

Chapter 5

Ignition system

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Degrees of difficulty

Easy, suitable for novice with little experience

Fairly easy, suitable for beginner with some experience

Fairly difficult, suitable for competent DIY mechanic

Difficult, suitable for experienced DIY mechanic

Very difficult, suitable for expert DIY or professional

Specifications

General information

Cylinder numbering1 to 4 from left to right
Spark plugs	see Chapter 1

Ignition timing

At idle	
YZF models5° BTDC @ 1250 rpm
FZS models10° BTDC @ 1250 rpm
Full advance	
YZF modelsNot available
FZS models50° BTDC @ 4500 rpm

Pick-up coil

Resistance189 to 231 ohms @ 20°C
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Ignition HT

Coils	
Primary winding resistance1.87 to 2.53 ohms @ 20°C
Secondary winding resistance (without plug cap)12.0 to 18.0 K-ohms @ 20°C
Spark plug cap resistance10 K-ohms @ 20°C
Minimum spark gap (see Section 2)6 mm

Throttle position sensor

Maximum resistance	
YZF models5.0 ± 1.0 K-ohms
FZS models5.0 ± 1.5 K-ohms
Resistance range	
YZF modelsZero to 5.0 ± 1.0 K-ohms
FZS modelsZero to 5.0 ± 1.5 K-ohms

5*2 Ignition system



2.2 Ground (earth) the spark plug and operate the starter - bright blue sparks should be visible

1 General information

All models are fitted with a fully transistorised electronic ignition system, which due to its lack of mechanical parts is totally maintenance-free. The system comprises a rotor, pick-up coil, ignition control unit and ignition HT coils (refer to the wiring diagrams at the end of Chapter 9 for details). All models are fitted with two HT coils. A throttle position sensor provides information for the ignition control unit.

The ignition triggers, which are on the alternator rotor on the left-hand end of the crankshaft, magnetically operate the pick-up coil as the crankshaft rotates. The pick-up coil sends a signal to the ignition control unit which then supplies the ignition HT coils with the power necessary to produce a spark at the plugs.

The system incorporates an electronic advance system controlled by signals from the ignition triggers, the pick-up coil and the throttle position sensor.

The system incorporates a safety interlock



A simple spark gap testing tool can be made from a block of wood, a large alligator clip and two nails, one of which is fashioned so that a spark plug cap or bare HT lead end can be connected to its end. Make sure the gap between the two nail ends is as specified.

circuit which will cut the ignition if the sidestand is put down whilst the engine is running and in gear, or if a gear is selected whilst the engine is running and the sidestand is down. It also prevents the engine from being started if the engine is in gear unless the clutch lever is pulled in.

Because of their nature, the individual ignition system components can be checked but not repaired. If ignition system troubles occur, and the faulty component can be isolated, the only cure for the problem is to replace the part with a new one. Keep in mind that most electrical parts, once purchased, cannot be returned. To avoid unnecessary expense, make very sure the faulty component has been positively identified before buying a replacement part.

Note that there is no provision for adjusting the ignition timing on these models.

2 Ignition system - check

*W

Warning: The energy levels in electronic systems can be very high. On no account should the ignition be switched on whilst the plugs or plug caps are being held. Shocks from the HT circuit can be most unpleasant. Secondly, it is vital that the engine is not turned over or run with any of the plug caps removed, and that the plugs are soundly earthed (grounded) when the system is checked for sparking. The ignition system components can be seriously damaged if the HT circuit becomes isolated.

1 As no means of adjustment is available, any failure of the system can be traced to failure of a system component or a simple wiring fault. Of the two possibilities, the latter is by far the most likely. In the event of failure, check the system in a logical fashion, as described below.

2 Disconnect the HT lead from one spark plug. Connect the lead to a spare spark plug and lay the plug on the engine with the threads contacting the engine (see illustration). If necessary, hold the spark plug with an insulated tool.

A Warning: Do not remove any of the spark plugs from the engine to perform this check - atomised fuel being pumped out of the open spark plug hole could ignite, causing severe injury!

