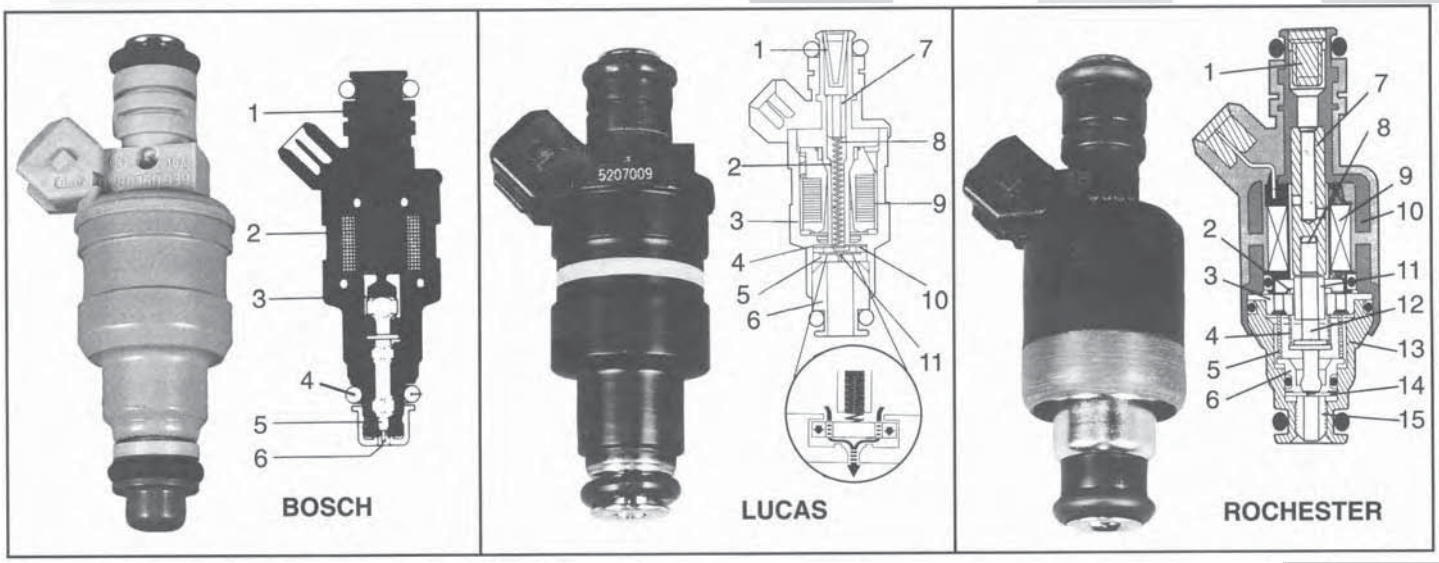
EFI INJECTORS

THERE ARE THREE TYPES OF DESIGN FOR EFI INJECTORS - PINTLE, DISC, and BALL :



PINTLE TYPE

Controls fuel flow by moving a pintle in and out of the fuel orifice. The pintle also atomizes the fuel by dispersing the fuel in a cone shaped pattern. These spray patterns will generally vary from 15 to 30 degrees of included angle dependent upon the injector selected. Fuel atomization is very good with these injectors.

1 - Filter
2 - Magnetic winding
3 - Solenoid
4 - O-ring
5 - Needle valve pintle
6 - Spray tip

DISC TYPE

Controls fuel flow by lifting a disc off of its seat. The disc has as many as six holes around its circumference. When the injector is activated,the disc is raised and fuel flows through the holes and exits out the orifice. The disc in this injector may actually rotate while the injector is operating. The spray pattern of this type of injector will generally vary for 10 to 20 degrees. These narrower spray patterns can aid in targeting the fuel. Fuel atomization is typically not as fine as the pintle type injector.

1 - Filter
2 - Core
3 - Body
4 - Shim
5 - Valve seat
6 - Nozzle
7 - Calibration slide
8 - Spring
9 - Coil assembly
10 - Spacer
11 - Disc

BALL TYPE

Controls fuel flow by raising a ball off its seat. This allows fuel to flow through the seat orifice and then out through a fixed director plate with several holes. The director plate serves to direct the fuel spray pattern. This type of injector has a 10 to 15 degree included angle spray pattern. The fuel atomization of this type of injector is similar to the disc type injector. Disc and ball type injectors by design are less susceptible to clogging. We have not experienced any clogging problems provided that the fuel is filtered. (See Kinsler Fuel Filters on Pages #162-166).

