

Standards of Service

Gasoline Engines



Serving Engine Builders, Rebuilders and Installers

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1 – SCOPE

This Standard applies to the practice of rebuilding and remanufacturing of reciprocating spark ignition automotive and industrial engines which are used in conjunction with standard ancillary components in applications intended by the original manufacturer.

This Standard does not apply to repaired or rebuilt engines which may only be partially repaired with little or no machining, nor does it apply to second-hand exchange engines on which little or no repair work may have been carried out.

2 – REFERENCED DOCUMENTS

The entire Standard is contained in this document.

3 – DEFINITIONS

For the purpose of this Standard the definitions below apply.

3.1 Short block assembly

A cylinder block and all those components contained within the limits of the block deck or decks, the pan rail, the block rear face and the timing cover, where fitted, including the crankshaft.

3.2 Cylinder head assembly

A rebuilt cylinder head fitted with valves, associated springs, retainers, and on overhead camshaft cylinder heads (OHC), camshaft, camshaft bearings, lash adjusters, tappets and rockers.

3.3 Long block assembly

A short block assembly together with a cylinder head assembly and all those components fitted within the rocker or cam cover, and timing cover. The whole presented as an assembly. A rebuilt or new oil pump, or kit, shall be supplied or fitted as appropriate.

3.4 Rebuilt engine and its synonym remanufactured $\frac{3}{4}$ describes an engine which has been:

(a) dismantled, cleaned, inspected, i.e. crack testing, pressure testing or visual examination, whichever is applicable or appropriate;

(b) the components have been inspected and machined when necessary to achieve the proper dimensions and finishes per acceptable industry standards;

(c) new parts, as defined in this Standard, have been installed as required; and

(d) the engine has been assembled to proper clearances and manufacturer's specified fastener tightening procedures.

NOTE: These terms may be applied to:

(a) the customer's own engine being rebuilt; or

(b) an exchange engine.

3.5 Salvaged component

A component which has been found to be beyond acceptable industry standards, but which is rendered suitable for normal service by acceptable salvaging techniques.

3.6 Replacement components

Replacement components are defined as items which are sourced from manufacturers or suppliers who can demonstrate fitness for purpose and who can support their products with written warranty.

3.7 Shall ¾ indicates that a statement is mandatory.

3.8 Should ¾ indicates a recommendation.

3.9 Inspection ¾ non-destructive testing.

4 – REBUILDING A SHORT BLOCK

4.1 Cylinder block

The cylinder block shall be disassembled, all oil and water galley plugs removed and thoroughly cleaned inside and out. The cylinder block, including all threaded holes, shall be inspected as appropriate to ensure suitability for reuse.

(a) The block deck surface shall be verified to be in conformance with the engine or replacement gasket manufacturers' specifications or machined as per specifications.

(1) In certain instances, such as engines with removable liners, the surface may not require machining, but in such instances liner recesses shall be checked and trued as required and the sealing surfaces shall be verified to conform to

acceptable industry standards.

(2) All other gasket or sealing faces on the block shall be checked for serviceability and corrected if necessary.

(b) Main bearing caps shall be checked for fit and all main bearing bores shall be measured for size, checked for roundness, taper and alignment, and remachined if required to ensure the correct fit of the replacement bearings. Thrust locations shall be checked and if out of tolerance, reclaimed or machined as required.

(c) All cylinders shall be resized (or sleeved), or new sleeves installed where appropriate, and honed to within the recommended limits of oversize with an appropriate surface finish.

4.2 Crankshaft

The crankshaft shall have all galley plugs removed and then be thoroughly cleaned and inspected for damage and specifications. On occasion, crankshafts may not need grinding in order to meet acceptable industry standards. In these instances journal roundness, surface finish, taper and diameter must be verified to be correct to the bearing manufacturer's specifications.

The crankshaft may be reclaimed by:

(a) journals that are not within specifications shall be ground to the same relative undersize and finish. If a crankshaft was originally heat treated and surface hardness is reduced below acceptable industry standards after grinding it shall be re-heat treated; and

(b) one or more crankshaft journals may be built up, reground and finished so as to maintain parity with the other journals. Thrust face condition shall be checked and built up and machined, or only machined, as required. Rear main sealing surfaces shall be checked and refinished as required. Crankshaft snouts to be inspected for wear and rectified as required.

4.3 Camshafts

The camshaft shall be inspected and if necessary, the camshaft lobes shall be ground, rebuilt or the shaft replaced; and

(a) all lobes, journals, gears, keyways, threads, seal areas and other applicable surfaces shall be inspected for wear; and

(b) auxiliary shaft journals shall be inspected and if necessary be reground, rebuilt or the shaft replaced; and

(c) hydraulic camshaft followers shall be replaced or rebuilt and tested; and

(d) mechanical followers shall be resurfaced if applicable or replaced where necessary, according to type.

