Twin Tec TCFI Low Idle RPM Tech Note - Preliminary

CAUTION: CAREFULLY READ INSTRUCTIONS BEFORE PROCEEDING. NOT LEGAL FOR SALE OR USE IN CALIFORNIA OR ON ANY POLLUTION CONTROLLED VEHICLES.

INTRODUCTION

This tech note provides detailed information about low idle RPM operation of the TCFI Gen 3, Gen 4, and Gen 5 series. **The term TCFI is used throughout this document as a generic term. Unless otherwise noted, values shown in tables and figures are for illustration purposes only and not necessarily representative of any particular application. In the United States, the TCFI is only sold for professional racing applications. This tech note is only applicable to overseas customers in areas where the use of the TCFI is not prohibited by law.**

The normal idle RPM for fuel injected Twin Cam engines is 1,000 RPM. Some of our overseas customers desire to lower the idle RPM to simulate the sound of classic Harley-Davidson® engines. If your engine has the original equipment (OE) or mild aftermarket camshafts, you can lower the idle to 700 RPM using the techniques discussed in this tech note.

Harley-Davidson® has issued a Technical Service Bulletin M-1185. Most 2006 models have narrow 8° spray pattern injectors (P/N 27625-06) that cause poor cold start, idle, and cruise. The replacement injectors (P/N 27709-06A) have a 25° spray pattern. You must verify that the injectors have been replaced. The TCFI will not operate correctly with the original injectors.

UBNDERSTANDING IDLE CONTROL

The TCFI controls idle RPM and AFR (air/fuel ratio) using individual control loops. Each control loop can operate open loop (without feedback correction) or closed loop (with feedback correction) depending on conditions. **Understanding how the TCFI system controls idle RPM is a pre-requisite before attempting the lower the idle RPM. Please take the time to read pages 1-4 in the TCFI Idle Tuning Tech Note that covers this subject in detail.**

INITIAL SETUP AND TUNING

Follow the steps in the TCFI Installation and Tuning Manual for a standard installation. Make sure that the auto-tuning process has been completed and that the engine is running properly at the normal 1,000 RPM idle before attempting to lower the idle RPM.

CHARGING SYSTEM

The alternator on some models may not be capable of supporting the normal electrical load when the engine is running at 700 RPM. At this low idle RPM, the battery will slowly discharge. When the battery voltage drops below 12 volts, the TCFI automatically raises the idle back to 1,000 RPM to prevent excessive battery discharge. Replacing the headlight and other running lights that are always on with LED units will significantly reduce the electrical load.

OIL PUMP

The stock oil pump on some models may not be capable of providing sufficient scavenge volume and oil pressure below the normal 1,000 RPM idle speed. Installation of a heavy duty oil pump, such as the Feuling 7000 series is highly recommended.