1 - Filter
2 - Guide ring
3 - Spacer
4 - Core spring
5 - Seat spring
6 - Seat
7 - Pole piece
8 - Stop
9 - Solenoid coil
10 - Solenoid body
11 - Core ring
12 - Core
13 - Spray tip housing
14 - Director
15 - Spray tip

SIEMENS DEKA

THE BASICS OF AN EFI INJECTOR

An EFI injector is a electronically controlled solenoid that controls fuel flow through an orifice. When the solenoid is activated, the orifice is exposed allowing fuel to flow. EFI injectors are available with various flow capacities. The injectors are electronically pulsed, typically measured in milliseconds (thousandths of a second), to control the amount of fuel delivered to the engine.

The percentage of time that the injector is pulsed is called the duty cycle. 100% duty cycle or Static Flow means the injector is open all the time. Static flows for injectors are specified at a certain pressure level. The test pressure rating may be in PSI, BAR, KPA, or KG/CM^2. Manufactures rate their injectors at different pressures. For accurate comparison of flow rates, be sure you are comparing flows at the same pressure levels, (see Fuel Flow versus Fuel Pressure - Page #138).

When properly sized for a specific application the injector will normally operate at 80-90% duty cycle. Injectors that are too large will not accurately deliver small amounts of fuel for good idle quality. Injectors that are too small may cause severe engine damage because of lean mixtures at large throttle openings and/or high engine RPM.

Kinsler Fuel Injection, Inc. 1834 THUNDERBIRD TROY, MICHIGAN 48084 U.S.A.
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EFI INJECTORS

ELECTRICAL DIFFERENCES

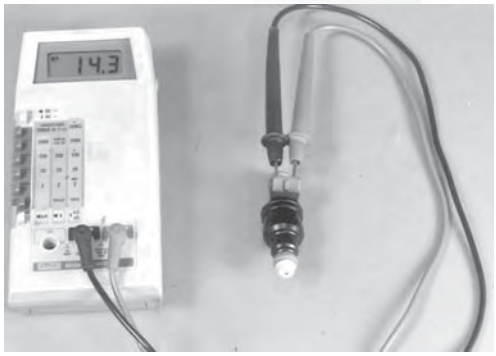
The solenoid inside an injector can be classified into one of two basic groups: low resistance or high resistance. The resistance of an injector coil can be measured with an ohm meter by attaching the meter leads to the two terminals on the injectors.

Low resistance injectors

Also referred to as *peak* and *hold*, measure between 2 and 5 ohms resistance. The drive circuit for these injectors are called current sensing or current limiting. A *peak* current is used to quickly open the injector, then a much lower *hold* current is used to maintain the open condition while reducing overall current draw.

High resistance injectors

Also referred to as saturation injectors, measure 12-16 ohms. The injector drivers for these injectors are called saturation drivers. These drivers simply turn the supply voltage on and off to pulse the injector. High resistance injectors typically respond slower than low resistance injectors. High resistance injectors may sometimes be controlled by a peak and hold driver. The drive circuit may not reach the peak current value and therefore not switch to the hold current. This may cause some drivers to overheat due to sustained high current. ECU manufacturers utilize various injector drivers. You must consult Kinsler Fuel Injection or the manufacturer regarding specific driver/injector compatibility.



Injector measures 14.3 ohm on voltiohm meter

FUEL FLOW versus FUEL PRESSURE

Injector flow capacity varies with changes in supply pressure. Increasing fuel pressure to the injector will result in additional flow and a potential improvement in atomization. When the pressure level is increased, the load against the injector solenoid will also increase. Some injectors solenoids will not handle the increased load. Please consult your Kinsler technical representative about specific injector operation. The load against the fuel supply system will also increase and fuel pump output will decrease. Please be sure that the fuel pump(s) will handle the increased load. (See Electric Fuel Pumps on Pages #124-130).

