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LABORATORY
TECHNICAL REPORT

MODIFICATION AND MAINTENANCE
OF PASSENGER VEHICLES OPERATING
IN HEAVY VOLCANIC ASH ENVIRONMENTS



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OPERATING IN HEAVY VOLCANIC ASH ENVIRONMENTS

1. Volcanic ash is similar, in many respects, to desert sand and dust. It can be removed from the engine air induction and ventilation systems by standard air filtration methods. Since the passenger car is not designed to operate in the heavy dust concentrations which are experienced in the early stages of ash fallout, Fig 1, additional induction air filtering capacity is required along with the addition of various ventilation filters. Additional filter capacity can be obtained through the use of a filter element cover and by the installation of a heavy duty truck air cleaner. Ventilation filtration for the passenger compartment can be achieved through the addition of a filter cover to the fresh air intake grille or duct. Component vents, lubrication filler pipes, various gasketed areas, the air pump and some EPA required components require special attention to eliminate all sources of dust or ash which may disable the vehicle.

2. The Washington State Patrol in cooperation with the Department of Transportation and the US Army Tank Automotive Command, R&D Center, Warren, Michigan, has developed vehicle modifications for police cars which encompass these guidelines. The modifications can be applied to most passenger vehicles and light trucks, with only minor variations. The modification details and general air cleaner and vehicle maintenance information is presented below.

A. AIR INDUCTION SYSTEM - MAINTENANCE

The standard automotive filter will perform satisfactorily for most "dusty road" operations. With knowledgeable care in performing air cleaner maintenance, the standard automotive air cleaner can even provide a limited degree of protection during heavy ash fallout conditions. The following rules of air cleaner maintenance are imperative for satisfactory air cleaner performance:

(1) Replace dirty element with a new or air cleaned spare element after thoroughly cleaning accumulated dust from the housing and cover with special attention to the seal surfaces. Return dirty element to shop for cleaning, inspection and reissue.

CAUTION: Never hit, rap, shake or otherwise strike a filter element against anything, including your hand.

Standard automotive air filter elements are easily crushed or bent. Any distortion in the element is a potential leak path of the super fine volcanic ash and is an open invitation for an engine failure, Fig 2. The only acceptable method of cleaning an automobile air

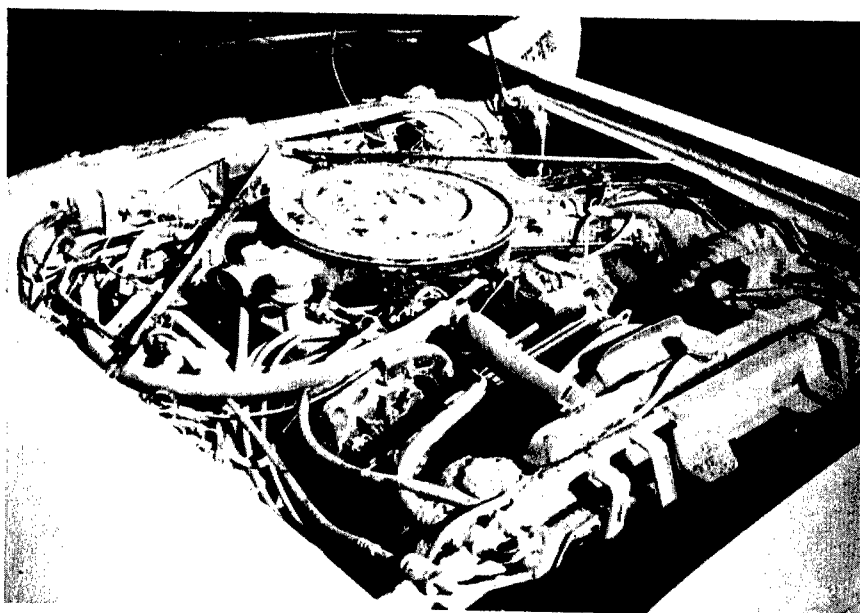


Figure 1-A

Washington State Patrol vehicle from Moses
Lake district after May 18 eruption.
Accumulated ash weighed in excess of 400
lbs after towing several hundred miles.

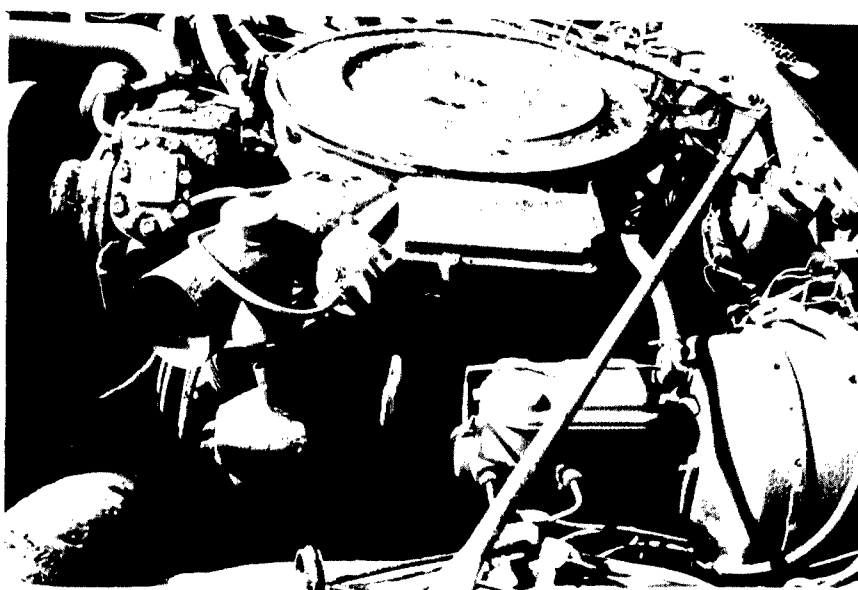


Figure 1-B

Close up of air cleaner on Moses Lake vehicle.

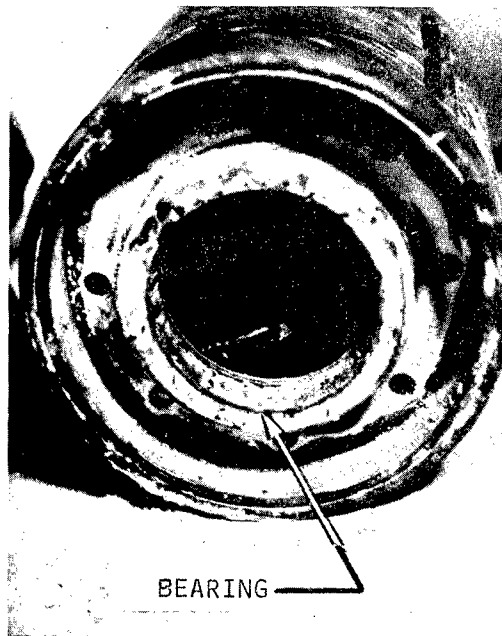


Figure 1-c

Emissions air pump showing packing of bearing with volcanic ash after 8.8 miles of vehicle operation in heavy fallout area.

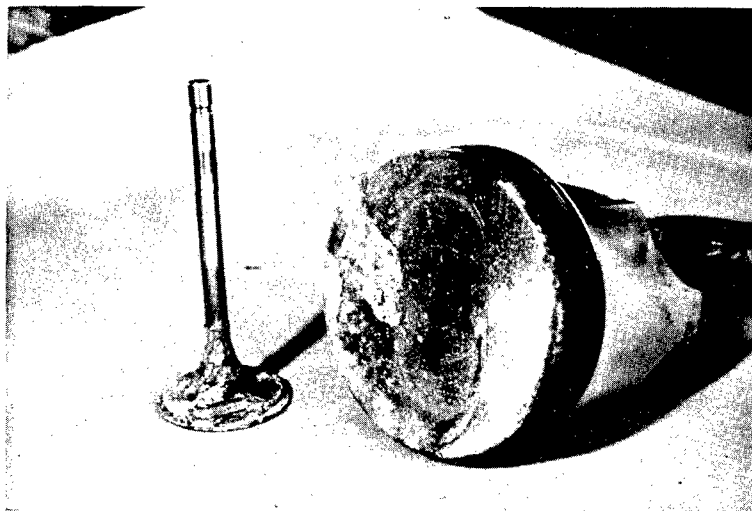


Figure 1-d

Ash deposits on piston and valve after 8.8 miles of operation in heavy volcanic ash fallout.

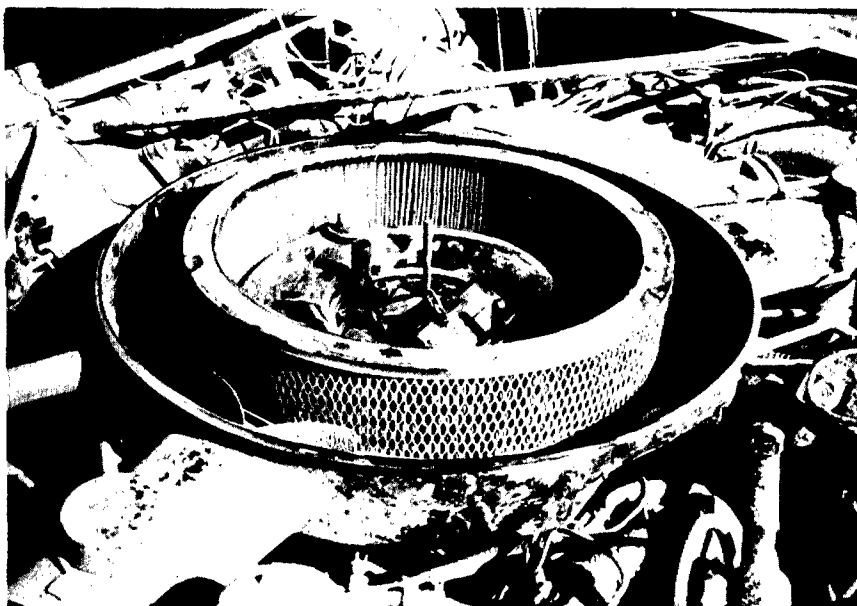


Figure 2-A

Air Cleaner on Moses Lake vehicle. Note accumulated ash on filter element seal surface indicating seal leakage.

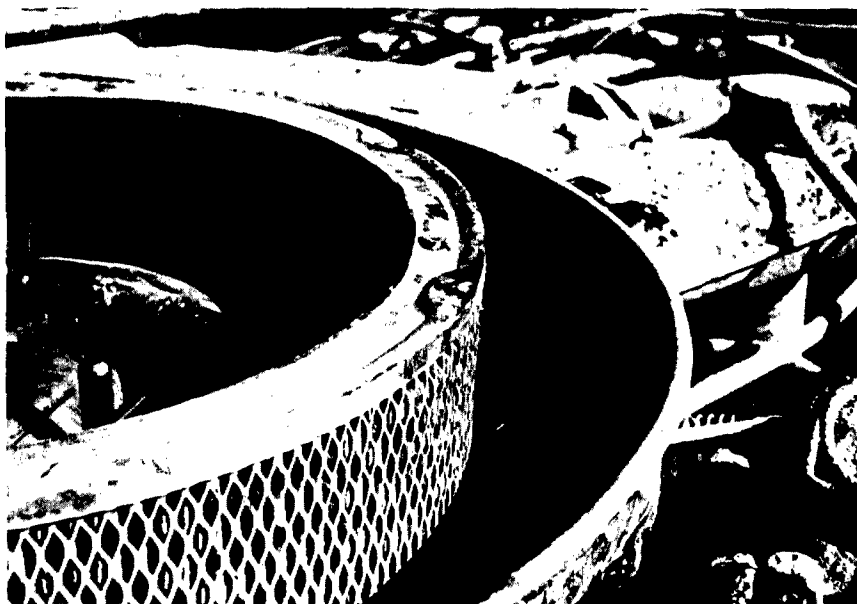


Figure 2-B

Air Cleaner on Moses Lake vehicle. Close-up of seal leakage.