3 Check that the kill switch is in the "RUN" position and the transmission is in neutral, then turn the ignition switch "ON" and turn the engine over on the starter motor. If the system is in good condition a regular, fat blue spark should be evident at the plug electrode. If the spark appears thin or yellowish, or is non-existent, further investigation will be necessary. Turn the ignition off and repeat the test for each spark plug in turn.

4 The ignition system must be able to produce a spark which is capable of jumping a particular size gap. Yamaha specify that a healthy system should produce a spark capable of jumping at least 6 mm. A simple testing tool can be made to test the minimum gap across which the spark will jump (see **Tool Tip**).

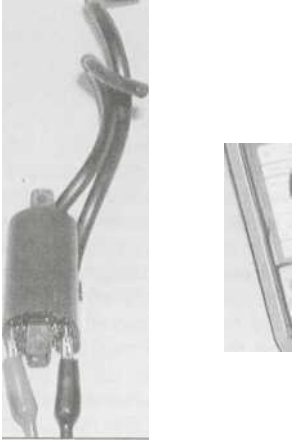
5 Connect one of the spark plug HT leads from one coil to the protruding electrode on the test tool, and clip the tool to a good earth (ground) on the engine or frame (see illustration). Check that the kill switch is in the "RUN" position, turn the ignition switch "ON" and turn the engine over on the starter motor. If the system is in good condition a regular, fat blue spark should be seen to jump the gap between the nail ends. Repeat the test for the other coil. If the test results are good the entire ignition system can be considered good. If the spark appears thin or yellowish, or is non-existent, further investigation will be necessary.

6 Ignition faults can be divided into two categories, namely those where the ignition system has failed completely, and those which are due to a partial failure. The likely faults are listed below, starting with the most probable source of failure. Work through the list systematically, referring to the subsequent sections for full details of the necessary checks and tests. **Note: Before checking the following items ensure that the battery is fully charged and that all fuses are in good condition.**

- Loose, corroded or damaged wiring connections, broken or shorted wiring between any of the component parts of the ignition system (see Chapter 9).
- Faulty HT lead or spark plug cap, faulty spark plug, dirty, worn or corroded plug electrodes, or incorrect gap between electrodes.
- Faulty ignition (main) switch or engine kill switch (see Chapter 9).
- Faulty neutral, clutch or sidestand switch, diode or starter circuit cut-off relay (see Chapter 9).
- Faulty pick-up coil or damaged rotor.
- Faulty ignition HT coil(s).
- Faulty ignition control unit.



2.5 Connect the tester as shown - when the starter is operated sparks should jump between the nails



3.4 To test the coil primary resistance, connect the multimeter leads between the primary circuit terminals on the coil



3.5 To test the coil secondary resistance, connect the multimeter leads between the spark plug leads

7 If the above checks don't reveal the cause of the problem, have the ignition system tested by a Yamaha dealer. Yamaha produce a tester which can perform a complete diagnostic analysis of the ignition system.

3 Ignition HT coils - check, removal and installation ^ <K

Check

1 In order to determine conclusively that an ignition coil is defective, it should be tested by a Yamaha dealer equipped with the special diagnostic tester.

2 However, the coil can be checked visually (for cracks and other damage) and the primary and secondary coil resistance can be measured with a multimeter. If the coil is undamaged, and if the resistance readings are as specified at the beginning of the Chapter, it is probably capable of proper operation.

3 Remove the seat (see Chapter 8).

Disconnect the battery negative (-ve) lead. On Both models, testing of the coils is made much easier if they are removed from the machine, due to restricted access. Remove the coils as described below, then test them as follows.

4 Set the meter to the ohms x 1 scale and measure the resistance between the primary circuit terminals on the coil (see illustration). This will give a resistance reading of the primary windings of the coil and should be consistent with the value given in the Specifications at the beginning of the Chapter.

5 To check the condition of the secondary windings, unscrew the spark plug caps from the HT leads and set the meter to the K-ohm scale. Connect one meter probe to one HT lead end and the other probe to the other lead end (see illustration). If the reading obtained is not within the range shown in the Specifications, it is likely that the coil is defective.

