shows the molecular exclusion chromatography of the polymer ERA-5 with its corresponding thermogravimetric curve in Fig. 4.
The crosslinking and bonding of the stationary phase is achieved by avoiding the use of peroxides which are the cause of many of the problems related to residual activity due to phase degradation and thermal instability exhibited in numerous imported columns.
The fact that a given stationary phase is crosslinked and/or chemically bonded to the capillary tube inner wall allows, if necessary, the recovery or regeneration of an accidentally contaminated column by washing it with the adequate series of solvents.

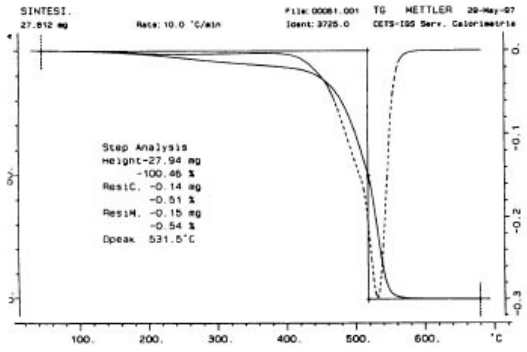


GPC Chromatogram of ERA-5 polymer

Step 4. Quality Control

Select proven quality

When you buy a ERA-Chrom capillary column you receive a product designed and manufactured with the aim to help you solve your analytical problems and which meets all of our quality criteria.
At the same time you obtain from our Technical Dept. at ERA-Chrom the assurance that we will be at your side to help you with all the problems and concerns experience in the lab.
Each column is individually tested and the accompanying test data is the proof that the column meets our quality specifications and thus we expect it to meet your demands. Each one of the columns obtained by this process is rigorously controlled by means of a strict Quality Control Test (Fig. 5 and 6), which ensures that you will receive a guaranteed quality product.

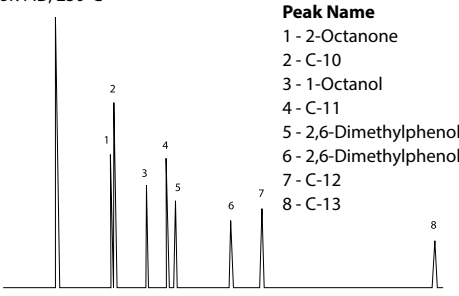


DTA Curve of ERA-5 polymer

Stationary Phase

The selection of the ideal column for a given analysis may look like a complex problem since we need to be right on the selection of the polarity of the stationary phase as well as column length, internal diameter and film thickness.
The polarity of the stationary phase is chosen depending on the kind of compounds you wish to separate. Non polar phases, such as ERA-1 and ERA-5, separate compounds by their boiling points. Intermediate polarity phases such as ERA-WAX, ERA-1701, combine retention by boiling point with the more selective interaction through hydrogen bridges or dipolar moments, etc., and thus provide a higher selectivity. The principal mechanisms of polar phases such as ERA-BCP100 (Cyanosilicone with 100% of cyano propyl groups) lie in the dipole-dipole interactions between the functional groups of the stationary phase and those from the substances to be separated. These type of phases retain polar compounds more than non polar ones.
In general, non polar phases are more thermally stable than the polar phases. In other words, the higher the column polarity, the lower its thermal stability. Most of ERA-Chrom columns are cross-linked, which results in high thermal stability. The cross-linking in a stationary phase produces slight changes in the physicochemical characteristics of the phase as well as in its polarity relative to the uncross-linked phase. Thus ERA-Chrom offers in its catalog columns with non bonded phases that show the selectivity of the original phase (for instance SE30, SE54, 20M, etc).

Column: ERA-5 60 m x 0.25 mm ID x 0.25 µm
Carrier gas: He, 25 psi.
Oven:110ºC (Isothermal).
Injection: 1µl, split. (1:100:250ºC)
Concentration: Aprox. 5ng of each compound on column
Detector: FID, 250ºC