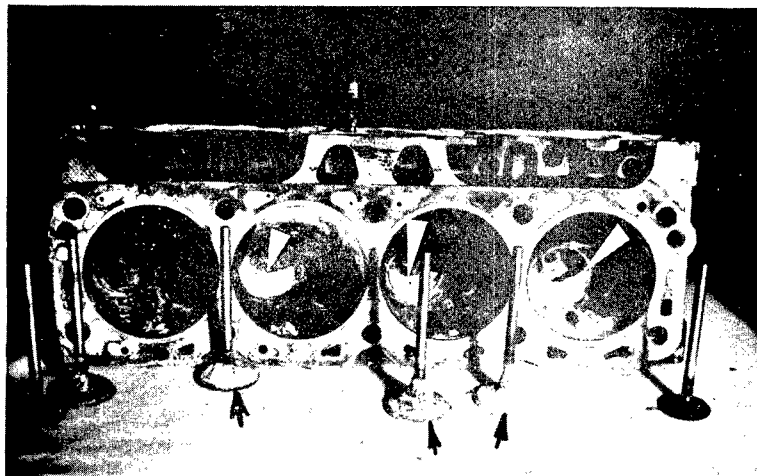
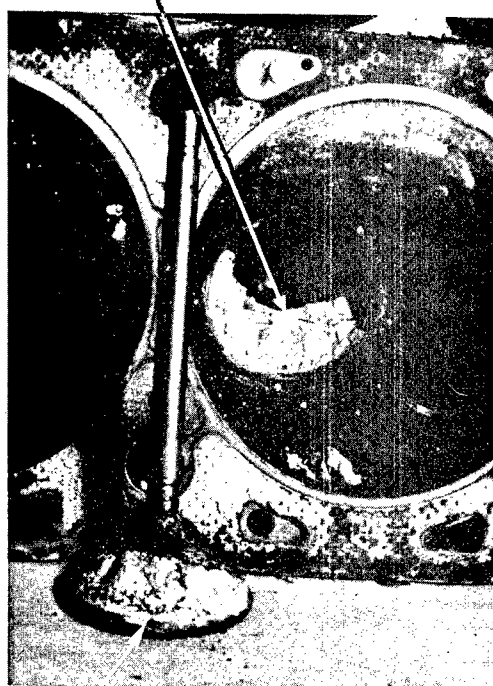


Figure 2-c

Ash build up in intake ports, combustion chambers and underside of valve head after 8.8 miles of operation in heavy ash fallout.

ASH DEPOSIT IN INTAKE PORT



ASH DEPOSIT

Figure 2-d

Inlarged view of intake valve and intake port after 8.8 miles of operation in heavy ash fallout.

filter element is to "back flush" it with compressed air. Direct the compressed air against the clean side (inside) of the filter, locally reversing the normal air flow direction.

(2) Tighten air cleaner cover wing nut tight. Sealing of the element is essential in preventing dust or ash leaks.

(3) (Maintenance Shop) Replace carburetor air horn to air cleaner housing gasket periodically. This gasket stretches with use. Insure that the inside diameter of the gasket fits correctly to carburetor air horn body.

(4) (Maintenance Shop) Install gasket under air cleaner cover wing nut, Fig 3. Cut gasket from 1/32 fiber gasket material (Vellumoid). Do not use a rubber material.

(5) (Maintenance Shop) Replace or thoroughly wash crankcase ventilation filter.

B. AIR INDUCTION SYSTEM - MODIFICATIONS

Under heavy dust conditions the standard filter element life will be considerably shortened. A number of vehicle modifications can be made which will extend the filter life. These modifications are described in Appendixes 1 thru 3 in the order of complexity, from simplest to most complex. The modifications have been applied to Washington State Patrol vehicles. Additional information on their application and performance experience can be obtained from the Washington State Patrol Fleet Maintenance Facility in Olympia, Washington, Appendix No. 4.

C. COMPONENT VENTS

Various components on the vehicle require vents to the atmosphere. These vents must be located and protected. Since in most cases very low air flow is encountered, a small piece of filter material will protect the unit. Securing the material to the vent so as to provide acceptable filtration will require ingenuity on the part of the shop personnel. Some specific applications are suggested below.

(1) Axle Vents: A number of different axle vent types are used. The ideal vent filter is to attach a hose to the vent and route it into the trunk of the vehicle. A stocking filter, or gas line filter, secured to the end of the hose with a plastic tie or hose clamp, completes the system, Figs 4 and 5. The filter stocking is formed by wrapping the hose end with a small piece of Filtrete filter media (Reference Appendix No. 4) and closing the end with a heavy duty office staple. Clamp the hose to the axle and provide sufficient hose length for axle jounce. Insure that the axle end of the hose is secured to the vent or properly inserted in the vent hole, or cover, and sealed. Secure the filter end of the hose in a protected area of the trunk. Locally wrapping the axle vent with the filter material, in lieu of the above hose method, may present some difficulties with mud clogging during and after rains.

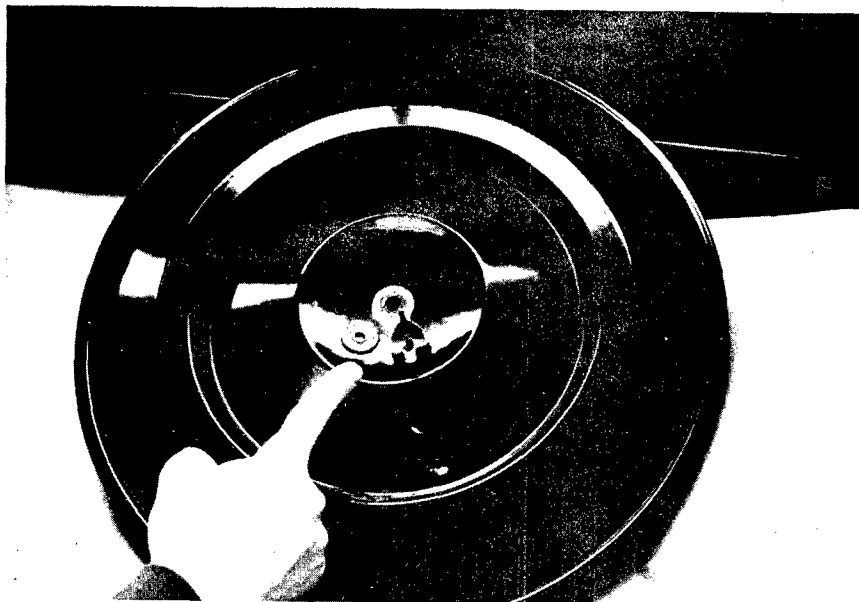


Figure 3

Installation of gasket under air cleaner cover wing nut.

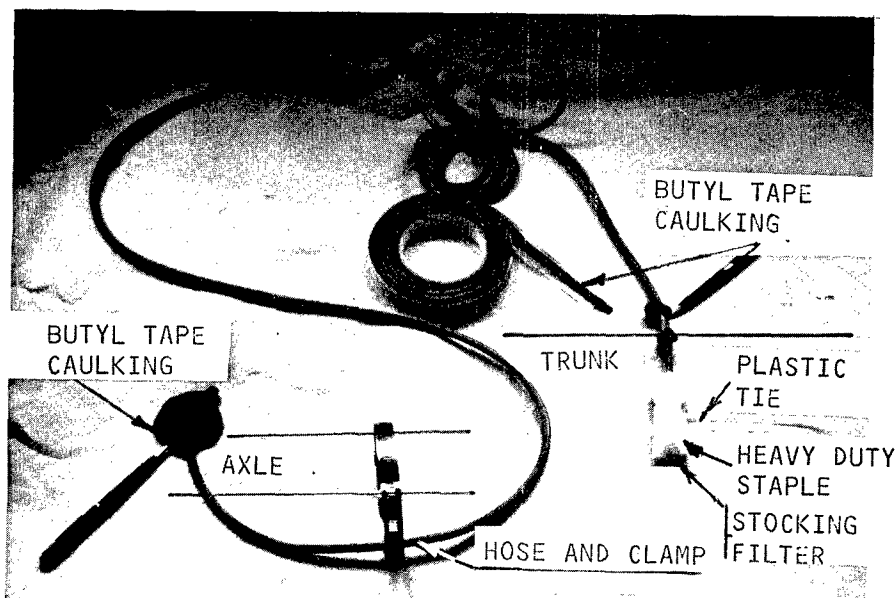


Figure 4

Axle and transmission vent filter modifications.
Stocking type filter.

(2) Transmission Vents: GM and Ford transmission vents are generally located on the exterior housing and are similar to axle vents. The above instructions for axle vents apply, including the recommendation to vent through a hose to the vehicle trunk. A simple vent wrap may be acceptable if located in a protected area, Fig 6. Chrysler Corporation transmissions are vented within the bell housing therefore, filtering of the vent is not practical.

(3) Engine Oil Filler Extension Spout with Push-On Oil Filler Cap: A sealed replacement cap is available for some applications, Fig 7. Where not available, form a Filtrete stocking filter and secure on spout or cap with a wire or plastic tie (Reference Para (1) above). In some cases a rubber o-ring may be installed in the push cap so that a seal is obtained at the edge of the oil filler pipe. The o-ring used must fit snug in the cap or leakage will occur. Check o-ring for chemical compatibility with motor oil by submerging o-ring in engine oil for 48 hours. Note if swelling or decomposition occurred.

(4) Engine Crankcase Breather: Remove canister type breather filters from cylinder head rocker cover and seal with butyl tape as shown in Fig 8.

(5) Fuel System Charcoal Filter/Vent: For systems with replaceable filter pads in the base of the canister, additional protection is provided by placing two or three layers of Lydall primary filter media (Reference Appendix No. 4) at its support base. Set the charcoal filter canister on the Lydall material and secure the canister in its mount, Fig 9. For some applications it may be necessary or desirable to minimize air flow restriction by installing a screen or perforated metal support under the canister mount to hold the filter material off of the fender, Fig 10. The Lydall material should be cleaned periodically by shaking or washing. Replace the standard canister filter pad when dirty. (NOTE: Some vehicles have two charcoal filters, Fig 11) For top vented canisters (Ford), stuff a wad of Filtrete material into the center post and secure a pad of Lydall material over the inlet, Fig 12. Tape the Lydall material to the canister. Check sealed units for excessive initial plugging by comparing air flow restriction on a new unit to the same air flow on the test unit. Low pressure (5 PSI) shop air applied to the inlet is acceptable. Adapt pressure gage to canister inlet or note sound of air flow. If unit is old or suspected of heavy ash ingestion, replace with a new unit, Fig 13.

