



FLUID BED PROCESSING

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ACHIEVE SUPERIOR RESULTS FOR FLUID BED COATING & GRANULATION

A **fluidized bed** occurs when a quantity of solid particles (generally contained in a holding vessel, most commonly a fluid bed processor) are placed under appropriate conditions to cause the mixture to behave as a fluid. This is typically done by forcing pressurized air, gas, or other fluids through the bed of solid particles. This causes the solid medium to acquire properties and attributes similar to those of normal fluids, resulting in what is known as **fluidization**.

Fluidized beds are commonly used in the pharmaceutical industry to dry, granulate, and coat any number of different active pharmaceutical ingredients (APIs), excipients, or other formulations.



FLUID BED GRANULATION

The fluid bed granulation process (also known as agglomeration) involves suspending particles in an air stream and spraying a liquid from the top of the system down onto the fluidized bed (**top-down spray**). Particles in the path of the spray get slightly wet and become sticky. The sticky particles collide with other particles in the bed of material and adhere to them to form granules. There are two different modes of fluid bed granulating: **wet stage** and **dry stage**.

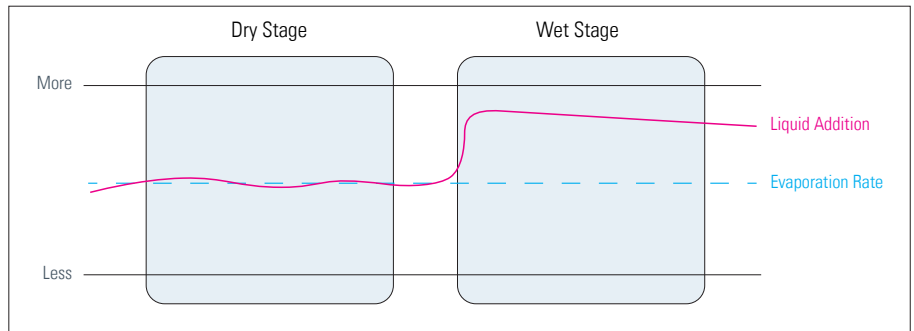
DRY STAGE GRANULATION

In dry stage granulation, the particles only require a slight wetting to become tacky and stick to each other. The granulating solution is applied at a rate less than or equal to its evaporation rate. Thus, the particles remain "dry" through the entire process.

WET STAGE GRANULATION

In wet stage granulation, the particles require a significant amount of moisture or granulating solution before they become tacky enough to stick to each other. The granulating solution is applied at a rate higher than the evaporation rate until the particles build up enough moisture to granulate.

Note: The characteristics of the particles when wet and the type of granulating solution being used will determine which mode of granulating is most appropriate. While dry stage is more common, wet stage granulating allows for denser products.



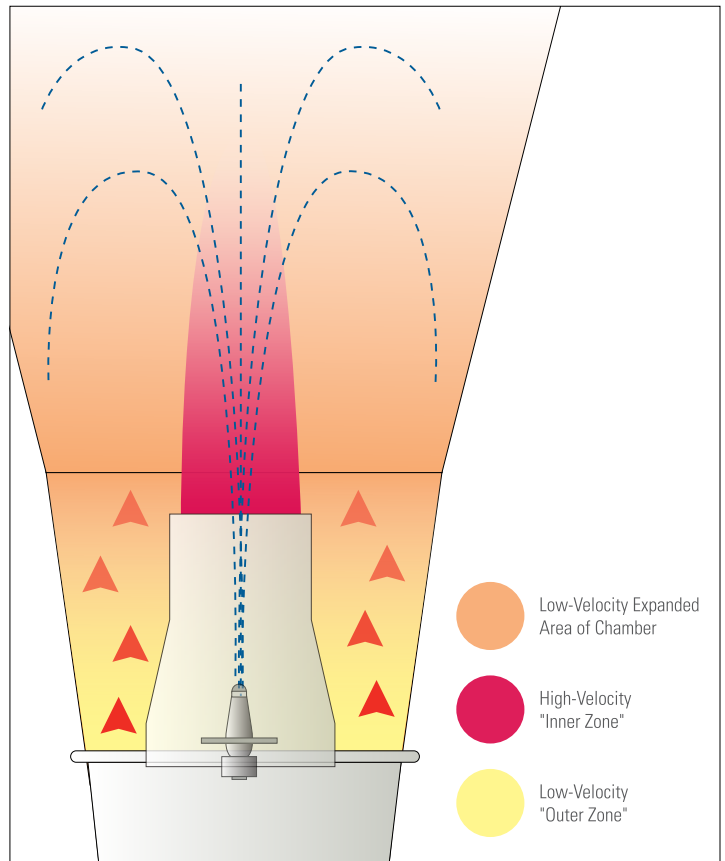
WURSTER COATING (FLUID BED COATING)

