A1
SEQUENCE V-D TEST CORRELATION TO FIELD DATA

Deposit and Wear Data Comparison

Oil	Field Data Description	Field Results	Mean	Std. Dev.	V-D Results	Mean	Std. Dev.
903	3 taxicabs each oil, Chrysler 6 cylinder, leaded fuel, 6000 mi. drain interval, total test length 45,000 mi. Note— 903 field data differs from 911 field data at the 95% C. L. by 0.4 Sludge, no difference in Varnish.	Sludge	8.5	0.12	Sludge	9.59	0.09
		Varnish	4.9	0.12	Varnish	7.85	0.28
		PSV	5.6	0.06	PSV	6.89	0.23
		Cyl.		—	Avg.		
		Bore	2.0		Cam	0.5	0.2
		Wear		—	Lobe		
					Wear		
911		Sludge	6.1	1.27	Sludge	9.26	0.18
		Varnish	3.7	0.81	Varnish	5.31	0.34
		PSV	5.9	0.25	PSV	6.74	0.03
		Cyl.		—	Avg.		
		Bore	3.4		Cam	1.5	0.8
		Wear		—	Lobe		
					Wear		
913	4 taxicabs Chevrolet 250 CID 6 cylinder, unleaded fuel, 12,000 mile oil and filter drain interval, test length 57,000 miles. Note— 913 field data differs from 914 field data at the 95% C. L. by 0.3 Sludge, 0.8 Varnish.	Sludge	7.7	0.56	Sludge	9.50	0.12
		Varnish	4.7	0.41	Varnish	6.51	0.31
		PSV	6.1	0.14	PSV	7.37	0.40
		Cam.		—	Avg.		
		Wear	3.0		Cam	0.5	0.2
		Lifter	0.2	—	Lobe		
		Wear			Wear		
914	5 taxicabs	Sludge	8.7	0.37	Sludge	9.63	0.07
		Varnish	6.3	0.63	Varnish	8.00	0.39
		PSV	6.3	0.47	PSV	7.51	0.26
		Cam.		—	Avg.		
		Wear	2.8		Cam	0.5	0.1
		Lifter	0.2	—	Lobe		
		Wear			Wear		

A2
TEST PRECISION DATA
NOVEMBER 1982

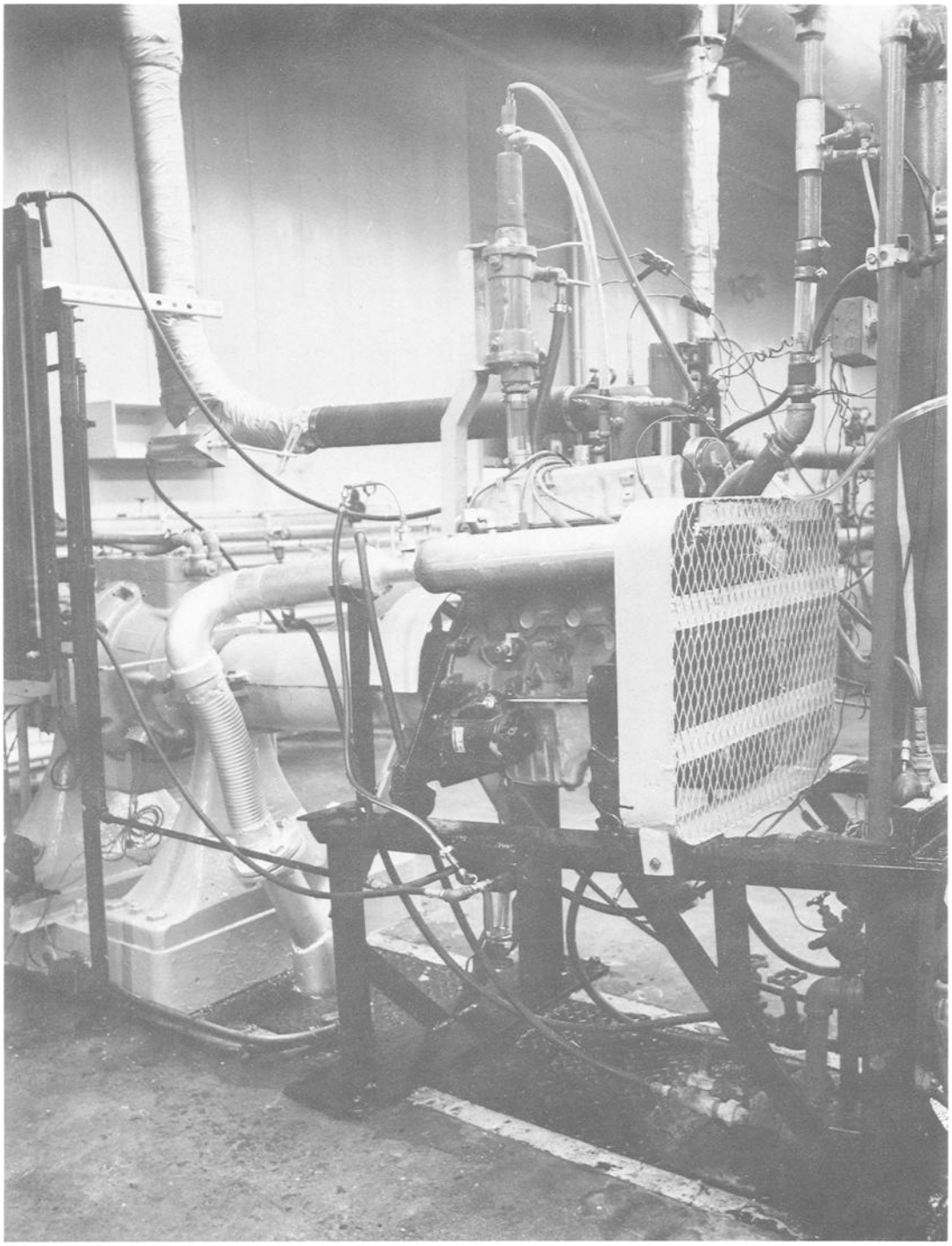
OIL	NUMBER OF TESTS	SLUDGE AVG.	SLUDGE σ	VARNISH AVG.	VARNISH σ	PIST. VARNISH AVG.	PIST. VARNISH σ	MAX. CAM W.* AVG.	MAX. CAM W.* σ	AVG. CAM W.* AVG.	AVG. CAM W.* σ
127-5	14	7.85	1.17	7.98	.52	8.10	.35	10.71	5.80	5.79	1.69
127-6	18	8.23	.74	7.91	.41	8.21	.24	9.20	2.38	5.31	1.48
200-3	105	9.59	.07	6.68	.38	6.93	.34	2.39	2.28	1.13	.71
200-4	13	9.60	.04	6.95	.20	6.87	.27	2.52	2.44	1.01	.62
903	8	9.58	.08	7.85	.24	7.08	.37	.72	.31	.53	.22
903-1	31	9.61	.05	7.28	.35	6.70	.23	.57	.25	.39	.19
911-1	23	9.32	.29	6.13	.57	6.96	.28	3.61	3.68	1.51	1.31
911-2	8	9.45	.05	6.26	.31	7.09	.14	3.46	4.13	1.04	.55
913	33	9.38	.18	7.47	.78	7.79	.42	.98	.75	.61	.36
913-1	45	9.37	.12	6.75	.75	7.63	.42	.56	.24	.39	.13
914	35	9.64	.07	8.20	.36	7.64	.35	.64	.31	.41	.16
915	13	8.03	1.06	6.11	1.20	7.09	.40	6.96	2.87	2.59	1.32
915-1	26	8.60	.56	6.40	1.04	7.32	.40	5.06	3.84	1.94	1.81
916	17	9.61	.08	6.82	.33	6.73	.25	.74	.18	.54	.18
916-1	73	9.61	.06	7.11	.41	6.82	.36	.76	.69	.45	.18
921	39	8.97	.62	8.66	.22	7.73	.22	5.61	3.33	2.56	1.47
923	38	9.55	.08	6.76	.40	7.14	.31	.93	.74	.54	.33
923-1	50	9.56	.05	6.41	.34	6.99	.26	.61	.28	.39	.16

