Universal Cam Sync Systems
Holley PN 556-123

NOTE: For a full color version of this instruction manual, please search for P/N 556-123 @ www.holley.com.

1.0 INTRODUCTION:

A cam sync signal is required to run sequential fuel injection. This tells the ECU which cylinder is cylinder #1 (or the first cylinder in the firing order as entered in the software).

NOTE: Installation of this kit should not be attempted until these instructions have been completely read and understood. Due to an infinite range of bracket mounting capabilities coupled with a relatively narrow sensor operating window, correct operation of this kit can only be assured from one application to next if a few very simple mathematical & geometric dimensioning techniques are used. If you are uncertain of your ability to correctly perform the techniques required to successfully install this kit, after reading these instructions, it is best to consult a professional for assistance.

2.0 APPLICATIONS:

This kit was specifically designed to provide a "plug-&-play" cam position signal to Holley EFI systems, although it may be used with any EFI system which can read a digital, square-wave input cam signal. 556-123 is intended for use on "Non-Chevy specific" applications (i.e.: Early model Small & Big Block Fords, etc.), equipped with external, dry timing-belt, cam drive systems, where the bracket assembly must be mounted directly to the front motor plate or some mounting surface other than a designated cam cover mounting flange. It is required that the upper cam drive pulley permits drilling & tapping of a ¼"-20 threaded hole for installation of the "Flying Magnet Target" screw. Suggested bracket & flying magnet target mounting locations are outlined in detail herein.

3.0 COMPONENT IDENTIFICATION:

Item #	Qty.	Components
1	1	Aluminum Sensor Bracket
2	2	1-1/2" Aluminum Spacer
3	1	Sensor Bracket T-Nut (SS)
4	1	¼"-20 Flying Magnet Target
5	1	¼" Split-Lock Washer (SS)
6	1	M12x1mm Sensor w/Jam Nut
7	1	M12 Flat Washer (SS)
8	1	M12 Internal-Tooth Washer
9	2	¼"-28 x 2.25" Screw
10	2	1/4" Flat Washer
11	2	1/4" Split-lock Washer
12	1	Mating Connector
13	1	TPA Lock
14	3	Seals
15	3	Pins
16	2	¼"-20 Nylon Insert Lock Nut
17	2	¼"-20 x 2.75 Screw

4.0 MATERIALS REQUIRED FOR INSTALLATION:

Vertical Mill, Drill Press, or Hand Drill (min.)	6" Dial Calipers	3/16" Allen Wrench
Spacer Trimming Device (lathe, saw, etc.)	6" Drafting Compass	Drill Bits: No. 7, No. 3, & 1/4"
7/16" Wrench or Socket w/ Ratchet	Small Crescent Wrench	Fine-Tip Permanent Marker
Permanent Strength Thread Adhesive	Center Punch	1/4"-20 & 1/4"-28 Bottoming Taps
Calculator w/ exponents (x^2) & Square Root $(\sqrt{x})$ functions		17mm Hex Wrench

5.0 SENSOR BRACKET ASSEMBLY

NOTE: The sensor and sensor bracket assembly will protrude a maximum distance of about 3" off of its mounting surface if using the supplied 1-1/2" spacers (**Figure 1**).

A long spacer has been provided so that this kit can be used in a wide range of applications. It is likely that the provided spacers will need to be trimmed to length in order to meet the required sensor-to-flying magnet target gap in some applications. In addition to shortening the provided bracket spacers, water pump spacers may also be required to provide adequate bracket clearance in some applications. Mock-fit the assembled bracket/sensor assembly at the desired location on the front of the engine to ensure that it will clear all accessory drives (i.e.: water pump, fuel pump, cam-driven distributor, etc.), prior to performing any machining operations.