6 If the reading is as specified, measure the resistance of the spark plug cap by

connecting the meter probes between the HT lead socket in the cap and the spark plug contact in the cap (see illustration). If the reading obtained is not as specified, replace the spark plug caps with new ones.

7 Should any of the above checks not produce the expected result, have your findings confirmed on the diagnostic tester (see Step 1). If the coil is confirmed to be faulty, it must be replaced with a new one; the coil is a sealed unit and cannot be repaired.

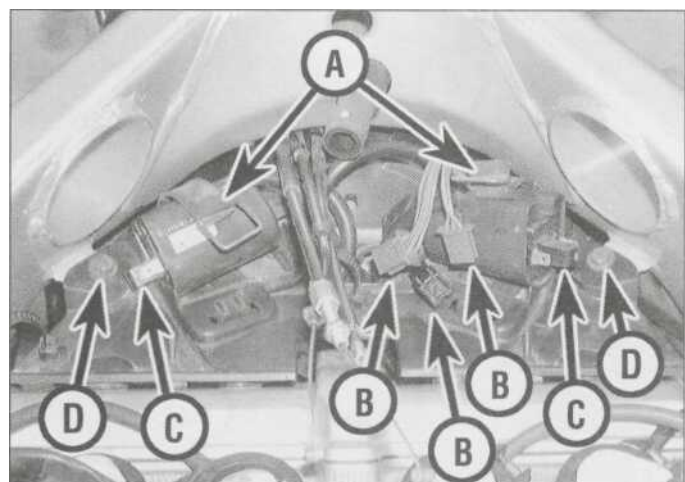
Removal

8 Remove the seat (see Chapter 8). Disconnect the battery negative (-ve) lead.

9 On YZF models, the coils are mounted on the inside of the frame behind the steering head - remove the fuel tank, the air filter housing and the carburetors for access (see Chapter 4). Release the rubber straps from the coil mounting plate and free the wiring loom, then disconnect the right-hand handlebar switch and cooling fan wiring connectors, and the primary circuit wiring connectors from the coils (see illustration).



3.6 Measure the resistance of the spark plug cap



3.9a Release the rubber straps (A), disconnect the wiring connectors (B and C), and unscrew the bolts (D)

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3.9b Remove the coil mounting plate, noting how it fits

Mark the locations of all wires and leads before disconnecting them. Feed the cooling fan connector down through the hole in the mounting plate. Pull the spark plug caps off the plugs. Unscrew the two bolts and remove

the coil mounting plate assembly (**see illustration**). Remove each coil from the plate. 10 On FZS models, the coils are mounted underneath the fuel tank - remove the tank for access (see Chapter 4). Unscrew the bolts on the ignition coil/fuel pump mounting bracket and free the rubber holder for the wiring loom from its hole, then displace the bracket - there is no need to disconnect any other wiring or hoses (**see illustration**). Disconnect the primary circuit electrical connectors from the coil and the HT leads from the spark plugs, then unscrew the bolts securing the coils and remove them from the plate, noting how they fit (**see illustration**). Mark the locations of all wires and leads before disconnecting them. Note the routing of the HT leads.