4.4 Connecting rod assemblies

All connecting rod assemblies (including bolts) shall be inspected for alignment and integrity; and

(a) the connecting rod journal bore shall be checked for size, roundness, taper, width and where necessary be resized or replaced.

(b) the piston end bore shall be checked as follows:

(1) fully floating pin types shall have the bushing removed and a new bushing fitted and machined to the correct fit for the replacement pin. Connecting rod center-to-center length shall be maintained when applicable; or

(2) press fit pin types shall be checked for parallelism, size and surface finish.

5 – REBUILDING A CYLINDER HEAD ASSEMBLY

5.1 Cylinder head

The cylinder head shall be disassembled, cleaned both inside and out to remove all foreign matter. The following work shall then be completed on the unit:

(a) The cylinder head shall be inspected and tested to ensure suitability for reuse, by magnetic particle crack detection, pressure test, vacuum testing or visual inspection as appropriate. Cracks which may cause subsequent failure shall be repaired or the component replaced.

(b) Water ports shall be inspected and if corroded outside of gasket sealing area shall be reclaimed by an appropriate method and machined so that water ports are sealed by a new gasket.

(c) The head surface shall be cleaned and checked to ensure straightness with a surface finish as specified by the engine or replacement gasket manufacturer. Cylinder heads that are not within specifications must be machined to specifications.

Certain types of cylinder heads may have insufficient allowance for machining in which case the flatness and surface finish shall be verified to conform to acceptable

industry standards. Machining the cylinder head for and installation of a cylinder head shim, or thicker cylinder head gasket, where appropriate within acceptable industry standards, is an acceptable procedure.

(d) In the case of overhead camshaft configurations, the camshaft bores shall be measured for size and checked for roundness, taper and alignment. Machining, line boring or straightening are acceptable practices for restoration of alignment and straightness. In some instances the fitting of replacement bearing shells, oversized components or metal build up may be carried out.

(e) Valve guides shall be inspected for wear and fit in the cylinder head, where appropriate, and restored to original clearances. Guides which do not meet these clearances shall be replaced, remachined or sleeved. Knurling is not an acceptable repair.

(f) Valve seats shall be machined in such a manner as to retain the correct seat angles, widths, valve heights and valve seating face concentric with the centerline of the valve guide bore.

(g) Where valve seat recession has occurred beyond acceptable limits, valve seat inserts shall be fitted.

(h) All defective valve seats shall be replaced. Replacement seats shall be fitted with the appropriate interference fit.

5.2 Rocker arm/shaft assembly

Rocker arm/shaft assemblies shall be completely dismantled, cleaned and inspected for wear and other defects. Components shall be machined or replaced as necessary.

5.3 Valve

The valve face shall be remachined and stems, keeper grooves, tips and valve margin inspected for wear and conformance with specifications and dimensions or the valve replaced. In all cases correct valve train geometry must be maintained.

5.4 Valve caps and valve spring retainers

All valve retaining components, i.e. collets, keepers, retainers, rotators, etc. shall be inspected for serviceability and replaced where necessary.

5.5 Valve spring

All valve springs shall be tested for squareness, free height and spring pressure at installed height and valve open height. The use of shims (spacers) and/or offset valve keepers are permitted in order to achieve installed height only.

6 – MISCELLANEOUS COMPONENTS

Miscellaneous components shall be checked as follows:

(a) Oil pump and pressure relief valve. The oil pump shall be disassembled, cleaned and inspected and remachined to restore correct clearances and finishes, and reassembled with suitable priming lubricant or replaced. Pressure relief valve assemblies $\frac{3}{4}$ the pressure relief valve assembly shall be dismantled and cleaned and the valve and springs replaced prior to reassembly, or replaced with a new or remanufactured unit. The oil pump drive shall be inspected and replaced when necessary.

(b) All push rods shall be inspected for straightness, damage and wear and replaced as necessary.

(c) The following shall be replaced:

- (1)** Timing belt.
- (2)** Timing chains.
- (3)** Unhardened chain sprockets.

(d) The following may be reused, if in good condition, replaced or rebuilt if considered necessary:

- (1)** Hardened chain sprockets.
- (2)** Timing chain guides and chain tensioners.
- (3)** Timing belt sprockets.
- (4)** Timing and drive gears.

(e) Miscellaneous rotating or wearing components, the condition of which may influence engine noise, performance, emission performance or durability, shall be removed, inspected and rebuilt or replaced as required.

(f) All bolts, screws, nuts and mating threads shall be checked for suitability for reuse. Torque to yield bolts should be checked or replaced in accordance with manufacturer's recommendations and specifications.

