

Ford Rotunda 78-0116 Timing Meter and the 78-0117 2.4L Adapter (for the BMW 2.4L Diesel Engine)

By Scott Asbury (TD-0302) 2014-05-05

The 78-0116 includes the meter and adapter 78-0117 (Adapter specific to 2.4L diesel)
(The Ford 78-0100 timing meter can be used with the 78-0117 adapter)

The original 78-0116 manual and the 78-0117 manual incorrectly list the offset value.

78-0116 says offset = -20.0° (incorrect in most cases)

78-0117 says offset = -20.4° (incorrect)

From Bulletin Number 84-14, Article No. 84-14-21 (July 3, 1984)

Correct offset = -21.2° (for engine 49S, most engines)

= -20.0° (for California engines)

The Injection Pump Timing (from page 22-07-35 from Ford 2.4L Diesel Turbo Engine Shop Manual)

2.5° BTDC at 750-800 rpm (idle speed 750 to 800 rpm) (See image below)

I also have a handwritten note with the following specs (unknown source)

$2.5^{\circ} \pm 1.0^{\circ}$ BTDC at 750rpm (49 states VE Pump)

$6.0^{\circ} \pm 1.5^{\circ}$ BTDC at 2000 rpm (California VP-20 Pump)

However, the Timing Specs are a little different from BMW 524td

$3.5^{\circ} \pm 1.5^{\circ}$ BTDC at 750 – 800 rpm (idle spec = 750 to 800 rpm)

$5.0^{\circ} \pm 1.5^{\circ}$ BTDC at 1500 rpm (See image below)

Note that on Lincoln 2.4L diesel vehicles, the trip minder connector must be disconnected before connecting the timing meter or incorrect timing readings may result. (See Ford manuals below)

The rpm display on the meter is triggered by two pins attached to the flywheel. The pins provide a reference to TDC. If one or both of these pins are missing or bent, you will get erroneous or inoperative rpm readings. (See Article 84-14-21 below). Inoperative rpm readings could also be caused by a bad sensor, incorrect gap between the sensor and the pins on the flywheel (unlikely), or bad wiring at the Diagnostic Connector. The sensor should measure about 80 ohms (± 10 ohms) between pins 8 and 10 on the Diagnostic Connector. BMW quit production of this sensor in 2009 and sensors can no longer be purchased new. I believe that to correctly test the sensor would require an oscilloscope. With the engine operating at idle and above, I was unable to obtain any kind of a signal with a standard VOM.

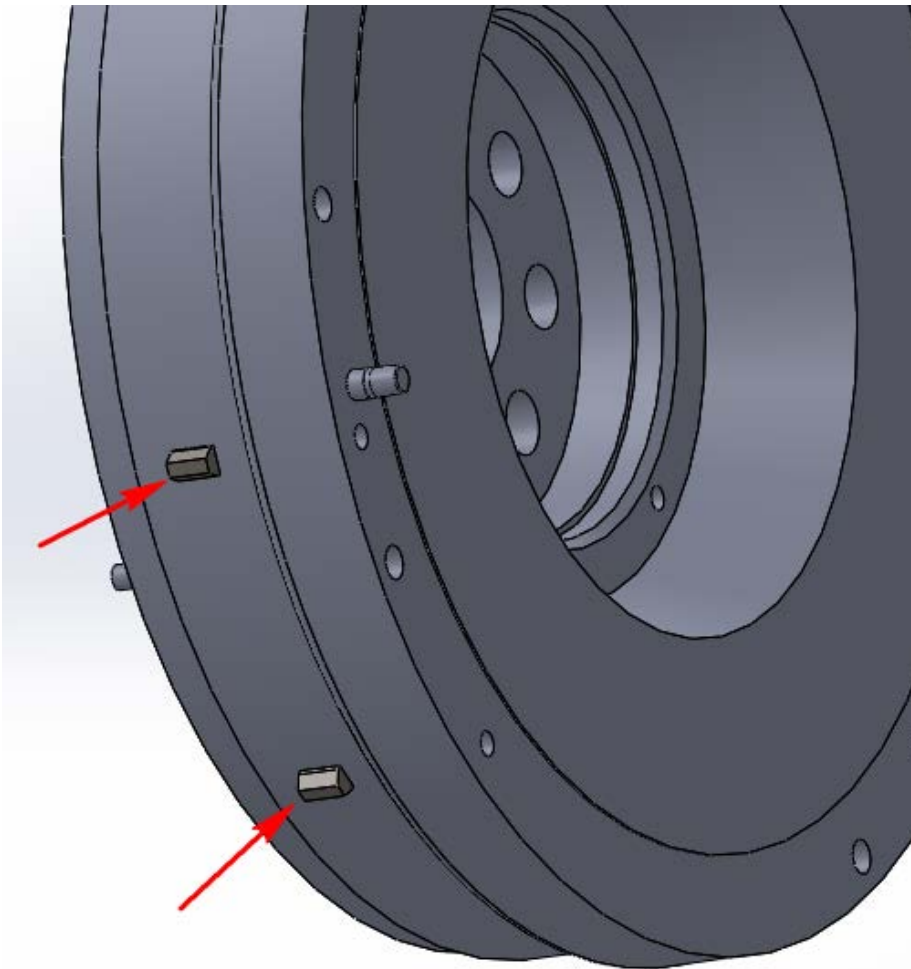
I have seen flywheels that were mounted incorrectly and were thus indexed incorrectly with regards to the crankshaft. If the flywheel is not indexed correctly to the crankshaft, the TDC pins will be offset away from TDC and the timing readout will be erroneous.

