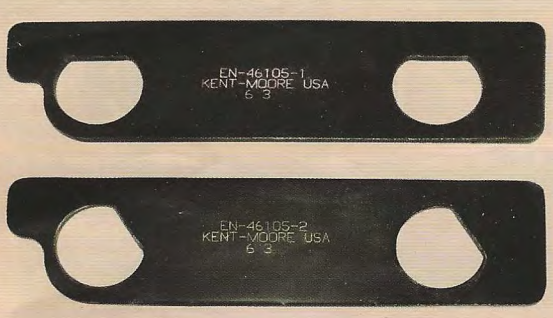
Timing Chain

VZ – VE Commodore Alloytec 3.6 Litre

The timing for this engine is carried out in two stages. It is important that you read all the instructions before commencing the job, especially the Notes and Cautions.
The suggested repair time is 6.5 hours.

Warning!

Retiming this engine requires the use of camshaft alignment tools EN 46105-1 and EN 46105-2. Do not attempt to carry this job unless you have these tools.



Note!

DO NOT turn crankshaft or camshafts while timing chains are removed unless otherwise stated.

Disconnect battery before starting work.

Remove spark plugs to ease turning the engine.

Turn engine in normal direction of rotation unless otherwise stated.

DO NOT turn engine by camshafts or other pulleys.

Follow all tightening torques.

Use Special Tools where directed.

Timing Chain Removal

1. Disconnect battery earth lead.
2. Remove engine cover.
3. Remove air cleaner assembly and intake duct.
4. Disconnect crankcase ventilation and evap hoses.
5. Disconnect Inlet Manifold Runner Control and throttle plate wiring, remove upper intake manifold.
6. Remove the engine cover mounting bracket.
7. Remove ignition coils and spark plugs.

Note:
Cover coil holes to ensure that no particles inadvertently fall into engine.

8. Remove rocker covers.
9. Drain cooling system. Remove upper and lower radiator hoses, coolant bleed and recovery hoses, cooling fans, and drive belt.
10. Remove harmonic balancer from crankshaft.
11. Unbolt power steering pump reservoir and relocate away from work area without disconnecting hoses.
12. Unbolt air-conditioning compressor and relocate away from work area without disconnecting refrigerant lines.

13. Remove camshaft position sensors and variable camshaft timing solenoids from engine.
14. Remove timing chain cover.
15. Turn crankshaft clockwise using special tool EN 46111, until the stage one (first) timing marks are aligned. ***See Diagrams #3 and #4***.
16. Install alignment tool EN 46105-1 to the rear of LH camshaft. ***See Diagrams #1 & #2***. You may need to use a spanner on the flat part of the camshafts to get the tool to fit.

Note:
Do not force or hammer the alignment tool onto the camshaft.

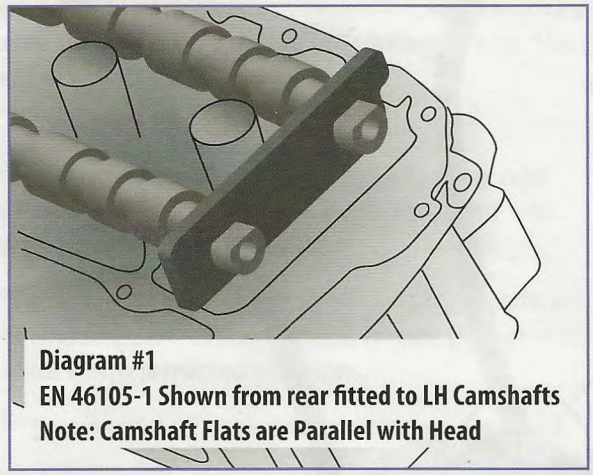


Diagram #1
EN 46105-1 Shown from rear fitted to LH Camshafts
Note: Camshaft Flats are Parallel with Head

Diagram #2
EN 46105-1 Shown from front fitted to LH Camshafts

Note:
Check the timing chains to ensure that the chains have shiny or coloured links to enable retiming of the engine. If not you may need to mark the chains before removing.