*Expressed in thousandths of an inch according to test convention.

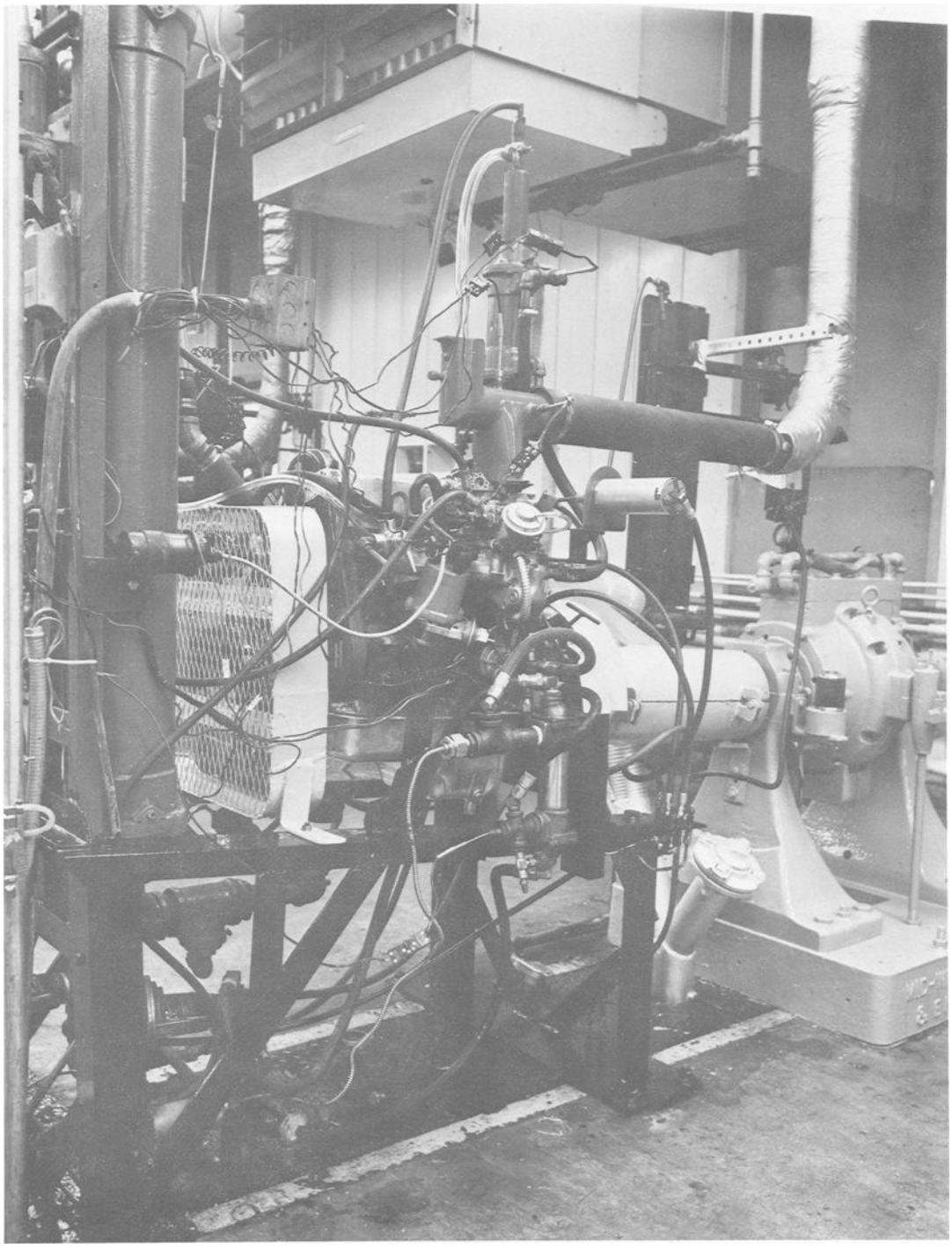
A3. Print Specifications and Photographs of Apparatus —