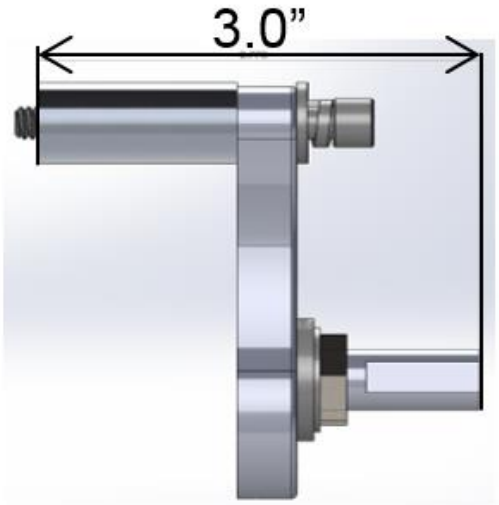

Figure 1: Bracket Assembly Standoff

The sensor bracket assembly goes together as shown in **Figure 2**, below.

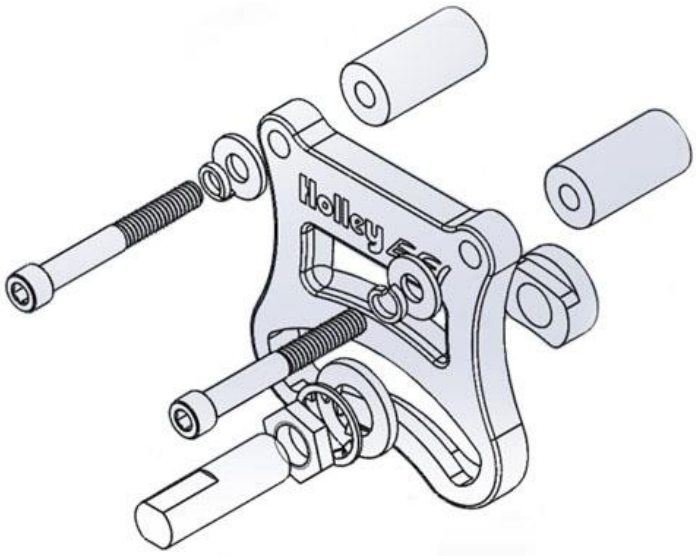

Figure 2: Sensor Bracket Assembly

5.1 LOCATING & MOUNTING THE SENSOR BRACKET

Figure 4 depicts three possible mounting positions for the sensor bracket-although it may be mounted anywhere between these points along the arc of the calculated Bracket Mounting Radius (R_B). Consequently, the sensor bracket can be mounted at infinitely many points about the perimeter of the upper cam pulley permitted there is adequate mounting surface & clearance.

Two sets of 1/4" screws have been provided to accommodate sensor bracket mounting in various applications & locations.

The 1/4"-20 x 2-3/4" screws (17) & mating 1/4" nylon insert lock-nuts (16) were provided to support thru-hole mounting (**Figure 3A**) of the bracket to a flat mounting surface up to 3/8" thick. Mounting position 1 (as seen in **Figure 4**, below) on an early model Ford application with one-piece, custom-made, front motor-plate may be a good candidate for this mounting strategy. In the vicinity of the block's centerline on the bridge of a one-piece motor-plate, there is usually adequate clearance between the motor plate and engine block at which a nut & wrench may be used to fasten the bracket to the plate. This is the preferred method of fastening whenever possible, as it provides the most secure means of bracket attachment.

The two 1/4"-28 x 2-1/4" screws (9) were provided for use in a case where the bracket must be mounted to a surface which is flush against another (**Figure 3B**). These are intended to be used when the screws cannot protrude the mounting surface as in the case when the sensor bracket must be mounted to a 1/4" thick motor plate which is located flush against the engine block or cylinder heads. Bracket mounting Positions 2 & 3 of **Figure 4** on an early model Ford application with a 1/4" think front motor plate may warrant this mounting strategy. In such a case, the motor plate must be drilled and tapped to accept the 1/4"-28 screws for mounting. The provided spacer & screw combination will offer exactly a 1/4" of thread engagement into the mounting plate if used as stock. If the spacer must be shortened for a specific application, then the screws must also be shortened (or replaced) by the same amount to maintain proper thread engagement in this case. Replacement screws are readily available through McMaster-Carr in 1/8" increments ranging from 1-3/8" to 2" & in 1/4" increments from 2" to 2-1/2", if required (Grade 8 or better are recommended).