The meter uses the TDC sensor signal and the signal from the wired #4 injector to display the Dynamic Injection Timing. If the TDC sensor or the signal from the wired #4 injector is not correct, the timing reading will be erroneous or inoperative.

Sticker provided for attachment to 78-0117 adapter (These are the correct offset values for the meter)



Vixen TD Flywheel Showing the TDC pins



If someone has a picture of the BMW 524td flywheel showing the TDC pins, send it and I will add it here.

If someone has a picture of the Lincoln 2.4L diesel flywheel showing the TDC pins, send it and I will add it here.

Send to: FlywheelPictures@ScottAsbury.com

SPECIFICATIONS

ENGINE

Type	6-cylinder, in-line, 4-cycle, overhead valve, water-cooled
Bore	3.150 in (80mm)
Stroke	3.189 in (81mm)
Displacement	149 cu in (2442.9 cc)
Compression ratio	23:1
Horsepower	114 (85 kw) at 4800 rpm
Minimum Torque	150 lb ft (210 N•m) at 2400 rpm
Compression pressure	348 psi (2400 kPa)
Valve clearance (cold engine)	Intake: 0.010 in (0.3mm) Exhaust: 0.010 in (0.3mm)

Cam Timing

Intake valve opens	6° BTDC
Intake valve closes	34° ABDC
Exhaust valve opens	46° BBDC
Exhaust valve closes	6° ATDC
Intake valve lift	0.374 in (9.5mm)
Exhaust valve lift	0.376 in (9.55mm)

Weight 433 lbs (196.4 kg) dry

FUEL SYSTEM

Injection firing order	1 5 3 6 2 4
Idle speed	750 + 50 - 0 rpm
Fast idle (cold-start) speed	900-1050 rpm
Injection pump timing	2.5° BTDC at 750-800 rpm

LUBRICATION SYSTEM

Complete System w/o oil cooler	7.1 qts (6.7L)
Complete System	7.9 qts (7.5L)
Engine oil pressure	57-85 psi at 4000 rpm

CA8273-A

BMW Timing Specifications

FUEL SYSTEM	a) 524 td A		
13 – 21			
13 51 ... Distributor Injection Pump VP-20			
Code number	VE 6/10 F 2400 R 118		
Pump internal pressure at idle speed	bar (psi)	3.5 ... 4.5 (50 ... 64)	
at 2000 rpm	bar (psi)	4.5 ... 6.0 (64 ... 85)	
from 4000 rpm on	bar (psi)	≥ 6 (85)	
Static injection beginning adjustment – stroke of distributor piston (with 1st cylinder piston at TDC)	mm (in.)	0.65 + 0.02 (0.0256 + 0.0008)	
Test value for static injection beginning adjustment – without following up with readjustment	mm (in.)	0.65 ... 0.69 (0.0256 ... 0.0272)	
Dynamic injection beginning (oil temp. > 70° C / 158° F)			
at idle speed	°crksh. BTDC	3.5 ± 1.5 (checked with BMW service test unit and test adapter, engine test P 06)	
at 1500 rpm	°crksh. BTDC	5.0 ± 1.5	
(oil temp. ≥ 60° C / 140° F)			
Idle speed	rpm	750 + 50	
Maximum speed	rpm	5350 ± 100	