A3.1 — Typical Test Stand, Left Forward View (photograph)
A3.2 — Typical Test Stand, Right Forward View (photograph)
A3.3 — Carburetor Air Supply System, Air Horn Adapter (photographs)
A3.4 — Carburetor Air Horn Adapter (detail specification)
A3.5 — Exhaust Gas Sample Probe and Flange (detail specification)
A3.6 — Exhaust Gas Analysis System (detail specification)
A3.7 — Typical Engine Cooling System Schematic (detail specification)
A3.8 — Typical Engine Cooling System, Venturi Flowmeter and Inverted U-Tube Manometer (photograph)
A3.9 — Typical Engine Cooling System, Flow Control Valve, Temperature Control Probe, Expansion Tank, Radiator Cap (photograph)
A3.10 — Engine Cooling System, Water Pump, Marine Manifold, Thermostat Housing (photograph)
A3.11 — Engine Cooling System, Intake Manifold Cap, Blowby Heat Exchanger, Fittings and Hoses (photograph)
A3.12 — Engine Cooling System, Thermostat Housing with Thermocouple (photograph)
A3.13 — Oil Cooling System Specifications
A3.14 — Oil Cooling System, Required Heat Exchanger Mounting, Typical Hoses and Fittings (photograph)
A3.15 — Oil Cooling System, Adapter Housing at Engine with Typical Fittings for Thermocouple and Pressure Taps (photograph)
A3.16 — Oil Cooling System, Oil Filter Fitted for Breakin (photograph)
A3.17 — Closed Crankcase Ventilation System, Required Fittings and Parts Configuration (detail specification)
A3.18 — Fabricated Oil Separator for Engine Ventilation System (detail specification)
A3.19 — Engine Ventilation System, Blowby Heat Exchanger and Fittings (photograph)
A3.20 — Engine Ventilation System, Three-way Valve (photograph)
A3.21 — Engine Ventilation System, Blowby Heat Exchanger with Thermocouple Installed (photograph)
A3.22 — Carburetor Modification Details (detail specification)
A3.23 — Carburetor Illustration Holley Model 5200 (exploded view)
A3.24 — Carburetor Mixture Adjustment Screw (detail specification)
A3.25 — EGR Fittings at Marine Manifold (photograph)
A3.26 — Camshaft Baffle Fabrication (detail specification)
A3.27 — Engine Oil Pan with Fabricated Drain Plug (photograph)
A3.28 — Rocker Arm Cover Modification (detail specification)
A3.29 — Rocker Arm Cover and Cam Baffle (photographs)
A3.30 — Pulley and V-Belt Arrangement (photograph)
A3.31 — Typical Idler Pulley, Rear View (photograph)
A3.32 — Crankcase Oil Fill Tube and Cap (photograph)
A3.33 — Typical Adjustable Dipstick (photograph)
A3.34 — Typical Flywheel Timing Index (photograph)
A3.35 — Distributor Modification (detail specification)
A3.36 — Oil Pump Calibration Apparatus (detail specification)
A3.37 — Oil Pump Calibration Apparatus (photographs)
A3.38 — Cam Lobe Flow Rating Apparatus (detail specification)
A3.39 — Typical Cam Lobe Flow Rating Apparatus (photograph)
A3.40 — PCV Valve Flow Test Stand (detail specification)
A3.41 — Typical PCV Valve Flow Apparatus (photograph)
A3.42 — Cylinder Block Pre-Stress Plate (detail specification)
A3.43 — Piston Ring Positioner (detail specification)
A3.44 — Positioning Ladder for Bore Micrometer (detail specification)

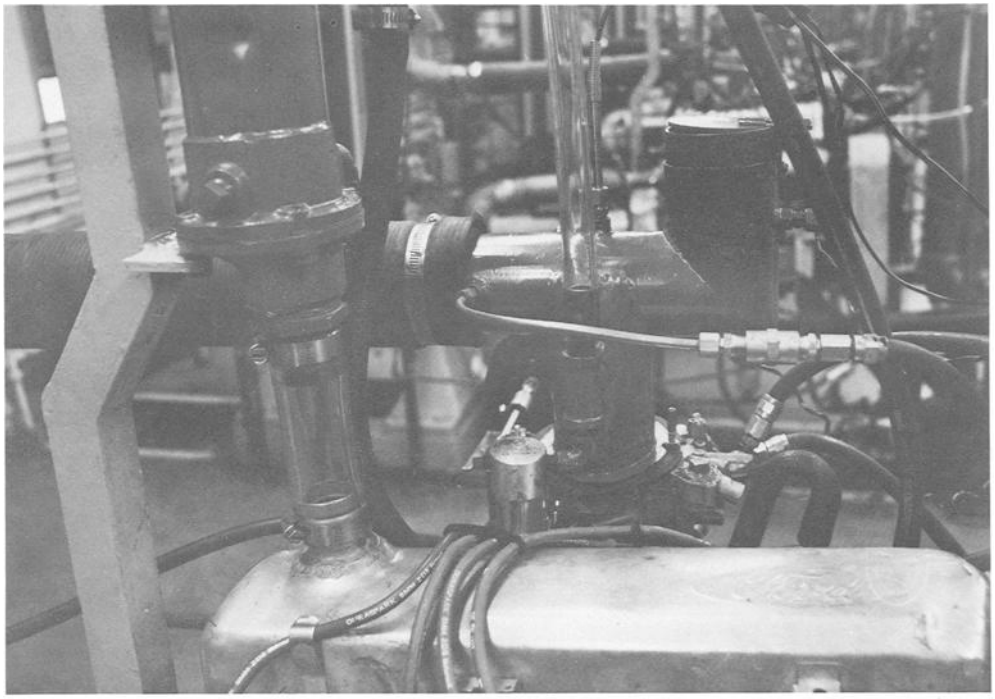
A3.1
TYPICAL TEST STAND
RIGHT FORWARD VIEW

