

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-175-4
Relating to Exemptions Under Section 27156
of the Vehicle Code

HYPERMAX ENGINEERING, INC.
TURBOCHARGER KIT

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 39515 and 39516 of the Health and Safety Code and Executive Order G-45-5;

IT IS ORDERED AND RESOLVED: That the installation of the add-on turbocharger kit manufactured by Hypermax Engineering, Inc. of 255 E. Route 72, Gilberts, Illinois, 60136, has been found not to reduce the effectiveness of required motor vehicle pollution control devices and complies with the forty (40) percent snap idle smoke opacity standard in Title 13, California Code of Regulations, Section 2180-2187, and therefore is exempt from the prohibitions of Section 27156 of the Vehicle Code for the 1992 model-year Ford Motor Company heavy-duty vehicles powered by a 7.3L Navistar International heavy-duty diesel engine. Hypermax's aneroid (puff limiter) is included as part of the turbocharger kit for the 1992 model year Ford Motor Company vehicles powered by a 7.3L Navistar International heavy-duty diesel engine.

This Executive Order is valid for the Hypermax Engineering, Inc.'s turbocharger kit which uses one of the following turbochargers:

1. AiResearch model 409900-2 with area ratio (A/R) of 0.96;
2. AiResearch model 465124-5004 with A/R of 1.15;
3. Holset Engineering model H2A7680E/FA019CA2 with A/R of 1.08;
4. Warner-Ishi model RHB7-9700VP28NFBRL552A with A/R of 1.10

Modifications to the OEM emission-related parts due to the installation of the turbocharger kit include replacement of the OEM exhaust system with a 3-1/2" diameter exhaust system.

This Executive Order is valid provided that installation instructions for this device will not recommend tuning the vehicle to specifications different from those submitted by the vehicle manufacturer.

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

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

Marketing of this device using an identification other than that shown in this Executive Order does not constitute any opinion as to the effect that the use of this device 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 ANY CLAIMS OF THE APPLICANT CONCERNING ANTI-POLLUTION BENEFITS OR ANY ALLEGED BENEFITS OF HYPERMAX ENGINEERING, INC.'S TURBOCHARGER KIT FOR INSTALLATION ON THE 1992 FORD MOTOR COMPANY VEHICLES POWERED BY A 7.3L NAVISTAR INTERNATIONAL HEAVY-DUTY DIESEL ENGINE.

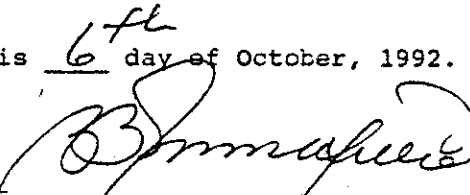
Section 17500 of the Business and Professions Code makes untrue or misleading advertising unlawful, and Section 17534 makes violation punishable as a misdemeanor.

Section 43644 of the Health and Safety Code provides as follows:

"43644. (a) No person shall install, sell, offer for sale, or advertise, or except in an application to the state board for certification of a device, represent, any device as a motor vehicle pollution control device for use on any used motor vehicle unless that device has been certified by the state board. No person shall sell, offer for sale, advertise, or represent any motor vehicle pollution control device as a certified device which, in fact, is not a certified device. Any violation of this subdivision is a misdemeanor."

Any apparent violation of the conditions of this Executive Order will be submitted to the Attorney General of California for such action as he deems advisable.

Executed at El Monte, California, this 6th day of October, 1992.



R. B. Summerfield
Assistant Division Chief
Mobile Source Division

State of California
AIR RESOURCES BOARD

EVALUATION OF HYPERMAX ENGINEERING, INC'S TURBOCHARGER KIT
FOR EXEMPTION FROM THE PROHIBITIONS OF VEHICLE CODE
SECTION 27156 IN ACCORDANCE WITH SECTION 2222, TITLE 13, OF
THE CALIFORNIA CODE OF REGULATIONS

October 1992

State of California
AIR RESOURCES BOARD

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CALIFORNIA CODE OF REGULATIONS

by

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State of California
Air Resources Board
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(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 mention of trade names or commercial products constitute endorsement or recommendation for use.)