BMW Reference Mark Transmitter Specs (TDC sensor attached only to the Diagnostic Connector, used by 78-0116)
 (Note that this is not the speed sensor that connects to the ECU and provides the signal for the tachometer)

ENGINE ELECTRICAL EQUIPMENT 12 – 5	a) 318 i b) 318 iA	a) 524 tdA	a) 528 e/A b) 325 e/A	a) 533 i/A b) 535 i/A	a) 633 CSi/A b) 635 CSi/A	a) 733 i/A b) 735 i/A
12 14 ... Control Units for TCI and DME						
TCI (transistor coil ignition system) Code number	0 227 100 111 since 12/84 1 705 607/608		-			
DME (digital motor electronics)	-	-	see Group 13 61 ...			
12 14 ... Reference Mark Transmitter						
Resistance of coil at 23 ± 5° C (73 ± 9° F)	ohm	-	80 ± 10	960 ± 10 %		
Resistance between coil and shield	k-ohm	-	≥ 60	≥ 100		
12 14 ... Speed Transmitter						
Resistance of coil	ohm			960 ± 10 %		
Insulation resistance	k-ohm			≥ 100		
Speed transmitter distance	mm (in.)		1.3 ± 0.1 (0.051 ± 0.004)			
Alternating voltage at idle speed	V		> 1.4			

Miscellaneous/General

JULY 3, 1984

BULLETIN NUMBER 84-14

Article No. 84-14-21

INJECTOR TIMING METER — 2.4L DIESEL — PROCEDURE

LINCOLN-MERCURY

1984 CONTINENTAL/MARK VII

CALIBRATIONS: All with 2.4L Diesel engines

An inoperative timing meter or erroneous readings can be caused by missing or bent timing pins.

If, when using the Rotunda timing meter model 078-00100, erroneous readings and/or inoperative condition is present, the following is recommended:

1. Raise vehicle on hoist.
2. Remove carburetor housing access grill, located at bottom of converter housing.
3. Verify that two pins are attached to rear of flywheel (it may be necessary to rotate crankshaft).

If one or both pins are bent or missing, meter will not function (Figure 22).

Incorrect information was published in the directions (included with timing adapters) sent to dealerships. It stated the offset adjustment specification was -20.0° .

The correct specification for 49S engines is -21.2° (4-40A-RXX calibrations) and the correct specification for California engines -20.0° (4-40S-RXX calibrations).

OTHER APPLICABLE ARTICLES: None

WARRANTY STATUS: "INFORMATION ONLY"

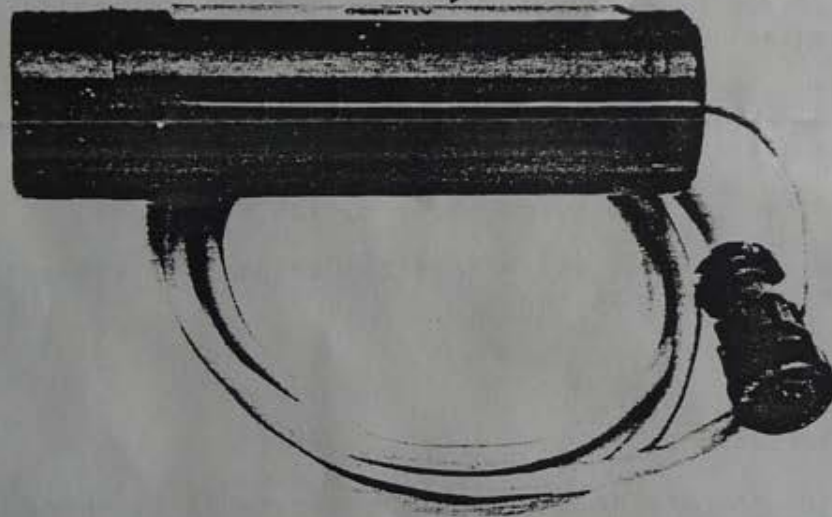
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ROTUNDA 78-0117

2.4L DIESEL ADAPTER

OPERATING INSTRUCTIONS

(For use with 78-0100 Diesel Tach/Timing Units)



GENERAL

The Rotunda 78-0117 Diesel Adapter is designed to verify and check engine rpm and diesel timing on 2.4L, 6-cylinder diesel engines. The adapter plugs directly into 78-0100 units, and to the engine diagnostic connector located above the injector for cylinder no. 5. With one test lead connection, the meter is able to sense the injector needle lift on cylinder no. 4 and the crankshaft reference pin position on the flywheel to display engine rpm and diesel timing measurements.