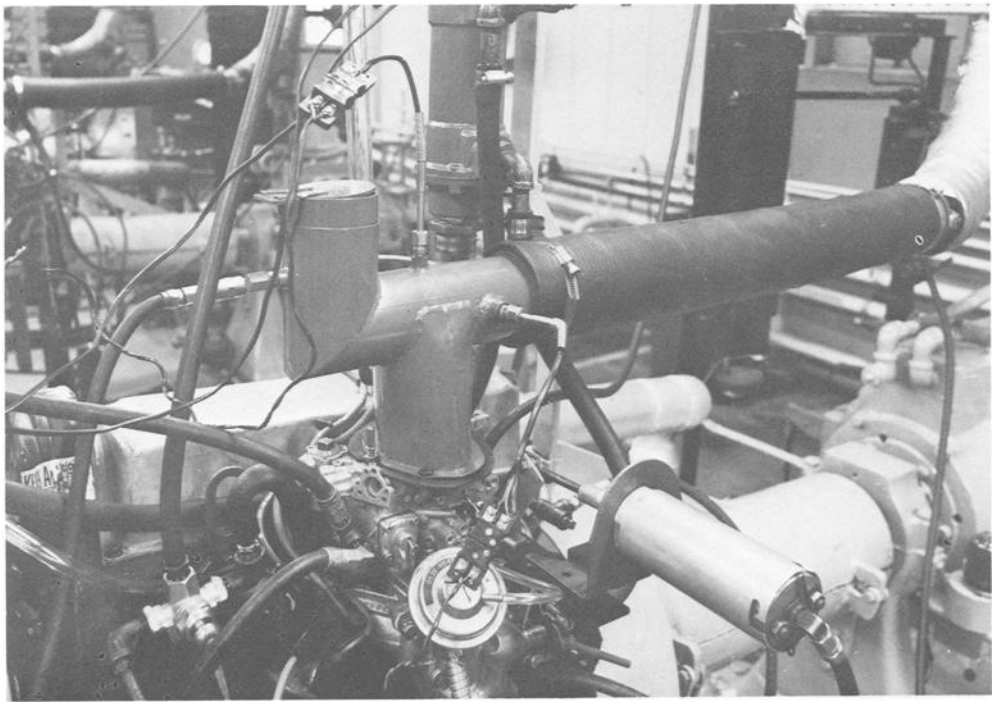


A3.2
TYPICAL TEST STAND
LEFT FORWARD VIEW

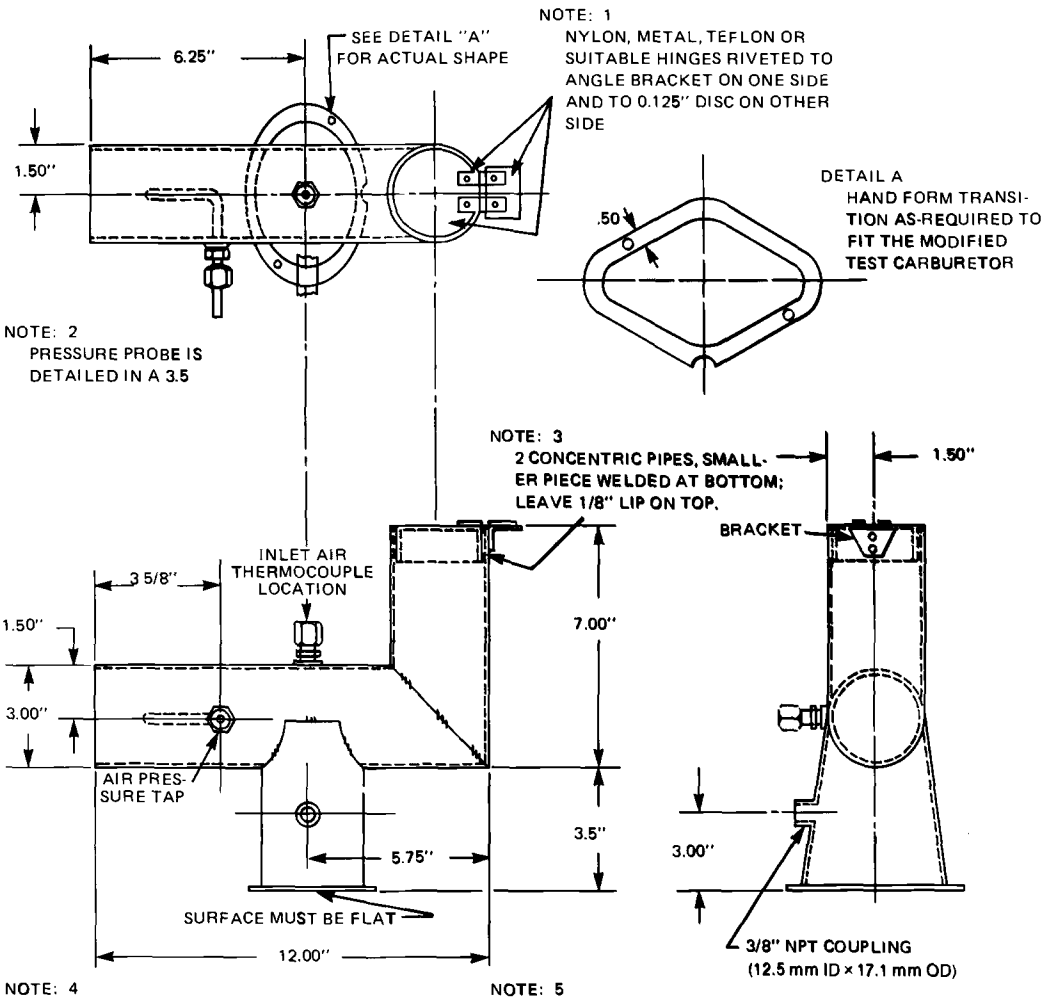


A3.3
CARBURETOR AIR SUPPLY SYSTEM
AIR HORN ADAPTER





A3.4
CARBURETOR AIR HORN ADAPTER



NOTE: 4
ALL DIM'S ± 1/16
NO SHARP EDGES
WELD AS INDICATED

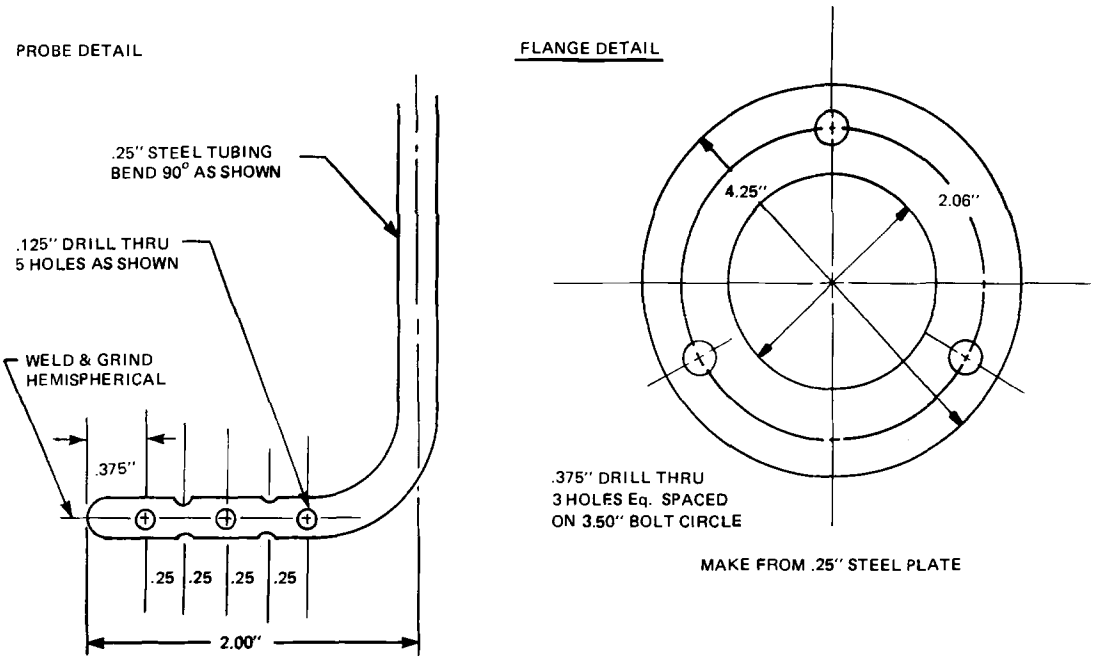
NOTE: 5
READY MADE AIR HORN ADAPTERS ARE AVAILABLE FROM CONCEPT ENGINEERING, INC. P. O. BOX 29265, SAN ANTONIO, TEXAS 78229