D. DISTRIBUTOR:

Some Washington State Patrol vehicles, which were disabled during the 18 May 80 eruption, were found to have a large amount of ash in the distributor. It is imperative, therefore, that the distributor be sealed to prevent abrasive and magnetic particles from electrically shorting or damaging the distributor. Caulking with butyl tape is recommended for sealing of the cap, vacuum advance and distributor body. Remove distributor and clean surfaces to be sealed. With distributor removed, seal the

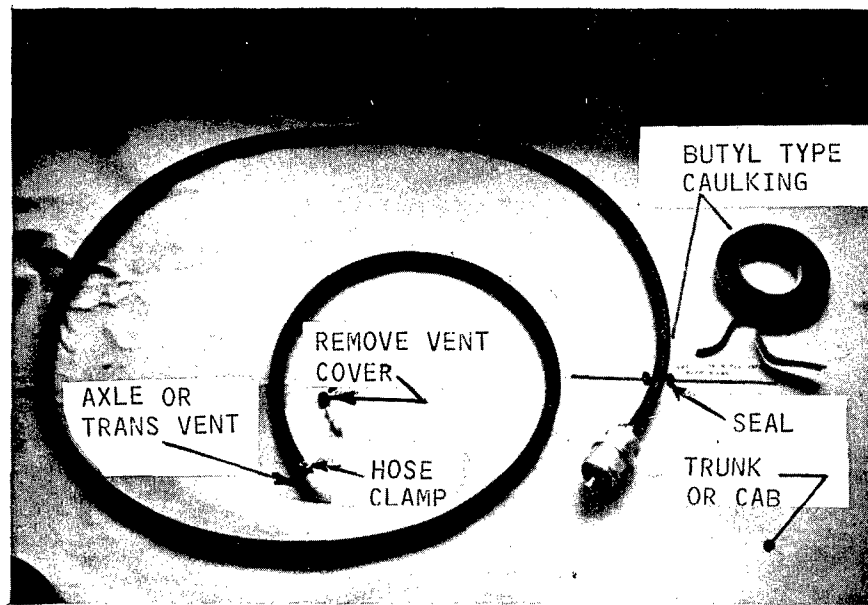


Figure 5

Axle and transmission vent filter modification.
Gasline filter type.

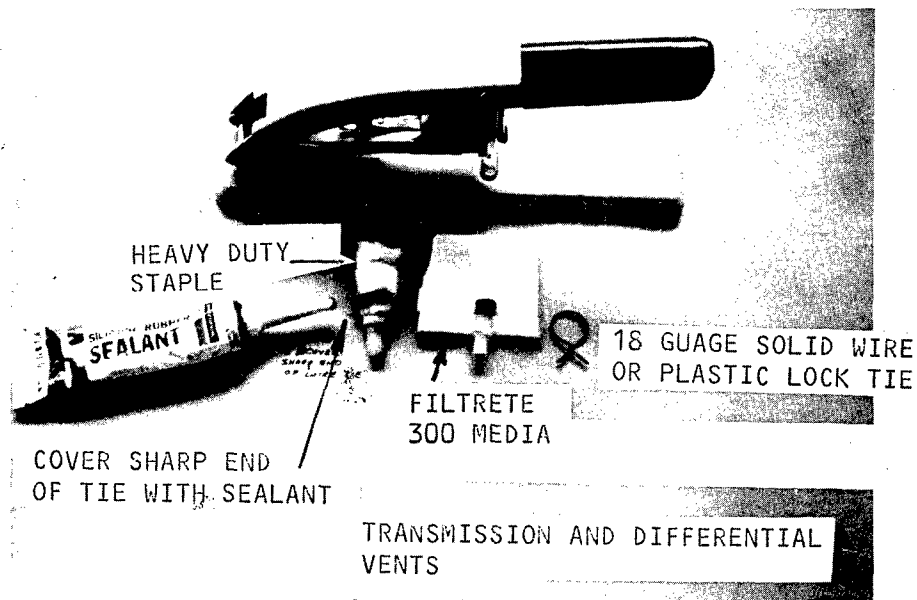


Figure 6

Alternate transmission vent filter. Protected
area only



Figure 7

Engine oil filler extension and replacement cap

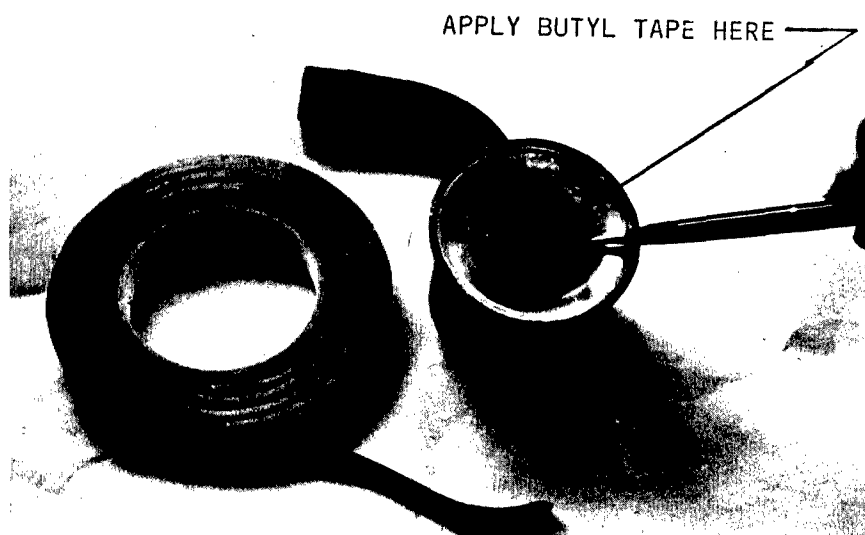


Figure 8

Sealing of engine crankcase breather.

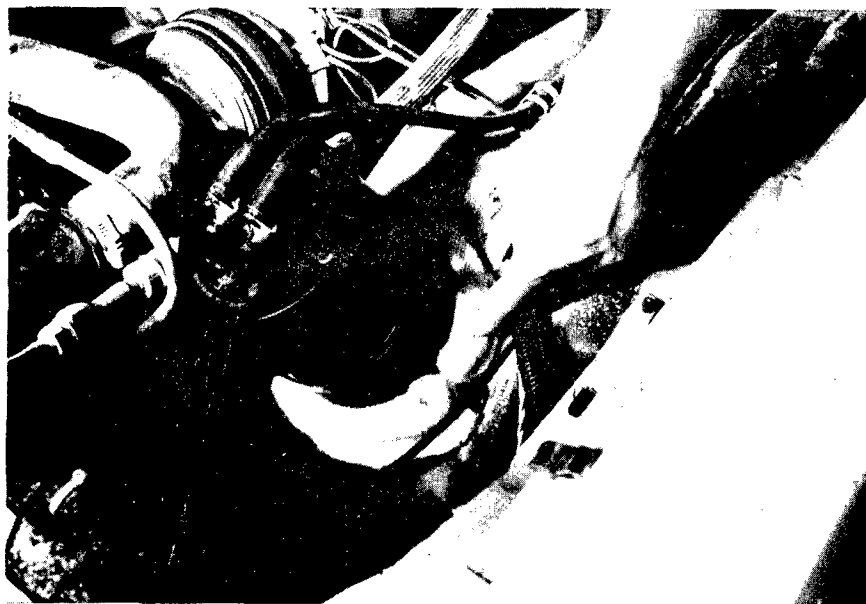


Figure 9

Additional filter protection for charcoal
filter canisters

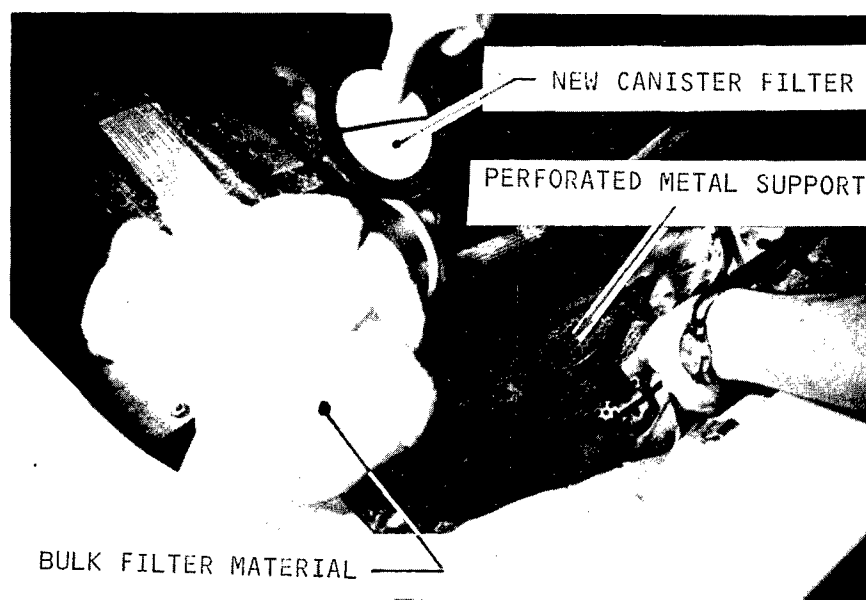


Figure 10

Charcoal filter bracket with perforated
metal support

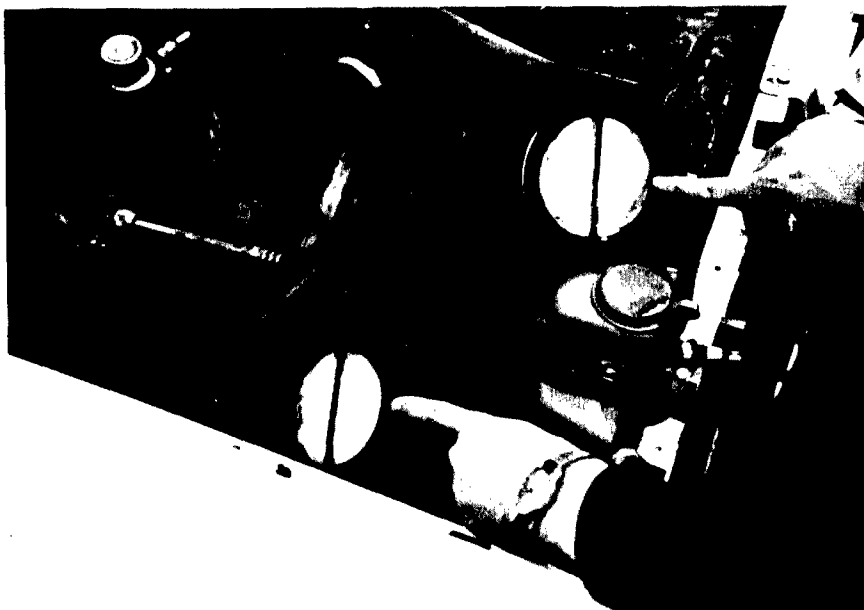


Figure 11
Standard filters in base of charcoal canisters.
Dual canister arrangement.