The Wurster process has been used for years to coat particles, spheres, granules, and tablets. Systems have been developed for use with a variety of coating formulations, including aqueous/organic solvents, hot saturated solutions and hot melts.

The basic concept in Wurster coating is to separate the particles in the fluid bed from one another in an air (gas) stream. While the particles are suspended, a coating formulation is sprayed from the bottom of the bed up onto the particles (**bottom-up spray**).

The process takes place inside a specially modified fluid bed that is divided into two zones by a partition. The inner area is a high velocity zone that separates the particles and pneumatically transports them past the spray nozzle. After passing the nozzle, the particles enter the expanded area of the chamber, slow down and fall back into the outer section of the fluid bed product bowl. The coating dries while the particles are suspended to prevent agglomeration from occurring when they enter the tranquil part of the bed.

The coated particles in the tranquil storage area remain fluidized just enough to allow them to continue moving towards the bottom of the bowl. When the particles reach the bottom, they are drawn back into the high velocity air stream and the cycle is repeated. This process continues until the desired level of coating has been achieved.



Wurster Process inside a fluid bed. The path of the particles in the air stream is illustrated by the dashed blue lines. The red triangles represent the fluidizing gas.

R&D SCALE

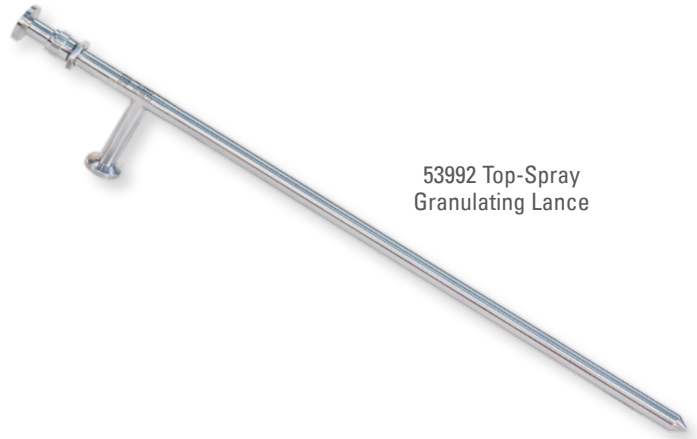
53992 TOP-SPRAY GRANULATING LANCE

PRODUCT OVERVIEW

Designed for use in R&D scale fluid bed dryers/granulators, and spray dryers, the completely customizable 53992 Top-Spray Granulating Lance is available in a range of orifice sizes to provide precision granulation and spray drying.

FEATURES AND BENEFITS

- For R&D scale applications
- 316SS construction
- Available in .016", .020", .028" and custom orifice sizes
- Spray pattern: full circular cone (top-down spray)
- Welded air cap and seamless tubing
- Sanitary design and connections
- Anti-bearding feature to ensure optimal performance
- Available with insertion graduations

53992 Top-Spray
Granulating Lance**SPRAY TIP: ENHANCE THE PERFORMANCE
OF R&D SCALE FLUID BED GRANULATORS**

Get the most out of your R&D scale fluid bed system with the new 53992 Top-Spray Granulating Lance. Available at custom lengths and with insertion graduations to ensure optimal spray height for fluid bed granulation, the lance is designed to provide superior spray performance and improve batch uniformity.