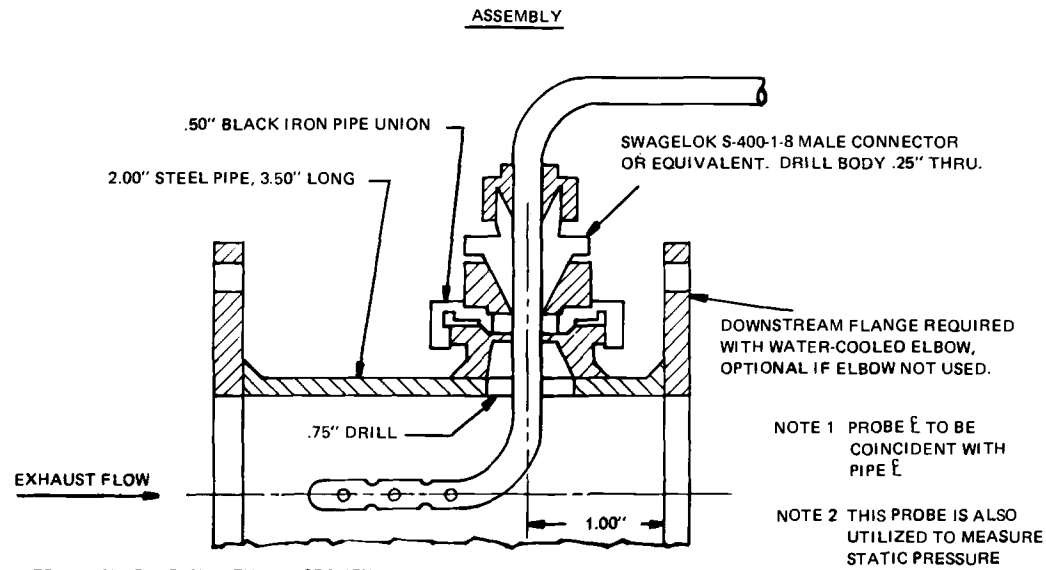
MATERIAL: STAINLESS, MILD, OR ALUMINUM

SI EQUIVALENTS

in	1/16	1/8	0.125	3/8	0.50	1.5	3.0	3.5	3-5/8	5.75	6.25	7.0	12.0
mm	1.6	3.2	3.2	9.5	12.7	38.1	76.2	88.9	92.1	146.0	158.8	177.8	304.8

A3.5
EXHAUST GAS SAMPLE PROBE AND FLANGE



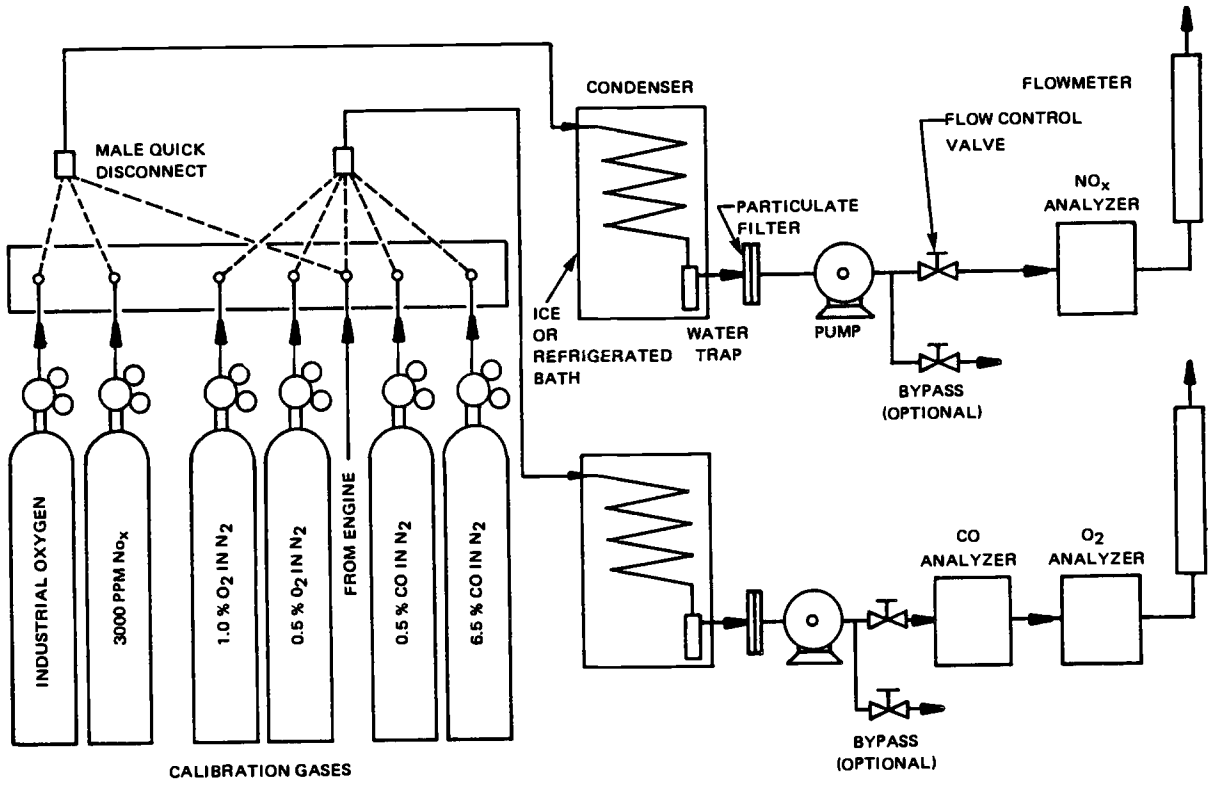


NOTE: BEND EXTERNAL TUBING SEGMENT AFTER ASS'Y. PARALLEL WITH PROBE AXIS AS SHOWN. THIS PERMITS VISUAL ALIGNMENT CHECK DURING OPERATION.