SUMMARY

Hypermax Engineering, Inc. (Hypermax) of 255 E. Route 72, Gilberts, Illinois 60136 has requested an update to Executive Order (E.O.) D-175-2, which exempts their Turbocharger Kit from the prohibitions in Vehicle Code Section 27156, to include the 1992 model year Ford Motor Company vehicles powered by a 7.3L Navistar International heavy-duty diesel engine.

Since the 1992 model year 7.3L Navistar International heavy-duty diesel engine is carried over from the 1989 model year for which an exemption has been granted and the snap idle test results indicate that smoke opacity of the modified vehicles was less than the 40 percent standard, staff believes that the add-on turbocharger kit will have no adverse effect on exhaust emissions from the engine for which the exemption update is requested. Hypermax is currently undergoing snap-idle tests to determine the smoke opacity levels of the 1990 to 1991 models installed with their turbocharger kit.

The staff recommends that Hypermax be granted an exemption as requested and that Executive Order D-175-4 be issued.

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EVALUATION OF HYPERMAX ENGINEERING, INC.'S ADD-ON TURBOCHARGER
KIT FOR EXEMPTION FROM THE PROHIBITIONS OF VEHICLE CODE
SECTION 27156 IN ACCORDANCE WITH SECTION 2222, TITLE 13, OF THE
CALIFORNIA CODE OF REGULATIONS

I. INTRODUCTION

Hypermax Engineering, Inc. (Hypermax) of 255 E. Route 72, Gilberts, Illinois 60136 has requested an update to Executive Order (E.O.) D-175-2 to include the 1992 model year Ford Motor Company vehicles powered by a 7.3L Navistar International heavy-duty diesel engine only. The E.O. D-175-2 currently exempts Hypermax's Turbocharger Kit from the prohibitions of Vehicle Code (VC) Section 27156 for the 1988-1989 model year Ford Motor Company vehicles powered by a 7.3L Navistar International heavy-duty diesel engine. Hypermax is currently undergoing snap-idle tests to determine the smoke opacity levels of the 1990 to 1991 models installed with their turbocharger kit.

II. CONCLUSIONS

Since the 1992 model year 7.3L Navistar International heavy-duty diesel engine is carried over from the 1989 model year for which an exemption has been granted and the snap idle test results indicate that smoke opacity of the modified vehicle was less than the 40 percent standard, the staff believes that the add-on turbocharger system will have no adverse effect on exhaust emissions from the engine for which the exemption update is requested.

III. RECOMMENDATION

The staff recommends that Hypermax be granted exemption for the add-on turbocharger kit for the 1992 model year Ford Motor Company vehicles powered by a 7.3L Navistar International heavy-duty diesel engine and that Executive Order D-175-4 be issued.

IV. TURBOCHARGER KIT DESCRIPTION

The purpose of the Hypermax turbocharger kit is to increase the power output of the engine by compressing the intake charge to pressures above that of the atmosphere. This increased pressure allows a greater charge density to enter the combustion chamber and increase the volumetric efficiency. The maximum fuel delivery is slightly increased in order to maintain proper air-fuel ratios when the turbocharger is providing positive manifold pressure (boost). The injection pump timing is retarded by two degrees from the original equipment manufacturer (OEM) specifications.

Hypermax offers four turbochargers with their system as follows:

1. AiResearch model 409900-2 with an area ratio (A/R) of 0.96;
2. AiResearch model 465124-5004 with an A/R of 1.15;
3. Holset Engineering model H2A7680E/FA019CA2 with an A/R of 1.08;
4. Warner-Ishi model RHB7-9700VP28NFBRL552A with an A/R of 1.10.

The major components of the kit include a turbocharger, custom intake adapters, 3-1/2" exhaust tubing, brackets, hoses and the hardware necessary to complete the installation.

Maximum positive manifold pressure is limited to 10 psig by the size of the turbine and the compressor. The maximum engine speed is regulated by the OEM fuel injection governor which is not modified by the installation of the kit. Therefore, by controlling maximum engine speed, maximum turbine speed and corresponding boost pressures are also controlled.

No OEM emission controls are removed or disconnected when the turbocharger kit is installed. Positive Crankcase Ventilation (PCV) system is re-routed to the compressor inlet. To meet the newly implemented opacity standard of 40 percent, Hypermax has developed an aneroid (Puff Limiter) for installation on the 1992 model-year Ford Motor Company heavy-duty vehicles powered by a 7.3L Navistar International heavy-duty diesel engine. Previous model year applications do not include the installation of the aneroid because such vehicle applications are not required to meet the 40 percent smoke opacity standards.