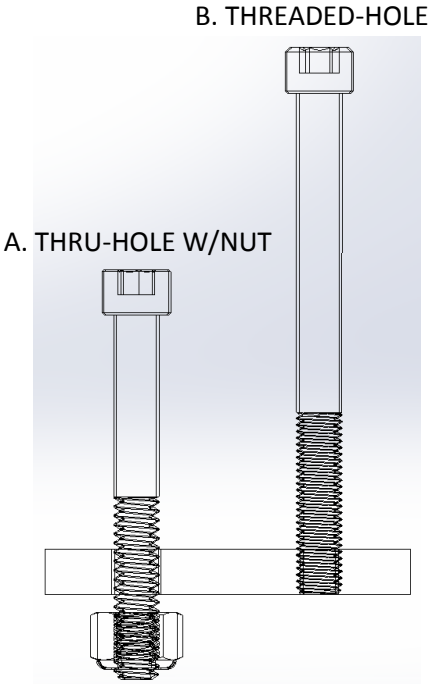

Figure 3: Sensor bracket mounting hole types.

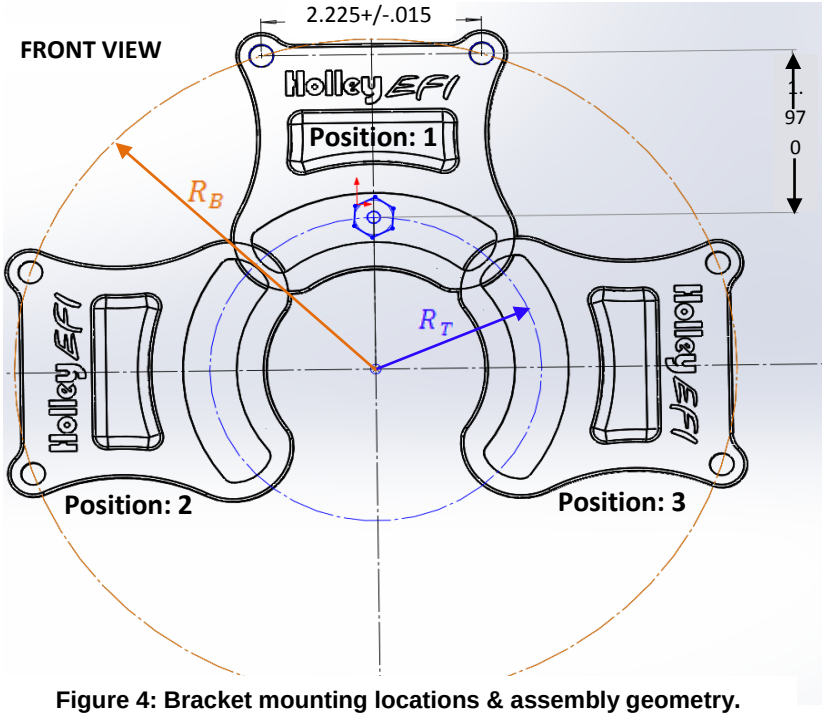

Figure 4: Bracket mounting locations & assembly geometry.

1. Use the geometric constraints of the upper cam hub to determine a suitable *Mag. Target Mounting Radius* [R_T] at which the Flying Magnet Target screw will be mounted for a given application. *Mag. Target Mounting Radius* is defined as the distance between the centerlines of the camshaft and that of the head of the flying magnet target screw as seen in **Figure 4** above. This may be chosen arbitrarily based on application, however a radius of **1.625" is both nominal & recommended,** if possible (see section 5.2 for details).