SI EQUIVALENTS

in.	.125	.25	.375	.75	1.00	2.00	2.06	3.50
mm	3.18	6.35	9.52	19.05	25.40	50.80	52.32	88.90

A3.6 Specification for Exhaust Gas Analysis System —



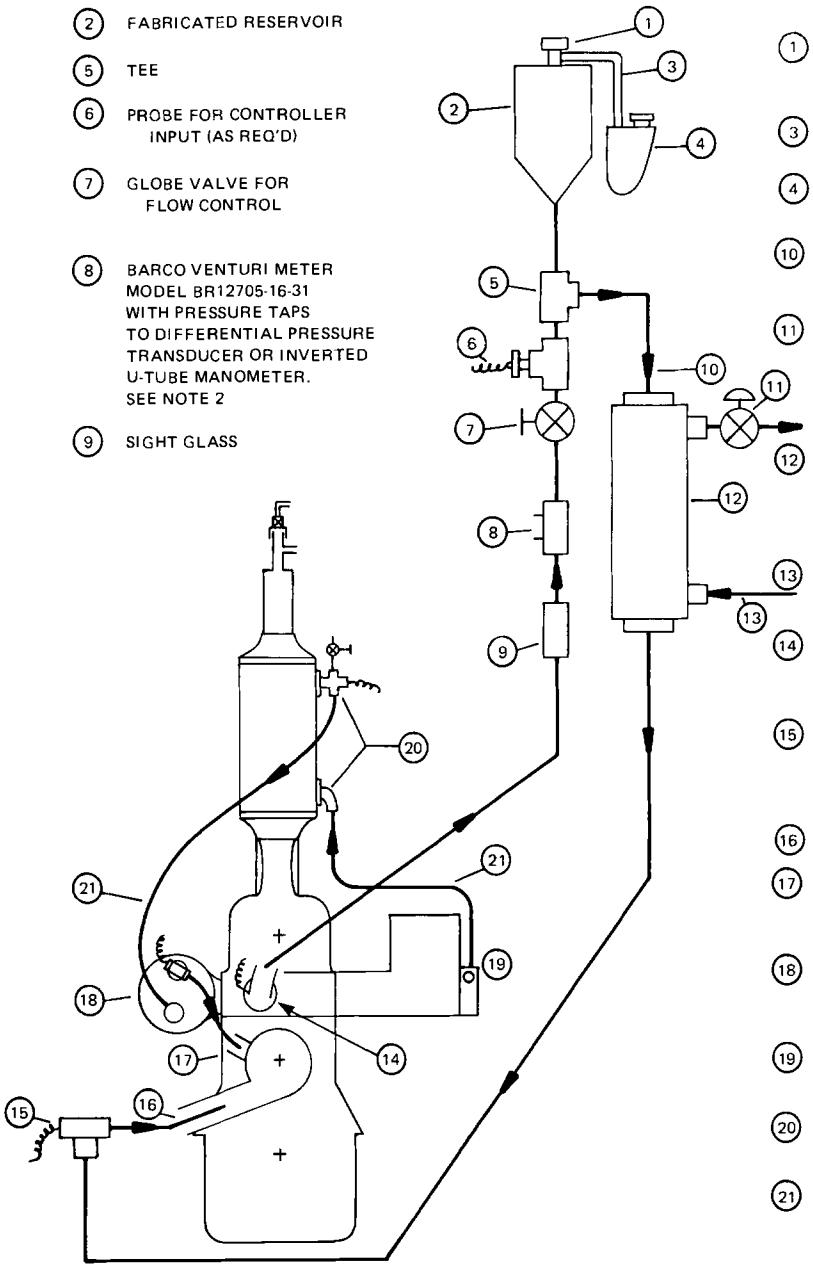
A3.6.2 — The typical system shown utilizes an ice bath condenser with a coil of 1/4 in. (0.64 cm) stainless steel tubing designed to adequately reduce moisture to a dew point of 34°F (1°C). If mechanical refrigeration is employed, the bath temperature should be controlled to 34 ± 2 F (1 ± 1°C). Flow of both exhaust and calibration gases should be identical and within specifications of the instruments. A bypass and a larger pump may be desirable to improve instrument response time when longer sample lines from the engine are needed. An air conditioned chamber for instrumentation is required if ambient temperatures are above the maximum recommended by instrument manufacturers.

A3.6.3 Required Calibration Gases —

Nominal 3000 ppm NOx, balance N_2	Manufactured to ± 5%
Nominal 6.5% CO, balance N_2	Certified to ±2%
Nominal 0.5% CO, balance N_2	
Nominal 1.0% O_2, balance N_2	
Nominal 0.5% O_2, balance N_2	
Optional Gases (for zero standard):	
N_2 for O_2 and CO analyzers	Industrial Grade
O_2 for NOx analyzer	

A3.6.4 — If the optional gases are not used as zero standards (to calibrate the zero readings of the analyzers), then the CO calibration gases may be used to "zero" the O_2 analyzer, the O_2 calibration gases may be used to "zero" the CO analyzer, and bottled air may be used to "zero" the NOx analyzer.

A3.7
TYPICAL ENGINE COOLING SYSTEM SCHEMATIC



(2) FABRICATED RESERVOIR

(5) TEE

(6) PROBE FOR CONTROLLER INPUT (AS REQ'D)

(7) GLOBE VALVE FOR FLOW CONTROL

(8) BARCO VENTURI METER MODEL BR12705-16-31 WITH PRESSURE TAPS TO DIFFERENTIAL PRESSURE TRANSDUCER OR INVERTED U-TUBE MANOMETER. SEE NOTE 2

(9) SIGHT GLASS

(1) RADIATOR CAP (MOTORCRAFT RS-40 P/N D2YY-8100-A)

(3) TRANSFER HOSE

(4) "CONSTANT FULL" RESERVOIR (FORD DOAZ8522A)

(10) ENGINE COOLANT (TUBE SIDE)

(11) PNEUMATIC FLOW CONTROL VALVE (REGULATED BY TEMP CONTROLLER WITH 3 REMOTE SET POINTS)

(12) HEAT EXCHANGER ROSS 803, AMERICAN STD P/N 5-030-06-048-001 } TYPICAL

(13) PROCESS WATER (SHELL SIDE)

(14) THERMOSTAT HOUSING WITH THERMOCOUPLE; SEE A3.12 FOR DETAILS.