MODIFYING SETUP FOR LOW IDLE RPM

1. The first step is to verify that the engine will run at the lower idle RPM. Download and open the existing setup file. For reference, print out the ET Based Idle RPM, ET Based IAC Position and Advance tables (Tables 1-3 below are examples). Edit the ET Based Idle RPM table as shown in Table 4. Note that the idle RPM values at 64º C and higher are modified. We recommend not modifying any of the values at lower temperatures.
2. To assure stable engine operation at the lower idle RPM, we recommend flattening out the ignition advance table in the idle range. If ignition advance increases from 500 to 1,000 RPM, engine RPM may tend to vary up and down. Table 5 shows the flattened advance that we used on our test motorcycles. Reducing the ignition advance at the desired idle RPM also helps keep the IAC value within a reasonable operating range.
3. Upload the modified setup file and start the engine. Use the TCFI Log software to monitor engine operation as the engine warms up. Allow the engine to reach at least 112º C. **Verify that the IAC value doesn't drop below the normal operating range, i.e. below 20.** If the IAC value drops below 20, you have two options: further reduce ignition advance or adjust the idle stop on the throttle body. Adjusting the idle stop on stock throttle bodies usually requires drilling out the tamper-proof screw and tapping the hole for a slightly larger set screw. If the idle stop setting allows the throttle blade to completely close and contact the throttle bore, the blade may bind while cold. If you adjust the idle stop screw, you must also check to make sure that the throttle blade is not binding when cold. If you adjust the idle stop, you may also have to readjust the TPS sensor to assure that the TPS voltage remains within 0.30-0.80 volts at idle.
4. The next step is to optimize the ET Based IAC Position table for lower RPM operation. Allow the engine to cool down (we recommend overnight). Start the engine and allow it to reach at least 112º C. Download the last 24 minutes (this is usually sufficient) of operating data with the TCFI Log software. In the chart display, click on ET and IAC for the cold start as shown in Figure 1. The worksheet shown in Table 6 shows data obtained from the chart. Use the blank worksheet on page 6 and fill in your data, using the procedure in steps 5-11 below.
5. The lowest temperature data will depend on your conditions. During the summer months, it may not be possible to obtain data at 16º C (61º F). In this case, start at 32º C.
6. Fill in the second row of the worksheet with the original IAC values from the ET Based IAC Position table you printed out in step 1.
7. Fill in the third row with the observed IAC values from your cold start, starting at the lowest temperature (either 16º C or 32º C) and up to 112º C.
8. The observed IAC value at 112º C (24 in our example) will be the nominal IAC value that the engine runs at once it reaches normal operating temperature.
9. To obtain the calculated values (bottom row) for your modified ET Based IAC Position Table, subtract the value at 112º C from all of the observed values in the third row. The calculated value should be zero at 112º C and all higher temperatures.
10. The last step in the calculation is to estimate the correct IAC values at low temperatures where observed values are not available. The IAC value increases at lower temperatures. On the second row, IAC increases 15 steps between 16º C and 0º C and an additional 15 steps between 0º C and -16º C. These same increases in IAC were used to estimate the values in the bottom row at 0º C and -16º C. Use your own values when doing your worksheet.
11. Once you have completed your worksheet, use the calculated values in the bottom row for your modified ET Based IAC Position table. Use the observed value at 112º C as new Nominal Idle IAC Steps value (on the Basic Modules Parameters screen). Edit and upload the setup file.

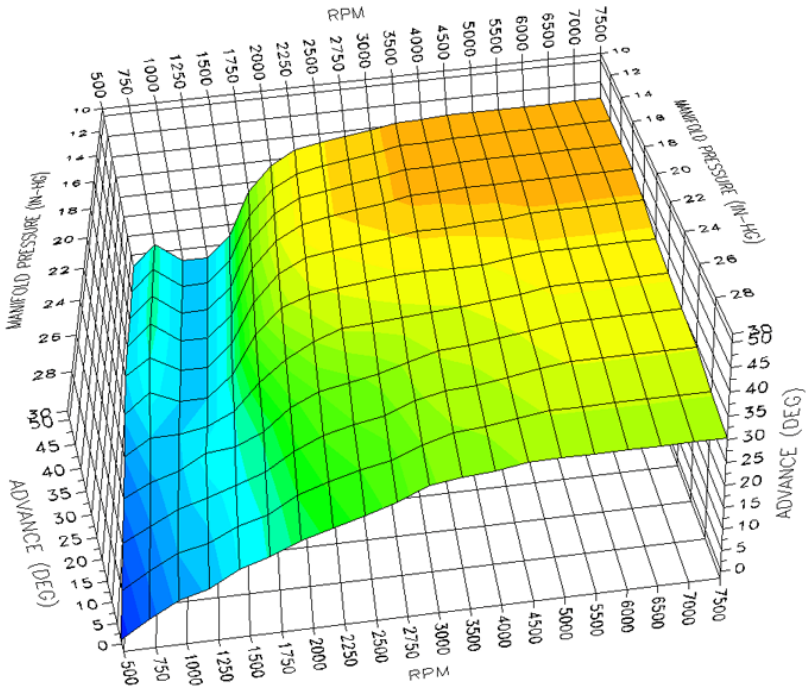
Table 1 – Original ET Based Idle RPM

ET (deg C)	-16	0	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240
Idle RPM	1359	1301	1199	1102	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Table 2 – Original ET Based IAC Position

ET (deg C)	-16	0	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240
IAC	60	45	30	15	8	5	3	2	0	0	0	0	0	0	0	0	0

