

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-225-1
Relating to Exemptions Under Section 27156
of the Vehicle Code

CRANE CAMS, INC.
ROCKER ARMS

Pursuant to the authority vested in the Air Resources Board by Section 27156 of the Vehicle Code; and

Pursuant to the authority vested in the undersigned by Sections 39516 and 39516 of the Health and Safety Code and Executive Order G-45-5;

IT IS ORDERED AND RESOLVED: That the installation of the rocker arms manufactured by Crane Cams, Inc. of 530 Fentress Blvd., Daytona Beach, FL 32114 has been found not to reduce the effectiveness of the applicable vehicle pollution control system and, therefore, is exempt from the prohibitions of Section 27156 of the Vehicle Code for those applications listed in Exhibit A, which is attached hereto and incorporated herein.

This Executive Order is valid provided that installation instructions for these rocker arms will not recommend tuning the vehicle to specifications different from those submitted by Crane Cams, Inc.

Changes made to the design or operating conditions of the rocker arms, as exempt by the Air Resources Board, which adversely affect the performance of a vehicle's pollution control system shall invalidate this Executive Order.

Marketing of this performance package using any identification other than that shown in this Executive Order or marketing of these rocker arms for an application other than those listed in this Executive Order shall be prohibited unless prior approval is obtained from the Air Resources Board. Exemption of these rocker arms shall not be construed as exemption to sell, offer for sale, or advertise any component of the kit as an individual device.

This Executive Order does not constitute any opinion as to the effect the use of these rocker arms may have on any warranty either expressed or implied by the vehicle manufacturer.

THIS EXECUTIVE ORDER DOES NOT CONSTITUTE A CERTIFICATION, ACCREDITATION, APPROVAL, OR ANY OTHER TYPE OF ENDORSEMENT BY THE AIR RESOURCES BOARD OF CLAIMS OF THE APPLICANT CONCERNING ANTI-POLLUTION BENEFITS OR ANY ALLEGED BENEFITS OF CRANE CAMS, INC. ROCKER ARMS.

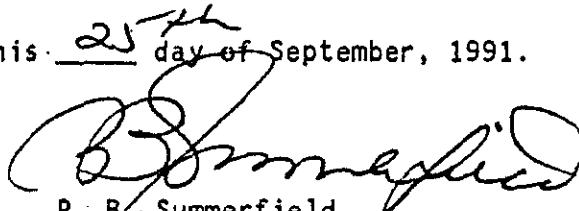
CRANE CAMS, INC.
ROCKER ARMS

EXECUTIVE ORDER D-225-1
(Page 2 of 2)

No claim of any kind, such as "Approved by the Air Resources Board" may be made with respect to the action taken herein in any advertising or other oral or written communication.

Violation of any of the above conditions shall be grounds for revocation of this order. The order may be revoked only after ten day written notice of intention to revoke the order, in which period the holder of the order may request in writing a hearing to contest the proposed revocation. If a hearing is requested, it shall be held within ten days of receipt of the request and the order may not be revoked until a determination after hearing that grounds for revocation exist.

Executed at El Monte, California, this 25th day of September, 1991.



R. B. Summerfield
Assistant Division Chief
Mobile Source Division

State of California
AIR RESOURCES BOARD

EVALUATION OF CRANE CAMS, INC. ROCKER ARMS
FOR EXEMPTION FROM THE PROHIBITIONS OF VEHICLE CODE
SECTION 27156 IN ACCORDANCE WITH SECTION 2222, TITLE 13, OF
THE CALIFORNIA CODE OF REGULATIONS

September 1991

State of California
AIR RESOURCES BOARD

EVALUATION OF CRANE CAMS, INC. ROCKER ARMS
FOR EXEMPTION FROM THE PROHIBITIONS OF VEHICLE CODE
SECTION 27156 IN ACCORDANCE WITH SECTION 2222, TITLE 13, OF
THE CALIFORNIA CODE OF REGULATIONS

by

Mobile Source Division
State of California
Air Resources Board
9528 Telstar Avenue
El Monte, CA 91731

(This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.)