Figure 12
Inlet to Ford charcoal canister

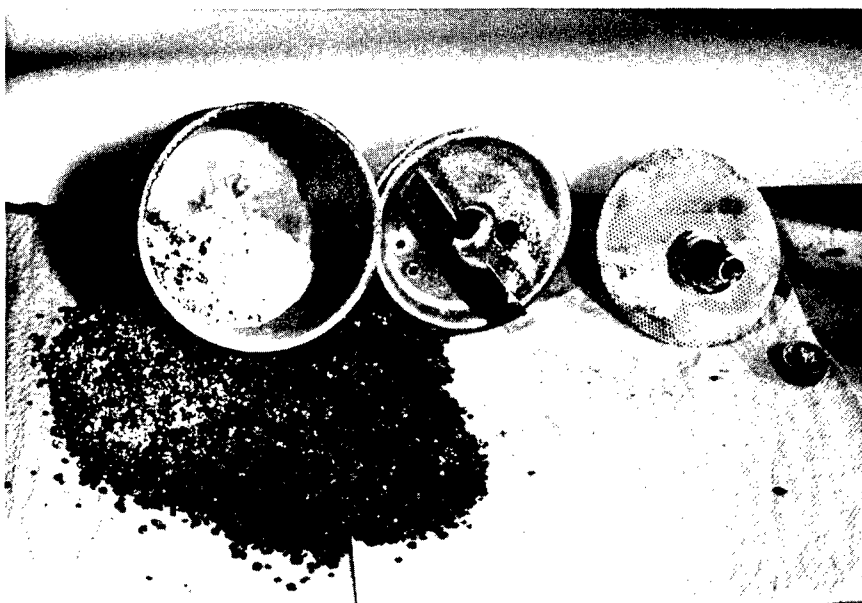


Figure 13

Heavy ash ingestion in top vented (Ford)
charcoal filter.

vacuum advance and the drain hole in the bottom of the housing. After reinstalling the distributor, and with the cap in place, press the butyl tape caulking into the space between the housing and cap, Fig 14.

CAUTION: Ignition problems may occur on some models due to a possible accumulation of moisture and ozone in the cap. On those models it may be necessary to correct the problem by removing the caulking from around the cap and wrapping the distributor cap to housing joint with the dual filter material (Lydall and Filtrete).

E. AIR PUMP

The air inlet on the emission system air pump is usually located behind the pulley. Limited air cleaning is provided by a centrifugal slinger attached to the pulley. The only effective method of protecting the air pump and preventing ash from being pumped into the engine and catalytic converter is to deactivate the pump. It is recommended that at the outset of a heavy fallout, or when subjected to heavy road dust conditions, the air pump belt be cut and removed from the pump. Prior to reactivating the pump it must be disassembled and thoroughly cleaned.

CAUTION: Do not cut belt if essential equipment is also driven by the air pump belt.

F. ALTERNATOR

There is no practical method of protecting the alternator from ash during a heavy fallout or under heavy road dust conditions. It is recommended that the auto industry be encouraged to develop a special alternator for the operation of emergency vehicles in fallout areas. The basis for such development is already available on some military vehicles. For example, the M-151, 1/4 ton truck, uses a 60 amp air cooled, 24 volt unit with special bearing seals and protection from abrasive dust. Other military vehicles have oil cooled alternators.

G. PASSENGER COMPARTMENT VENTILATION GRILLE

One of the most important and useful modifications is the passenger compartment ventilation grille filter, Fig 15. Both filter medias described in Appendix No. 4 are used. Cut out a paper pattern of the grille area to be covered. Allow slits for the washer nozzles if required. Using the prefitted pattern, cut out filter pads from the Filtrete and Lydall materials. Place the Filtrete pad on the grille first, followed by the Lydall pad, Fig 16. Two Lydall pads may be used for additional ash holding capacity. Secure the filter pads with nylon cords. Attach small springs or heavy rubber bands to the cords to insure tension, Fig 17. Anchor cords to sheet-metal screws installed at each end of grille.

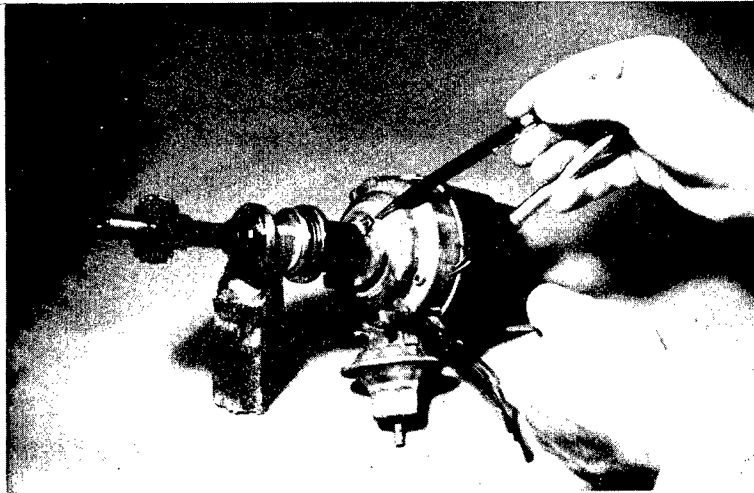


Figure 14

Typical distributor. Location of drain hole in base of housing and sealing of cap and vacuum advance.

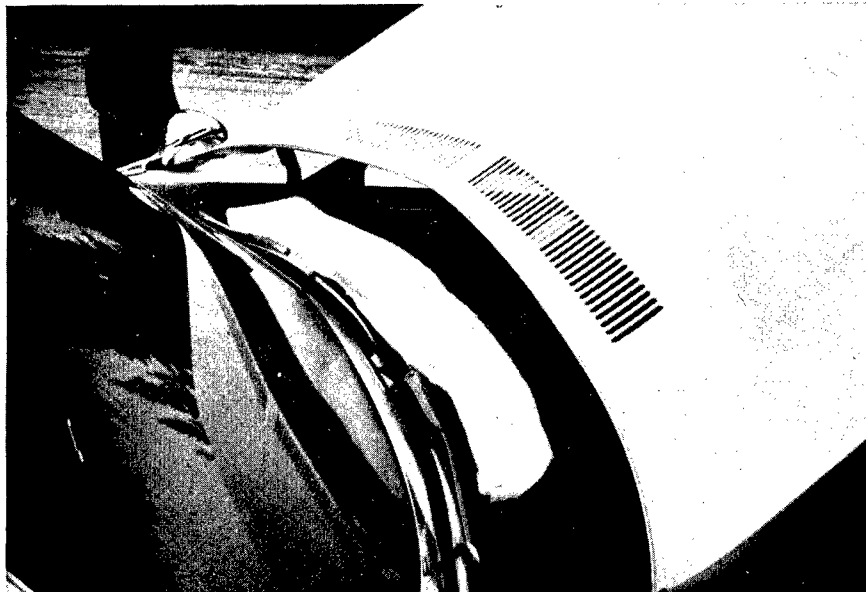


Figure 15

Passenger compartment ventilation grille filter.

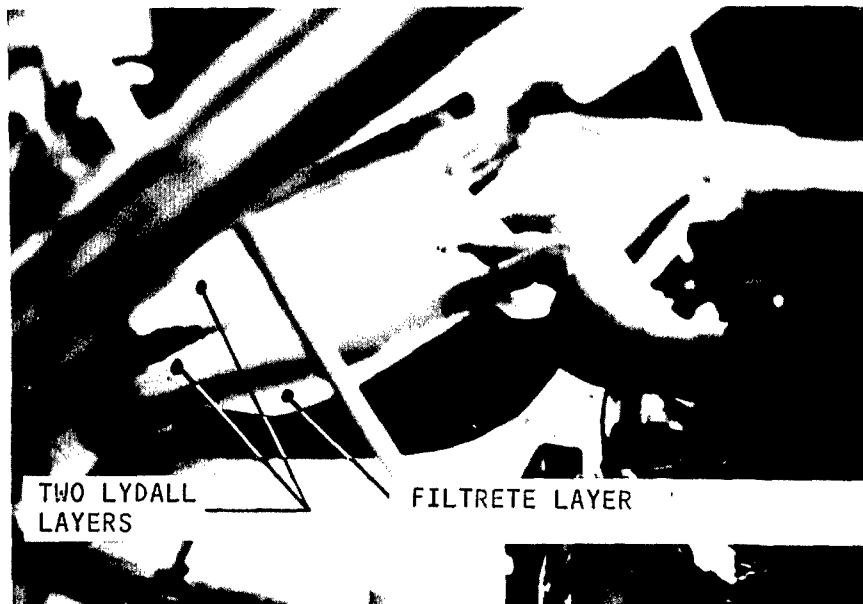


Figure 16

Cab ventilation filter showing various media layers.



Figure 17

Method of securing passenger compartment ventilation grille filter pads. A nylon fishing line is stretched over the filter pads and under the rubber cowling seal. The line is then attached to a tensioning spring with a snap swivel and secured to the cowl with sheet metal screws

The Lydall pads may be shook out or washed as required. Do not wash or shake the Filtrete material. Replace the Filtrete material when the clean side (bottom) appears dirty. When driving, the vehicle ventilation blower should be operated at high or maximum output to pressurize the passenger compartment. Insure that the washer nozzles are clear of the filter media at all times by placing a one inch diameter, small hole washer over the nozzle and hold in place with a spring clip. A split cotter pin makes an excellent clip. The washer may be cut out of a heavy plastic bottle.

H. STATIC ELECTRICITY

Some test data is available which indicates that a static electric charge on a vehicle will attract and hold dust. As a precautionary measure it is recommended that a static electricity ground strap be installed on the vehicle.

I. GENERAL MAINTENANCE

(1) General: Manufacturer recommended maintenance intervals should be reduced to half the specified period when operating for extended periods in ash fallout areas where some ash blowing and road or shoulder accumulations of ash are still present. Reference Federal Emergency Management Agency (FEMA) bulletins for additional maintenance information.

(2) Brake System: Clean wheel brake assemblies every 50 to 100 miles for severe ash fallout conditions or every 200 to 500 miles for heavy road dust conditions (roadway covered with ash). Clean brake housings with shop air or vacuum cleaner and check bearing seals for wear and leakage of dust into bearing. Check brake linkages for proper functioning. Check for ash inside of wheel cylinder boot if extreme accumulations of ash are found in drum. Disassemble and clean entire brake hydraulic system if ash is found inside boot. Check wheel cylinders for seized or sluggish pistons.

(3) Alternator: Clean alternator winding with compressed air after heavy fallout accumulation or every 500 to 1000 miles of severe dust exposure (1/4 mile visability). Determine if alternator bearings are damaged through sound and excessive play checks.

(4) Air Filter: Clean air filter when restriction gage indicates the specified restriction level (Reference Appendix 2, Para 3). Inspect air cleaner housings (prefilter and standard auto), hoses, fittings, etc. for damage and dust leaks. Reference instructions in Para 2A and Appendixes 1 and 3.

(5) Vents: Check all vent filters for ash accumulations and function when servicing air filter.

(6) Charcoal Filters: Clean Lydall filter pads when servicing air filter. Replace canister filter if dirty.

(7) Engine Oil/Chassis Lubrication: Change engine oil and oil filter and lubricate chassis at 50 to 100 mile intervals for very dense dust conditions (heavy fallout-less than 100 foot visibility). Extend service interval to 500-1000 miles for moderate dust conditions (over 1/2 mile visibility). Check ball joints and linkage for excessive play.

(8) Drive Shaft: Check universal joints for excessive play at oil change. Repack bearings at shorter than specified intervals, depending on ash conditions.

(9) Washing: Wash engine compartment, steering linkage and vehicle undercarriage with garden hose to remove ash accumulations. Frequent washing is recommended.