V. TURBOCHARGER KIT DISCUSSION

The applicant is making the add-on turbocharger kit available for the 1992 model year Ford Motor Company vehicles powered by a 7.3L Navistar International heavy-duty diesel engine. Certification documents show that the 1992 model year 7.3L Navistar International heavy-duty diesel engine is carried over from the 1989 model year for which the turbocharger kit has been exempted. Previous testing of the turbocharger showed no adverse affect on exhaust emissions. However, starting with the 1992 model year heavy-duty diesel vehicles, snap-idle smoke opacity testing was required pursuant to California Code of Regulations (CCR) Section 2182, Heavy-Duty Diesel Vehicle Smoke Opacity Test Procedure. The overall smoke opacity could not exceed 40 percent as required by the CCR Section 2182 (c). Turbochargers do not kick-in immediately upon engine start up. Thus, during transient periods, air is momentarily restricted even though fuel is increased, causing an increase in peak smoke. To meet the 40 percent opacity standard, Hypermax developed an aneroid which reduces the response time (boost to fuel) of the turbocharger. This has a favorable impact on particulate emissions as well as meeting the 40 percent opacity standard. During periods of low manifold pressures, such as during rapid acceleration, the aneroid reduces the fuel charge to each cylinder by lowering the fuel rail pressure. As the turbocharger increases the intake manifold pressure, the fuel pressure increases to rated pump calibration volume and pressure. According to the manufacturer, the system, if properly adjusted, reduces the smoke opacity while not affecting performance and no other modifications to the system are necessary for installation on the 1992 model year applicable vehicles.

Smoke opacity testing performed in accordance with California Code of Regulations (CCR) Section 2182 et seq. was conducted at the Hypermax facilities on a 1992 Ford Motor Company F-250 pick-up truck powered by a 7.3L Navistar

International heavy-duty diesel engine. Smoke opacity tests were conducted with the aneroid installed, and adjusted to the optimum level.

Results are as follows:

<u>Run Number</u>	<u>Percent Opacity</u>
1	38.4
2	39.0
3	38.4
4	35.9

The snap-idle test results indicate that the smoke opacity of the modified vehicle was less than 40 percent. This demonstrates that the addition of the Hypermax Engineering, Inc. turbocharger kit will not have an adverse effect on emissions for the 1992 Ford Motor Company vehicles powered by a 7.3L Navistar International heavy-duty diesel engine for which the exemption was requested.

Hypermax has submitted all the required information and fulfilled the requirements for an exemption.

APPENDIX .

ANEROID INSTALLATION INSTRUCTIONS

Background:

The state of California limits 1992 aftermarket turbocharger equipped diesel engines to a 40% maximum snap idle smoke opacity. Briefly, California's roadside testing requires a vehicle's engine to be rapidly accelerated from low idle to high idle at no load. The peak exhaust smoke opacity is measured and recorded. 1992 and later vehicles must not exceed 40% opacity.

The Hypermax Engineering Fuel Injection Pump Aneroid, or "Puff Limiter", limits the O.E.M. Stanadyne Injection Pump's fuel delivery to the naturally aspirated setting until sufficient turbocharger boost or intake manifold pressure is available for an acceptable smoke level during acceleration.

It is strongly recommended that the user seek the services of an authorized diesel fuel injection shop to equip his injection pump with the Hypermax Engineering 6.9/7.3L Aneroid.

Injection Pump Cover Removal:

(Note: To avoid a fire, be certain top of engine is cool to the touch if the aneroid is being installed without the injection pump being removed from the engine.)

- 1) Disconnect electrical connections (2).
- 2) Disconnect fuel return line.
- 3) Remove 3 cover screws and remove cover from housing.
- 4) Remove return fuel valve assembly and "O" ring.
- 5) Remove terminal nut/washer assembly (two sets) from the top front of the cover and remove the electric shut-off solenoid from the cover including the small plastic insulating washers.
- 6) Remove the side terminal nuts (one set) and remove the cold advance solenoid. Again, be sure to remove the insulating washers.