(15) TEE WITH THERMOCOUPLE FOR INLET TEMP., LOCATED 12 TO 16 INCHES UPSTREAM OF PUMP INLET.

(16) WATER PUMP INLET

(17) HEATER HOSE FITTING AT PUMP INLET

(18) UPPER AND LOWER 3/8" NPT (12.5 mm ID) FITTINGS IN MARINE MANIFOLD

(19) INTAKE MANIFOLD CAP 3/8" NPT FITTING (12.5 mm ID)

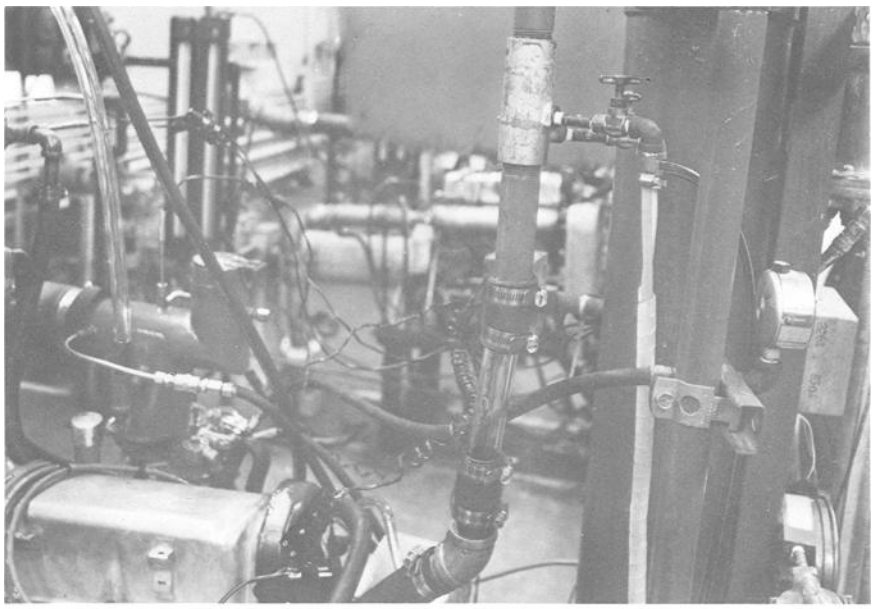
(20) 3/8" NPT FITTINGS IN HEAT EXCHANGER AIR BLEED VALVE. (12.5 mm ID)

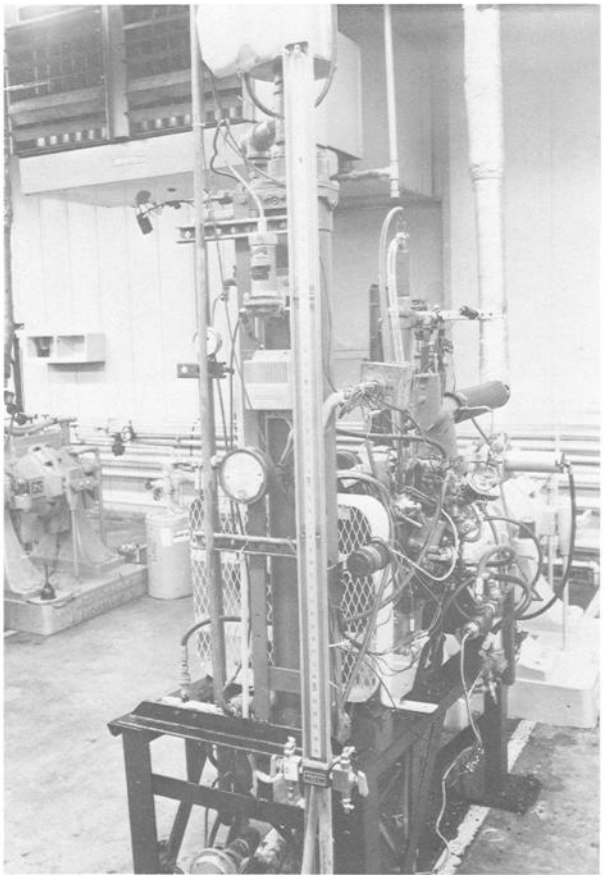
(21) 5/8" (15.9 MM) ID HOSE

NOTE 1 - OBSERVE THERMOCOUPLE LOCATIONS: IN THERMOSTAT HOUSING, AT WATER PUMP INLET, AT MARINE MANIFOLD OUTLET, AND AT BLOWBY HEAT EXCHANGER OUTLET.

