Camshaft code number <sup>1</sup> ) left/right	Engine	Engine special version No.	Intake valve opens ATDC <sup>2</sup> )
02/03	117.960		12 <sup>o</sup> (10 <sup>o</sup> )
04/05	117.961		20 <sup>0</sup> (18 <sup>0</sup> )
08/09	116.964	012.468/01	22 <sup>0</sup> (20 <sup>0</sup> )
	116.965		
	117.962		
	117.963		
	117.964		
	117.965		
14/15	117.963	012.406/10	18 <sup>0</sup> (16 <sup>0</sup> )
16/17	117.968	012.480/01	17 <sup>0</sup> (16 <sup>0</sup> )
18/19	117.967	012.468/05	27 <sup>0</sup> (26 <sup>0</sup> )
	117.968	012.468/06	
		012.468/14	
		012.468/15	
20/21	116.965		21 <sup>0</sup> (20 <sup>0</sup> )
	117.965		
24/25	117.968 RÜF		17 <sup>0</sup> (16 <sup>0</sup> )
26/27	117.967	012.468/05	
	117.968 CAT	012.468/06	
		012.468/14	27 <sup>0</sup> (26 <sup>0</sup> )
		012.468/15	
60/61	116.960	012.406/03	12 <sup>0</sup> (10 <sup>0</sup> )
	116.961	012.406/04	
	116.962	012.406/07	
	116.963	012.406/08	
62/63	116.960	012.406/01	24 <sup>0</sup> (22 <sup>0</sup> )
	116.961	012.406/02	
	116.962	012.406/05	
	116.963	012.406/06	
70/71	116.962	012.468/03	16 <sup>0</sup> (14 <sup>0</sup> )
	116.963	012.468/04	
	116.964		
	116.965		

# Timing in degree (<sup>0</sup>) crankshaft with 2 mm valve lift

Camshaft code number association can be taken from the spare part microfilms.
With new timing chains and a running time of below 20 000 km, adjust the timing of the right-hand camshaft according to the values in brackets.

Tightening torques	Nm
Bolts for cylinder head cover	3
Bolts for camshaft sprockets M 14 x 1.5 x 40	100
Hydraulic valve clearance compensating elements in cylinder head	60

### Special tools

Spring compressor for valve spring	C From Test	123 589 03 61 00
Dial gauge holder	11004-10150	363 589 02 21 00
Valve clearance wrench 17 mm		116 589 02 01 00
Socket insert 27 mm	1004-613	001 589 65 09 00
Square drive	( <u>ccccccco)</u> 11004-10282	617 589 00 16 00

**Conventional tool** 

Dial gauge A 1 DIN 878

e.g. Mahr, D-7300 Esslingen Order No. 810

#### Note

During assembly jobs it is sufficient if the marks on the camshafts coincide at ignition TDC position of 1st cylinder.

Check "intake valve opens" on 1st and 6th cylinder at 2 mm valve lift.

## Checking

1 Check camshaft code number on rear end of camshafts.



2 Remove rocker arm (1) and valve clearance compensating elements (2) on intake valve of 1st and 6th cylinder. Install valve adjusting screw (1), part No. 116 050 11 20, on intake valve of 1st and 6th cylinder instead of compensating elements (2). Install rocker arm.

#### Caution!

The rocker arms and the valve clearance compensating elements should be installed in the place from which they were removed.

3 Rotate crankshaft (27 mm socket) until the cam tip rests against intake valve of 1st cylinder in upward position.

Rotate crankshaft in engine direction of rotation only.

4 Turn valve adjusting screw until rocker arm rests free of play against camshaft heel (arrow).



5 Attach dial gauge holder to cylinder head.

6 Clamp dial gauge with extension pin in dial gauge holder with a preload of 3 mm.

The measuring pin should rest on the valve spring retainer in an accurately vertical position.



7 Set the large pointer to 0.

8 Rotate crankshaft until the pointers of the dial gauge return by 2 mm to a preload of 1 mm. The valve lift will then be 2 mm.

9 In this engine position the value on the vibration damper should be in agreement with the value "Intake valve opens" in the table.

10 Perform this test on the intake valve of 6th cylinder by repeating figures 4 to 9.

If the timing must be corrected, install an offset Woodruff key or if the chain has been elongated too much, a new timing chain.

Woodruff keys are available in the following steps:

Offset Part No. mm		For a correction of approx.	
0.7	621 991 04 67	4 <sup>0</sup>	crank angle
0.9	621 991 02 67	6 1/2 <sup>0</sup>	crank angle
1.1	621 991 01 67	8 <sup>0</sup>	crank angle
1.3	621 991 00 67	10 <sup>0</sup>	crank angle

An offset by one tooth on the camshaft sprocket results in approx.  $18^{\circ}$  on the crankshaft.

An offset of the Woodruff key to the right (in the direction of driving) results in an earlier commencement of opening, while an offset to the left results in a later commencement of opening.



Installation position A results in earlier commencement of opening Installation position B results in later commencement of opening

11 Mark camshaft sprockets and timing chain relative to each other (arrow).

12 Remove the respective camshaft sprocket.

13 Place a rag under the camshaft and remove the Woodruff key.

14 Insert the selected Woodruff key.

15 Install the camshaft sprocket while paying attention to the color coding.



The wide collar on the camshaft sprocket should face to the camshaft (arrow).

Do not tighten the bolt.

16 Repeat items 4 to 9.

17 Tighten bolt to 100 Nm.

18 Check basic position of hydraulic valve clearance compensating elements and correct (05–213).

19 Complete the engine.