Equipping New Cover:

- 1) Install cold advance solenoid and secure with terminal nut/washer assembly. Install nuts and washers the same way they were removed from the old cover. Tighten nuts to 12 inch-lbs. Do not overtighten.
- 2) Install electric shut-off solenoid and install with terminal nut/washer assemblies.
- 3) Grease return valve "O" ring and install valve and fitting into cover. If the return fitting requires realignment hold the return valve assembly with a wrench to avoid stripping the threads in the cover.

- 4) Grease aneroid "O" ring and install aneroid assembly into machined bore of new cover. Install set screw and locate screw into the groove on the aneroid housing. The screw should sit flush in the cover when it is correctly installed in the groove machined for it. Place the aneroid plate into the cover, angled side inboard. Screw the plate onto the shaft until the shaft protrudes about $\frac{1}{4}$ ".
- 5) Install rectangular section seal ring into cover groove.

New Cover Installation:

- 1) Place a clean screwdriver into the pump housing at the left front corner (drive end) and push the governor linkage towards the rear of the pump. While doing this, install the cover fitted with the aneroid making sure the aneroid "plate" is between the throttle shaft and the tab of the governor linkage as illustrated on the installation drawing.
- 2) When you are certain the aneroid plate is between the shaft and linkage tab slide the front of the cover around and onto the injection pump, removing the screwdriver at the last instant. (Note: Be certain the aneroid/cover assembly is in the correct location to avoid an engine runaway upon start-up!!)
- 3) The cover should now be about $\frac{1}{4}$ " forward, and slightly raised in front, of its final placement. Slide cover rearward and downward to allow installation of 3 cover screws. Tighten screws to 40 inch-lbs.
- 4) Reattach return line and electrical connections. (Note: If the return fitting requires realignment, hold return valve assembly with wrench to avoid stripping threads in cover.)

Setting Cut Back Fuel Quantity:

If, per our recommendation, the aneroid is being set up on a fuel injection pump flow bench, charge the aneroid air fitting with 5 PSI air pressure and set the injection pump per Stanadyne factory set-up sheets, but for turbocharged fuel delivery (see Hypermax Engineering Pump Setting Fuel Curves).

After the fuel injection pump is set, remove the 5 PSI air source and set the aneroid cut back fuel delivery to 60cc at 1200 pump RPM. This is done by loosening the aneroid to cover set screw and turning the aneroid assembly counterclockwise (less fuel). Lock the set screw and lock seal it to the cover boss with a dab of silicone sealer.

If the services of an authorized diesel fuel injection shop are not available, the following procedure may be used to set the fuel cut back:

Before starting the engine, remove the air filter assembly to gain access to the turbocharger air inlet. Fold up a heavy towel to use to block the air flow through the turbocharger to the engine should an engine runaway occur as a result of improper aneroid cover installation.

Have a helper start the engine while you are poised over the turbocharge inlet. (Note: Stand to the side, not the front, of the engine to avoid contact with the fan blade.)