Table 3 – Original Ignition Advance

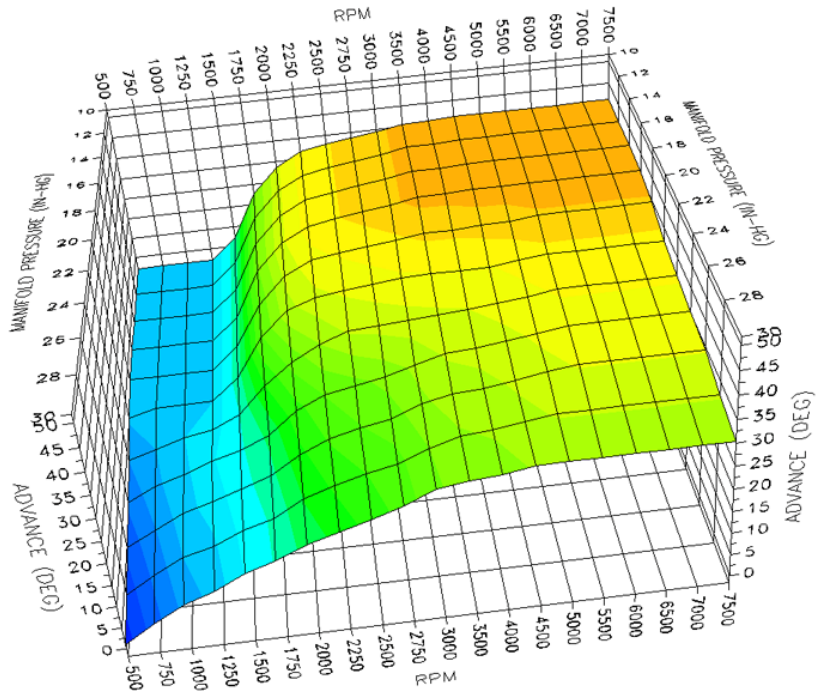


MAP/RPM	500	750	1000	1250	1500
10	12.0	17.1	12.0	12.0	17.1
12	12.0	17.1	12.0	12.0	17.1
14	12.0	17.1	12.0	12.0	17.1
16	12.0	17.1	12.0	12.0	17.1
18	12.0	16.0	12.0	12.0	17.1
20	10.4	15.0	12.0	12.0	17.1
22	8.1	12.0	12.0	13.0	16.0
24	6.3	9.5	11.4	15.0	15.7

Table 4 – Modified ET Based Idle RPM

ET (deg C)	-16	0	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240
Idle RPM	1359	1301	1199	1102	1000	898	699	699	699	699	699	699	699	699	699	699	699

Table 5 – Modified Ignition Advance



MAP/RPM	500	750	1000	1250	1500
10	12.0	12.0	12.0	12.0	17.1
12	12.0	12.0	12.0	12.0	17.1
14	12.0	12.0	12.0	12.0	17.1
16	12.0	12.0	12.0	12.0	17.1
18	12.0	12.0	12.0	12.0	17.1
20	10.4	12.0	12.0	12.0	17.1
22	8.1	10.0	12.0	13.0	16.0
24	6.3	9.5	11.4	13.8	15.7