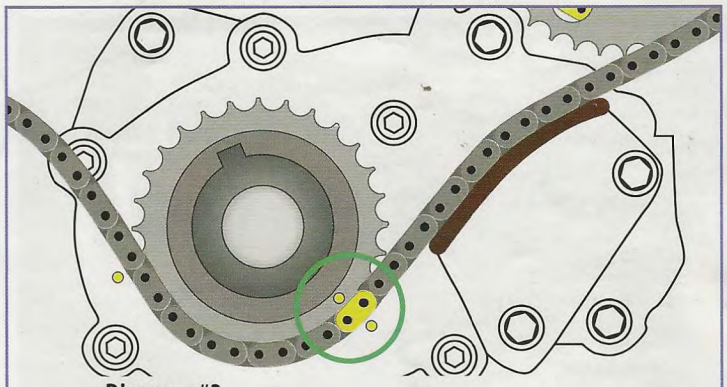


Diagram #3
Crankshaft at Stage One Timing Mark

17. Remove the RH timing chain tensioner, taking care not to loose any of the spring loaded components.
18. Remove the RH timing chain.
19. Remove the tensioner for the primary timing chain, taking care not to loose the spring-loaded components, and then remove the primary timing chain.
20. Remove the tensioner for the LH timing chain, taking care not to loose spring-loaded components, and then remove the LH timing chain.

Caution:
If you are removing any sprockets, do not mix them up! The LH intermediate sprocket is marked with the letters LB, while the RH intermediate sprocket is marked RB. On both intermediate sprockets the word Front should be visible when installed.

Caution:
The primary camshaft drive chain lower guide is not separately serviceable. If the primary camshaft drive chain lower guide must be replaced, the oil pump must be replaced.

Caution:
The oil pump is not serviceable. Once dissembled the pump must be replaced. Therefore, only disassemble the pump if you wish to confirm your prior diagnosis.