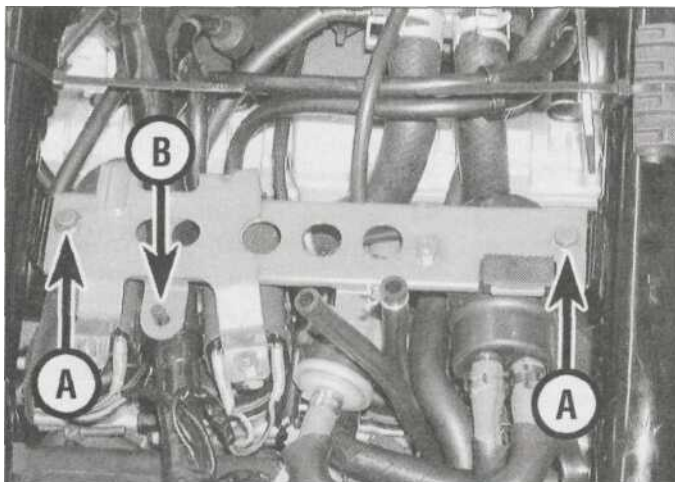
Installation

11 Installation is the reverse of removal. Make sure the wiring connectors and HT leads are securely connected.

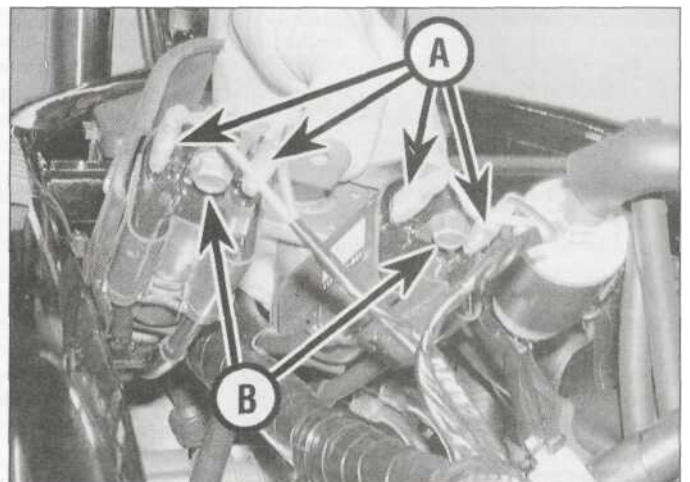
4 Pick-up coil - check and replacement

Check

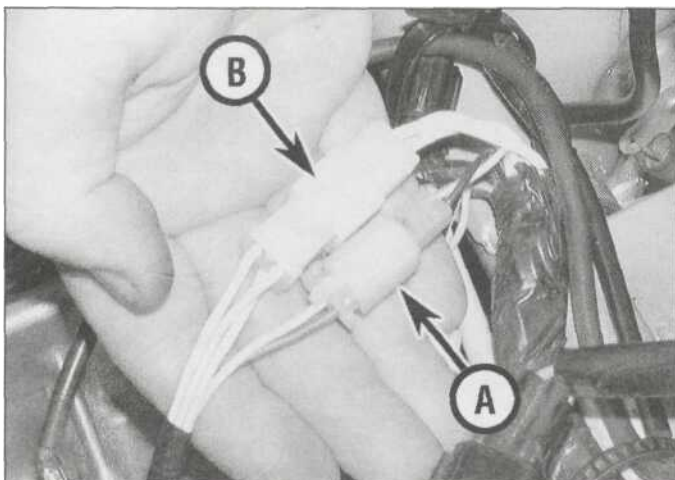
- 1 Remove the seat (see Chapter 8). Disconnect the battery negative (-ve) lead.
- 2 On YZF models, remove the fuel tank (see Chapter 4). On FZS models, remove the left-hand side cover (see Chapter 8, Section 3), then displace the turn signal and starter circuit cut-off relays from the mounts on the left-hand side of the frame and draw the four wiring connectors out from behind them.
- 3 Trace the pick-up coil/alternator wiring from the top of the alternator cover on the left-hand side of the engine and disconnect it at the connector with the blue and yellow wires (**see illustrations**). Using a multimeter set to the ohms x 100 scale, measure the resistance between the terminals on the pick-up coil side of the connector.



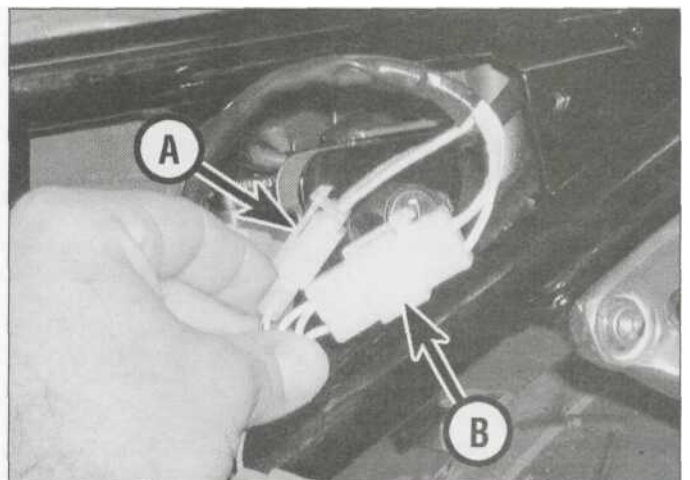
3.10a Unscrew the bolts (A) and free the rubber holder (B), then displace the bracket



