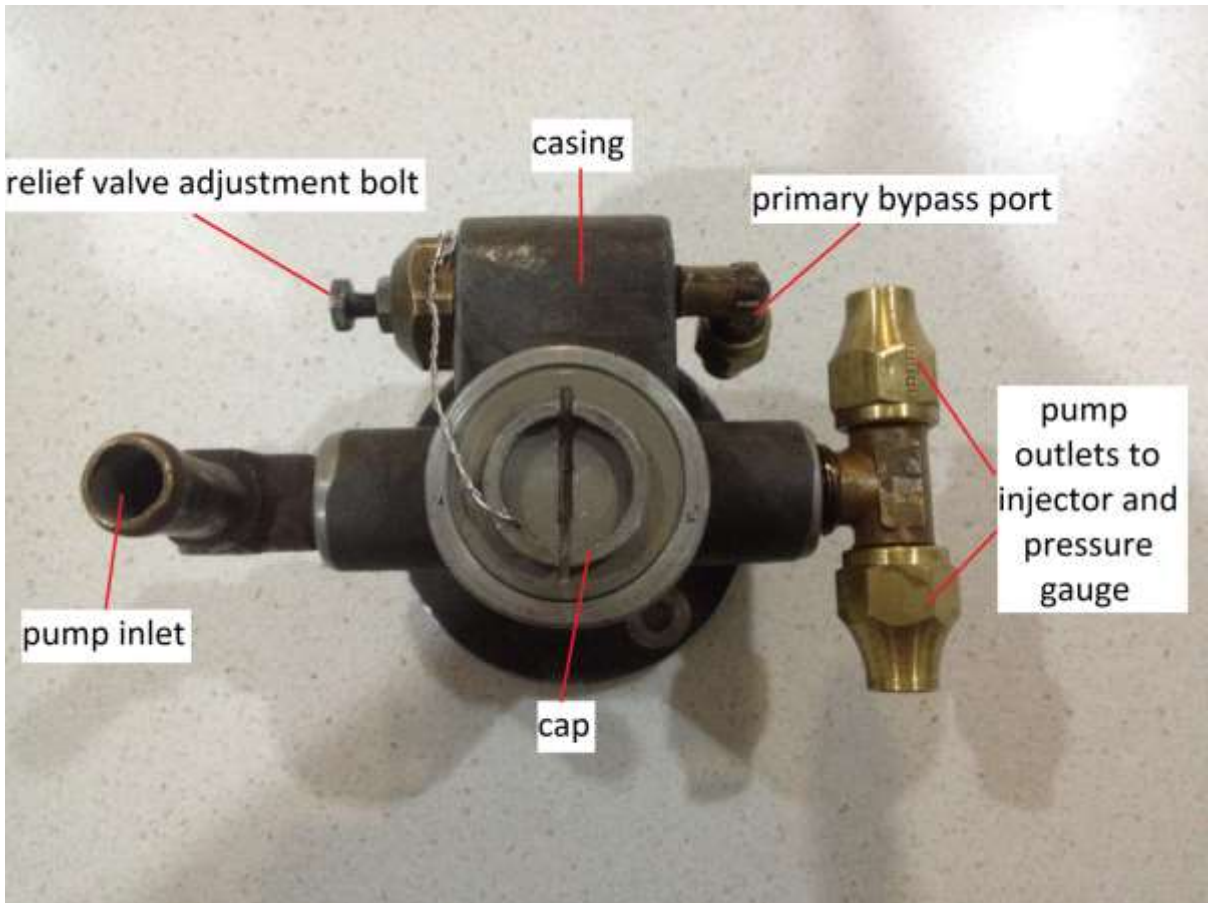


Most Hilborn fuel injection systems that are familiar run Hilborn's PG series fuel pumps. Three PG pumps were made: PG150, PG175 and PG250. Each PG pump has a serial number, with the first digit stamped (not cast) indicating the pump volume. Prior to the PG series, Hilborn used the BL series. The BL series offered two pumps, the BL235 and the larger BL420. As a guide:

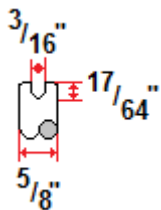
Pump	Size	Service	Power (kW)
BL234 and BL420	-	Very small displacement engines (typically one to four cylinders, for example 108ci Offenhauser or 152ci Chev), running on petrol or methanol.	-
PG150	#00	Small engines such as motorcycles or four cylinder engines, running on petrol or methanol.	200
	#0	Medium size engines, 200" to 360", running petrol or methanol. Use with carburettors or small turbo engines.	400
	#S0	Medium size engines, 360-410ci running petrol, methanol, or small amounts of nitromethane.	-
	#1/2	Same as #S0, just a higher pump volume.	500
	#1	Large engines on petrol and small amounts of nitromethane. Also for blown engines on petrol, methanol, and small amounts of nitromethane.	700
PG175	#2	Large engines with high percentages of nitromethane and blown engines on methanol.	1300
	#4	Very large engines, high percentages of nitromethane, and blown engines on nitromethane.	-
PG250	#5	Largest pump volume. Very large engines on nitromethane. Also for turbo or supercharged engines.	-

The BL series fuel pumps are a sliding vane positive displacement pumps. In the information below, we will examine a Hilborn BL420, marked with serial number C931. The pump has a cast alloy housing, machined to suit carry a steel volute and carbon shaft support. The vanes and shaft are of steel, whilst the end plate is of carbon.



The pump is driven by the engine, typically by connecting to the distributor/magneto (via an angle drive), the camshaft (via a cam spud) or the crankshaft (via a pulley and belt). The pump flange bolts to the engine. In some installations the pump/engine flange is sealed by an o-ring, as per the photo below. The o-ring seals the engine oil from leaking out of the pump/engine flange connection. An alternative is to use a gasket on the flange face.

The pump shaft drive-end is fitted with a slotted drive, and accepts a drive tang (similar to a flat blade screwdriver) The dimensions of the slotted drive are as per below.



In the photo below, the slotted drive can be seen in the middle of the pump casing. Imagine inserting a screwdriver in there to turn the pump over.



The drive end of the shaft is sealed with a lip seal, part number 240009, held in place by a circlip. This seal prevents fuel from leaking from the pump into the engine oil. The seal has the following specifications:

Housing bore: 1.124"

Outside diameter: 1.135"

Shaft size: 0.625"

Width: 0.175"

The photo below shows the lip seal removed. The retaining circlip is not shown.