DIMENSIONS — 53992 TOP-SPRAY GRANULATING LANCE

	A in. (mm)	B in. (mm)	C in. (mm)
	33.63 (854.20)	30.00 (762.00)	2.38 (60.45)

PERFORMANCE DATA

Data on Spray Set-Up(s)	Type of Data	Available Spraying Material(s) for Data Type
CP53992-301 (.016" / 0.4 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
CP53992-302 (.020" / 0.5 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
CP53992-303 (.028" / 0.7 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®

PRODUCTION SCALE

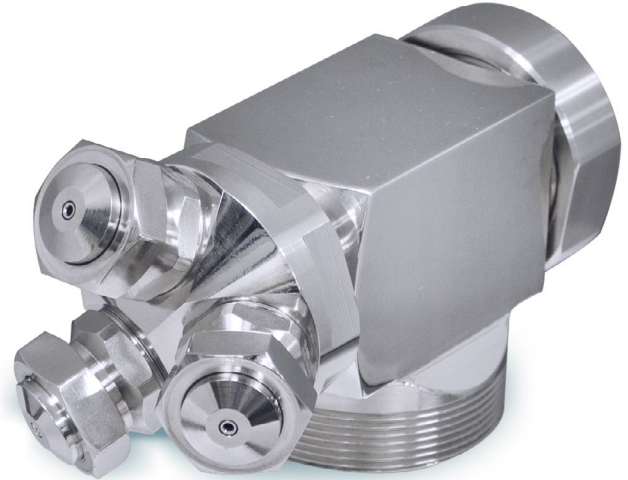
46920/46925 TOP-SPRAY GRANULATING NOZZLES

PRODUCT OVERVIEW

Our production scale top-spray granulating nozzles are intended for use in larger-size fluid bed granulators. Engineered with a three or six-orifice “cluster-head” configuration, the nozzle produces a fine spray for consistent, uniform granulation, even at larger batch sizes.

FEATURES AND BENEFITS

- For pilot/production scale applications
- Fine spray
- Materials: 316L stainless steel, FDA-approved EPDM O-rings and Teflon® gaskets
- Modular design for quick disassembly
- Spray pattern: wide cone (top-down spray)
- Models available with air-actuated liquid shut-off feature (46925 Only)



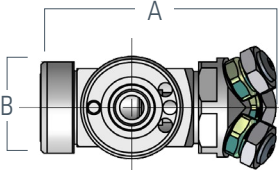
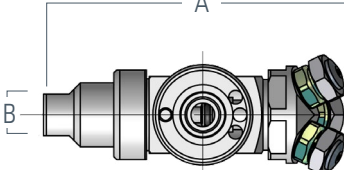
46920 Top-Spray Granulating Nozzle

SPRAY TIP: RETROFIT EXISTING MACHINES FOR SUPERIOR GRANULATION

Production scale top-spray granulating nozzles are designed to replace old or worn nozzles supplied with large batch fluid bed granulating systems, and are available with customizable lance configurations to fit your system’s exact specifications.



DIMENSIONS — 46920 / 46925 TOP-SPRAY GRANULATING NOZZLES

46920 (No liquid shut-off)	46925 (With liquid shut-off)	Nozzle Number	A in. (mm)	B Flats in. (mm)
		46920	4.66 (118.36)	1.75 (44.45)
		46925	6.04 (153.42)	0.81 (20.57)

PERFORMANCE DATA

Data on Spray Set-Up(s)	Type of Data	Available Spraying Material(s) for Data Type
SU1A (.016" / 0.4 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
SU1 (.020" / 0.5 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
SU2A (.020" / 0.5 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
SU2 (.028" / 0.7 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
SU4 (.060" / 1.5 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
SU5 (.100" / 2.5 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®

ORDERING INFORMATION — 46920 / 46925 TOP-SPRAY GRANULATING NOZZLES

To order, select either model 46920 or 46925, spray-set up (see above), and materials.