2. Calculate the required *Bracket Mounting Radius* [R_B] (as seen in **Figures 4 & 5**) from the camshaft centerline by using the following equation:

Bracket Mounting Radius [R_B] =Mag. Target Mounting Radius [R_T] + 1.970”

Example: If the nominal *Mag. Target Mounting Radius* value of 1.625” is chosen, then the Bracket Mounting Radius [R_B] would be calculated as such:

Bracket Mounting Radius [R_B] =1.625” + 1.970” = 3.595”

**Jot this value down for use in the next step!

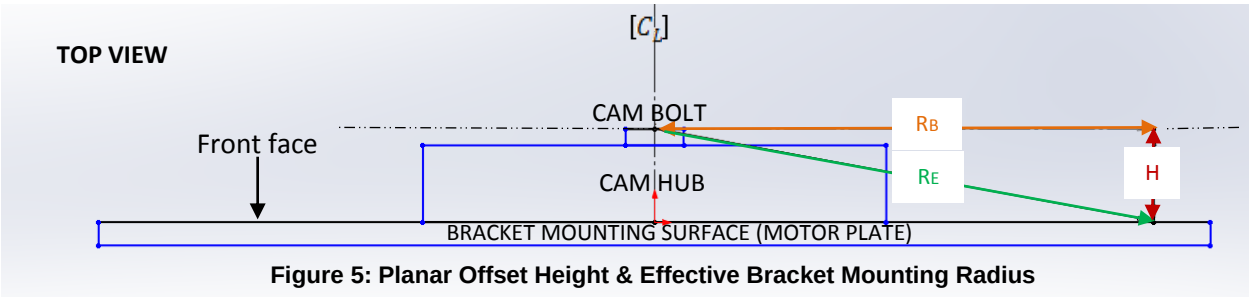

Figure 5: Planar Offset Height & Effective Bracket Mounting Radius

3. Use a set of calipers to measure the *Planar Offset Height* [H] for the application (**Figure 5**). This is defined as the difference in height from the exact surface/plane which contains the camshaft’s centerline [C_L], to the front face of the desired bracket mounting surface.

NOTE: *Planar Offset Height* [H] has a positive value if the cam hub protrudes the mounting surface (as shown in **Figure 5**), a negative value if the cam hub is recessed behind the mounting surface, & a value of zero (0) if the cam hub is coplanar (or on the same plane or at the same height) as the front face of the desired bracket mounting surface. For the sake of simplicity, all values of [H] can be entered in the forthcoming equation for *Effective Bracket Mounting Radius* [R_E] as positive values. *Planar Offset Height* [H] should always be measured from the front face of the motor plate or bracket mounting plate.

4. Calculate *Effective Bracket Mounting Radius* [R_E] from the *Bracket Mounting Radius* [R_B] (calculated in step 2), & the measured *Planar Offset Height* [H] using the following equation:

Effective Bracket Mounting Radius [R_E] =$\sqrt{(R_B)^2 + (H)^2}$

Example: R_B=3.595”, H=1.25”, R_E=?:

- $(R_B)^2 = (3.595)^2$=12.9240
- $(H)^2 = (1.25)^2$=1.5625
- $(R_B)^2 + (H)^2$=(12.9240+1.5625)=14.4865
- R_E=$\sqrt{14.4865}$=3.806”
- Try it with your calculating device prior to continuing!

NOTE: The *Effective Bracket Mounting Radius* value of 3.806” calculated in this example is considered to be theoretically perfect for an application with a planar offset height of 1.25” only! The final calculated value for *Effective Bracket Mounting Radius* **may vary by +/-0.050”** (3.756” to 3.856” in this case) when drilling to locate the bracket.

Figure 6: Drafting compass anatomy & tip-to-tip distance.