SUMMARY

Crane Cams, Inc. has applied for an exemption from the prohibitions of Vehicle Code Section 27156 for their rocker arms for installation on 1991 and older General Motors (GM) vehicles equipped with 262 CID (4.2L) to 454 CID (7.4L) V-8 gasoline engines. Crane Cams has submitted a completed application and all the required information, as well as exhaust emissions test data performed at Crane Emissions Laboratory which demonstrated that the specified rocker arms do not have any adverse effect on the exhaust emissions of the affected vehicles.

Based on the submitted information, results of the emission tests performed at Crane Emissions Laboratory, and an engineering evaluation, the staff concludes that the installation of Crane Cams rocker arms will not adversely affect exhaust emissions on the specified vehicles.

The staff recommends Crane Cams, Inc. be granted an exemption as requested and that Executive Order D-225-1 be issued.

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EVALUATION OF CRANE CAMS, INC. ROCKER ARMS
EXEMPTION FROM THE PROHIBITIONS OF VEHICLE CODE SECTION 27156 IN ACCORDANCE
WITH SECTION 2222, TITLE 13, OF THE CALIFORNIA CODE OF REGULATIONS

I. INTRODUCTION

Crane Cams, Inc. of 530 Fentress Blvd., Daytona Beach, Florida 32114, has applied for an exemption from the prohibitions of Vehicle Code Section 27156 for their rocker arms for installation on 1991 and older General Motors vehicles. Crane Cams has submitted a completed application and all the required information, as well as exhaust emissions test data performed at Crane Emissions Laboratory which demonstrated that the specified rocker arms do not have any adverse effect on the exhaust emissions of the affected vehicles.

II. CONCLUSIONS

Based on the submitted information, results of the emission tests performed at Crane Emissions Laboratory, and an engineering evaluation, the staff concludes that the Crane Cams, Inc. rocker arms will not adversely affect exhaust emissions from vehicles for which the exemption is requested.

III. RECOMMENDATION

The staff recommends that Crane Cams, Inc. be granted an exemption as requested and that Executive Order D-225-1 be issued.

IV. ROCKER ARMS DESCRIPTION

The rocker arms are specifically designed for installation on 1991 and older General Motors vehicles powered by 262 CID (4.2L) to 454 CID (7.4L) V-8 gasoline engines. The rocker arms operate in conjunction with the original equipment manufacturer's (OEM) emission control systems already

certified with the stock engines. The purpose of using the modified rocker arms is to increase the overall engine performance by modifying the valve characteristics. The applicant claims the device uses proprietary materials, clearances, geometry and heat treatment to achieve improvements in the engine performance.

The Crane Cams rocker arm is designed to increase the rocker arm ratio of the small block GM V-8 gasoline engines with 262 to 400 CID engine sizes from a 1.5:1 to 1.6:1. For GM V-8 engines with 396 to 454 CID engine sizes, stock rocker arm ratio is increased from 1.7:1 to 1.8:1. Rocker arm part numbers for the appropriate engine sizes are shown in appendix A. The installation instructions for the device is shown in Appendix B.

V. DISCUSSION OF THE ROCKER ARMS

Crane Cams submitted comparative emission testing conducted at Crane Emissions Laboratory. A 1984 federally-certified Chevrolet Camaro powered by a 305 CID engine was used as the test vehicle for the rocker arms. To calibrate the Camaro to California specifications, Crane Cams changed the prom based on documentation given to Crane Cams by General Motors. This calibration change was verified and accepted by the ARB when Crane Cams was testing for their Compucam 2000 camshaft for the same GM application. The dynamometer inertia weight and loading used during the testing were 3625 lbs. and 7.8 hp, respectively.

Comparative emission testing consisted of cold-start CVS-75 Federal Test Procedure in the baseline and modified configurations. The test results are shown in Table 1.

Table 1

CVS-75 TEST RESULTS
(Crane Emissions Laboratory)

Test Mode	Exhaust Emissions (gm/mi)		
	HC	CO	NOx
Baseline	0.37	5.48	0.64
1.6 rocker arms	0.31	5.38	0.71
Difference	-0.06	-0.10	0.07

The CVS-75 emissions test results at Crane Emissions Laboratory indicate that HC, CO and NOx emissions of the rocker arms to be within the limits specified in the procedures for exemption. This demonstrates that the installation of the increase ratio rocker arms for all 1991 and older General Motors 267 CID (4.4L) to 454 CID (7.4) V-8 gasoline engines will not adversely affect the exhaust emissions.