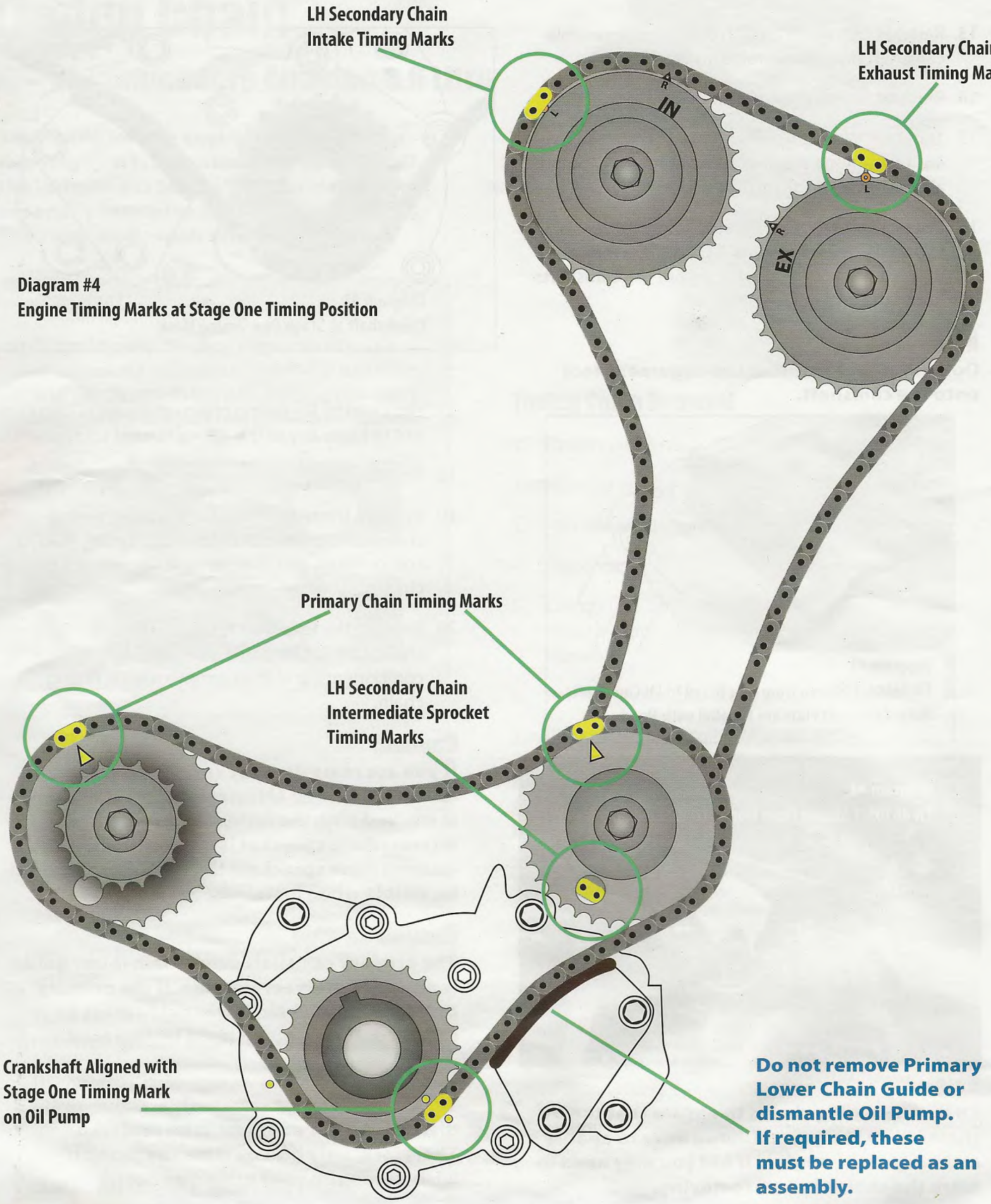


Diagram #4
Engine Timing Marks at Stage One Timing Position

Cleaning and Inspection

- Clean gaskets from timing chain cover and inspect for any damage.
- Carefully clean the engine front cover sealing surfaces. Insert a piece of cardboard between the oil pan front and the oil pump in order to prevent any pieces of old gasket falling into the oil pan.
- Check timing chain guides and sprockets for wear, gouges, or deformities.
- Inspect the timing chains for wear and for cracked or loose rollers.

Note:

Due to the tendency for these timing chains to stretch, it is recommended that, unless they have covered relatively few kilometres, they be replaced.

Note:

If reusing the chains ensure that they are refitted to their original position, and not swapped left and right.

- Clean and inspect the tensioners for debris, wear, and freedom of movement. Rotate plungers and lock into retracted positions.
- Ensure that all seals and gaskets are replaced.

Diagram #6
Triangular and Circular Timing Marks correspond with Right And Left

Diagram #5
Crankshaft at Stage One Timing Mark

Do Not Remove Lower Primary Chain Guide or Dismantle Oil Pump

Timing Chain Installation

Note:

The valve timing on this engine is carried out in two stages.

Stage 1, where the crankshaft timing mark is at approximately the 23-minute mark, is where the LH secondary chain and then the primary chain are fitted.

Stage 2, where the crankshaft timing mark is at approximately the 43-minute mark, is where the RH secondary chain is fitted.

Stage One

1. Turn crankshaft so that the crankshaft timing mark is aligned with the first timing mark using special tool EN 46111. ***See Diagrams #3 and #4***.

Note:

If the engine is still fitted to the vehicle it is best to use a mirror to check timing mark alignment.

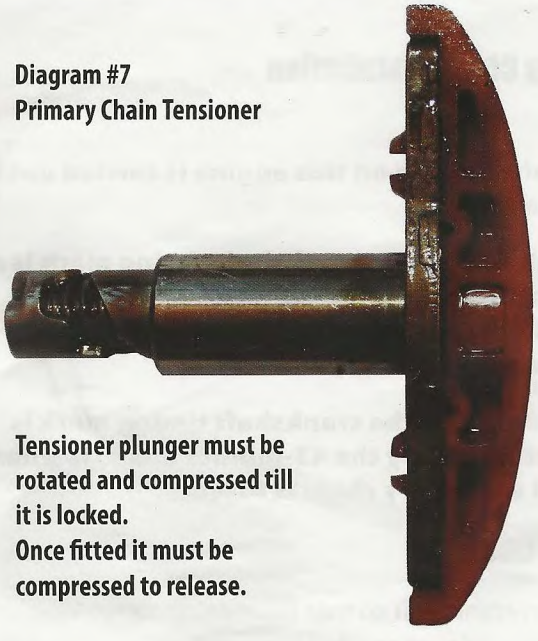
2. Install alignment tool EN 46105-1 to the rear of LH camshaft. ***See Diagrams #1 and #2***. Use a spanner on the flat part of the camshafts to get them into the correct position to enable the tool to fit.
3. Turn LH intermediate chain sprocket to the position shown in ***Diagram #4***.

4. Install the LH chain to inner intermediate sprocket, ensuring that the bright plated or marked chain link can be seen through the timing mark hole in the sprocket. Fit the chain over the LH camshaft sprockets, aligning marked links with the circular timing marks (those marked with an 'L'). ***See Diagram #4.***

5. Fit LH chain guides and tensioner.

Note:
After fitting tensioner, compress it with your hand to ensure that it unlocks the plunger, and applies tension to the chain.