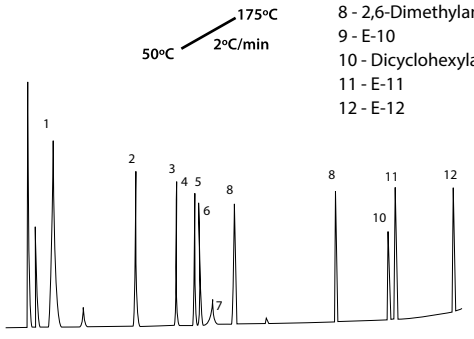
Peak Name
1 - 2-Octanone
2 - C-10
3 - 1-Octanol
4 - C-11
5 - 2,6-Dimethylphenol
6 - 2,6-Dimethylphenol
7 - C-12
8 - C-13

QUALITY CONTROL TEST

Length

The efficiency of a chromatographic column (number of theoretical plates per meter) is a function of its length. The standard length used for most of the separations is 25-30 meters. With this length one can obtain a high efficiency with relative short times of analysis. Columns of 15m are used for rapid control analyses, reaction monitoring, etc. as well as for the chromatography of high molecular weight substances while columns of 50-60 m, 100 m or 150 m are used for very complex samples.
ERA-Chrom exclusively has a 150 m column for detail analyses of petroleum and essential oil hydrocarbons.As a general rule, we can say that in a constant temperature chromatographic analysis, the number of theoretical plates and analysis time are directly proportional to the column length while resolution is directly proportional to the square root of the theoretical plates. Thus, we need to take into account that when we double column length, its resolution only increases by 40% whereas analysis time doubles.

Column: ERA-5 30 m x 0.25 mm ID x 0.25 µm
Carrier gas: He, 12 psi.
Injection: 1µl, split. (1:100), 260ºC
Detector: FID, 280ºC



Peak Name
1 - 2,3-Butanediol
2 - C-10
3 - 1-Octanol
4 - 2,6-Dimethylphenol
5 - C-11
6 - Nonanal
7 - 2-Ethylexanoic acid
8 - 2,6-Dimethylanine
9 - E-10
10 - Dicyclohexylamine
11 - E-11
12 - E-12

GROB test

Internal Diameter

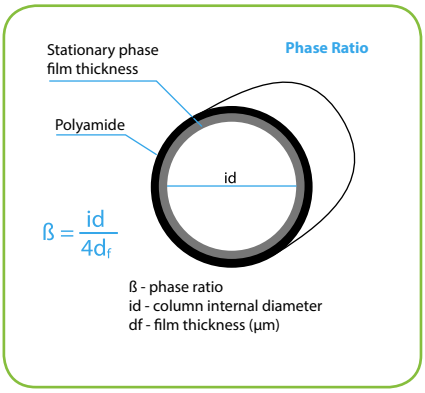
The column internal diameter is inversely proportional to its separation power. The smaller the diameter, the larger the efficiency and thus a higher resolution but at the same time the loading capacity decreases.
For samples containing a large number of substances where you may need a given resolution, it is recommended to use small internal diameter columns (0.20-0.25 mm) and for samples with a high range of concentrations higher internal diameter columns are recommended (0.32-0.53 mm) since these larger diameters allow for the injection of a higher sample amount.
Columns of 0.53 mm have a loading capacity similar to that of packed columns, which they replace in many analyzes, with better resolution, higher chemical inertness and lower analysis time.
The 0.32-0-53 mm ID columns can be used with either the injector for capillary columns or with the packed column injector, due to the high flow-rates at which they can operate.
In the increasingly used GC-MS systems it is recommended to work with small ID columns (0.10mm, 0.15mm, 0.18mm, 0.20 mm and 0.22 mm) so as not to exceed the capacity of the vacuum system.
Recently, capillary columns of 0.1 mm ID have appeared on the market.
These generate high plate numbers or, in other words, to reduce analysis time without losing resolution. The high efficiency of these columns (7000-10000 plates/meter) allows the resolution of complex samples using shorter column lengths, thus with very short analysis times, with the resulting cost reduction for the laboratory. Evidently, their loading capacity is a limiting factor and in order to obtain the best performance from these columns we need to take into account instrumental factors (injector-detector).