The operator instructions included with the 78-0100 diesel tach/timing meter are to be used for reference only. The magnetic probe, luminosity pickup, luminosity probe, and cetane tester are not used when testing 2.4L engines with the 78-0117 adapter. Use the test preparation and test procedure that follow.

TEST PREPARATION

1. Start the engine and allow it to reach normal operating temperature.
2. Turn off the engine.

ROTUNDA 78-0117

2.4L DIESEL ADAPTER

OPERATING INSTRUCTIONS

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GENERAL

The Rotunda 78-0117 Diesel Adapter is designed to verify and check engine rpm and diesel timing on 2.4L, 6-cylinder diesel engines. The adapter plugs directly into 78-0100 units, and to the engine diagnostic connector located above the injector for cylinder no. 5. With one test lead connection, the meter is able to sense the injector needle lift on cylinder no. 4 and the crankshaft reference pin position on the flywheel to display engine rpm and diesel timing measurements.

The operator instructions included with the 78-0100 diesel tach/timing meter are to be used for reference only. The magnetic probe, luminosity pickup, luminosity probe, and cetane tester are not used when testing 2.4L engines with the 78-0117 adapter. Use the test preparation and test procedure that follow.

TEST PREPARATION

1. Start the engine and allow it to reach normal operating temperature.
2. Turn off the engine.

3. Disconnect the 8-pin tripminder connector located near the air filter housing.

NOTE: If the tripminder connector is not disconnected in step 3, incorrect timing readings may result.

4. Connect the adapter to the meter.
5. Clamp the meter power leads to the battery: RED to the positive battery terminal; BLACK to the negative battery terminal.

NOTE: If the tripminder connector is disconnected after the power leads are attached to the battery, disconnect and reconnect the power leads to reset the meter.

6. Set the OFFSET on the meter to -20.4 degrees.
7. Remove the dust cover from the diagnostic connector and plug the adapter into it.

TEST PROCEDURE

1. Start the engine. Be sure the engine is at normal operating temperature.
2. Read the engine rpm and diesel timing shown on the meter.
3. Turn the engine off.
4. Compare the readings to manufacturer's specifications.
5. Remove the power leads and adapter from the engine.
6. Make adjustments per manufacturer's recommendations, if necessary. Then repeat test procedure to verify adjustment.

Rotunda 

**ROTUNDA DIESEL
TACH/TIMING METER
MODEL 78-0116**

INSTRUCTION MANUAL



SAFETY PRECAUTIONS

The following precautions must always be observed when doing automotive testing:

1. To ensure safe operation and to prevent personal injury, completely read the instructions presented in this pamphlet before testing.
2. Exhaust gases contain carbon monoxide, which is a colorless and lethal gas. For this reason, always work in well ventilated areas.
3. Diesel fuel fumes are explosive. **DO NOT** smoke around diesel fuel.
4. Wipe up fuel spills immediately and dispose of soaked rags in air-tight containers.
5. Before testing, always check the vehicle fluid levels. **DO NOT** test a vehicle if the fluids are low.
6. To extend the life of the tester leads, keep them off the floor and away from moving engine parts.
7. Raise drive wheels off the ground before performing any tests with the engine running.
8. Always set the parking brake. Also, on vehicles equipped with manual transmissions, place the shift lever in neutral; on vehicles equipped with automatic transmissions, be sure the shift lever is in park.
9. When checking timing, stay clear of rotating engine parts.

NOTE: Always check the coolant level when the engine is cold to prevent injury.

GENERAL

The Rotunda 78-0116 Diesel Tach/Timing Meter designed to verify and check engine rpm and diesel timing on 2.4L, 6-cylinder diesel engines. Adapter P/N 78-0117, included with the meter, plugs directly into the meter and into the engine diagnostic connector located above the injector for cylinder no. 5. With one test lead connection, the meter is able to sense the injector needle lift on cylinder no. 4 and the crankshaft reference pin position on the flywheel to display engine rpm and diesel timing measurements.

TEST PREPARATION

1. Start the engine and allow it to reach normal operating temperature.
2. Turn off the engine.
3. Disconnect the 8-pin tripminder connector located near the air filter housing.

NOTE: If the tripminder connector is not disconnected in step 3, incorrect timing readings may result.