APPENDIX NO 1

AIR INDUCTION - MODIFICATION #1 FILTER ELEMENT WRAP

1. The standard automotive filter element can be covered with one or more supplementary medias which will hold large amounts of dust and can be easily removed, shook out and reinstalled, Fig 1. The service period will not be extended by the use of the supplementary media, but the overall life of the standard automotive filter element will be increased and the filter will be easier to clean. The filter element wrap is a combination of two different materials which were found to be most effective in laboratory tests and later confirmed by vehicle tests in ash fallout areas. The bulk filter materials are identified as follows:

Primary Filter (First filter to receive dust or ash)

Lydall media "fill 137"

Final Filter (Second filter to receive dust or ash)

Filtrete Media G1-200 (F) or G1-300 (F)
(A subsidiary of Eaton Air Filter, Inc.)

See Appendix No 4 for complete ordering information

2. INSTALLATION

A. Cut strips from both medias equal to the standard filter element height and circumference. Allow for a two inch overlap on the length of the final filter (Filtrete material). No not overlap the primary filter (Lydall material). Cut to butt fit.

B. Cut three cords from butcher's string (or similar material) to required length (approximately circumference of element). Attach cord ends to a heavy rubber band or small spring, as shown in Fig 2. The elastic cords will be used to provide the necessary tension for holding the media to the element face.

C. First, wrap the final filter material (Filtrete) snugly around the standard automotive filter element. Overlap the ends. Place one prefitted elastic cord (Item B) at the center of strip. Wrap the primary filter material (Lydall), over the final filter material. Cut as required to butt ends. The wrap materials should not extend more than 1/16 inch beyond top and bottom edge of standard element.

D. Place two prefitted elastic cords (Item B) around material. Insure that the wrap materials fit snug to element and that the elastic cords have adequate tension to hold the materials in place. Place cords approximately 1/2 inch from each edge, Fig 2.

3. MAINTENANCE

Remove primary (Lydall) filter and shake out dust. Striking against a chain link fence is recommended. Washing in soap and water is permissible.

CAUTION: Do not shake, beat or wash the
Filtrete material (final filter).

The Filtrete material will disintegrate with rough usage. The final filter wrap will last several cleanings of the primary filter material. Replace the final filter when its clean side shows significant amounts of dust discoloration.

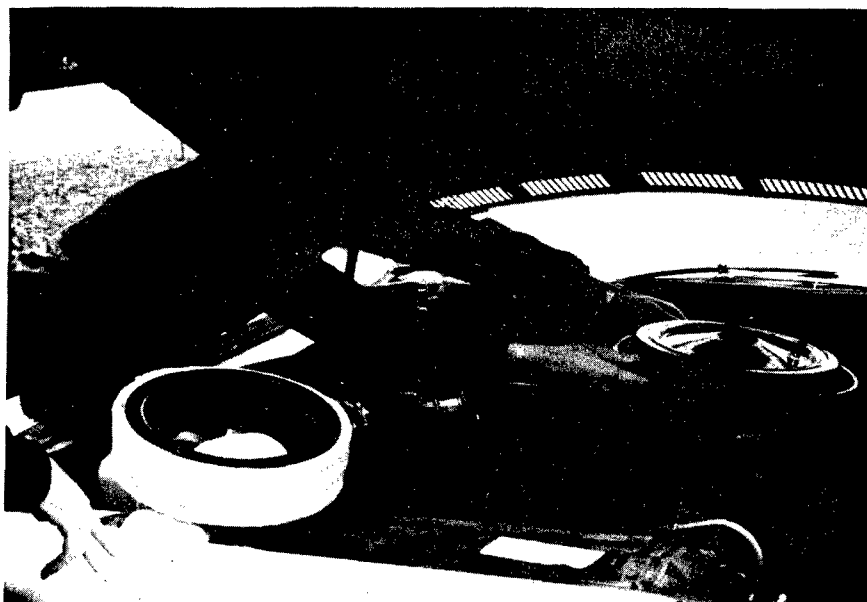


Figure 1

Standard Automotive Filter Element with Filter
Wrap Media in place

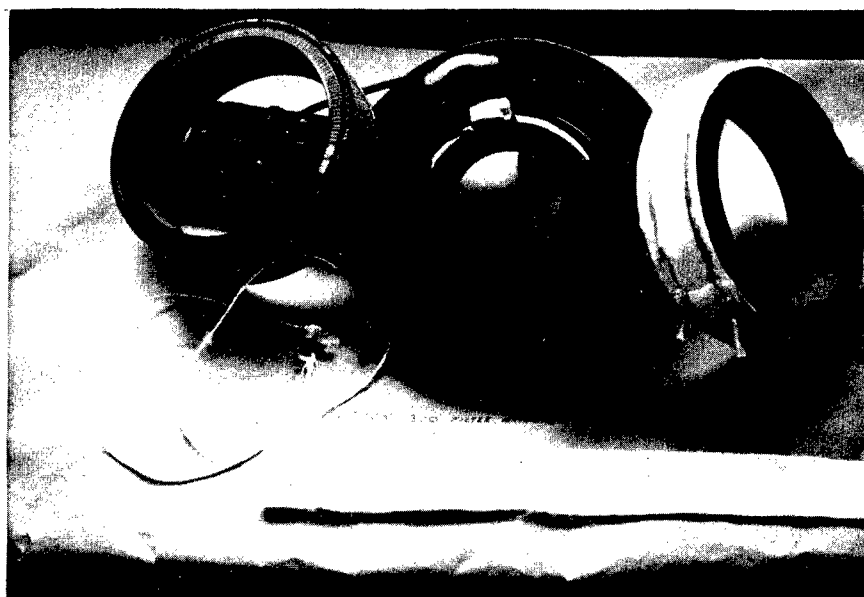


Figure 2

Standard Air Cleaner with Detail of Filter
Wrap Components. (Single Wrap View Shown. Additional
Wrap Layers Similar to that shown.)

APPENDIX NO 2

INDUCTION AIR - MODIFICATION #2 AIR FILTER RESTRICTION GAGE

1. The installation of an air filter restriction gage will assist in determining when to service the air filter and in preventing "over cleaning" of the element. A usual misconception regarding air cleaner maintenance is that a new filter cleans better. Assuming that the filter is not dented or otherwise damaged, a used, or dirty filter actually cleans the induction air much better than a clean filter. The problem with a dirty filter is that as the dust builds up on the filter paper, or media, the restriction to air flow increases and a reduced amount of air is drawn into the engine. By not knowing the actual restriction across an air cleaner element, the individual tendency is to "over clean" the unit. The result is often dust leakage from personnel incurred damage or improperly assembled filters. Ideally, the filter should be cleaned only when the restriction becomes excessive. "Excessive" restriction will be discussed in paragraph 3.

2. INSTALLATION

The air restriction gage is usually purchased as a kit which should include the following, Fig 1:

Gage - 0 to 30 inches of water (minimum range) or
0 to 60 inches of water (preferred range)
non-locking indicator feature

Fittings - Filtered damper orifice fitting, pickup fitting and gage fitting

Hose - Size and length as required to match fittings and location

For suggested sources - see Appendix No 4

Locate the pickup fitting on the standard automotive air cleaner housing or cover, on the clean side of the filter element, Fig 2. The pickup fitting can be secured with a nut and washers, brazing or other methods as available. The selected method should provide a strong, rigid and sealed fitting. Mount the gage on the dash or other location visible to the driver.

3. OPERATION

A. The restriction reading will change with vehicle speed and load and will depend on the air cleaner modifications used. Generally, for spark ignition engines, an air cleaner restriction gage is read at maximum speed and load conditions. For police vehicles this could be in excess of 100 mph at wide open throttle, (wot). A more practical standard for determining excessive restriction

is a predetermined arbitrary maximum restriction at a given level road cruise speed. The maximum restriction selected for this level road speed should be determined by the reduction in maximum speed and performance. For example, assume that 25 inches of water (in wg) restriction at 55 mph level road speed was selected as the arbitrary maximum restriction value. If, with this level road restriction, the vehicle could only accelerate to 80 mph at wot up a long steep grade, then the selected maximum restriction of 25 in wg is too high and a lower restriction limit must be selected. A test restriction can be applied to the air cleaner by partially blocking the air inlet to the truck air cleaner with cardboard and tape.

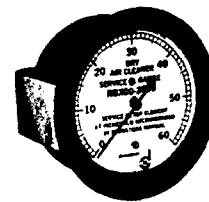
B. Each make of vehicle may have a different maximum level road cruise restriction limit. There will also be a significant difference in the maximum cruise restriction limit between the standard vehicles and those with modifications described in Appendixes 1 and 3. The following estimated restriction levels may be used as initial guides in determining the maximum level road restriction.

STD VEHICLE AIR CLEANER	15-20 in wg
STD AIR CLEANER WITH INDUCTION AIR MODIFICATION NO 1	10-15 in wg
STD AIR CLEANER WITH INDUCTION AIR MODIFICATION NO 3	10 in wg

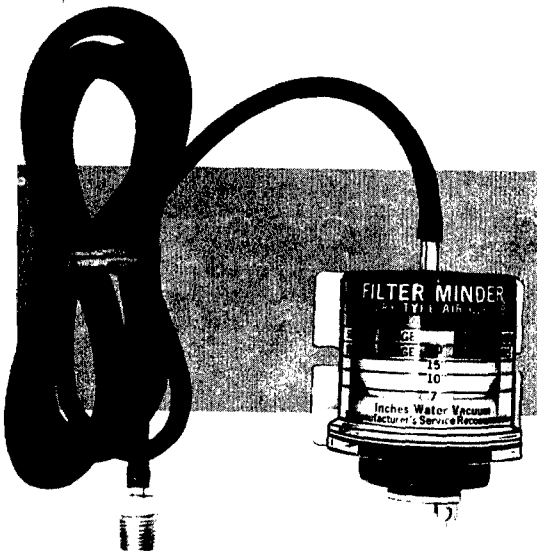
Service Indicators



Type a
diaphragm gage



Type b
dial gage



Type a kit
diaphragm gage

Figure 1

Various types of air cleaner restriction gages (also known as service indicators). Type b dial gage recommended.