Film Thickness

The film thickness of the stationary phase deposited inside the capillary column exerts an influence on the number of effective theoretical plates that can be obtained with the column for a given separation, on its loading capacity, on the bleed level and on the elution temperature of a compound.
A film thickness of 0.25-0.32 mm is the standard thickness allowing for a compromise between loading capacity and resolution; and for the injection of samples with a wide volatility range.
Thick films increase retention of the most volatile components whereas thin films provide faster elution at lower temperatures. As a general rule, thin films (0.1 µm) must be used for compounds with a high molecular weight such as triglycerides, antioxidants, etc., which have elution temperatures over 300°C. Thick films must be used for low boiling substances because thick films increase the interaction between the substances and the stationary phase. Specifically, 3-5 µm films are used to separate solvents, gases, and very volatile substances at room temperature or lower.
When the thickness of the stationary phase increases, thermal stability decreases, and thus the bleed level is higher which will limit the maximum operating temperature of the column.
The ß factor defines the relation between the column internal diameter and the stationary phase thickness, thereby helping you to select the most appropriate column for your analysis.
In addition, the ß factor allows for the easy exchange of columns since, for a given analysis with the same stationary phase, similar ß factors will result in the same or very similar retention times and capacity factors. Of course, this implies taking into account the column loading capacity (phase thickness and internal diameter).

ß Factor

ß	Column suitable for the separation of:
>400	High molecular weight compounds
100	- 400 All purpose use
<100	Volatile compounds of low molecular weight



(Fig.7)

Bleed Level

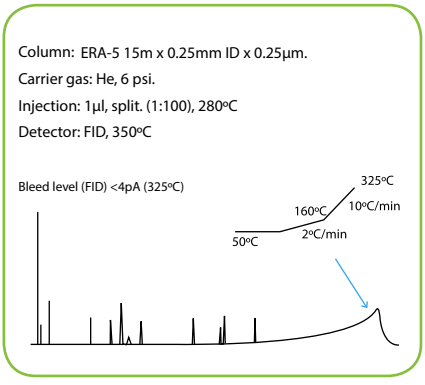
The bleed level of stationary phase from a capillary column is the parameter which will determine the level of sensitivity in a given assay. It is directly related to the amount of stationary phase in the column and thus with the film thickness. It also increases exponentially with temperature (Fig.7).
A low bleed level will allow you to work without problems with the whole range of modern high sensitivity detectors and at the same time will result in less contamination.
This will also allow the quantification of high boiling point or high molecular weight compounds which are analyzed by means of high temperature gradients.

Maximum Efficiency

All manufacturing stages for capillary columns have been optimized in order to be able to offer our customers columns of very high efficiency.

Maximum Reproducibility

When you select a ERA-Chrom column for your analyses you can be assured that each of the steps in thr production process has been thoroughly controlled to ensure that there are no deviations from the established quality parameters. All of the steps incorporate the maximum possible automation procedures.
This translates into a high reproducibility level with regards to the chromatographic performance of our columns.



BLEED LEVEL (GROB TEST)

Inter Internal diameter (mm)	Theoretical Plates (N/m)
0,10	7.000 - 9.000
0,20	4.700 - 5.500
0,25	3.300 - 4.600
0,32	2.700 - 3.700
0,53	1.400 - 2.200

Wide Stationary Phase Selection

ERA-Chrom Separation in its catalogue a selection of capillary columns prepared with the stationary phases most commonly used in the field of gas chromatography (see the next table).