3.10b Disconnect the primary circuit connectors (A) and the spark plug caps, then unscrew the bolts (B) and remove the coils



4.3a Pick-up coil wiring connector (A), alternator wiring connector (B) - YZF models



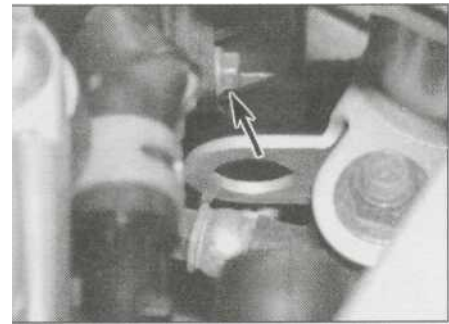
4.3b Pick-up coil wiring connector (A), alternator wiring connector (B) - FZS models

4 Compare the reading obtained with that given in the Specifications at the beginning of this Chapter. The pick-up coil must be replaced with a new one if the reading obtained differs greatly from that given, particularly if the meter indicates a short circuit (no measurable resistance) or an open circuit (infinite, or very high resistance).

5 If the pick-up coil is thought to be faulty, first check that this is not due to a damaged or broken wire from the coil to the connector; pinched or broken wires can usually be repaired.



5.3a Disconnect the wiring connectors (arrowed)...



5.3b ... then unscrew the bolt (arrowed) and remove the unit

Replacement

6 The pick-up coil is wired integrally with the alternator stator, which means that the stator must be renewed along with the coil if the coil is faulty. However it is worth checking with a Yamaha dealer to see if the coil can be obtained separately and wired into the loom to avoid the extra expense of paying for a stator as well.

7 Refer to Chapter 9 and replace the alternator stator/pick-up coil assembly.

5 Ignition control unit - check, removal and installation §

Check

1 If the tests in the preceding or following Sections have failed to isolate the cause of an ignition fault, it is possible that the ignition control unit itself is faulty. No test details are available with which the unit can be tested on home workshop equipment. Take the machine to a Yamaha dealer for testing on the diagnostic tester.

Removal

2 Remove the seat (see Chapter 8). Disconnect the battery negative (-ve) lead.

3 On YZF models the control unit is mounted in front of the battery - remove the fuel tank for access (see Chapter 4). Disconnect the wiring connectors from the ignition control unit, then unscrew the bolt on the bottom of the unit and remove the unit - the bolt is best accessed via the right-hand side of the frame above the rear brake master cylinder reservoir hose (see illustrations).

4 On FZS models the control unit is mounted in front of the taillight assembly - remove the tail cover for access (see Chapter 8, Section 3). Disconnect the wiring connectors from the ignition control unit, then remove the screws securing the unit and remove it.

Installation

5 Installation is the reverse of removal. Make sure the wiring connectors are correctly and securely connected.

Ignition timing - general information and check

General information

1 Since no provision exists for adjusting the ignition timing and no component is subject to mechanical wear, there is no need for regular checks; only if investigating a fault such as a loss of power or a misfire, should the ignition timing be checked.

2 The ignition timing is checked dynamically (engine running) using a stroboscopic lamp. The inexpensive neon tube lamps should be adequate in theory, but in practice may produce a pulse of such low intensity that the timing mark remains indistinct. If possible, one of the more precise xenon tube lamps should be used, powered by an external source of the appropriate voltage. **Note:** Do not use the machine's own battery as an incorrect reading may result from stray impulses within the machine's electrical system.

Check

3 Warm the engine up to normal operating temperature then stop it.

4 Unscrew the timing inspection plug from the alternator cover on the left-hand side of the engine (see illustration).

5 The timing mark on the alternator rotor which indicates the firing point at idle speed

for the No. 1 cylinder is a scribe line. The static timing marks with which this should align are the notches in the threads for the inspection plug on the alternator cover (see illustration).