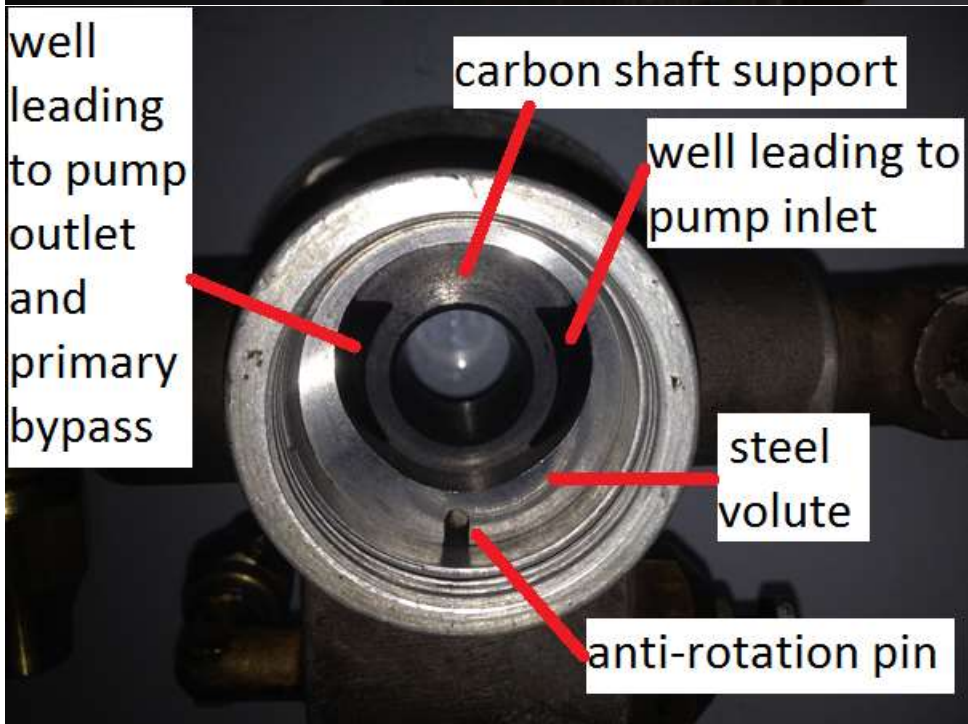


The seals are available from Hilborn. An alternative is to source them from CBC Bearings, who supply a federal Mogul National Oil Seals part, made of nitrile.

Where the pump drive is not lubricated from the engine oil circuit, Hilborn recommends that the pump coupling should be checked for oil regularly by removing $\frac{1}{8}$ "-NPT inspection plug in the side of the pump drive – see the recessed allen-headed plug in the photo below. It is recommended that the space be kept about half full with engine oil. Hilborn further recommends that the seals in the fuel pump should be replaced every year.



The pump shaft runs in the carbon shaft support, which acts as both a shaft bearing and a drive-end volute seal. The carbon shaft support is central to the pump casing, and is a complex casting/extrusion as it features wells that connect to both the inlet, outlet and primary bypass ports.



Hilborn no longer is able to provide the carbon shaft support as a replacement part. It is a complex moulding, difficult to manufacture in a backyard, and being carbon is probably pretty fragile. Hint... take care not to belt the carbon shaft support when handling the pump. The shaft carries the two steel vanes. The vanes are notched, with the two notches riding over each other with the vanes in a crossed location.



The vanes run in a 0.4185" deep eccentric steel volute, which is fitted to the casing with an anti-rotation pin. The non-drive end of the pump shaft is sealed by a carbon disc (1.392" diameter and 0.1875" wide), retained in place with a cap.



The carbon disc is available as a replacement part from Hilborn. The cap is threaded 1½-12UNF, and sealed to the casing with a BS216 o-ring (inside diameter: 1.125", thickness: 0.139", outside diameter: 1.403"). The o-ring can be seen in the photo above, smooshed between the carbon disc and cap. The O-rings are available from both Hilborn and CBC Bearings. CBC Bearings provide part number BS216V75, which is a Viton ring.

Whilst the Viton o-ring and nitrile seal are suitable for engine oil and petrol, they will suffer degradation if the pump is run in methanol service. This is likely to be the source of Hilborn's recommendation that the o-rings (and seals) are changed annually. A longer methanol service life will be gained if fluorosilicone o-rings and seals are used.

The pump inlet is fitted with a 90° brass male pipe nipple to ½" hose. The pump outlet is tapped to ⅜"-NPT, and fitted with a brass tee. The tee outlet fittings are 45° flare seats with ⅝-18UNF (not -6AN).

The pump features a primary bypass outlet port, tapped to ⅜"-NPT. A 90° brass male fitting with 45° flare seats with 7/16-20UNF thread (not -4AN) is installed in the primary bypass port. The pump also features an externally adjusted relief valve.