LIST OF ERA-Chrom CAPILLARY COLUMNS AND SIMILAR PERFORMANCE PHASE CHART

ERA-Chrom	PHASE COMPOSITION	AGILENT	SUPELCO	RESTEK	VARIAN	SGE	ALLTECH	QUADREX	USP NOMENCL
ERA-1, ERA-1HT, ERA-1MS, ERA-S, ERA-POL, ERA-50.2PONA ERA-2887	100% dimethyl polysiloxane	HP-1, HP101, ULTRA-1, DB-1, DB-1ht, DB-2887	SPB-1, EQUITY-1 SPB-1 SULFUR	Rtx-1, Rtx-2887	CP-SIL 5 CB CP-SIL 5 CB MS	BP-1	AT-1	007-1	G1, G2, G38
ERA-5, ERA-5HT, ERA-5MS, ERA-STEROL, ERA-5AMINE, ERA-G27, ERA-5.625	95% dimethyl - 5% diphenyl polysiloxane	HP-5, ULTRA-2, DB-5, DB5.625, DB-5ht, PAS-5	SPB-5, EQUITY-5 PTE-5, SAC-5, PTE-5QTM	Rtx-5, XTI-5, Rtx-5 MS	CP-SIL 8 CB	BP-5	AT-5	007-2	G27, G36
ERA-MT.X5	95% dimethyl - 5% diphenyl polysilphenylene	HP-5TA, DB-5MS	MDN-5	Rtx-5Sil MS	CP-SIL 8 CB Low Bleed/MS	BPX-5	AT-5ms	007-5 MS	
ERA-1301, ERA-G43	6% cyanopropylphenyl-94% dimethyl polysiloxane	HP-1301, HP-624 DB-1301, DB-624	SPB-1301, OVI-43	Rtx-1301, Rtx-624		BPX-624	AT-624		G43
ERA-14	14% diphenyl-86% dimethyl polysiloxane				CP-SIL13CB				
ERA-20	20% diphenyl-80% dimethyl polysiloxane		SPB-20, VOCOL				AT-20	007-7	G28, G32
ERA-35	35% diphenyl-65% dimethyl polysiloxane	HP-35, DB-35	SPB-35	Rtx-35		BPX-35, BPX-608	AT-35	007-11	G42
ERA-1701	14% cyanopropylphenyl-86% dimethyl polysiloxane	HP-1701, PAS-1701, DB-1701	SPB-1701	Rtx-1701	CP-SIL19CB	BP-10	AT-1701	007-1701	
ERA-225	50% cyanopropylphenyl-50% dimethyl polysiloxane	HP-225, DB-225		Rtx-225	CP-SIL43CB	BP-225	AT-225	007-225	G7, G19
ERA-PAG	50% poluethylene - 50% polypropylengycol		PAG						
ERA-FFAP	treated polyethyleneglycol for acidic compounds	HP-FFAP, DB-FFAP	NUKOL, SP-1000	STABILWAX-DB	CP-WAX 58 CB	BP-21	AT-1000, FFAP	007-FFAP	G25, G35
ERA-50	50% diphenyl-50% dimethyl polysiloxane	HP-50+, DB-17, DB-608	SPB-50, SPB-2250	Rtx-50	CP-SIL 24 CB		AT-50	007-17	G3
ERA-50HT	50% diphenyl-50% dimethyl polysiloxane	DB-17ht		Rtx-65	TAB-CB			007-65HT	G17
ERA-F50	50% trifluoropropylmethyl polysiloxane	DB-210, DB-200		Rtx-200			AT-210	007-210	G6
ERA-WAX	100% polyethylenglycol	HP-20M, INNOWAX DB-WAX, DB-WAXetr	SUPEL-COWAX-10 Carbowax 20M	STABILWAX	CP-WAX 52 CB	BP-20	AT-WAX	007-CW	G14, G15, G16, G20, G39
ERA-WAX.PL	treated polyethylenglycol for basic compounds	CAM, HP-BasicWax	Carbowax-Amine		CP-WAX 51 CB				
ERA-MT.WAX	100% polyethylenglycol	HP-WAX, DB-WAX			CP-WAX 57 CB				
ERA-OmegaTWAX	100% polyethylenglycol		OMEGAWAX	FAMEWAX					
ERA-BCP100	100% biscyanopropyl polysiloxane		SP-2340	Rt-2340	CP-SIL 88				
ERA-CRESOL	non bonded phase				CP-CRESOL				
ERA-17	50% diphenyl-50% dimethyl polysiloxane	HP-17							G3
ERA-MTV	bonded phase	DB-502.2, HP-VOC	VOCOL	Rtx-502.2					
ERA-608	bonded phase	HP-608	SPB-608			BP-608			
ERA-TCEP	1,2,3-tris (cyanoethoxy)propane		TCEP	Rt-TCEP	CP-TCEP				