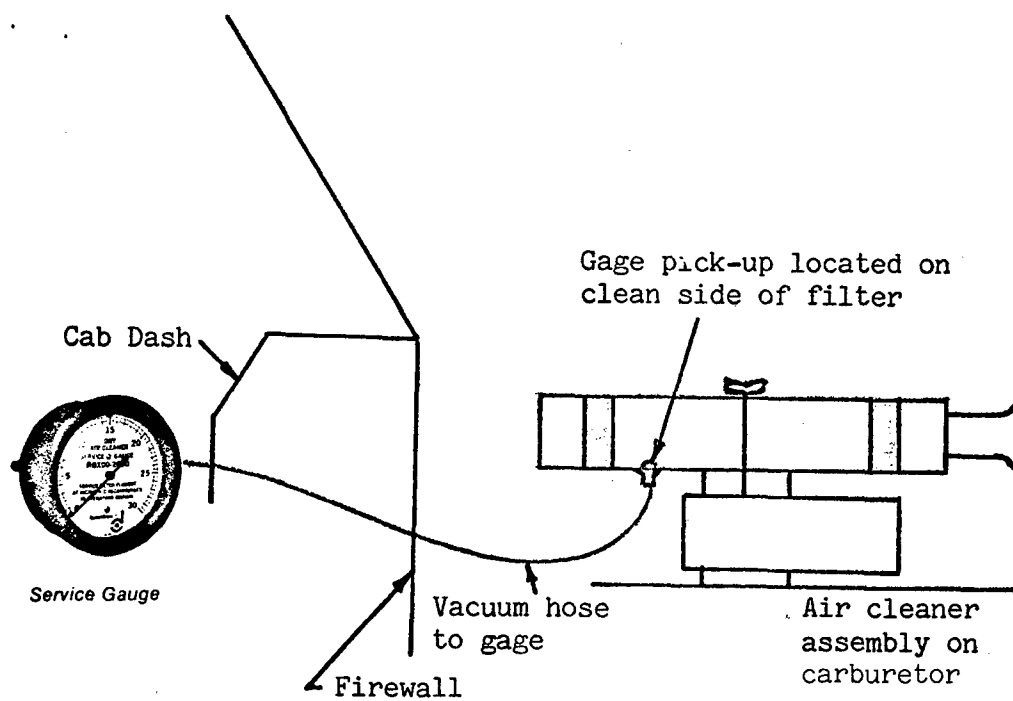


Figure 2

Location of air restriction (service) gage pickup on air cleaner housing.

APPENDIX NO 3

AIR INDUCTION - MODIFICATION #3 HEAVY DUTY TRUCK AIR CLEANER INSTALLATION

1. The major operational problem experienced during heavy ash fallout is the short life, or capacity, of the standard automotive air filter. The addition of a truck air filter will increase the amount of filtering material which is available to hold the ash and thereby permit the vehicle to operate under extreme fallout conditions for extended periods of time. Any available heavy duty, washable element, truck air cleaner with an air flow rating of 700 std. cubic feet per minute (CFM or SCFM) or greater, will provide adequate induction air filtering capacity. (Note, if truck air cleaner is equipped with an inertial precleaner the rating may be reduced to 300 CFM - air flow ratings are based on 6 in wg initial restriction). The following heavy duty air cleaners are being used by the Washington State Patrol:

United Air Cleaner Models E211D12B and E111D7B (700 CFM Units)

Donaldson Air Cleaner Model FGH-10-0138 (330 CFM Unit)

See Appendix No 4 for additional information

2. INSTALLATION

The following installation steps are recommended:

A. Mount the air cleaner housing to the front bumper using minimum 1 1/4 x 1 1/4 x 1/8 structural steel "angle iron" brackets and 1 x 1/8 in steel bands. Stabilizer rods or straps should be used to prevent vibration or movement of the unit during vehicle operation. If the vehicle bumper is equipped with push bars, a 1 1/4 inch "angle iron" section can be bolted or welded to the top of the push bar frame and the air cleaner mounted to it, Fig 1. Insure that the air cleaner location selected permits easy access to the filter element and incurs minimum air restriction to the radiator.

B. Remove the air cleaner rain cap, if so equipped, and point the air inlet toward the radiator and slightly down as shown in Fig 1, to avoid picking up dust from the vehicle hood and rain water. Locating the inlet pipe in this direction is also important because it provides a significant degree of inertial separation, or precleaning, to the truck filter with a corresponding increase in vehicle operating capability.

C. The standard vehicle air cleaner housing must be sealed to prevent quantities of ash from by-passing the truck air cleaner and prematurely clogging the standard filter. The inlet or "dirty side"

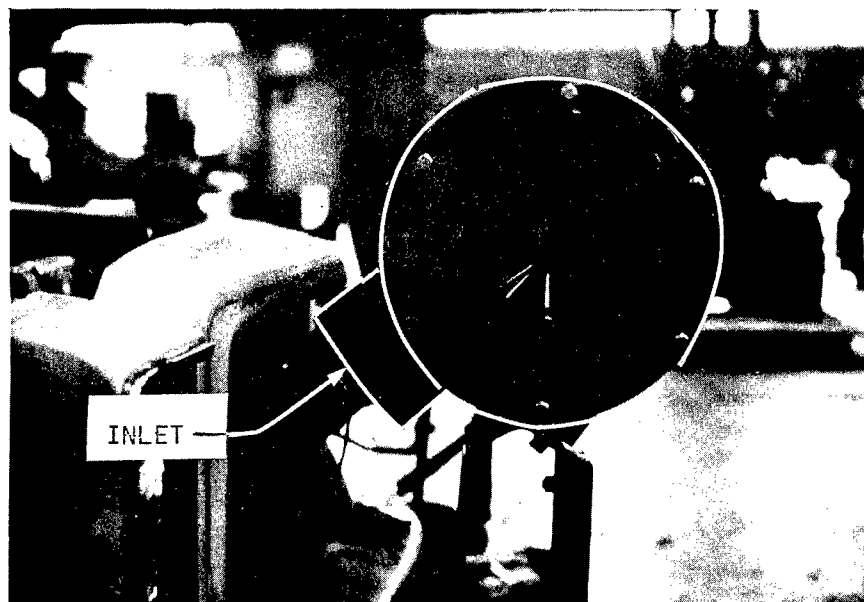


Figure 1

Air cleaner mounted on bumper push bar.
Note that air cleaner inlet is positioned toward
the rear of the vehicle in the grille cavity.

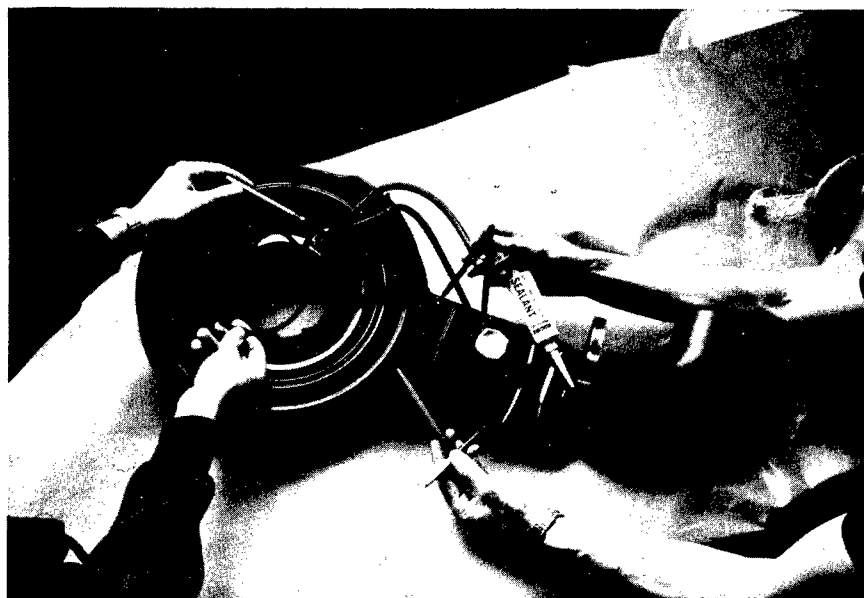


Figure 2

Sealing of the air cleaner housing showing
location of areas to be sealed.

Bottom view of GM air cleaner housing. Sealing
of hot air control, sensor and air horn joints.
Note installation of heavy duty truck type
induction air hose elbow on end of air horn.

of the standard vehicle air cleaner is not air tight. Relatively large holes and gaps are present in the air horn and body. Therefore, every seam, gap, hole or opening must be located and sealed. This includes crimped and spot welded seams. Refer to Figs 2 thru 9. Butyl tape (strip caulking material) and silicone rubber sealant bond well to clean housings. Silicone sealant requires several days for complete curing. Do not use duct tape or other types of adhesive tape for sealing.

D. In addition to dust leaks, the hot air valves and secondary inlets on some air cleaner models must also be deactivated and sealed, Figs 7 and 8. The secondary inlet on some models can be sealed by stretching a piece of heavy truck tire inner tube over the inlet and securing it with silicone rubber sealant and hose clamps, Figs 9 and 10. Elimination of the secondary inlet may cause excessive restriction at wide open throttle (wot) conditions. If the condition is unacceptable (Ref Appendix No. 2, Para. 3) an auxiliary duct to the secondary inlet can be tee'd into the primary duct. The tee, or "Y" section should be constructed from rigid exhaust pipe.

CAUTION: Insure that all welds are solid and will not leak. Bubble testing is recommended.

An alternate method of reducing the excessive restriction would be to cut the primary air inlet horn off at a location where the cross-sectional area is large enough to provide the air flow required.

NOTE: The flared inlet on some air filters will have to be removed in order to provide a clamping surface for the induction air duct.

E. Inspect carburetor to air cleaner gasket and replace if enlarged or otherwise defective. Add air cleaner cover wing nut gasket. Reference Item 2A (4) of basic instructions.

F. Install filter element wrap per Appendix No. 1, Air Induction - Modification #1, except that only the final filter (Filtrete) should be installed. Deletion of the primary filter (Lydall) will decrease the overall restriction.

G. Install heavy duty, flexible induction hose and molded rubber, truck type induction hose adaptors to the installed truck air cleaner and/or vehicle air cleaner, Figs 2, 10 and 11. Adaptor combinations of various sizes and shapes may be required to make the final connections. Some adaptors may be joined by rubber cement bonding as recommended by the manufacturer. See Appendix No. 4 for suggested sources.

H. Support inside of molded rubber adaptors to prevent their collapsing during high restriction periods. Restrictions in excess of 30 in wg will be experienced during hard accelerations. Support adaptors by placing sections of wire supported duct, or hand formed spring wire coils, inside the molded rubber adaptors. Insure that all

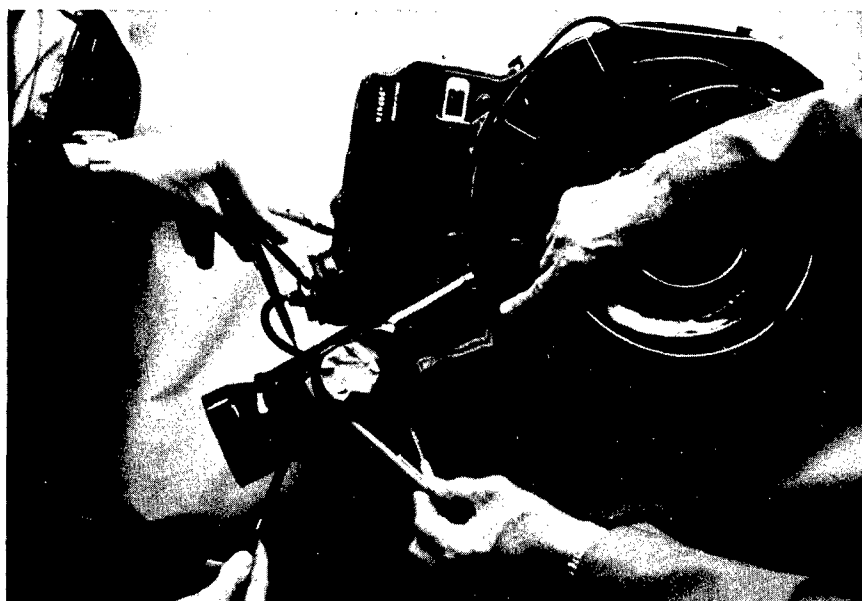


Figure 3

Sealing of air cleaner housing showing location of areas to be sealed.