The timing marks can be highlighted with white paint to make them more visible under the stroboscope light.

6 Connect the timing light to the No. 1 cylinder HT lead as described in the manufacturer's instructions.

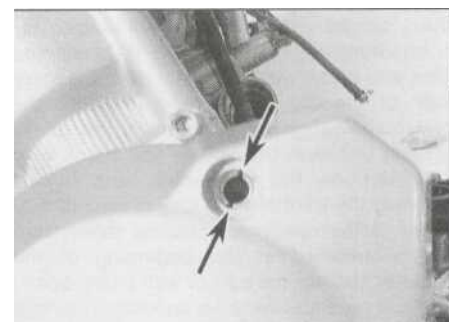
7 Start the engine and aim the light at the timing inspection hole.

8 With the machine idling at the specified speed, the scribe line on the rotor should align with the static timing marks (notches).

9 Slowly increase the engine speed whilst observing scribe line. The line should move clockwise, increasing in relation to the engine speed until it reaches full advance.

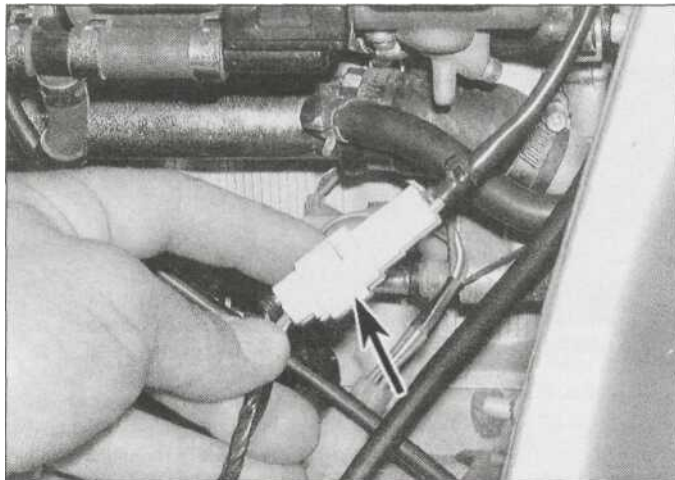
10 As already stated, there is no means of adjustment of the ignition timing on these machines. If the ignition timing is incorrect, or suspected of being incorrect, one of the ignition system components is at fault, and the system must be tested as described in the preceding Sections of this Chapter.

11 When the check is complete, install the timing inspection plug and tighten it securely (see illustration 6.4).

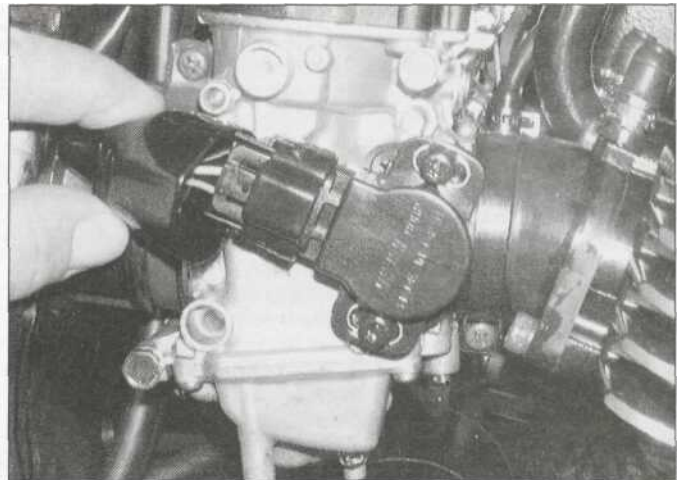


6.5 The notches (arrowed) are the static timing marks

6.4 Unscrew the timing inspection plug



7.4a On YZF models, disconnect the throttle position sensor wiring connector (arrowed)



7.4b On FZS models, disconnect the connector from the sensor

7 Throttle position sensor - check, adjustment and replacement



1 The throttle position sensor (IPS) is mounted on the outside of the right-hand carburettor and is keyed to the throttle shaft. The sensor provides the ignition control unit with information on throttle position and rate of opening or closing.