Figure 1 – Logged ET and IAC Data from Cold Start

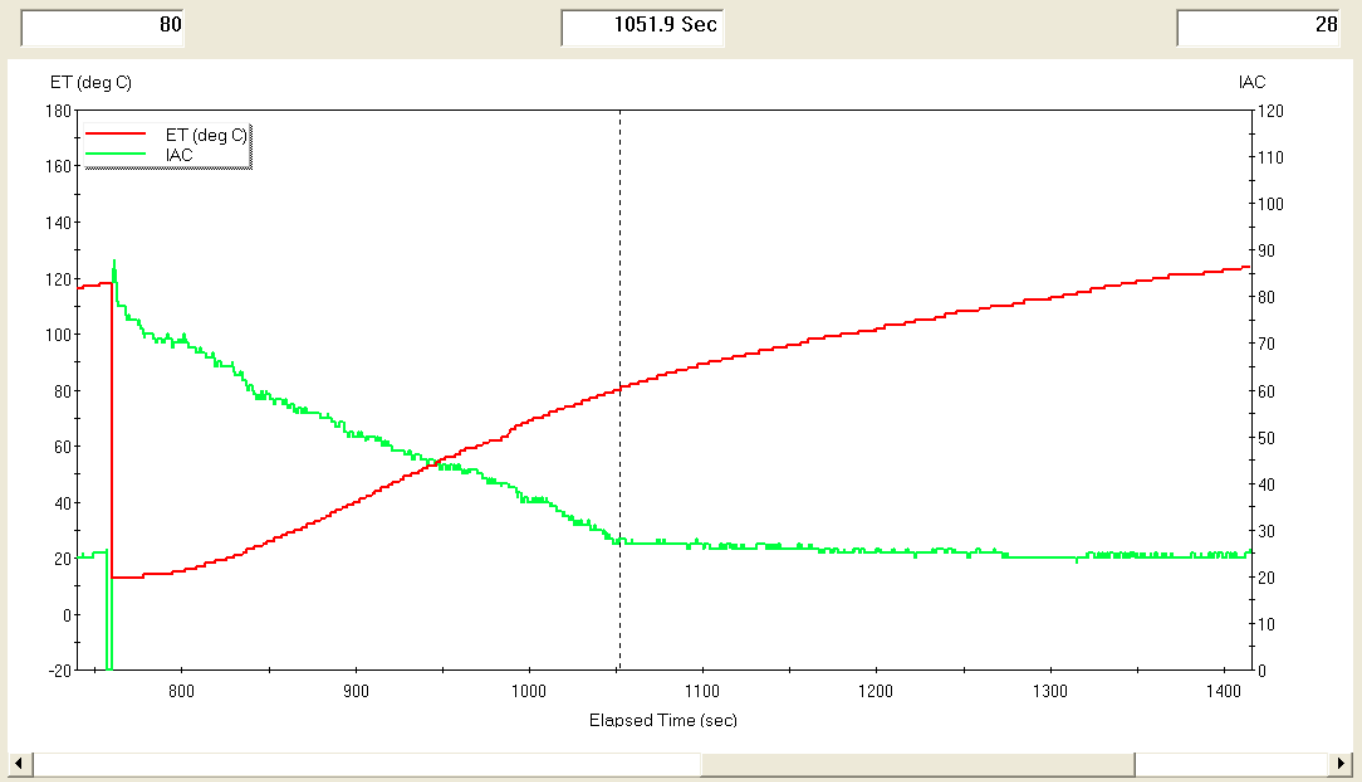


Table 6 – ET Based IAC Position Worksheet

ET (deg C)	-16	0	16	32	48	64	80	96	112
Original IAC Values (from Table 2)	60	45	30	15	8	5	3	2	0
Observed IAC Values (from Figure 1)			68	54	46	40	28	26	24
Calculated IAC Values (for Modified Table 7)	74	59	44	30	22	16	4	2	0

Table 7 – Modified ET Based IAC Position

ET (deg C)	-16	0	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240
IAC	74	59	44	30	22	16	4	2	0	0	0	0	0	0	0	0	0

ADDITIONAL CONSIDERATIONS

Lowering the idle below 1,000 RPM is somewhat of an R&D project, since Harley-Davidson® didn't intend their Twin Cam engines to run at a lower RPM. We were able to successfully use the procedure explained above on two test motorcycles, a 2007 Softail® with 103 CID engine and stage 3 modifications and a 2012 Softail® with 103 CID engine and stage 2 modifications. If you run into issues, need help with the worksheet, or have questions, please email us at techsupport@daytona-twintec.com. Attach your setup file and logged data from the cold start.

Some additional considerations are listed below:

1. **Battery voltage drop during cold start test (step 4 on page 2)**. Since the engine will be running for about 8-10 minutes at a low idle RPM, the battery may discharge below 12 volts on touring models with heavy electrical loads. As explained on page 1, the TCFI will then raise the idle back to 1,000 RPM, defeating the purpose of the cold start test. To avoid this scenario, leave a battery charger connected during the cold start test.
2. **Exhaust considerations**. Customers continue to ignore our warnings about using open exhausts with an auto-tuning system. If the exhaust system is marginal as far as reversion effects at 1,000 RPM, the situation is only going to be worse at 700 RPM.
3. **Forbidden idle RPM zones**. 700 RPM has been tested without any issues. If you want to try a different idle RPM, do not pick values that are close to the border between RPM cells, i.e. 625 RPM or 875 RPM. If the engine operates right at the border between two cells, a phenomena referred to as “aliasing” can cause auto-tuning to fail as one cell becomes progressively leaner and the adjacent cell becomes progressively richer.
4. **Cold start enrichment**. If the engine tends to stall a few seconds after initial start, you may have to adjust the 2D cold start enrichment tables. Refer to the TCFI Idle Tuning Tech Note for details.
5. **Oil pressure and scavenging check**. We recommend installing an oil pressure gauge – at least during the initial tuning phase. If oil pressure drops below 3-5 psi, engine damage may occur. If the engine stalls for no apparent reason after prolonged low RPM idle, check the engine oil sump for excessive oil accumulation. If this occurs, the only solution is to install a heavy duty oil pump.

Blank ET Based IAC Position Worksheet

ET (deg C)	-16	0	16	32	48	64	80	96	112
Original IAC Values									
Observed IAC Values									
Calculated IAC Values									