The ARB did not conduct confirmatory tests to validate the emission test results submitted by Crane Cams. However, an engineering analysis was performed comparing the rocker arm's increase in the valve lift to that of the Compucam 2000 series camshaft. Crane Cam's Compucam 2000 series has previously been tested at the Haagen-Smit Laboratory using the same test vehicle (1984 Chevrolet Camaro) and was found to have no adverse effect on emissions. The camshaft when compared to OEM, increased the intake valve lift by 20.31 percent and the exhaust valve lift by 15.97 percent (see Table 2).

Table 2

Sample calculations as related to GM 5.0 liter gasoline engine.

Maximum camshaft intake lobe height in stock configuration -----	.2344 of an inch
Maximum camshaft intake lobe height in modified configuration -----	.282 of an inch
Maximum camshaft exhaust lobe height in stock configuration -----	.2561 of an inch
Maximum camshaft exhaust lobe height in modified configuration -----	.297 of an inch
Stock rocker ratio -----	1.5 to 1
Crane rocker arm ratio -----	1.6 to 1
Valve lift = lobe height x rocker arm ratio	

Intake Specifications

Rocker Arm

$0.2344 \times 1.5 = 0.3516$ valve lift in stock configuration
 $0.2344 \times 1.6 = 0.3750$ valve lift in modified configuration
intake difference = 0.0234 of an inch or a 6.67 percent difference

Modified Camshaft

$0.282 \times 1.5 = 0.423$ valve lift in modified configuration
intake difference = 0.0714 of an inch or a 20.31 percent difference

Exhaust Specifications

Rocker Arm

$0.2561 \times 1.5 = 0.3842$ valve lift in stock configuration
 $0.2561 \times 1.6 = 0.4098$ valve lift in modified configuration
intake difference = 0.0256 of an inch or a 6.67 percent difference

Modified Camshaft

$0.297 \times 1.5 = 0.4455$ valve lift in modified configuration
intake difference = 0.0614 of an inch or a 15.97 percent difference

In a comparison, the rocker arms increased the intake valve lift and exhaust valve lift by only 6.67 percent over the OEM. Since previous testing showed that a 20.31 percent increase in the intake valve lift and a 15.97 percent increase in the exhaust valve lift do not cause a significant increase in vehicle emissions, staff concludes that Crane Cam's rocker arms which increase the valve lifts by a much smaller percentage will not adversely affect emission of applicable vehicles.

Crane Cams has submitted all the required information and fulfilled the requirements for an exemption. The test results and engineering evaluation confirmed that Crane Cams rocker arms meet the requirements for the exemption.

APPENDIX A

Energizer Aluminum Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio, 3/8 stud (for press-in studs) -----	3005
1.6 Ratio, 3/8 stud -----	3002
1.6 Ratio, 7/16 stud -----	3003

"Super Blue" Extruded Aluminum

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio, 7/16 stud -----	3051

Hi Intensity Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio, 3/8 stud -----	11746-16
1.6 Ratio, 7/16 stud -----	11747-16

Pedestal Mount Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio Intake Offset Left -----	11734L-1
1.6 Ratio Intake Offset Right -----	11734R-1
1.55 Ratio Exhaust Offset Left -----	11737L-1
1.55 Ratio Exhaust Offset Right -----	11737R-1
1.6 Ratio Exhaust Offset Left -----	11738L-1
1.6 Ratio Exhaust Offset Right -----	11738R-1

Aluminum Rockers

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 396-454 cu. in. 65-91 with Dart "Big Chief" cyl. heads	
1.75 Ratio Intake Offset Left -----	11732L-1
1.75 Ratio Intake Offset Right -----	11732R-1
1.8 Ratio Intake Offset Left -----	11733L-1
1.8 Ratio Intake Offset Right -----	11733R-1
1.8 Ratio Exhaust -----	13739-1