Example

Model Number	—	Material Code	46925	—	316EPF
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Material Code

316EPF = FDA EPDM

316SS = 316 stainless steel

SPRAY SET-UP

Example

Set-Up Number	—	Material Code	SU1A	—	316SS
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R&D SCALE

7/16-20-FBCAU(S)-___-316L

FLUID BED COATING NOZZLES

PRODUCT OVERVIEW

Our R&D scale fluid bed coating nozzles are designed to provide superior Wurster coating performance for R&D scale fluid bed coating systems.

FEATURES AND BENEFITS

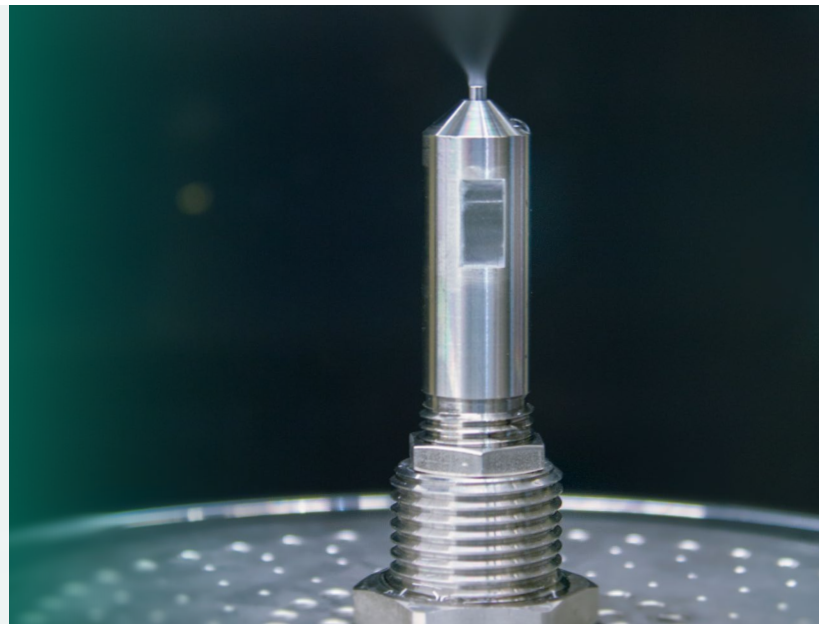
- For R&D scale applications
- Available in 2 options - long and short
- Medium to fine spray
- Materials: 316L stainless steel, EPDM O-rings, FDA-approved Teflon® gaskets
- 0.020", 0.032", 0.040", 0.047" and custom nozzle orifice sizes available
- Spray pattern: full circular cone (bottom-up spray)
- Anti-bearding setups



7/16-20-FBCAUS-___-316L
Short Fluid Bed
Coating Nozzle

SPRAY TIP: USE MULTIPLE NOZZLES FOR LARGER COATING APPLICATIONS

R&D scale fluid bed nozzles are designed for small-scale fluid bed coating applications— specifically Wurster coating— requiring only one spray nozzle.



DIMENSIONS — 7/16-20-FBCAU-___-316L & 7/16-20-FBCAUS-___-316L FLUID BED COATING NOZZLES

Nozzle Number	A in. (mm)	B in. (mm)	C in. (mm)	D Flats in. (mm)
7/16-20-FBCAU	7.04 (178.82)	4.79 (121.67)	1.64 (41.66)	1.12 (28.58)
7/16-20-FBCAUS	4.76 (120.90)	2.69 (68.33)	1.64 (41.66)	

PERFORMANCE DATA

Data on Spray Set-Up(s)	Type of Data	Available Spraying Material(s) for Data Type
VAR. 001 (.020" / 0.5 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
VAR. 002 (.032" / 0.8 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
VAR. 003 (.040" / 1.0 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
VAR. 004 (.047" / 1.2 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®

ORDERING INFORMATION — 7/16-20-FBCAU-___-316L FLUID BED COATING NOZZLES

To order, specify nozzle number, set-up and material code.