7 – ASSEMBLY PROCEDURES

7.1 Engine assembly

During short block assembly the following procedures shall be observed:

- (a) All components shall be thoroughly cleaned.
- (b) All expandable plugs shall be replaced. All non-expandable plugs may be refitted if inspected and in good condition.
- (c) All applicable mating surfaces shall be lubricated with an appropriate lubricant and surfaces susceptible to storage corrosion shall be treated with suitable rust inhibitor.
- (d) Cylinder block shall be reassembled using the following new or rebuilt parts as determined in Sections 3.5 and 3.6:
 - (1) Main, connecting rod and cam bearings and bushings.
 - (2) Pistons, pins and rings.
 - (3) Gaskets, expansion plugs and seals.
 - (4) Oil pump relief valve assemblies.

7.2 Cylinder head assembly

During cylinder head assembly the following procedures shall be observed:

- (a) All components shall be thoroughly cleaned.
- (b) All applicable mating surfaces shall be lubricated with an appropriate lubricant and surfaces susceptible to storage corrosion shall be treated with a suitable rust inhibitor.
- (c) All overhead camshaft and auxiliary shaft bearings/bushings shall be replaced as required to restore correct clearance.
- (d) All seals and gaskets shall be replaced with new items.
- (e) Valve spring pressures may not be adjusted using a spring shim or offset keeper.

7.3 Long Block Assembly

A long block assembly is a combination of a short block as described in 3.1 and assembled as in 5.1 and a cylinder head as described in 3.2 and assembled as in 5.0.

NOTE:

(a) All relevant bolts, nuts, screws, oil pump relief valve and springs, etc. shall be tightened to specifications as determined by the manufacturer.

(b) All running clearances shall be checked and corrected during assembly.

8 – ENGINE REMOVAL, PREPARATION AND RE-INSTALLATION

The engine shall be removed from and re-installed in the vehicle in accordance with approved service procedures. Care should be taken to recover all fluids and gasses from the engine prior to removal. All fluids and gasses shall be stored or disposed of in accordance with Federal, State and local EPA and municipal regulations.

Confirm proper operation and integrity of all engine controls, sensors, emission controls, operating systems, ignition systems, fuel systems and cooling systems.

Consult AERA's Break-In-Procedure and Engine Installation brochures for additional guidelines on engine re-installation.

9 – WARRANTY

An engine as described by this Standard shall be accompanied by a written warranty statement.

10 – QUALITY ASSURANCE

These Standards for quality and test procedures embrace every kind of repair of internal combustion spark ignition engines 3/4 from the repair of individual engine parts to a rebuilt engine with the goal of restoring the established properties and characteristics of the engine.

10.1 Technical prerequisites

The following equipment must be available for the proper execution of quality-assured engine repairs:

- Cleaning equipment capable of cleaning all areas of the engine parts.
- Cylinder sizing machinery for oversizing and honing of cylinders and the installation of cylinder sleeves.
- Crankshaft grinders and surface finishing equipment.
- Align boring or line honing equipment for the treatment of main and cam bearing bores.
- Connecting rod equipment for the treatment of the connecting rods, including equipment to accurately gage bore diameter, roundness and taper. (honing, boring, straightening, etc.)
- Surface grinder or milling machine.
- Crankshaft straightening press.
- Head straightening equipment.
- Hydraulic press.
- Valve seat & guide equipment.
- Valve seat finishing equipment to include accurate gaging, designed for this purpose, to determine valve seat concentricity. Vacuum testing may be used in conjunction with, but not exclusively to determine machining accuracy of the finished seat.
- Equipment for the treatment of engine valves.
- Thermal equipment for fitting of parts.

- Non-destructive test equipment, i.e. magnetic particle inspection, etc.
- Hardness tester.
- Spring pressure test equipment.
- Precision measuring instruments for inside and outside diameters and depths with a minimum accuracy of $\pm 0.0001''$ or $.0025\text{mm}$, i.e. micrometers, dial indicators, cylinder bore gauges.
- Radius gauges, straight edge, surface analyzer, torque wrenches.

10.2 Technical resources

Reference materials to establish and verify manufacturers' engine specifications.

11 – STANDARDS ADDENDUM (FTC GUIDELINES)

Federal Trade Commission guides for the rebuilt, reconditioned and other used automobile parts industry

DEFINITIONS

Industry Member - Any person, firm, corporation or organization engaged in the sale or distribution of any industry product as defined below.