2 When the ignition is first switched on, or while the engine is running, the throttle position sensor performs its own self-diagnosis in the event of failure or faulty wiring. When a fault occurs, the tachometer will be seen to display zero rpm for 3 seconds, then 3000 rpm for 2.5 seconds, then the actual engine speed for 3 seconds, whereupon it will repeat the cycle until the engine is switched off.

Check

3 Remove the fuel tank, and on YZF models the air filter housing (see Chapter 4). The throttle sensor is mounted on the outside of the right-hand carburettor.

4 Make sure the ignition is switched off, then disconnect the sensor's wiring connector (see illustrations). Using an ohmmeter or multimeter set to the K-ohms range, measure the sensor maximum resistance by connecting the meter probes between the blue and black wire terminals on the sensor side of the connector. Now measure the resistance range by connecting the meter probes between the yellow and black wire terminals on the connector, and slowly opening the throttle from fully closed to fully open. If the readings obtained differ from those specified at the beginning of the Chapter, replace the sensor with a new one.

5 If the readings were as specified, using a multimeter set to resistance, or a continuity tester, check for continuity between the

terminals on the wiring loom side of the sensor wiring connector and the corresponding terminals on the ignition control module connector (first disconnect it). There should be continuity between each terminal. If not, this is probably due to a damaged or broken wire between the connectors; pinched or broken wires can usually be repaired. Also check the connectors for loose or corroded terminals, and check the sensor itself for cracks and other damage. If the wiring and connectors are good, check the adjustment of the sensor as described below.

6 If the sensor is suspected of being faulty, take it to a Yamaha dealer for further testing. If it is confirmed to be faulty, it must be replaced; the sensor is a sealed unit and cannot be repaired. If the sensor is good, have the ignition control unit checked by the dealer.

Adjustment

YZF models

7 Before adjusting the sensor, check the idle speed and carburettor synchronisation (see Chapter 1).

8 Turn the ignition switch on, then disconnect the sensor wiring connector (see illustration 7.4a). Using an ohmmeter or multimeter set to the K-ohms range, connect the meter probes between the yellow and black wire terminals on the sensor side of the connector. The sensor must be adjusted so that the minimum resistance reading, i.e. with the throttle fully closed, is 0.116 x the maximum reading obtained in Step 4. For example, if the maximum reading was 5.0 K-ohms, then the minimum reading required is 0.116 x 5, which is 0.58 K-ohms (580 ohms).

9 Slacken the sensor mounting screws and rotate the sensor until the reading is as calculated for your max. reading, then tighten the screws evenly and a little at a time. Unless

an angled screwdriver is available, it may be necessary to displace the carburettors to access the screws (see Chapter 4). If it cannot be adjusted to within the range, or if no reading is obtained, check it as described above.

FZS models

10 Before adjusting the sensor, check the idle speed and carburettor synchronisation (see Chapter 1).

11 Turn the ignition switch on, then disconnect and reconnect the sensor wiring connector (see illustration 7.4b). This sets the ignition control unit to sensor adjustment mode.

12 Slacken the sensor mounting screws and rotate the sensor until the tachometer needle reads 5000 rpm. If the tachometer reads either 0 rpm or 10,000 rpm, the angle of the sensor is either too narrow or too wide. Adjust it as required until the reading is 5000 rpm, then tighten the screws evenly and a little at a time. If it cannot be adjusted to within the range, or if no reading is obtained, check it as described above.

Replacement

13 Remove the fuel tank, and on YZF models the air filter housing and the carburettors (see Chapter 4). The throttle sensor is mounted on the outside of the right-hand carburettor.

14 On FZS models, disconnect the wiring connector (see illustration 7.4b). Unscrew the sensor mounting screws and remove the sensor, noting how it fits.

15 Install the sensor and lightly tighten the screws, then connect the wiring connector and adjust the sensor as described above until the correct reading is obtained. On completion, tighten the screws evenly and a little at a time.

16 Install the carburettors and air filter housing (YZF models) and fuel tank (see Chapter 4).