Example

Nozzle Number	—	Set-Up Number	—	Material Code
7/16-20-FBCAU	—	001	—	316L

Material Code
316L = 316L Stainless Steel

PILOT SCALE

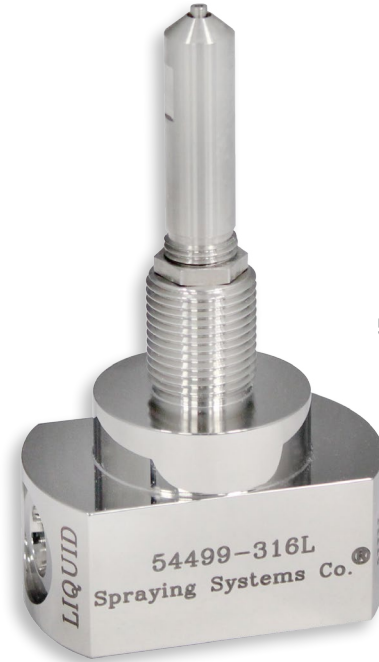
54499 FLUID BED COATING NOZZLES

PRODUCT OVERVIEW

Intended to replace existing nozzles in pilot and small production scale fluid bed systems, 54499 fluid bed coating nozzles provide superior spray performance and are designed to meet your system’s exact specifications.

FEATURES AND BENEFITS

- For pilot/production scale applications
- Fine spray
- Materials: 316L stainless steel, EPDM O-rings, FDA-approved Teflon® gaskets
- 0.047" and 0.059" nozzle orifice sizes available
- Spray pattern: narrow full cone (bottom-up spray)



54499 Fluid Bed Coating Nozzle

SPRAY TIP: SIMPLIFY SCALE-UP TO LARGER BATCH SIZES

Pilot scale fluid bed coating nozzles are designed to minimize the challenge of scale-up from small R&D applications to larger pilot and production scale batches. 54499 pilot scale fluid bed coating nozzles retain the same fluid tip size as the smaller, R&D scale nozzles, making it simple to achieve the same results in larger systems.



DIMENSIONS — 54499 FLUID BED COATING NOZZLES

A* in. (mm)	B* in. (mm)	C* in. (mm)	D in. (mm)	E dia. in. (mm)	F in. (mm)	G in. (mm)
4.50 (114.30)	2.75 (69.85)	1.87 (47.50)	0.06 (1.52)	2.50 (63.50)	1.09 (27.69)	1.50 (38.10)

*Custom lengths available.

PERFORMANCE DATA

Data on Spray Set-Up(s)	Type of Data	Available Spraying Material(s) for Data Type
VAR. 001 (.047" / 1.2 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Spray Velocity	Water / OPADRY®
VAR. 002 (.059" / 1.5 mm Orifice)	Coverage and Flow Rate	Water / OPADRY®
	Drop Size Information	Water / OPADRY®
	Spray Velocity	Water / OPADRY®

ORDERING INFORMATION — 54499 FLUID BED COATING NOZZLES

To order, specify nozzle number, set-up and material code.

Example

Nozzle Number	—	Set-Up Number	—	Material Code
54499	—	001	—	316L

Material Code

316L = 316L Stainless Steel

PRODUCTION SCALE
46910 / 46915 FLUID BED COATING
NOZZLES

PRODUCT OVERVIEW

Intended to replace existing nozzles already in use in larger pilot or production scale fluid bed systems, our customizable production scale fluid bed coater nozzles are designed to improve your Wurster coating application.

FEATURES AND BENEFITS

- For pilot/production scale applications
- Fine spray
- Materials: 316L stainless steel, EPDM O-rings, FDA-approved Teflon® gaskets
- 1.5mm, 2.2mm and 4.0mm nozzle orifice sizes available
- Spray pattern: narrow full cone (bottom-up spray)
- Models available with air-actuated liquid shut-off feature (46915 Only)
- Custom nozzle lengths available