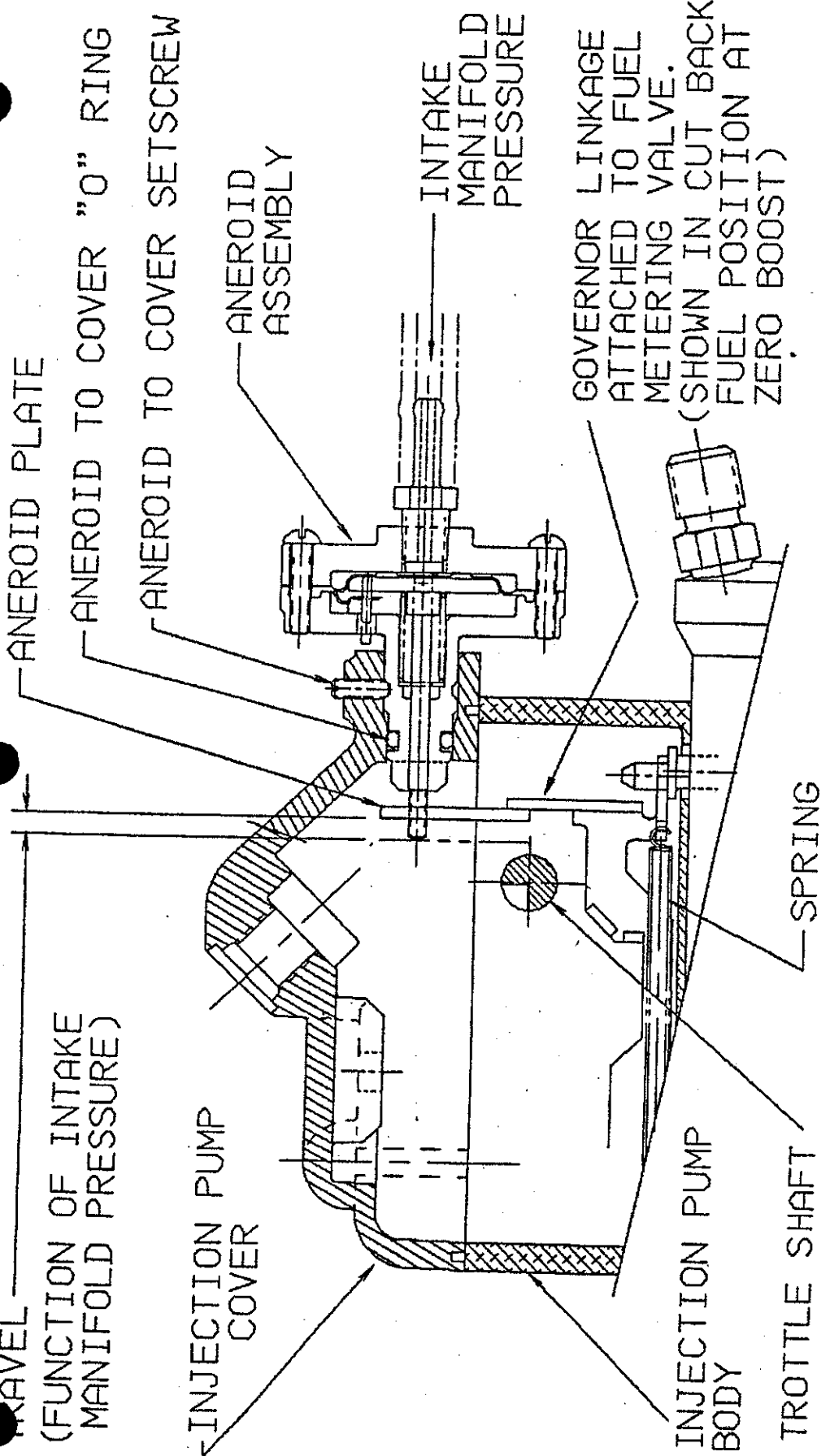
If the engine starts and begins to accelerate without any throttle application, quickly cover the inlet with the towel. This will starve the engine for air and shut it down. Allow the engine to cool and remove the aneroid cover and install it correctly per the instructions.

With the engine idling, check for any fuel leaks. Allow the engine to warm up until the coolant temperature reaches normal. With the engine idling, loosen the aneroid to cover set screw and rotate the aneroid assembly clockwise until the low idle is effected (lowered) then turn the aneroid assembly counterclockwise 4 turns. Lock the set screw and seal it with a dab of silicone sealer.

Final Connections:

- 1) Connect the aneroid air fitting to the intake manifold turbocharger air housing with the push on hose provided. The air fitting on the intake manifold air housing shares a tee fitting with the vehicle's boost pressure gauge line (intake manifold pressure).
- 2) If possible, have the snap idle acceleration smoke opacity checked at a diesel engine repair facility or a California inspection station. Should a minor adjustment be necessary, loosen the aneroid to cover set screw and rotate the aneroid assembly clockwise to reduce the exhaust smoke opacity. The adjustment is extremely sensitive: 1/8 of a turn will lower the opacity 10%. If no change in opacity is noted at 1/4 of a turn, do not attempt further adjustment without professional assistance.

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HYPERMAX ENGINEERING INC.