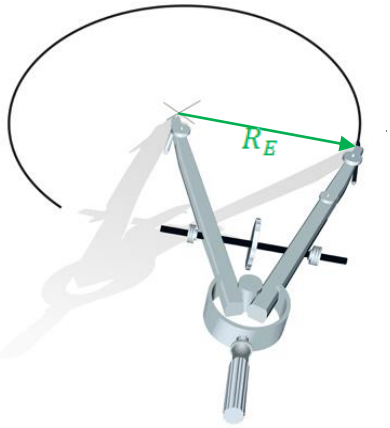

Figure 7: Drawing Bracket Mounting arc.

5. Use a pair of calipers to set the "tip-to-tip" distance on a drafting compass to the *Effective Bracket Mounting Radius* [R_E] value calculated in step 4 (see **Figure 6**). With the compass's pivot point located on the cam's centerline, lightly scribe or draw an arc of radius [R_E] along the motor plate in the vicinity of the desired bracket mounting location as seen in **Figure 7**.

NOTE: It is recommended to verify that the arc drawn from the *Effective Bracket Mounting Radius* [R_E] measures within (+/- .050") of the value calculated prior to continuing. This can be checked by measuring from the cam center to the perimeter of the arc with calipers.

6. Establish desired sensor bracket angular mounting position about the cam hub by holding the sensor bracket flush against the desired mounting surface & sliding it to the desired angular position on the mounting surface about the arced-line. The arced-line should pass through the approximate centers of the sensor bracket's mounting holes as seen in **Figures 4 & 8**.

7. Hold the bracket fixed at the previously established location & use a fine-tip marker to place a mark (dot or line) at the approximate center of one of the sensor bracket's mounting holes. This mark should intersect the arced-line as shown in **Figure 8** below. The bracket can now be moved.

   NOTE: If the upper cam pulley protrudes the intended bracket mounting surface or motor plate, it may be easier to perform steps 6 & 7 by first removing the upper cam pulley. This will allow the sensor bracket to be held flush against the motor plate making it much easier to mark & verify desired bracket mounting location prior to drilling &/or tapping.

8. With a pair of calipers, measure 2.225" +/- .010" (2.235" to 2.215") from the intersecting mark made in step 7, & make another mark crossing the arced-line as shown if **Figure 8** below. The origin of these intersecting marks indicate the bracket mounting points.

9. Use the proper drill size to drill the motor plate at the origin of the intersecting marks. If thru-hole drilling is required, use a 1/4" drill bit & if threaded-hole mounting is preferred, use a No. 3 drill bit.

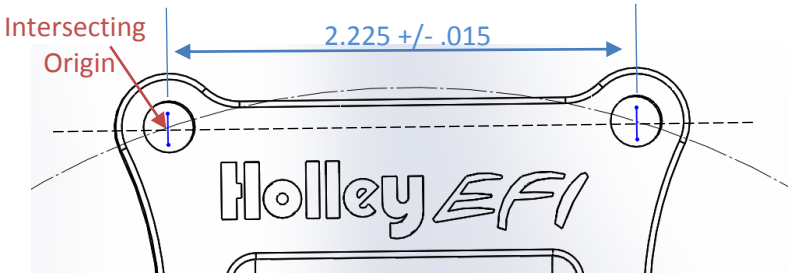

Figure 8: Marking the mounting plate for bracket mounting hole drilling

NOTE: If drilling by hand, consider using a center-punch to make indentions at the origin of the intersecting marks prior to drilling.

10. Use a ¼"-28 tap to cut threads into the mounting plate-if required. A closed-end tap like (McMaster PN: 26035A251) may be required if on-engine tapping of a motor-plate is required and the tap cannot protrude the rear of the plate.

11. Install the sensor into the sensor bracket using the sensor jam nut, M12 flat washer (7), M12 lock washer (8), & T-nut (3) as seen in **Figure 2** above. Run the sensor's jam nut down enough to remove excess play from the assembly but do not tighten the sensor jam nut at this time. The sensor and T-nut should be left free to slide within the bracket's slot.