46915 Fluid Bed
Coating Nozzle

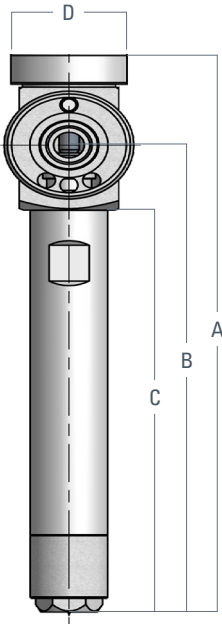
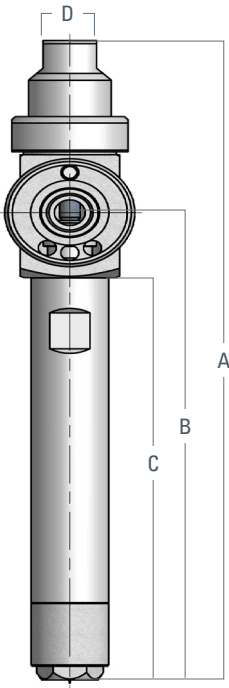
**SPRAY TIP: CUSTOM LANCE ASSEMBLIES
AVAILABLE FOR FLUID BED COATERS**

In addition to fluid bed coating nozzles, we are able to manufacture customizable lance assemblies to fit your existing fluid bed system.

To view a specification sheet, click on the link above.



DIMENSIONS — 46910 / 46915 FLUID BED COATING NOZZLES

46910 (No liquid shut-off)		46915 (With liquid shut-off)		
				
Nozzle Number	A* in. (mm)	B* in. (mm)	C* in. (mm)	D Flats in. (mm)
46910	10.37 (263.40)	8.50 (215.90)	7.01 (178.05)	1.75 (44.45)
46915	11.75 (298.45)	8.50 (215.90)	7.01 (178.05)	0.81 (20.57)

*Custom lengths available. For 46910 and 46915 Wurster Coating Nozzles, length B determines both length A and C. Choose length B based on your system's requirements.

PERFORMANCE DATA

Data on Spray Set-Up(s)	Type of Data	Available Spraying Material(s) for Data Type
VAR. 001 (.059" / 1.5 mm Orifice)	Coverage and Flow Rate	Water
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
VAR. 002 (.086" / 2.2 mm Orifice)	Coverage and Flow Rate	Water
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®
VAR. 003 (.157" / 4.0 mm Orifice)	Coverage and Flow Rate	Water
	Drop Size Information	Water / OPADRY®
	Relative Span Factor	Water / OPADRY®

ORDERING INFORMATION — 46910 / 46915 FLUID BED COATING NOZZLES

To order a complete 46910 / 46915 fluid bed coating nozzle, first specify a nozzle assembly. Then, use the chart below and the performance data on the previous page to determine the appropriate fluid cap and air cap to complete your nozzle.

NOZZLE ASSEMBLY

Choose either model number 46910 (no liquid shut-off) or model 46915 (with liquid shut-off) and specify an extension length.

Example

Model Number	-	Extension Length	-	Material Code
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46915 - **8.5*** - **316EPF**

Material Code

316EPF = FDA EPDM

316L = 316L stainless steel

*Custom lengths available. Specify extension length based on your system's requirements.

VARIATION TABLE

Set-Up Number	Fluid Cap Number	Air Cap Number
VAR. 001 (.059" / 1.5 mm Orifice) <i>Consists of:</i>	WF15-316L (1.5 mm Orifice) +	WA95-316L (9.5 mm Orifice)
VAR. 002 (.086" / 2.2 mm Orifice) <i>Consists of:</i>	WF22-316L (2.2 mm Orifice) +	WA95-316L (9.5 mm Orifice)
VAR. 003 (.157" / 4.0 mm Orifice) <i>Consists of:</i>	WF40-316L (4.0 mm Orifice) +	WA95-316L (9.5 mm Orifice)

FLUID CAP

Reference the performance data and use the table above to select the appropriate size fluid cap and air cap for your application.

Example

Fluid Cap Type	Fluid Cap Number	-	Material Code
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WF **15** - **316L**

AIR CAP

Example

Fluid Cap Type	Fluid Cap Number	-	Material Code
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WA **95** - **316L**