Shaft-Mounted Needle Bearing Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio Intake and Exhaust -----	84790-1
1.6 Ratio Intake -----	84791-1
1.6 Ratio intake, 1.55 ratio exhaust -----	11790-1

Aluminum Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio 3/8 stud -----	11759-16
1.6 Ratio 7/16 stud -----	11755-16
1.6 Ratio 7/16 stud -----	11768TR-16
Variable Ratio (1.5, 1.55, 1.6), 3/8 stud -----	11778-16
Variable Ratio (1.5, 1.55, 1.6), 3/8 stud -----	11779-16
Variable Ratio (1.5, 1.55, 1.6), 7/16 stud -----	11780-16
Variable Ratio (1.5, 1.55, 1.6), 7/16 stud -----	11781-16
1.6 Ratio Left and Right Exhaust, 7/16 stud -----	11770TR-16
1.6 Ratio Left 7/16 stud -----	11770L-1
1.6 Ratio Right 7/16 stud -----	11770R-1

Aluminum Rocker Arms Cont.

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio Left 7/16 stud -----	11766L-1
1.6 Ratio Right 7/16 stud -----	11766R-1
1.6 Ratio Left 7/16 stud -----	11762L-1
1.6 Ratio Right 7/16 stud -----	11762R-1

Aluminum Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 396-454 cu. in.	
1.8 Ratio 7/16 stud -----	13755-16
1.8 Ratio 7/16 stud -----	13768TR-16

APPENDIX B

Exhibit A cont.

Aluminum Rockers

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 396-454 cu. in. 65-91 with Dart "Big Chief" cyl. heads	
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1.75 Ratio Intake Offset Right -----	11732R-1
1.8 Ratio Intake Offset Left -----	11733L-1
1.8 Ratio Intake Offset Right -----	11733R-1
1.8 Ratio Exhaust -----	13739-1

Shaft-Mounted Needle Bearing Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio Intake and Exhaust -----	84790-1
1.6 Ratio Intake -----	84791-1
1.6 Ratio intake, 1.55 ratio exhaust -----	11790-1

Aluminum Rocker Arms

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Variable Ratio (1.5, 1.55, 1.6), 7/16 stud -----	11781-16
1.6 Ratio Left and Right Exhaust, 7/16 stud -----	11770TR-16
1.6 Ratio Left 7/16 stud -----	11770L-1
1.6 Ratio Right 7/16 stud -----	11770R-1

Exhibit A

Energizer Aluminum Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio, 3/8 stud (for press-in studs) -----	3005
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Chevrolet V8, 262-400 cu. in.	
1.6 Ratio, 3/8 stud -----	11746-16
1.6 Ratio, 7/16 stud -----	11747-16

Pedestal Mount Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio Intake Offset Left -----	11734L-1
1.6 Ratio Intake Offset Right -----	11734R-1
1.55 Ratio Exhaust Offset Left -----	11737L-1
1.55 Ratio Exhaust Offset Right -----	11737R-1
1.6 Ratio Exhaust Offset Left -----	11738L-1
1.6 Ratio Exhaust Offset Right -----	11738R-1

CRANE Cams®

ROCKER ARM INSTALLATION INSTRUCTIONS

CAUTION: READ COMPLETELY BEFORE INSTALLING!

- **ROCKER ARM PART NUMBERS 11744, 11745, 11746 and 11747** are designed for valve springs up to 1.500" diameter and a maximum open pressure of 500 pounds. **PART NUMBER 13744** is designed for valve springs up to 1.630" diameter and a maximum open pressure of 550 pounds.

- **IMPORTANT**-Changing rocker arm ratios affects piston-to-valve clearance and can create valve spring coil bind. Higher than standard ratios can also cause pushrods to bind in the cylinder head or guideplate. Recheck these areas to eliminate failures.

- We recommend that you install rocker arms on one cylinder at a time and then adjust valve lash for that particular cylinder. Following this procedure will eliminate problems caused by too tight of an adjustment (bent valves, bent or broken pushrods, rocker arm studs, etc.)