The normally-closed valve takes feed from the bypass outlet port. When the relief valve is opened, it recycles pressurised fuel back to the pump inlet port. The relief valve seat is machined into the alloy body, and features a guided brass plug. The plug appears to have an elastomer sealing face. The plug is backed by the relief valve spring, which in turn is backed by a brass adjustment bolt carrier. The adjustment bolt is #10-32UNFX²⁷/₃₂" , ³/₈" AF and is fitted with a lock nut. The adjustment bolt rides in a brass relief cap (³/₄-16UNF, ¹⁵/₁₆" AF) which threads into the pump body and is sealed with a fibre washer. The relief valve adjustment is factory set, with the intention that it never be changed (i.e. it is not a tuning parameter). The relief valve has a 0.445" diameter orifice. The spring has a free length of 0.630", a diameter of 0.374", a maximum compression (coil bind) of 0.357", is made from 0.044" diameter wire and has a spring constant of 0.0250inch/lb_f.

The relief valve was utilised by Hilborn for installations where the pump was used in carburetted service. The lower pressures required by a carburettor are provided by use of the relief valve. Where the fuel pump is used in fuel injection service, the relief valve setting can be adjusted to a much higher pressure. Ultimately, if the adjustment bolt is screwed in enough the spring will enter coil bind, hard-seating the relief valve such that it cannot lift.

The table below indicates how the relief valve pressure may be varied by adjusting the adjustment bolt in from a gentle (soft) seating.

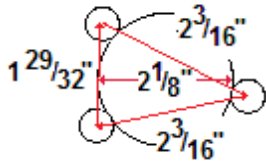
Pressure (psi)	Spring compression required (")	Rotation required (turns)
10	0.038	1¼
30	0.114	3¼
50	0.19	6¼
70	0.266	8¾
90	0.35	11½

Note that at the 90psi setting, the relief valve is effectively at coil bind. There is very little difference between the valve set at 90psi, and the valve being hard-seated and not lifted. In practice, the maximum relief valve setting is probably 80psi. The table can be used to initially set the relief valve. The setting should then be confirmed by observing fuel delivery pressure (via a pressure gauge) under a number of load conditions (most notably when the throttle is snap shut from full load). Where a carburettor is used, fuel delivery pressures of much less than 10psi may be needed (for example Stromberg carburettors run happily in the 2.5-4.5 psi range, Holley carburettors in the 5-7psi range and SU carburettors in the 1.5-3.5 psi range. The table above is not an effective tool for setting the relief valve for these low pressures. The best means to do so is to set the relief valve such that it is soft seated, then start the engine. The relief valve adjustment bolt can then be turned in until the desired fuel pressure is achieved.

Both the relief valve cap and the carbon disc cap are straight threads (not tapered) and liable to coming loose with vibration. To prevent this, both caps are locked together with safety wire. The original factory safety wire was brass, though in the photos above I have replaced it with stainless steel wire.

The pump outlet is plumbed to the metering valve, with the second leg of the pump outlet leg plumbed to a pressure gauge. A 50-75psi gauge is recommended, with 100psi range being noted to be too coarse. The primary bypass port is connected to the bypass container, which houses a spring loaded check valve and the primary bypass pill. The outlet of the primary bypass container returns to the fuel tank, and should be at least ³/₈". All fittings must be at least ⁵/₁₆" in hole size.

The pump body is drilled on a 3-bolt equilateral (non-equidistant) pattern. The $\frac{17}{64}$ " bolt holes (to suit $\frac{1}{4}$ " studs) are set around a $2\frac{1}{8}$ " circle, with the hole centres at $2\frac{3}{16}$ ", $2\frac{3}{16}$ " and $1\frac{29}{32}$ " as per the diagram below:



The pump rotation is marked on the casing, as per the arrow stamped next to the serial number in the photo below:



In theory, it is possible to change the pump rotation by opening the pump, pressing out the carbon shaft support, pressing out the steel volute and removing the anti-rotation pin. The anti-rotation pin is reassembled 180° around the casing, as is the volute. The shaft support is then refitted. Many, many years ago Hilborn offered this service. However, the skillset within Hilborn has been lost, and they are no longer confident on the full pressing process. There is a significant risk that the carbon shaft support is damaged, especially if the process is done in a backyard. Given the carbon shaft support is no longer available, it would be a pretty brave soul who undertook the work.