Bottom view of Chrysler air cleaner housing. Sealing of hot air control, air horn joints and electronic spark control housing flanges.

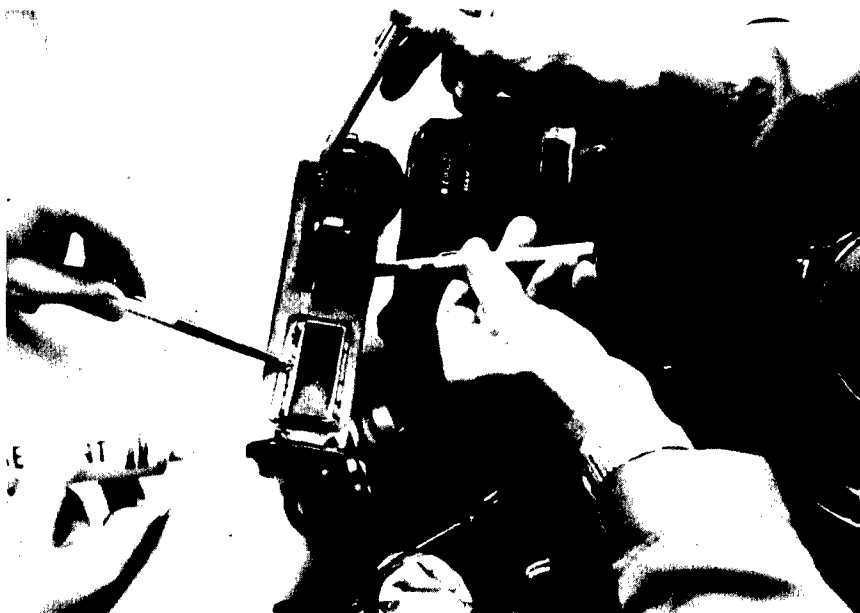


Figure 4

Sealing of air cleaner housing showing
location of areas to be sealed.

Chrysler air cleaner electronic spark
control housing flange.

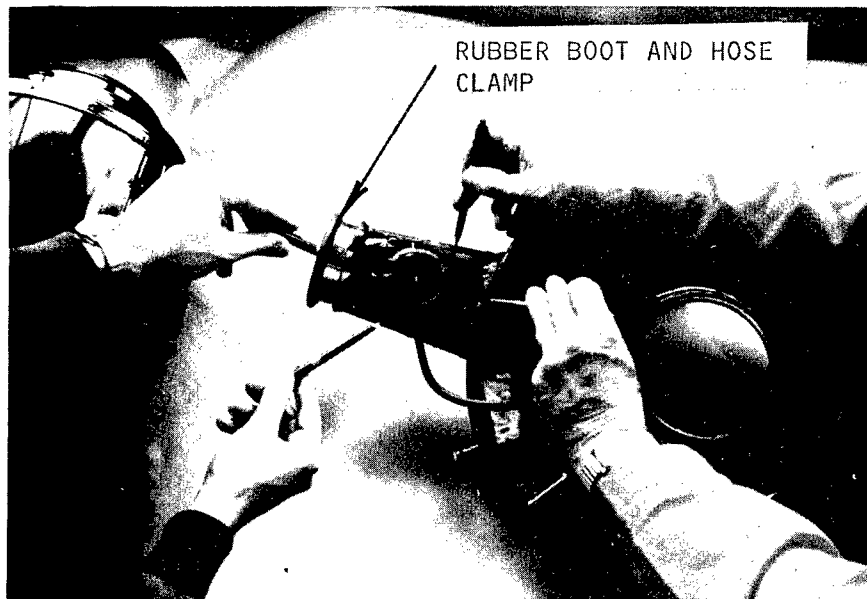


Figure 5

Sealing of air cleaner housing showing location of areas to be sealed.

Chrysler air cleaner secondary inlet.
Note rubber boot over inlet.



Figure 6

Sealing of air cleaner housing showing
location of areas to be sealed.

GM air cleaner crankcase vent filter.

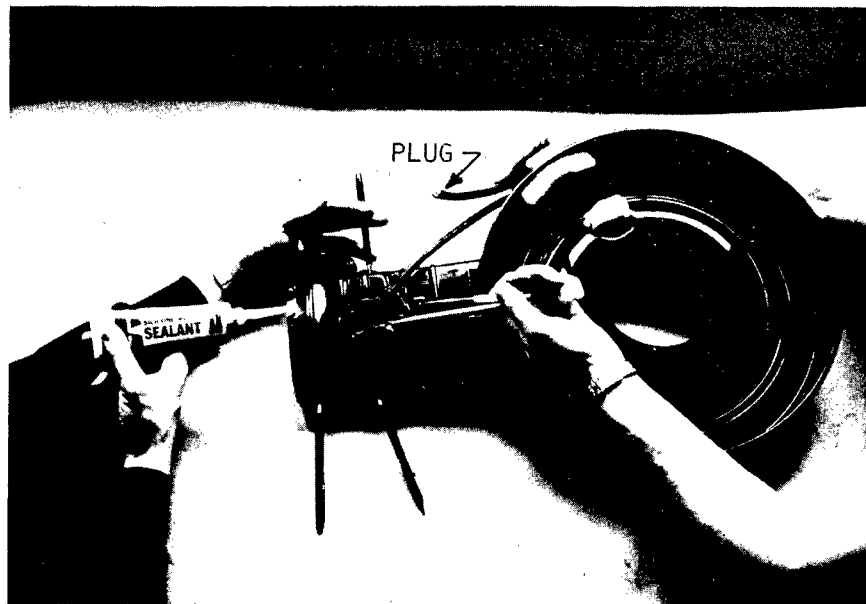


Figure 7

Sealing of air cleaner housing showing location of areas to be sealed.

GM air cleaner inlet air horn. Sealing of air horn seams, use of sealant when attaching induction air hose and deactivating hot air valve. Note plugged vacuum line.



Figure 8

Sealing of air cleaner housing and
deactivation of hot air valve.

Chrysler air cleaner primary inlet showing
areas to be sealed and method of deactivating
hot air valve. Note screws (with sealant)
plugging vacuum line.

Note that a sealant is used when attaching
the induction air hose.

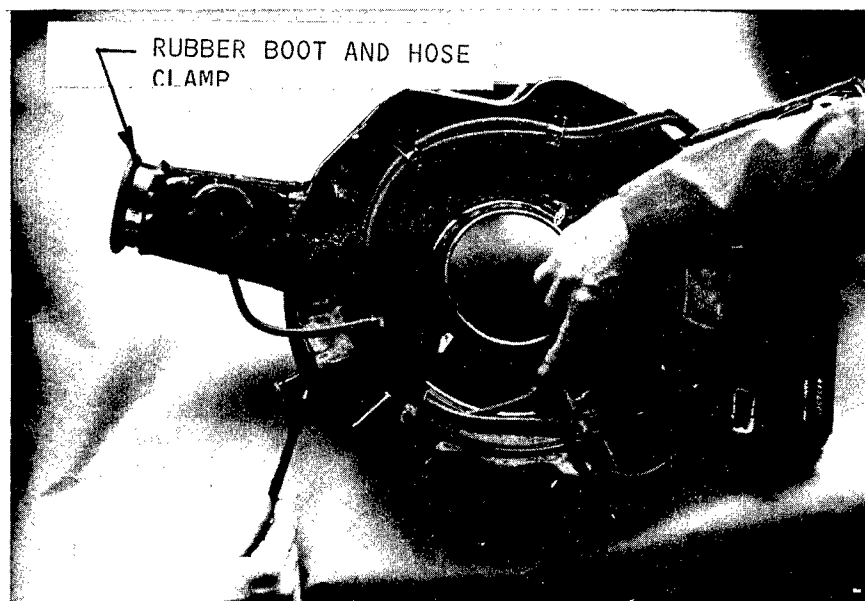


Figure 9

Sealing of air cleaner housing showing location of areas to be sealed.

Sealing of secondary inlet and underside of Chrysler air cleaner.

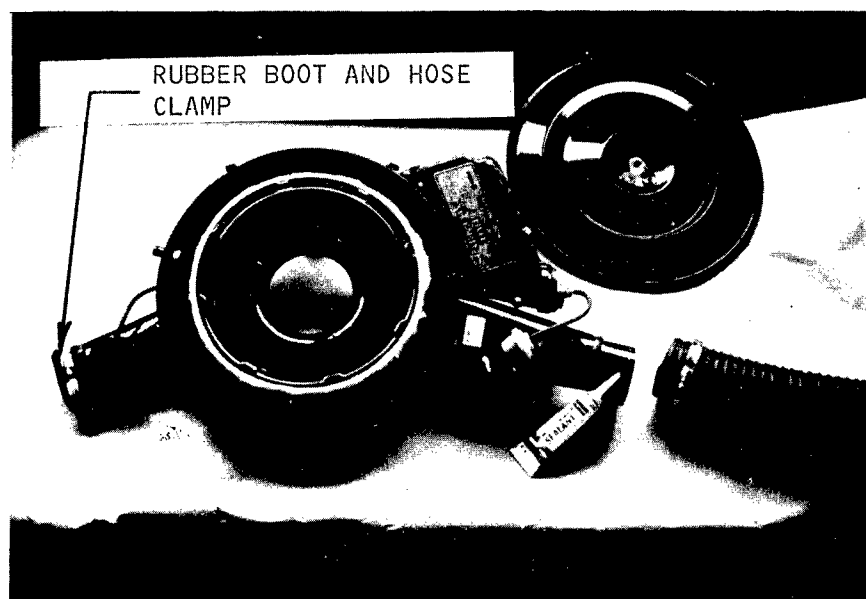


Figure 10

Installation of heavy duty flexible induction hose to Chrysler air cleaner air horn.

wire ends are bent inward to prevent puncturing of adaptor wall. If wire supported duct sections are used inside the molded rubber adaptors, select duct sizes which approximate the inside dimension of the adaptor and use the maximum length permissible. Excessive looseness of the duct sections in the adaptors will result in high restrictions.

I. Install heavy duty ducting from the vehicle air horn to the bumper mounted truck air cleaner outlet. The ducting should be specifically manufactured for vacuum (i.e. induction air) applications and should have the following characteristics:

- (1) Wound wire supported
- (2) Heavy duty, impregnated fabric material. The duct must be sealed by dip coating
- (3) Good flexibility. Duct should bend 180 degrees within approximately one diameter
- (4) Do not use a sleeved duct which can separate from the basic duct wall and internally collapse

The following commercial brand duct is satisfactory:

- (1) FEDFLEX Type C
- (2) SEDFLEX

Duct size will depend on vehicle air cleaner air horn dimensions and size of rubber adaptors.

J. Routing of the induction air duct between the vehicle air cleaner and the bumper mounted truck air cleaner will require different approaches for each vehicle model. In general, routing of the duct can be accomplished by variations in one of the following paths:

- (1) Over the radiator core support. This will require local flattening of the duct at the core support.
- (2) Through the radiator core support. Note: Protect duct from the sharp edge of the hole.
- (3) Through the fender cavity, Fig 12. Some body members may have to be bent to accommodate the duct, Fig 13. Care must be taken in routing of the induction air duct to avoid sharp objects which can cut or wear through or puncture the thin duct wall. Where such hazards cannot be voided, additional protection must be provided. A safe policy is to cover the duct with a section of heavy wall hose, or an old tire inner tube, wherever the duct touches anything. This is especially recommended when using the fender cavity route.