EXAMPLE OF SYSTEM WITH INCREASING FUEL PRESSURE

Formula:	Supply	-	Engine Usage	=	Bypass
System Pressure	**1- #10208 Fuel Pump (tested at 13.2 volts)**		**8- #10057 Injectors (static flow)**		**Bypass Flow**
45	330 lbs/hr	-	156.0 lbs/hr	=	174 lbs/hr - OK
70	300 lbs/hr	-	196.0 lbs/hr	=	104 lbs/hr - OK
100	260 lbs/hr	-	284.7 lbs/hr	=	-24.7 lbs/hr **< Danger**

Pressure rises as the square of the flow through an orifice, so to double the flow through an injector takes four times the pressure :

$$\text{New Press} = \text{Old Press} \times \left(\frac{\text{New Flow}}{\text{Old Flow}}\right)^2$$

If we know the flow of an injector at some pressure, we can figure the flow at a new pressure :

$$\text{New Flow} = \text{Old Flow} \times \sqrt{\frac{\text{New Press}}{\text{Old Press}}}$$

CALCULATION FOR INJECTOR SIZE SELECTION

Maximum Engine output (H.P.) times Brake Specific Fuel Consumption (B.S.F.C.) at Peak Power times 1.175 (Conversion factor from 85% duty cycle to static flow) divided by number of injectors equals Static Flow required per injector. If actual B.S.F.C. value is not available, use 0.5 for normally aspirated engines operating on gasoline. Use 1.1 - 1.2 B.S.F.C. for normally aspirated methanol burning engines.

Example : 1) Small block Chevrolet V8 on gasoline. [500 (h.p.) X 0.5 (B.S.F.C.)] X 1.175 / 8 = 36.7 lbs/hr

2) Big block Chevrolet V8 on methanol. [1100 (h.p.) X 1.1 (B.S.F.C.)] X 1.175 / 8 = 177.7 lbs/hr

Look for an injector that has flow close to flow rate at the operating pressure and the correct resistance for your electronics.

METHANOL WITH EFI

Most EFI injectors are compatible with methanol based fuels. The problems are from the chemical affects of the methanol. Methanol attracts water which can cause rusting of internal components. When methanol comes into contact with aluminum it corrodes the aluminum and when it drys it turns to a 'sand-like' residue which can easily clog up injectors, filters, pressure relief valve, and fuel pump. The only 100% way not to have a problem is to totally flush the entire fuel system after each use with cleaning solvent or gasoline. Methanol is extremely corrosive to aluminum components, fuel rails, fittings, etc. This aluminum oxidation also will put contamination in the fuel system, possibly causing problems. It is highly recommended that stainless steel fuel rail be used.

FLOWING AND GROUPING

EFI injectors are not perfect out of the box. We have measured as much as 12% variation in flow rates of the same part number injector. To obtain the best possible fuel distribution, it is advisable to have the injectors flow tested. Kinsler flows new or used injectors and can provide the test results.

We group similar flowing injectors to minimize the spread in distribution.

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EFI INJECTORS

Manufacturers rate injectors at different pressures. For accurate flow comparison, be sure to compare flows at the same pressure. To calculate the flow at different pressures see "ORIFICE THEORY" on Pages #202-203.

STYLE 1

Type: disc (D) or pintle (P)
Top: o-ring Bottom: o-ring
Center to center on o-rings: 2.550"

High Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr	Type
10125	15.0	18.7	P
10119	17.9	22.3	P
10123	26.1	32.5	P
10090	26.2	33.2	P
10148	25.7	33.3	P
10121	31.1	38.8	P
10186	32.7	40.6	D
10177	32.2	40.1	P
10150	32.5	41.1	P
10142	43.8	54.7	D
10083	55.7	69.5	P

Low Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr	Type
10109	20.2	25.8	P
10113	20.6	26.6	P
10117	32.2	40.8	P
10132	32.8	41.3	P
10160	40.7	49.1	P
10082	56.9	70.6	D
10188	57.7	73.0	P
10165	65.0	81.1	P
10080	73.8	92.7	D
10081	84.8	105.9	D
10092	158.0	197.0	P

STYLE 2

Type: disc
Top: o-ring Bottom: o-ring
Center to center on o-rings: 2.500"

High Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10051	14.5	19.5
10052	31.7	40.2
10058	38.6	48.0
10059	44.1	55.0

Low Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10057	19.5	24.5
10060	51.7	64.6

STYLE 3

Type: ball
Top: o-ring Bottom: o-ring
Center to center on o-rings: 2.600"

High Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10067	24.3	30.6
10068	40.7	50.3
10069	50.2	60.3

Low Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10070	73.2	Call for Details
10071	94.5	

STYLE 4

Type: disc
Top: o-ring
Bottom: smooth open face end

Kinsler #10086;
modification to bottom captive o-ring detail.