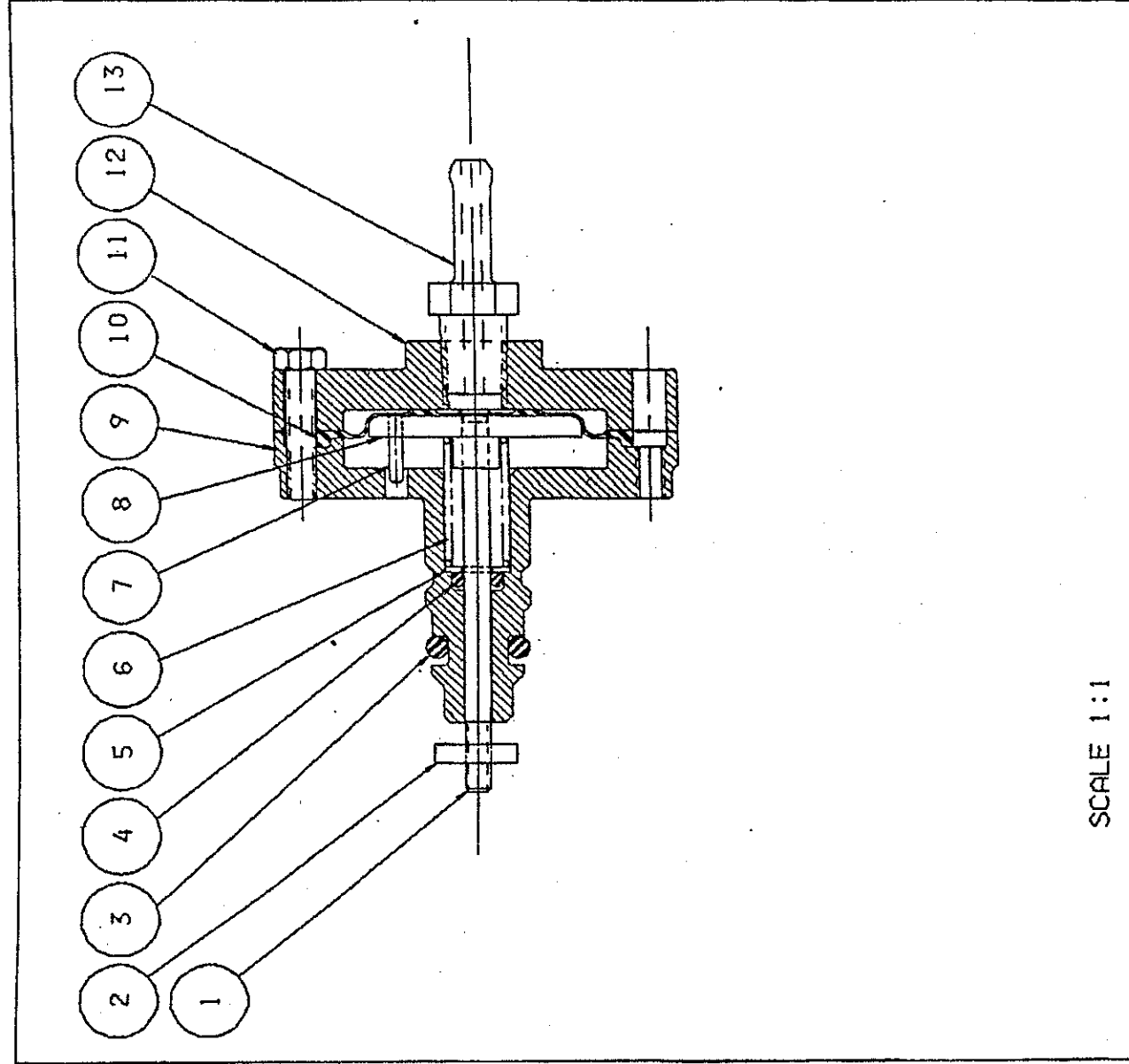
Name: ANEROID INSTALLATION DWG

Material: x

Tolerances: .X=+/- .06 .XX=+/- .030 .XXX=+/- .010

Date: 6-5-92 Scale: 1:1

Part no. HYP-402



- 1 SHAFT DIAPHRAM DISK
- 2 PLATE FUEL CONTROL
- 3 O-RING 3/32
- 4 O-RING 1/16
- 5 WASHER SPRING SEAT
- 6 SPRING
- 7 PIN 1/16 X 5/16
- 8 DISK DIAPHRAM SUPPORT
- 9 HOUSING ANEROID
- 10 DIAPHRAM
- 11 SCREW #6-32 X .62 LONG
- 12 COVER ANEROID
- 13 HOSE BARB, 1/16 NPT

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#006
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HYPERMAX ENGINEERING INC.

Name: ANEROID ASSEMBLY (PH-4)

Material: x

Tolerances: .X+/- .06 .XX+/- .050 .XXX+/- .010

Date: 4-13-92 Scale: 2:1

Part no. HYP-385

SCALE 1:1