ERA-Chrom PHASE RECOMMENDATIONSCHART			
ERA-Chrom Phase	**Application**	**Composition**	**Polarity**
ERA-1, ERA-1HT, ERA-1MS	Amines, hydrocarbons, pesticides, PCBs, phenols, sulfur compounds, flavors and fragrances	100% Dimethylpolysiloxane	Non-polar
ERA-5, ERA-5HT, ERA-5MS	Semivolatiles, alkaloids,drugs, FAMEs, halogenated compounds, pesticides, herbicides	5% Phenyl 95% dimethylpolysiloxane	Non-polar
ERA-1701	Pesticides, herbicides, derived sugars, solvent drugs, aromatic hydrocarbons	86% dimethylpolysiloxane 7%phenyl, 7% cyanopropyl	Mid-polar
ERA-WAX, ERA-WAX.PL, ERA-MT.WAX	FAMEs, aromas, solvents, BTEX, alcohols, xilene isomers, alcoholic drinks, aromatics, glycols	100% Polyethylene glycol	Polar
ERA-FFAP	FAMEs, free acids, phenols, fragrances, acrilates, glycols	Polyethyleneglycol esterified with nitroterephthalic acid	Polar
ERA-20	Organic volatile compounds, alcoholic drinks, aromatic products	80% dimethylpolysiloxane 20% diphenyl	Mid-polar
ERA-5.AMINE	Specially column for the analysis of amines	95% dimethylpolysiloxane 5% diphenyl	Non-polar
ERA-225	FAMEs, alditol acetates, neutral sterols	50% dimethylpolysiloxane 25% phenyl, 25% cyanopropyl	High-Mid Polar
ERA-5.625	EPA methods to the analysis of semi volatile compounds	95% dimethylpolysiloxane 5% diphenyl	Non-polar
ERA-35	CLP-pesticides, aroclors, pharmaceuticals, drugs of abuse, amines	65% dimethylpolysiloxane 35% diphenyl	Low-Mid-polar
ERA-608	Specifically designed for analysing chlorinated pesticides and PCBs. Designed for the EPA 508, 608 and 8080 methods	Propietary bonded and crosslinked phase	Non-polar
ERA-50, ERA-50HT	Drugs, glycols, pesticides, steroids, waxes, triglicerydes	50% diphenyl-50% dimethylpolysiloxane	Mid-polar
ERA-PAG	FAMEs, solvents, aromas	50% Polyethylene, 50% Polyepropylenglycol	Polar
ERA-F50	Residual solvents, pesticides, herbicides	35% Trifluoropropyl- 65% dimethyl polysiloxane	Polar
ERA-1301	Pesticides, arochlors, organic volatiles	94% dimethylpolysiloxane 6% cyanopropylphenyl	Mid-polar
ERA-624	Volatile priority pollutants, EPA Method 502.2	6% Cyanopropyl-phenyl, 94% dimethylpolysiloxane	Polar
ERA-14	Pesticides, phenols, halogenated compounds	86% dimethylpolysiloxane 14% diphenyl	Low-Mid-polar
ERA-MT.X5	Semi volatile compounds analysis	Silarylene	Non-polar
ERA-BCP100	FAMEs (cis trans isomers), derived sugars, PCB's, dioxins	100% Cyanopropyl Polysiloxane	Polar
ERA-POL	Analysis of complex mixtures of hydrocarbons according to the ASTM Standards	100% dimethylpolysiloxane	Non-polar
ERA-50.2PONA	Analysis of hydrocarbons (Paraphine, Olephine, Naftens and Aromatics)	100% dimethylpolysiloxane	Non-polar
ERA-S	Analysis of sulphurous compounds (natural gas, petrol, wines, beers…)	100% dimethylpolysiloxane	Non-polar
ERA-G43	Made to fulfil the specifications of the American Pharmacopea (USP) for the analysis of residual solvents	94% dimethylpolysiloxane, 6% cyanopropylphenyl	Mid-polar
ERA-G27	Produced to fulfil the American Pharmacopea's (USP) specifications, for the organic volatiles impurities' test in pharmacs	95% dimethylpolysiloxane 5% diphenyl	Non-polar
ERA-STEROL	Complex mixtures analysis of sterols, from animal or vegetal origin	95% dimethylpolysiloxane 5% diphenyl	Non-polar
ERA-2887	Suitable column for SIMDIS evaluation based on ASTM Test Method D2887	100% dimethylpolysiloxane	Non-polar
ERA-MT.WAX	Analysis of volatiles in alcoholic beverages and solvents. Maximum resolution of amylic alcohols.	100% Polyethylene glycol	Polar
ERA-17	Drugs, glycols, pesticides, steroids	50% diphenyl-50% dimethylpolysiloxane	Low-Mid-polar
ERA-CRESOL	For the analysis of phenol compounds (phenols, cresilic acids)	Stationary Phase non bonded	Polar
ERA-OmegaTWAX	FAMEs, Waxes	100% Polyethylene glycol	Polar
ERA-TCEP	Analysis of alcohols in gasoline	Phase1, 2, 3-tris (2-cyanoethoxy) propane	Polar