Very Low Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10129	63.8	79.0
Ohms : 0.85		

STYLE 5

Type: pintle
Top: hose Bottom: bung

Kinsler #10192; injector adapter for captive o-ring inlet detail.
Kinsler #10087; modification of injector for #10192 adapter

Low Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10105	18.1	22.6
10107	20.3	26.2
10100	36.3	44.9
10102	43.6	52.7
10103	51.0	64.3

STYLE 6

Type: pintle
Top: shank
Bottom: smooth open face end

Kinsler #10085; modification to top and bottom captive o-ring detail.

Low Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10136	38.5	46.6
10134	48.7	60.4
10137	53.0	64.0

STYLE 7
'EV6 long body'

Type: disc
Top: o-ring Bottom: o-ring
Center to center on o-rings: 2.550"

Low Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10154	36.7	45.8
10155	36.7	45.8

#10154 has dual stream spray pattern designed for 4-valve engines

STYLE 8

Type: disc
Top: o-ring
Bottom: o-ring
Center to center on o-rings: 1.500"

High Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10061	21.4	26.7
10062	30.5	38.0
10063	44.0	54.9

STYLE 9
'EV6 standard'

Type: disc
Top: o-ring Bottom: o-ring
Center to center on o-rings: 2.075"

High Resistance

Part #	45 PSI lbs/hr	70 PSI lbs/hr
10075	25.7	32.1

TO CONVERT lbs/hr to cc/min

$$\frac{\text{lbs/hr}}{5.7} \times 60 = \text{cc/min}$$

TO CONVERT cc/min to lbs/hr

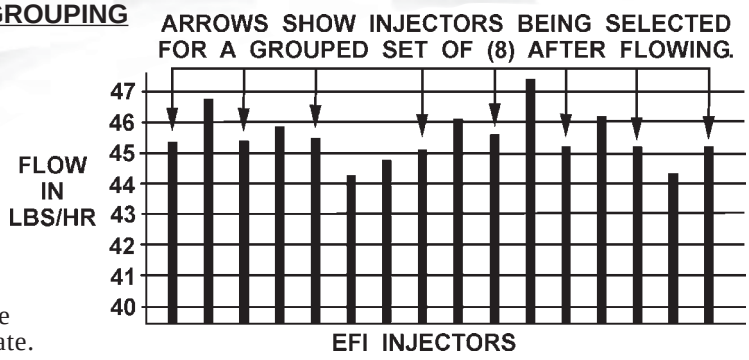
$$\frac{\text{cc/min} \times 5.7}{60} = \text{lbs/hr}$$

EFI INJECTORS : PARTS AND MODIFICATIONS

FLOW AND GROUPING

We offer this service on new injectors and customer's injectors.

EFI injectors of the same rated size do not necessarily have the same flow rate.



FOR ULTIMATE RESULTS - THIS IS A MUST !!!

'DUMMY' INJECTOR

10193	Kinsler billet aluminum 'dummy' injector, o-ring top and bottom, black anodized for stock appearance, ideal for blocking fuel rail and manifold ports that are not in use

#10193

LABOR TO MODIFY EFI INJECTORS

BEFORE

AFTER

10085	Modify injectors #10134, #10136, #10137 to dual o-ring

BEFORE

AFTER

10087	Modify injectors #10100, #10102, #10103, #10105, #10107 for conversion to o-ring inlet, machine inlet to a shank with .308" O.D., inlcudes Kinsler #10192 adapter