Diagram #7
Primary Chain Tensioner



Tensioner plunger must be rotated and compressed till it is locked.
Once fitted it must be compressed to release.

6. Install primary chain ensuring the stage one timing marks are aligned. The marked links need to align with the triangles on the intermediate sprockets and the dot on the crankshaft sprocket. ***See Diagrams #4 and #6.***

7. Install the primary chain upper guide.

8. Refit the primary chain tensioner. Release the tensioner by pushing it in against spring pressure to unlock the plunger.

9. Remove the camshaft alignment tool EN 46105-1 from the rear of LH camshaft.

Stage Two

1. Turn the crankshaft clockwise until the crankshaft timing mark is aligned with the second timing mark using special tool EN 46111. ***See Diagrams #8 and #14.***

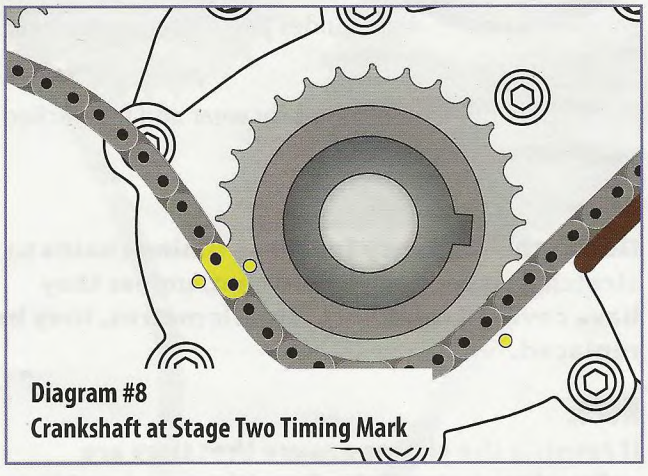


Diagram #8
Crankshaft at Stage Two Timing Mark

2. Fit the camshaft alignment tool EN 46105-2 to the rear of LH camshaft. Fit the camshaft alignment tool EN 46105-1 to the rear of RH camshaft. ***See Diagrams #10, #11 and #12.*** Use a spanner on the flat part of the camshafts to get them into the correct position to enable the tool to fit.

3. Install the RH chain to the sprockets, aligning the bright plated or marked chain links with the intermediate sprocket alignment hole and the camshaft sprocket triangular marking (those marked with an 'R'). ***See Diagrams #9 and #14.***