6.0 FLYING MAGNET TARGET POSITIONING & INSTALLATION

Flying magnet target location is determined by the calculated angular cam sync position & user-defined *Mag. Target Mounting Radius* [R_T]. These specifications vary with crank trigger type and cam pulley geometric constraints. The following set-up applies to "one pulse per fire (i.e.: MSD)," "60-2", & "36-1" crank inputs.

6.1 Determining Proper Angular Position of the Flying Magnet Target Screw

The cam sync signal must occur in a specific range to properly identify which cylinder is cylinder #1. If this is not done properly, individual cylinder trims will not be performed on the correct cylinder or worse yet, the wrong cylinder may be fired if using individual coils-resulting in possible engine damage. This parameter is heavily dictated by the angular position (in crank degrees) of the Flying Magnet Target screw.

1. Reinstall the upper cam pulley if it has been removed for steps 6 & 7 above.

2. Ensure desired mechanical cam timing has been set and all upper cam hub nuts have been tightened to manufacture's specifications.

3. Using the supplied spacers (1), ¼" washers (10 & 11), and appropriate ¼" screws & jam nuts (9 or 17&16), mount the bracket and sensor assembly to the mounting surface according to **Figure 2**, above.

4. Tighten the ¼" screws down until the bracket is just snug. Do not compress the split-lock washers at this time.

5. Calculate correct cam sync phasing for the specific application. If using Holley EFI, correct cam sync phasing and therefore, flying magnet target cam trigger angle can be calculated using the following formula:

$$\text{Cam Sync Position} = \text{Crank Reference Angle} + (1080°/\text{Number of Cylinders}) \pm 30°$$

Example: 8 cylinder engine with an Ignition Reference Angle of $60°$.
Cam Sync Position = $60°$ + ($1080°$/8) = $195°$ BTDC #1

$195°$ would be the centrally "perfect" location in this specific example. However, this location can vary by +/- $30°$ degrees from this nominal target value with no issues.

Number of Cylinders	Ignition Reference Angle	Cam Trigger Location Range (BTDC #1)
4	$60°$	$330°$ +/-$30°$
6	$60°$	$240°$ +/-$30°$
8	$60°$	$195°$ +/-$30°$

NOTE: It is important to make certain that the cam trigger event does not coincide with the crank pulse in 1-pulse per fire applications (i.e.: MSD). If using 36-1 or 60-2 crank trigger wheels, the cam trigger event should not coincide with the tooth directly before the gap.

6. Once correct cam sync position has been calculated, manually rotate the engine until the balancer's timing pointer lines up with the calculated value. ($195°$ in this example.)

7. Mark the face of the cam pulley hub with a vertical line through the slot of the sensor bracket using a fine-tip marker as seen in **Figure 9**. Make certain the surface marked is within the range of sensor travel. Ideally, the diameter of the sensor tip can be split equally about the vertical reference-mark.

Figure 9: Angular Reference Marking

6.2 Determining Proper Radial Location for the Flying Magnet Target Screw

The sensor bracket's slot and T-nut offers $60°$ of angular adjustment. This feature performs optimally if the flying magnet target is mounted on the cam hub at the suggested *Mag. Target Mounting radius* (R_T) of 1.625" +/- .010", as mentioned above. The nominal value will ensure the centerline of the sensor will remain cordial or otherwise, track the same radial path as that of the flying magnet target's centerline throughout the full $60°$ sweep of sensor travel. If the target screw is mounted at a radius other than the suggested 1.625", the distance between the sensor & flying magnet target centerlines diverges or separates as the sensor is adjusted off of the bracket's slot centerline. This effect will increase the more the chosen *Mag. Target Mounting radius* differs from that of the recommended value.

1. After marking the cam hub for proper angular position, remove the sensor bracket assembly so that the hub may now be marked for desired radial positioning of the flying magnet target screw.