#10190 ***#10191*** ***#11190*** ***#10195***

#10197 ***#10196*** ***#10194***

EFI INJECTOR PARTS

10190	Inlet screen, O.E. replacement, fits Bosch top feed EFI injectors
10191	Inlet screen, fits most top feed EFI injectors
10194	Bung seal, GM type, outlet of injector, .350" I.D. x .540" O.D.
10195	Retainer clip, Bosch style
10196	Bung seal, Bosch injector, .305" I.D. x .540" O.D.
10197	O-ring, for Bosch injector, top or bottom
11190	Pintle cap, specially made for Kinsler, cone tip design shields pintle, large molded locking ring securely retains cap on injector, fits several Bosch injectors

#10192

#10198

#10199

INJECTOR ADAPTERS

10192	Adapter, billet aluminum, has internal and external o-ring, fits an injector that has been modified to have inlet shank of .307" O.D. (see #10087 injector modification), Measurement does not include o-rings, .310" I.D. x .525" O.D.
10198	Inlet adapter, Delron, fits #10134, #10136, and #10137, .300" I.D. x .505" O.D.
10199	Outlet washer, Delron, fits #10129, #10134, #10136, and #10137, .310" I.D. x .527" O.D.

#10396

INDIVIDUAL INJECTOR FUEL CONNECTORS

10396	Single injector cup, 6 AN male flare, stainless steel, with Bosch type clip groove
10397	Single injector cup, 8 AN male flare, stainless steel, with Bosch type clip groove

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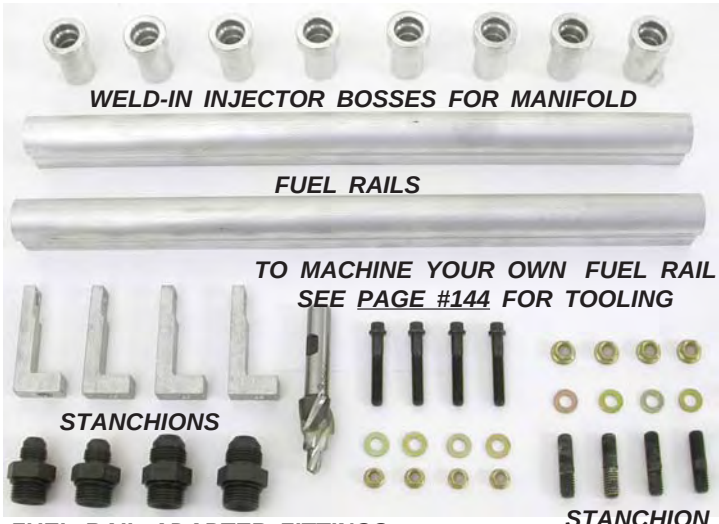
EFI FUEL RAILS - NEW .970" I.D. RAIL!

We can supply a completed fuel rail for our manifold or yours, or we can machine a rail to your print or supply a partially machined rail for you to finish. Individual components available!



Our 8 AN fuel rails with .685" ID are more than adequate for most applications. Our 12 AN fuel rails with .970" ID have twice the cross-sectional area of the 8 AN rails... we recommend these for very high horsepower gas engines, most methanol engines, systems with very large injectors, or two injectors .... call our technicians for advice.

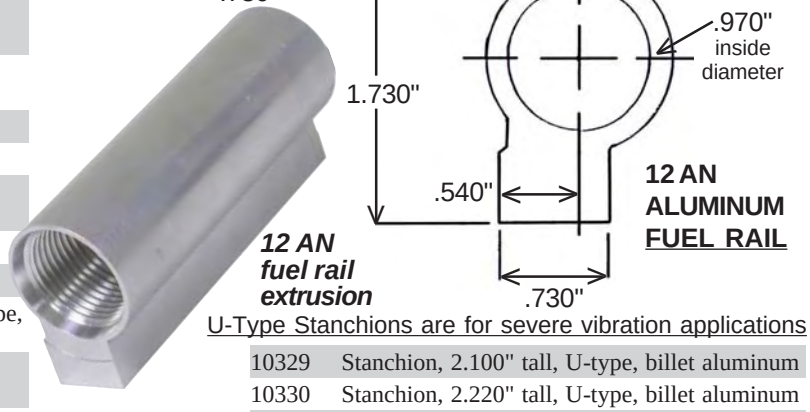
The problem: When a very large EFI injector is pulsed (opened), it takes a very quick "gulp" of fuel out of the rail, causing a large instantaneous pressure drop. These pressure drops can reinforce each other in a random ram tuning within the rail and attached fuel hoses that cause chaotic pressure pulsing; we have seen plus and minus 30 psi on a 130 psi supply (100 - 160 psi range). As the pressure waves travel through the fuel rail, some injectors are likely to open when there is a high or low local pressure... this causes very significant cycle to cycle rich and lean conditions to the cylinders, as once the injector opens, it's simply a function of the pressure acting on it's outlet orifice(s). A pressure gauge will not respond accurately to these pulses as they are too fast; we use very fast responce piezoelectric pressure transducers to analyze these systems.