Industry Products - Industry products are automotive parts and automotive assemblies which have been used or which contain used parts, whether such parts or assemblies have been rebuilt, remanufactured, reconditioned, relined, or otherwise. The term "automotive assemblies" as herein used mean any part or assembly designed for an automobile, truck, motorcycle, tractor or similar self-propelled vehicle. Industry products include, but are not limited to, armatures, generators, starters, carburetors, clutches, distributors, connecting rods, crankshafts, cylinder blocks, engine assemblies, fuel pumps, brakes, master and wheel brake cylinders, power brakes, shock absorbers, starter drives, solenoids, automatic transmissions, regulators, spark plugs, springs, windshield wiper motors and water pumps. Automobile tires are not products of the industry.

Deception As To Previous Use Of Products

It is an unfair trade practice to represent, directly or by implication, that any industry product is new or unused, or that any part of an industry product is new or unused when such is not the fact, or to misrepresent the extent of previous use thereof.

It is an unfair trade practice for an industry member to offer for sale or sell any industry product unless a clear and conspicuous disclosure that such product has been used or contains used parts is made in all the industry member's advertising, sales promotional literature and invoices concerning the product, on the container in which the product is packed and if the product has been rebuilt, remanufactured, reconditioned or has the appearance of being new, on the product with sufficient permanency to remain thereon after installation for a reasonable period of time under ordinary conditions of use, and in such manner that said disclosure cannot be easily removed or obliterated.

Form of Disclosure - The disclosure that an industry product has been used or contains used parts as required by this section may be made by use of a word such as, but not limited to, "Used," "Second-hand," "Repaired," "Remanufactured," "Reconditioned," "Rebuilt," "Relined," whichever is applicable to the product involved. On invoices to the trade only the disclosure required by this section may be made by use of any number, mark, or other symbol which is clearly understood by all purchasers receiving such invoices as meaning that the products, or parts thereof, identified on the invoices have

been used.

Conspicuousness of Disclosure - The disclosure required by this section shall be of such size or color contrast and so placed as to be readily noticeable to purchasers or prospective purchasers reading advertising, sales promotional literature, or invoices containing same, or reading any representation as to content on the container in which an industry product is packed, or inspecting an industry product before installation, or with a minimum of disassembly after installation.

It is unfair trade practice to place any means or instrumentality in the hands of others whereby they may mislead purchasers or prospective purchasers as to the previous use of industry products or parts thereof.

DESCRIPTION AS TO IDENTITY OF REBUILDER, REMANUFACTURER, RECONDITIONER OR RELINER:

It is an unfair trade practice to misrepresent the identity of the rebuilder, remanufacturer, reconditioner or reliner of an industry product.

In connection with the sale or offering for sale of an industry product if the identity of the original manufacturer of the product, or the identity of the manufacturer for which the product was originally made, is revealed and the product was rebuilt, remanufactured, reconditioned or relined by other than the manufacturer so identified, it is an unfair trade practice to fail to disclose such fact wherever either of said manufacturers is identified in advertising and sales promotional literature concerning the product, on the container in which the product is packed, and on the product, in close conjunction with, and of the same permanency and consciousness as, the disclosure of previous use of the product required by this section.

Examples of disclosures considered to be in compliance with the requirements of this section are as follows:

(1) Disclosure of the identity of the rebuilder as, for example: *Rebuilt by John Doe Co.*

(2) Disclosure that the product was rebuilt by an independent rebuilder as, for example:

Rebuilt by an Independent Rebuilder.

(3) Disclosure that the product was rebuilt by other than the manufacturer so identified as, for example: *Rebuilt by other than XYZ Motors.*

(4) Disclosure that the product was rebuilt for the identified manufacturer, if such is the case, as, for example: *Rebuilt for XYZ Motors.*

MISREPRESENTATION AS TO CONDITION OF PRODUCTS AND MISUSE OF THE TERMS "REBUILT," "FACTORY REBUILT," "REMANUFACTURED," ETC.:

It is an unfair trade practice to use, or cause or promote the use of, any statement or representation in advertising, on containers, on industry products, or elsewhere, which has the capacity and tendency or effect of misleading or deceiving purchasers or prospective purchasers as to the condition of an industry product, or the extent that an industry product has been repaired or reconstructed.

It is an unfair trade practice to use the words "Rebuilt," "Remanufactured," or words of similar import, as descriptive of an industry product which, since it was subjected to any use, has not been dismantled and reconstructed as necessary, all of its internal and external parts cleaned and made free from rust and corrosion, all impaired, defective or substantially worn parts restored to a sound condition or replaced with new, rebuilt, or unimpaired used parts, all missing parts replaced with new, rebuilt or unimpaired used parts, and such rewinding or machining and other operations performed as are necessary to put the industry product in sound working condition.

It is an unfair trade practice to represent an industry product as "Factory Rebuilt" unless the product was rebuilt as described in paragraph (b) of this section as a factory generally engaged in the rebuilding of such products.