- Except with **ROCKER ARM PART NUMBER 13744**, any pushrod guideplates used must be either a flat style or one of Crane Cams new "short step" models. Refer to your Crane Cams Catalog for the correct part number guideplates for your application. Most stepped guideplates are too tall, and will interfere with the rocker arms, therefore binding the valve train. Part number 13744 will accept most popular types of guideplates, flat or stepped. Guideplate-to-rocker arm clearance must be checked with all guideplates.

- Some newer Chevrolet V-8 cylinder heads are factory equipped with "Self Aligning" rocker arms. These rocker arms have a stamped recess on the valve tip end, to guide the rocker arm and position the pushrod in the pushrod guideplate. **NOTE:**The stock Chevrolet pushrod guideplates and pushrods **ARE NOT HEAT TREATED** (hardened), and cannot be used with Crane rocker arms. To use Crane rocker arms you must replace the guideplates with either the hardened factory Chevrolet high performance guideplates or Crane pushrod guideplates. (See Crane Master Catalog) If heat treated pushrod guideplates are used **YOU MUST USE HEAT TREATED CRANE CAMS PUSHRODS!**

- If Factory-style stamped steel valve covers are used, you may need to trim away the inside brace to clear the guideplates. Check this before running the engine! Late model GM factory cast valve covers may not have sufficient clearance to permit a rocker arm change without grinding the internal bolt support bosses.

If you have any questions regarding these installation instructions please contact one of our Crane Cams Technical Specialists. (904) 258-6174, Monday through Friday, 8:00 AM to 8:00 PM, Eastern Time. For 24 hour, 7 days-a-week camshaft and valve train component recommendations contact Crane Dial-A-Cam, (904) 258-6174, wait for answer and press "4" on your touch-tone telephone.

STEP 1

Place the rocker arm on the stud with the flat side of the fulcrum turned up.

STEP 2

Check to make sure that the bottom side of the rocker arm does not touch the lower portion of the rocker arm stud or the stud boss with the lifter on the base circle, or "heel", of the cam and the pushrod is all the way down. See arrow on Figure 1.

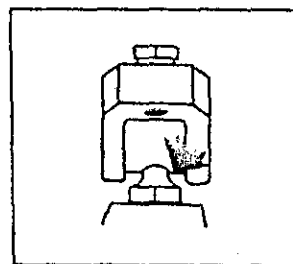


FIGURE NO. 1

STEP 3

Check the clearance between the underside of the rocker arm and the valve spring/retainer combination. **THIS STEP IS**

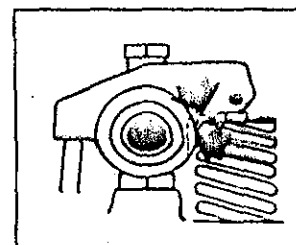


FIGURE NO. 2

EXTREMELY IMPORTANT! YOU MUST HAVE A MINIMUM OF .040" CLEARANCE IN THE AREAS SHOWN IN FIGURE 2. Normally, the *least* clearance will occur when the valve is closed and the lifter is on the base circle of the cam, you must recheck for clearance *throughout its travel* after adjust the valve lash. **UNDER NO CIRCUMSTANCES SHOULD YOU ATTEMPT TO GET ADDITIONAL CLEARANCE BY GRINDING OR MODIFYING THE ROCKER ARMS.** Additional clearance can be properly obtained by using longer than stock pushrods and/or valve stem lash caps.

STEP 4

Valve Adjustment- MAKE SURE THAT THE PUSHROD IS PROPERLY SEATED IN THE LIFTER AND IN THE ROCKER ARM BEFORE MAKING ADJUSTMENT! FOR HYDRAULIC LIFTER CAMS: Turn the engine in the normal direction of rotation until the *exhaust* pushrod on the cylinder that you're adjusting starts to move UP. Now adjust the **INTAKE** rocker arm on that cylinder to zero lash with no pre-load... then 1/2 to 1 turn more. The rocker arm is adjusted by turning the hex nut until you obtain the proper adjustment. Now tighten the setscrew and torque the hex nut to a *maximum* of 15-20 foot pounds. Rotate the engine in the normal direction of rotation until the intake valve that you've now adjusted opens and almost closes.