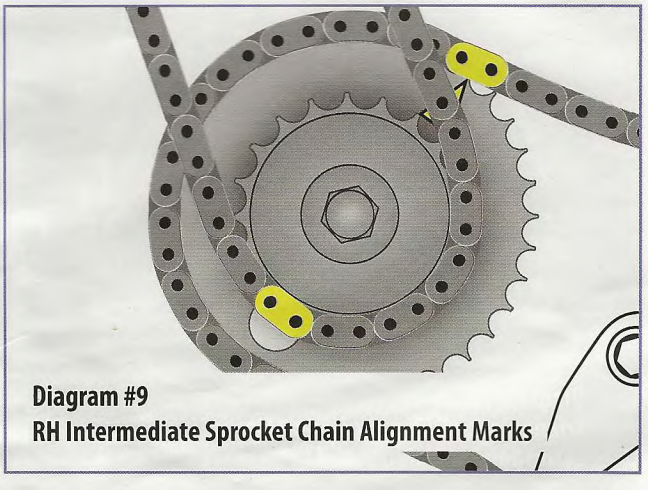


Diagram #9
RH Intermediate Sprocket Chain Alignment Marks

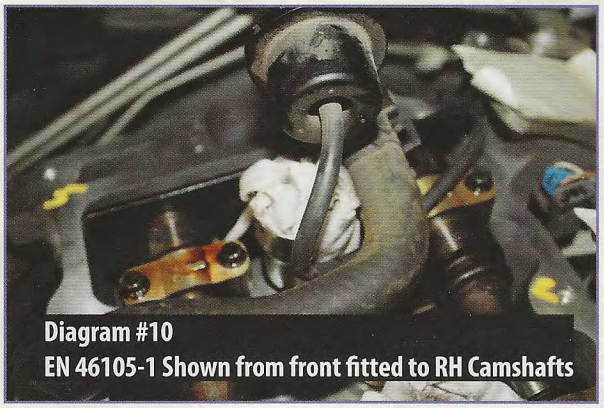


Diagram #10
EN 46105-1 Shown from front fitted to RH Camshafts

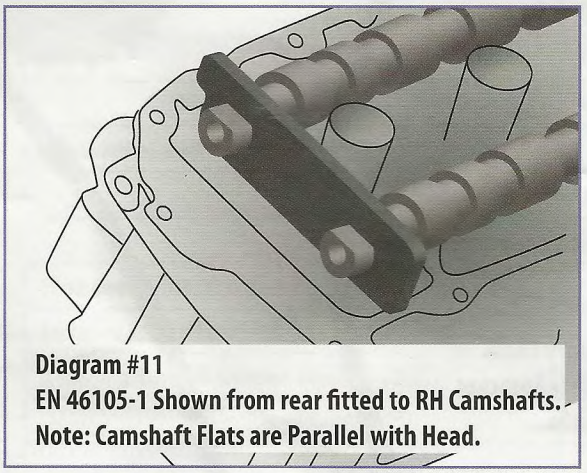


Diagram #11
EN 46105-1 Shown from rear fitted to RH Camshafts.
Note: Camshaft Flats are Parallel with Head.

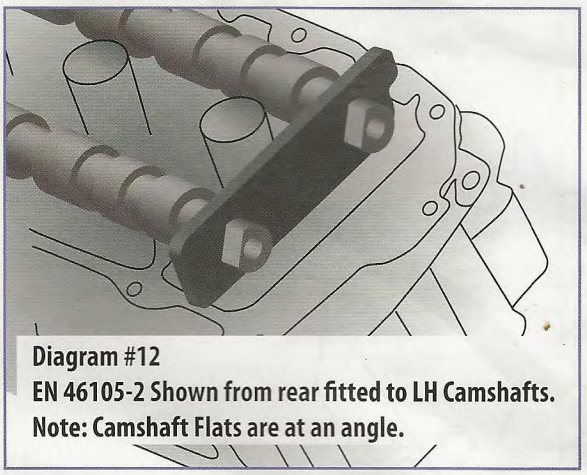


Diagram #12
EN 46105-2 Shown from rear fitted to LH Camshafts.
Note: Camshaft Flats are at an angle.

Special Tools Required are:

- **EN 46111 - Crankshaft Turning Tool**
- **EN 46105-1/2 - Camshaft Locking Tools**

4. Install chain guides and tensioner. This tensioner also needs to be released by pushing it in against spring pressure to unlock the plunger.
5. Recheck that the timing marks are all aligned. ***See Diagram #14***.
6. Recheck the chain tensioners, to ensure they are released and are applying spring pressure to the chains.
7. Remove camshaft alignment tools EN 46105-1 and EN 46105-2 from the camshafts.
8. Rotate the crankshaft at least one full turn clockwise, using special tool EN 46111, to ensure that everything moves freely and smoothly.
9. Refit all parts in reverse order of disassembly, using new gaskets and seals.

Note:
Two 8 x 1.25mm studs can be fitted to the block, to guide the timing chain cover when refitting. Fit the remaining bolts finger tight before removing the studs and refitting the original bolts. Then tighten cover bolts evenly.