2. Measure the desired *Mag. Target Mounting radius* (R_T) from the camshaft's centerline with a pair of calipers. Again the recommended range is between (1.615" & 1.635").

3. Place a second reference mark perpendicular to the existing angular mark at the correct measured distance from the camshaft's centerline. This should create an intersection at which the hub can be drilled and tapped for flying magnet target installation as seen in **Figure 10** below.

Figure 10: Drilling the Cam Hub

6.3 Mounting the Flying Magnet Target

1. Using a No.7 drill bit, drill a through hole at the intersection of the angular and radial reference marks (**Figure 11**). This may be done with a hand drill-on engine, or a drill press or vertical mill-off engine (recommended). It is advised to use a center-punch to help locate the drill bit prior to drilling the cam pulley.

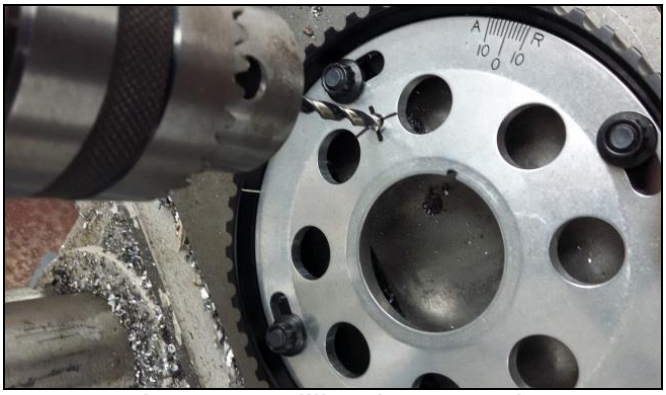

Figure 11: Drilling the Cam Hub.

NOTE: If drilling on engine, care must be taken to keep from drilling into the underlying belt drive cover and block once the drill bit passes through the cam hub. A split-lock washer has been included for added flying target retention. If it is desired to use the supplied washer & the cam hub in question has a tapered face (like the hub shown), it may be necessary to spot-face a flat onto the face of the cam hub. This should be made concentric to the No.7 hole using a 1/2" end mill. This will provide an appropriate surface on which the split-lock may properly seat.

2. Using a 1/4"-20 tap, thread the drilled hole (**Figure 12**).

NOTE: If the flying magnet screw protrudes beyond the rear surface of the cam pulley hub, ensure that it cannot make contact with the underlying cam cover studs. This can be done by making sure that the engine can be rotated a full revolution without interference. Camshaft end-play should be considered as well. File or trim the screw, if necessary.

3. Apply a liberal amount of permanent-strength thread adhesive to the threads of the flying magnet screw and thread it into the cam hub until it stops.

NOTE: Do not torque the flying magnet screw beyond 75 in-lbs. as doing so my result in stripped threads. It is recommended to allow the thread adhesive at least 24 hours to cure before operating the engine.

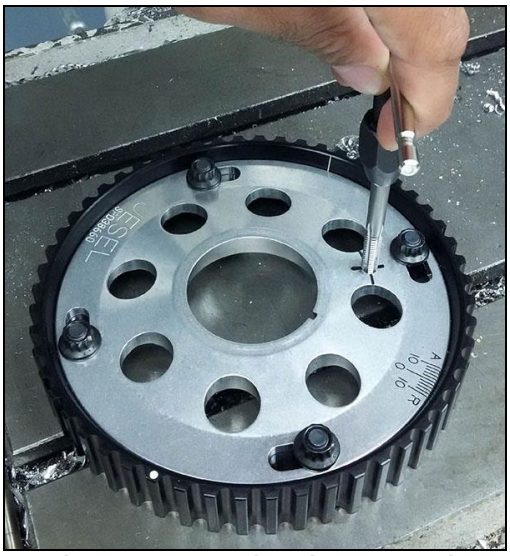

Figure 12: Tapping the Cam Hub

Figure 13: Finished Cam Hub

7.0 FINAL INSTALLATION & SENSOR GAP

1. Re-install the upper cam hub (if it has been re-removed for drilling in previous steps) and re-attach the sensor bracket assembly to the mounting surface using the appropriate mounting hardware. Tighten the ¼" screws using a 3/16" Allen & 7/16" box wrench (if necessary).