Why the larger rails help: All fuel has some air in it, especially after the system has run a little, because the return fuel absorbs more air as it falls back into the tank. This makes the fuel a bit compressible, thus the larger rail assists the ability to take a "gulp" with less pressure drop. We have seen 45 horsepower picked up by just switching from our 8 AN to our 12 AN rails.

Avoid using individual supply hoses to the injectors; they cause huge pressure drops because of the pulsing flows. If you must use them, make them all the same length, and as large an ID as possible... 3/16" ID is too small; 3/8" would be much better

ALUMINUM FUEL RAILS

Extruded aluminum fuel rail material in bulk form, cut to desired length, partially machined, or machined to fit. Billet aluminum mounting stanchions are available in varying heights to aid in the installation of EFI injectors with different overall body lengths. We offer a complete line of mounting hardware and adapter fittings. Our extrusion design allows for the drilling and tapping of 8 AN female o-ring end ports (NO pipe thread which can crack the tube, or sealer compound to get in your fuel system).

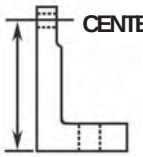


10300	Extruded aluminum fuel rail tubing, 6061-T6 alloy, .680" I.D., .110" wall, .900" wide x 1.3" tall, priced per foot
10301	Extruded aluminum fuel rail tubing, 6061-T6 alloy, .970" I.D., .140" wall, 1.250" wide x 1.730" tall, priced per foot
10365	Labor, machine one end of extruded aluminum fuel rail for 8 AN female o-ringed thread
10366	Labor, machine both ends of one rail to square off raw cut piece
10303	Stanchion, 2.000" tall, L-type, billet aluminum
10305	Stanchion, 2.050" tall, L-type, billet aluminum
10308	Stanchion, 2.100" tall, L-type, billet aluminum, used on Kinsler manifolds with Bosch or Rochester EFI injectors
10310	Stanchion, 2.150" tall, L-type, billet aluminum
10312	Stanchion, 2.200" tall, L-type, billet aluminum
10313	Stanchion, 2.000" tall, L-type, billet aluminum, Special L-type, pad for installation of #10314 bell crank bracket
10314	Bracket, bolts to stanchion #10313 to mount Kinsler #5485 bell crank bearing, used on Buick V6 'Indy Light' cars
10317	Stanchion, 2.250" tall, L-type, billet aluminum
10319	Stanchion, 2.300" tall, L-type, billet aluminum

U-Type Stanchions are for severe vibration applications

10329	Stanchion, 2.100" tall, U-type, billet aluminum
10330	Stanchion, 2.220" tall, U-type, billet aluminum
10331	Stanchion, 1.960" tall, U-type, billet aluminum

10355	Injector cup extension, 1.135" long, 6 AN male + o-ring, billet aluminum
10357	Injector cup extension, 1.355" long, 6 AN male + o-ring, billet aluminum
10359	Injector cup extension, 2.0" long, 6 AN male + o-ring, billet aluminum, not machined for injector detail



Stanchion height is measured from bottom of stanchion to the centerline of the fuel rail mounting hole.

10348	Stud kit, set of (4) 5/16-18 x 1 1/4" studs with recess hex, washers, and jet nuts
10349	Bolt kit, set for mounting (4) U-type stanchions, 5/16-18 x 1 1/4" cap screws, (4) special washers, (4) small hex nuts for studs, cross bolts, washers, and nuts
10350	Bolt kit, set of (4) for mounting fuel rail to stanchion, 1/4-20 x 1" long small head 12-pt. bolts with washers and jet nuts