ERA-Chrom STANDARD PHASE COLUMNS

0.10 mm ID Columns - Polyimide coated

Phase code	Film Thickness (microns)	Length (m) 10	15	20	40
ERA-1	0,1	ERA001905		ERA001912	
	0,2				ERA001988
	0,4	ERA001929		ERA001931	ERA001933
ERA-5	0,1	ERA002029		ERA002036	
	0,17	ERA002105			
	0,33	ERA002120			
	0,4	ERA002053		ERA002056	
ERA-1701	0,1			ERA002137	
	0,4			ERA002145	
ERA-WAX	0,1	ERA002176		ERA002179	
	0,2	ERA002215		ERA002218	
ERA-FFAP	0,1			ERA002219	
ERA-225	0,1			ERA002310	
ERA-50	0,1	ERA002513		ERA002514	
	0,2	ERA002541			
ERA-1MS	0,1	ERA002543		ERA002544	
ERA-5MS	0,1	ERA002583		ERA002586	
	0,4	ERA002593		ERA002594	
ERA-MT.WAX	0,1	ERA002733		ERA002734	
	0,2	ERA002756		ERA002758	
ERA - MT.X5	0,4	ERA002775			
ERA-XWAX-280	0,1	ERA002798	ERA002797	ERA002799	
	0,2		ERA002825	ERA002830	

0.20 mm ID Columns - Polyimide coated

Phase code	Film Thickness (microns)	Length (m) 12	15	25	30	50	60
ERA-1	0,15		ERA001976	ERA001977	ERA001978	ERA001979	ERA001980
	0,33	ERA002006		ERA002004		ERA002005	
	0,35		ERA001923	ERA001924	ERA001925	ERA001927	ERA001928
	0,5		ERA001938	ERA001942	ERA001946		ERA001954
ERA-5	0,15		ERA002095	ERA002096	ERA002097	ERA002098	ERA002099
	0,33	ERA002122		ERA002119		ERA002121	
	0,35		ERA002047	ERA002048	ERA002049	ERA002050	ERA002052
	0,4						ERA002055
	0,5		ERA002061	ERA002065	ERA002069	ERA002073	ERA002077
ERA-1701	0,2		ERA002168		ERA002169		ERA002171
ERA-WAX	0,2		ERA002213		ERA002214		ERA002217
	0,4		ERA002186		ERA002187		ERA002189
	0,5		ERA002190				
ERA-FFAP	0,3		ERA002237		ERA002238		ERA002239
ERA-225	0,2		ERA002321	ERA002322	ERA002323		
ERA-5.625	0,33	ERA002351		ERA002348		ERA002349	
ERA-1MS	0,33	ERA002577	ERA002572	ERA002573	ERA002574	ERA002575	ERA002576
ERA-5MS	0,11			ERA002580			
	0,33	ERA002621	ERA002616	ERA002617	ERA002618	ERA002619	ERA002620
ERA-624	1,12			ERA-002652			
ERA-MT.WAX	1,4				ERA002754		
ERA-MT.X5	0,33	ERA002796		ERA002794		ERA002795	
ERA-XWAX-280	0,2		ERA002826		ERA002827		ERA002829
	0,4						ERA002807

Ordering Information

Custom Standard Quotations – Direct Purchase orders	e-mail: info@erachrom.com
Shipping	Shipments via courier.
Payment	1) Credit Card 2) Pre-Pay - Proforma Invoice 3) TT in advance prior to shipment
Terms and Conditions of Sales	Prices are EXW DUS. Prices are subject to change without notice. The purchase of a ERA-Chrom product assumes the acceptance of ERA-Chrom's "General Sales Terms and Conditions". This information is available in our web site (www.erachrom.com) and upon request.
Minimum Order	Minimum order is 1.000,00 EUR .
Warranty	All ERA-Chrom Chromatography products come with a three months warranty. ERA-Chrom products are available only through authorized distributors. No warranties, claims for damages, or other claims will be honored if products are purchased through unauthorized channels.
Technical Service	Contact your local ERA-Chrom Distributor or e-mail: info@erachrom.com for any technical question
Return Policy	If it is necessary to return material, please contact your local ERA-Chrom Distributor or e-mail: info@erachrom.com for a Return Authorization Form and shipping instructions.

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