NOTE: If attaching the bracket with threaded-holes & ¼"-28 screws (9), it is highly recommended to apply a liberal amount of permanent-strength thread adhesive to the threads of the screw prior to final installation. Do not tighten these beyond 75 in-lbs, as doing so may result in stripped threads.

2. Slide the sensor in the sensor bracket's slot until it is located directly over the head of the flying magnet target. Lock the sensor in place by hand-tightening the sensor's jam-nut.
3. Using a feeler gauge, set the gap between the sensor and the head of the flying magnet target to .040"-.080" by backing the jam nut off and screwing the sensor in or out of the T-nut as seen in **Figure 14**. The smaller the gap, the better.

NOTE: It will be necessary to cut or turn the provided spacers to length if the desired sensor gap cannot be achieved with the provided spacer lengths. A good rule-of-thumb in determining a suitable spacer length for a given application is to cut the spacers such that the rear or inside face of the sensor mounting bracket is within 3/8" from the head of the flying magnet target screw. This should allow the minimum sensor gap to be achieved, while leaving enough of the sensor exposed for tightening. It is important to remember that the sensor bracket, cam hub, & target should be tightened to spec before making any measurements required for spacer alteration.

4. Lock the sensor's position by holding the sensor in place with a crescent wrench and tightening the jam nut with a 17mm wrench (**Figure 15**). Do not tighten the jam nut beyond 23 ft.-lbs or damage to the sensor's threads may result.

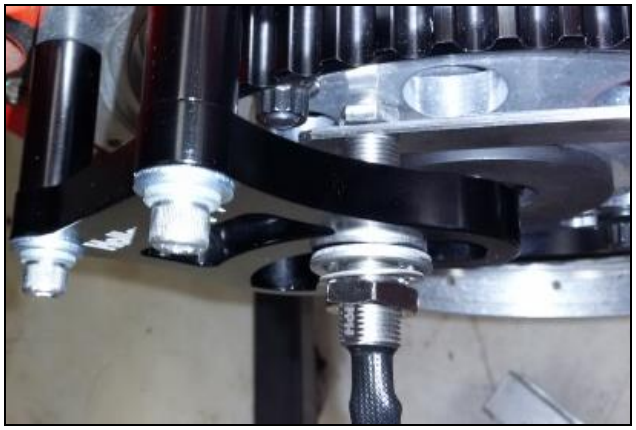

Figure 14: Adjusting Sensor Gap

Figure 15: Locking Sensor Gap & Position

8.0 SENSOR SETUP

Loose pins and seals are included and must be crimped onto an existing harness (Holley P/N: 558-306 or 558-431). Use the proper tools to crimp metripak 150 style pins (Delphi P/N: 12155975-Available thru Wytek, Inc. Item No.: 509). It is advised to use shielded wiring (with drain wire grounded at the ECU end) to connect to the sensor. The pins are inserted into the back of the connector. Install the TPA lock after the wires are inserted.

The following is the proper wiring for the included sensor:

A – Red- 5V to 20V “clean” switched power. Pin B20 (“EST 12V Output”) on Holley EFI systems would be good choices.

B – White-Sensor Output to ECU cam input signal (Pin A22 on Holley EFI).

C – Black-Sensor ground. Connect to a “clean” ECU ground, such pin A14 (“IPU Ground”) on Holley EFI systems.

If using Holley EFI, set the cam sensor “Type” to “Digital Rising” or “Digital Falling” in *Ignition Type* under Ignition Parameters. “Digital Falling” is recommended.

HOLLEY TECHNICAL SUPPORT
1-270-781-9741

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