4. Connect the adapter to the meter.
5. Clamp the meter power leads to the battery: RED to the positive battery terminal; BLACK to the negative battery terminal.
6. Set the OFFSET on the meter to -20.0 degrees.
7. Remove the dust cover from the diagnostic connector and plug the adapter into it.

TEST PROCEDURE

1. Start the engine. Be sure the engine is at normal operating temperature.
2. Read the engine rpm and diesel timing shown on the meter.

3. Turn the engine off.
4. Compare the readings to manufacturer's specifications.
5. Remove the power leads and adapter from the engine.
6. Make adjustments per manufacturer's recommendations, if necessary. Then repeat test procedure to verify adjustment.

METER DIAGNOSTICS

Listed in the chart below are several conditions that will affect the operation of the meter. If any of these conditions exist, read the items that correspond to the condition in the POSSIBLE CAUSE and CORRECTIVE ACTION columns.

METER OPERATION CHECK

1. Attach the power leads to the meter to a 12 volt battery.
2. With power to the unit, the meters should read as follows:
 - a. The RPM meter should read zero.
 - b. Turn the OFFSET ANGLE adjustment knob fully clockwise. The DEGREES meter should read -170° to -190°.
3. If the meter does not respond as indicated above, contact your local Sun Service Facility.

SERVICE INFORMATION

For repair and service information, contact Sun Electric Corporation Service Center. In shipping the unit, enclose return address, name to contact, and a brief description explaining the nature of the difficulty.

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Degrees and rpm meters inoperative.	Reversed polarity, no power to meter.	Check: Battery connections, battery leads to meter.
2. Degrees and/or rpm reading fluctuates.	Intermittent readout.	1. Check adapter for proper attachment. 2. Check for erratic leaking or improperly adjusted fuel injector or a fuel restriction.

REGIONAL OFFICES

Atlanta: 569 Lee Industrial Blvd., Austell, GA 30001, (404) 944-1090
Boston: 59 Manley Street, Brockton, MA 02401, (617) 584-0900
Buffalo: 9700 Main Street, Clarence, NY 14031, (716) 759-6821
Charlotte: 620 North I-85, Charlotte, NC 28216, (704) 399-5681
Chicago, S.: 7518 W. 98th Place, Bridgeview, IL 60455, (312) 430-4600 & 4601
Cincinnati: 2973 P. G. Graves Lane, Evendale, OH 45241 (513) 563-2660
Cleveland: 14411 Foltz Parkway, Strongsville, OH 44136, (216) 238-6037
Dallas: 735 109th St., Arlington, TX 76011 (817) 461-0044
Denver: 4905 East 41st St., Denver CO 80216, (303) 355-1691
Detroit: 34153 Industrial Road, Livonia, MI 48150, (313) 522-8383
Houston: 1702 Townhurst Drive, Houston, TX 77043 (713) 465-4477
Kansas City: 1510 East Spruce, Olathe, KS 66061 (913) 782-0300
Los Angeles: 16658 Arminta St., Van Nuys, CA 91406, (213) 782-0459
Miami: 1015 NW. 6th St., Deerfield Beach, FL 33441, (305) 428-5151
Milwaukee: 665 Larry Court, Waukesha, WI 53186 (414) 786-8630
Minneapolis: 14850 Martin Dr., Eden Prairie, MN 55344, (612) 937-1505 & 1506
Nashville: 1854 Airline Drive #20, Nashville, TN 37210 (615) 885-1972
New Orleans: 5135 Storey Street, Harahan, LA 70123, (504) 733-1424
New York City: 3180 Expressway Dr. South, Central Islip, NY 11722, (516) 234-9181
Omaha: 4320 S. 102nd Street, Omaha, NE 68127, (402) 331-5061
Philadelphia: 2520 Wyandotte Road, Willow Grove, PA 19090, (215) 659-7780
Phoenix: 3821 North 34th Ave., Phoenix, AZ 85017, (602) 278-5514
Pittsburgh: 270 Alpha Drive, Pittsburgh, PA 15238, (412) 963-7770
St. Louis: 515 Rudder Road, Fenton, MO 63026 (314) 343-5011
San Jose: 2040 Hartog Drive, San Jose, CA 95131, (408) 263-4200
Seattle: 14328 Linden Ave., N., Seattle, WA 98133, (206) 365-9000
Washington, D. C.: 5024 Herzel Place, Beltsville, MD 20705, (301) 937-3510, 3511 & 3512