Diagram #13
Special Tools

EN 46111

EN 461105 - 1

EN 461105 - 2

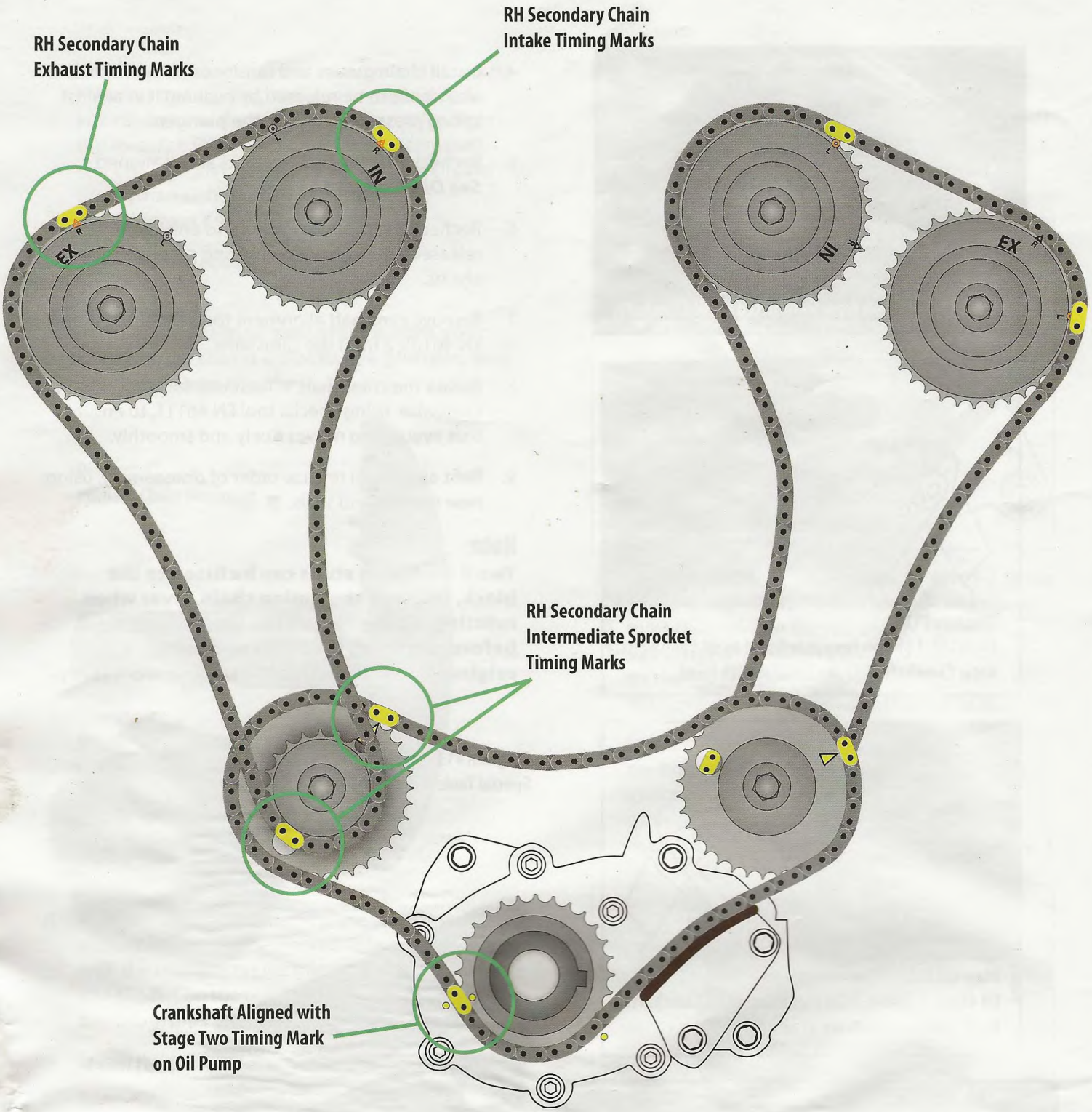


Diagram #14
Engine Timing Marks at Stage Two Timing Position

3.6 Alloytec Bolt Tension	Notes	Torque
Camshaft Sprocket Bolt		58Nm
Camshaft Cap Bolt		10Nm
Camshaft Intermediate Sprocket Bolt		58Nm
Crankshaft Balancer Bolt		
	1st Step	100Nm
	2nd Step	150 Degrees
Crankshaft Rear Oil Seal Housing		10Nm
Cylinder Head Bolt		
	M8 1st Step	15Nm
	M8 2nd Step	60 Degrees
	M11 1st Step	45Nm
	M11 2nd Step	Loosen 120 Degrees
	M11 3rd Step	30Nm
	M11 4th Step	150 Degrees
Flywheel Bolts		
	1st Step	30Nm
	2nd Step	75 Degrees
Heater Inlet/Outlet Pipes		10Nm
Intake Manifold Bolts		23Nm
Timing Chain Cover Bolt		
	1st Step	20Nm
	2nd Step	60 Degrees
Oil Pump		
	Bolt	25Nm
	Cover Bolt	13Nm
	Left Guide Bolt	13Nm
Primary Chain		
	Tensioner Bolt	23Nm
	Upper Guide Bolt	23Nm
Secondary Chains (Left & Right)		
	Guide Bolt	23Nm
	Shoe Bolt	23Nm
	Tensioner Bolt	23Nm
Starter Motor Bolt		50Nm
Oil Pan to Block Bolt (M8)		23Nm
Oil Pan to Rear Seal Housing (M6)		10Nm
Thermostat Housing Bolt		10Nm
Transmission to Engine Bolt		50Nm
Torque Converter Bolt		60Nm