K. Short lengths of rigid exhaust pipe may be used to join duct and adaptor ends.

L. Use non-hardening gasket cement or silicone rubber sealant on all duct/hose or adaptor connections.



Figure 11

Installation of heavy duty molded rubber induction hose adaptors to bumper mounted truck air cleaner.

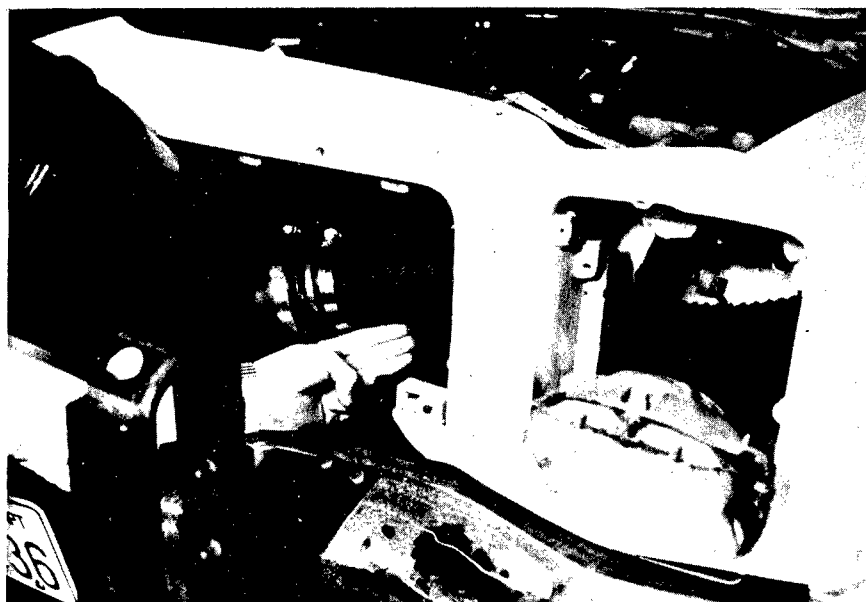


Figure 12

Installation of heavy duty flexible induction hose in fender cavity and behind headlight/grille support members. Insure clearance around sharp sheet metal edges.



Figure 13

Bending structural members to provide clearance for induction hose.

M. Heavy duty, worm gear or T-Bolt type hose clamps must be used at all connections. One hundred fifty in-lb torque rated clamps are preferred.

3. MAINTENANCE

The following maintenance will be required to insure maximum benefits from the truck air filter.

A. Follow the procedures for establishing the maximum level road cruise restriction outlined in Appendix No 2, Modification No 2 (Operation).

B. When the air restriction gage indicates that the system requires cleaning, remove both filter elements (Truck and standard automotive elements) and inspect air cleaner as recommended in Paragraph 2A of the basic instructions. Visually inspect the elements for distortion, torn or damaged seals, tears and, most importantly, dust leak paths. Dust leaks usually occur between the pleat folds on the inside (or clean side) of the media at the bonded element ends and across the seals. Note: Allow approximately 15 to 30 minutes for thorough air cleaning. Reference Fig 14.

C. The truck filter should be washed if air cleaning does not adequately reduce the system restriction. Professional washing by a reputable firm is preferred. In-house washing by shop personnel is acceptable provided adequate care is taken not to damage the media and to thoroughly rinse the element with a garden hose (without nozzle). Always inspect the element for damage after air cleaning or washing. Inspection of the element is accomplished by holding a 100 watt bulb inside the element and looking for evidence of pin holes, etc. from the opposite side. Reference Fig 14.

D. Replace the Filtete media wrap on the standard auto filter element if previously found dirty and removed (Item B). Reference Appendix No 1, Modification No 1 for instructions.

CAUTION: Do not install the primary filter media (Lydall) on Mod 3 applications. Reference Appendix No. 3, Para 2F

E. Visually inspect the entire system for leaks. Pay particular attention to the following:

- (1) Air cleaner to carburetor gasket
- (2) Butyl tape loose or missing from joints, seams, etc.
- (3) Holes, tears, wear spots or damaged areas on the flexible duct (Add protective cover, see Para 2J (3) above).

Element Cleaning Methods

Clean Duralife element by one of the following methods:

Compressed Air or Washing.

Compressed air is recommended when element will be re-used immediately because a washed element must be dried before re-use. However, washing does

a better job and must be used when exhaust soot has lodged in fine pores of the filter media. Use Donaldson D-1400 detergent which contains a special additive for removing soot and carbon.

Replace element after 6 cleanings or annually, whichever occurs first.

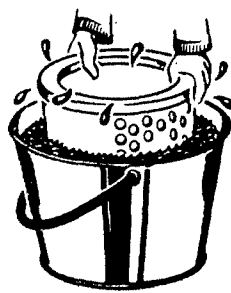
Do not remove plastic fin assembly — back-flowing with compressed air or washing will remove dust from beneath the fin assembly.

Request Form P45-7188 "How to Service Duralife and Duralife II Elements" for additional information.



Compressed Air

Direct air through element in the direction opposite to normal air flow through the element. Move nozzle up and down while rotating element. Keep nozzle at least one inch from pleated paper. Maximum air pressure to prevent damage of element is 100 P.S.I.



Washing

1. Soak element 15 minutes or more in Donaldson D-1400 and water solution. See carton for full instructions.
2. Rinse until water is clear (Maximum water pressure 40 P.S.I.)
3. Air-dry or use warm flowing air, max. 160°F. Do not use compressed air or light bulbs.



Inspection

Place bright light inside element and rotate element slowly. If any rupture, holes or damaged gaskets are discovered — replace.

General Service Tips

The air cleaner should be inspected periodically to maintain maximum engine protection and maximum service life. These inspections should include the following points:

1 — Inspect the air transfer duct between the air cleaner and the engine to be sure all clamps are tight, all flange joints are tight, and there are no cracks in the ducting.

2 — Air cleaner mounting bolts and clamps must be tight to hold the air cleaner securely.

3 — Check the dust cup to make sure it is sealing 360° around the air cleaner body.

4 — Vacuum valve must be in place, not inverted or damaged, and free from obstruction.

5 — Check for dents and damage to the air cleaner which could mean a leak.

6 — Make sure all inlet accessories are free from obstructions and securely mounted.

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donaldson

Figure 14



Donaldson Company, Inc.
1400 West 94th Street
Minneapolis, Minnesota

Mailing Address:
Box 1299
Minneapolis, Minnesota 55440

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Washing procedures do not apply to standard passenger car air cleaner filters or non-washable truck filter elements.

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(4) Loose hose clamps

(5) Separations in vulcanized or bonded areas on the molded rubber adaptors or flexible duct

(6) Evidence of dust leakage on the inside of the flexible induction air duct (to the extent possible).

F. Reassemble system and road check level road cruise restriction.

APPENDIX NO 4

SOURCE INFORMATION

The following source information is intended as an aid, or guide, in obtaining the equipment and materials referenced in these instructions. It does not constitute an indorsement of any of the products by the Washington State Patrol, The Department of Transportation, The Federal Emergency Management Agency (FEMA) or the Department of the Army. It is recommended that various business directories be consulted for additional source information.

1. AGENCIES

Washington State Patrol
4242 Martin Way
Olympia, Washington 98504
ATTN: MAJ J. Ramberg/Mr. R. Nesbit
(206) 753-6851

Federal Emergency Management Agency
Vancouver, Washington
ATTN: Mr. J. Kerr
Technical Information Dir.
(206) 696-7801
(202) 653-7860 (Washington D.C.)

US Army Tank Automotive Research & Development Command
Warren, Michigan 48090
ATTN: DRDTA-RG/CPT C. Ennis/Mr. J. Woidke
(313) 573-2413

2. TRUCK FILTERS

United Air Cleaner
Models E211D12B or E111D7B
Contact the following office for dealer information and additional technical data:

United Filtration Corp.
United Air Cleaner Div.
9705 S. Cottage Grove Avenue
Chicago, Illinois 60628
ATTN: Mr. D. Tortorici/Mr. J. Dreznes
(313) 734-5000

Donaldson Co., Inc.
Model FHG-10-0138
Contact:

Donaldson Co., Inc.
1400 W. 94th Street
Minneapolis, Minnesota 55431
ATTN: Mr. W. Mellgren
(612) 887-3662

or

Donaldson Co. District Sales Office
Menlo Park, California
ATTN: Mr. L. Coon
(415) 321-0357

3. BULK FILTER MATERIAL

a. Primary Filter (First filter to receive ash)
Lydall Media, Fitt 137
Contact:

Lydall Inc.
Westex Div.
4115 Ogden Ave.
Chicago, Illinois 60623
ATTN: Mr. F. Lukens
(312) 277-8000

b. Final Filter (Second filter to receive ash)
Filtrete Media G1-200(F) (200 oz)
or G1-300(F) (300 oz)

Contact:

Filtrete Corp.
Subsidiary of Eaton Air Filter Inc.
2400 Bellevue
Detroit, Michigan 48207
ATTN: Mr. L. Keeney/Mr. Carlos Araujo
(313) 925-3440

4. AIR CLEANER RESTRICTION GAGE

a. Diaphragm Service Indicator Type
Filter Minder Model 1780-315

Contact:

Engineered Products Co.
3120 Kimball Avenue
Waterloo, Iowa 50702
ATTN: Mr. H. Leighty
(319) 234-0231

b. Dial Gage Type

(1) Donaldson Co. Model RBX00-2604

Contact:

Donaldson Co., Inc.
1400 W. 94th Street
Minneapolis, Minnesota 55431
ATTN: Mr. W. Mellgren
(612) 887-3662

or

Donaldson Co. District Sales Office
Menlo Park, California
ATTN: Mr. L. Coon
(415) 321-0357

(2) Marshalltown Instrument Co.
Models 83K or 83KB
Purchase order must include following:
0-60 in. wg water vacuum
2.5 inch dial face

Contact:

Marshalltown Instrument Co.
Marshalltown, Iowa
(515) 752-9299

5. INDUCTION AIR HOSE, DUCTING AND MOULDED RUBBER ADAPTORS.

Brand Names-Hose
Fedflex Type C
Sedflex

Sources - Hose, Ducting and Adaptors

Huntington Rubber Co.
Portland Oregon, 97219
ATTN: Mr. N. P. Lesh
(503) 246-5411

Air Flow Systems
Tukwila, Washington 98188
ATTN: Mr. Dan Osborne
(206) 575-0930

Diversified Industries
Seattle, Washington
ATTN: Mr. Clark
(206) 762-3660

Additional sources can be obtained from telephone directory under truck equipment and rubber hose suppliers.

6. BUTYL TAPE (Also known as auto glass replacement tape)

Source: Local auto dealers, auto parts suppliers or auto glass installers.

Butyl tape is manufactured by a number of different companies. The following manufacturers can furnish local distributor information for their products:

TREMCO Inc.
Cleveland, Ohio
(216) 354-7892

ADCO Products Co.
Jackson, Michigan
(517) 764-0334

3-M Corp
Seattle, Washington
ATTN: Mr. S. Marsh
(206) 244-7200

7. FILTER WASHING (Truck filters only)

Filter Care Inc.
307 34th Avenue S.W.
Albany, Oregon 97321
(503) 967-7949