(The intake pushrod should move slightly more than half way down in its travel.) Now adjust the exhaust rocker arm on that cylinder. Set the exhaust rocker arm at zero lash, then 1/2 to 1 turn more. Tighten the set-screw and torque the hex nut to 15-20 foot pounds. Continue this procedure for each cylinder, doing one at a time, until all of the rocker arms are adjusted the same.

FOR MECHANICAL AND ROLLER TAPPET CAMS: Use the same basic procedure as above, except instead of pre-loading the lifter, you must set the rocker arm to the proper valve lash spec as shown on your camshaft spec card. Remember to recheck your adjustment after the hex nut has been torqued.

STEP 5

It is necessary to check for proper clearance between the rocker arm and the valve cover, especially around any filler cap openings or baffles. Place the valve cover you plan to use, and the gasket you'll be using on the head and screw in (two or three threads in is fine) a couple of hold-down bolts to locate the cover. Leave the bolts loose to allow the cover to move if

there is interference with the rocker arms. Hold the cover down with your hand and turn the engine over with the starter. **DO NOT START THE ENGINE!** If you have interference with the rocker arms you can gain the needed clearance in several ways. Minor interference can be corrected by using an extra thick, or double, valve cover gasket or by modifying the inside of the valve cover. Some applications may require use of aftermarket "taller than stock" valve covers.

STEP 6

Remove the valve cover(s) and pour a bottle of Crane Cams Super Lube 99003-1 over the rocker arms. Install the valve covers using fresh, non-compressed gaskets. Your engine is now ready to run.

STEP 7

If you have a mechanical or roller tappet cam you should recheck your valve adjustment after a short period of time. The engine should be started and allowed to warm up to a normal operating temperature. Then check the valve lash adjustment for the proper "hot" setting as per your cam spec card.

REMINDER: EXCESSIVE LASH INCREASES STRESS ON THE ENTIRE VALVETRAIN AND WILL INCREASE WEAR AND THE POTENTIAL OF VALVE TRAIN BREAKAGE.

NOTE: If you have any questions or need additional technical assistance, call our Tech Department 904/258-6174.

SPECIAL INSTRUCTIONS FOR ENGINES EQUIPPED WITH NON-ADJUSTABLE ROCKER ARMS (SUCH AS FORD, AMERICAN MOTORS, ETC.)

If your engine was originally equipped with "rail type", "pedestal mount" or "bridge mount" rocker arms (consult your shop manual for specific identification or details), you will need to machine your cylinder heads to accept pushrod guideplates and the proper screw-in rocker arm studs, or utilize one of our rocker arm conversion kits. The use of metal pushrod guideplates also requires that you must use special heat treated hardened pushrods such as those available from Crane Cams. These pushrods are designed for use with guideplates and will not rapidly wear out as will stock or stock-type, soft pushrods.

CRANE Cams

530 Fentress Blvd., Daytona Beach, FL 32114

CRANE Cams®

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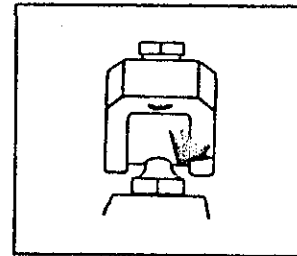


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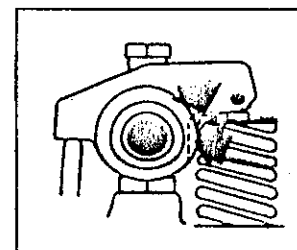


FIGURE NO. 2

Exhibit A cont.

Aluminum Rocker Arms Cont.

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 262-400 cu. in.	
1.6 Ratio Left 7/16 stud -----	11766L-1
1.6 Ratio Right 7/16 stud -----	11766R-1
1.6 Ratio Left 7/16 stud -----	11762L-1
1.6 Ratio Right 7/16 stud -----	11762R-1

Aluminum Rocker Arms

<u>APPLICATION</u>	<u>PART NO.</u>
Chevrolet V8, 396-454 cu. in.	
1.8 Ratio 7/16 stud -----	13755-16
1.8 Ratio 7/16 stud -----	13768TR-16