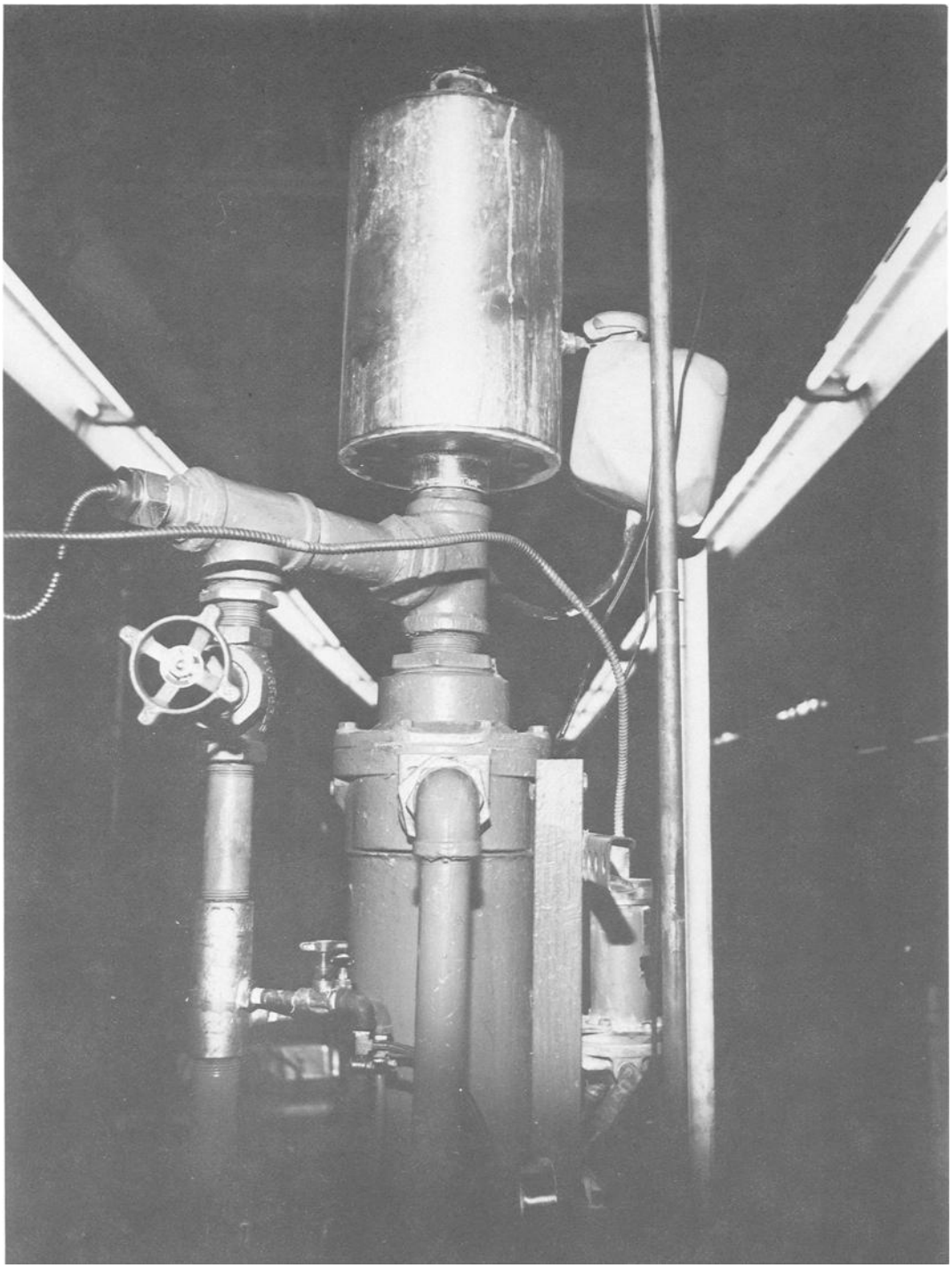
NOTE 2 - AVAILABLE FROM: AEROQUIP CORPORATION
AMB DIVISION/INDUSTRIAL PRODUCTS
300 SOUTHEAST AVE.
JACKSON, MICHIGAN 49203

A3.8
TYPICAL ENGINE COOLING SYSTEM
VENTURI FLOWMETER
INVERTED U-TUBE MANOMETER



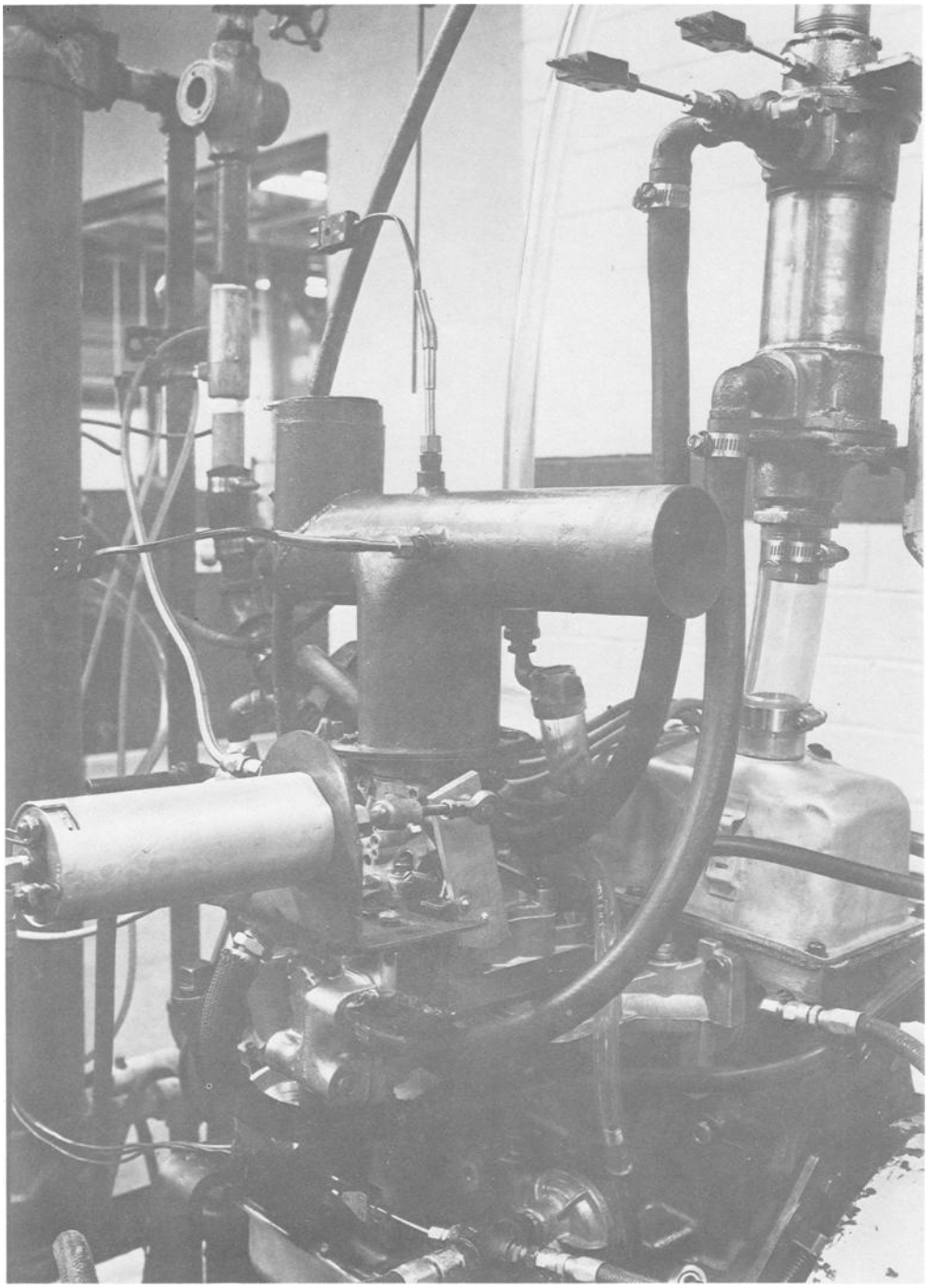


A3.9
TYPICAL ENGINE COOLING SYSTEM
FLOW CONTROL VALVE, TEMPERATURE CONTROL PROBE, EXPANSION TANK, RADIATOR CAP

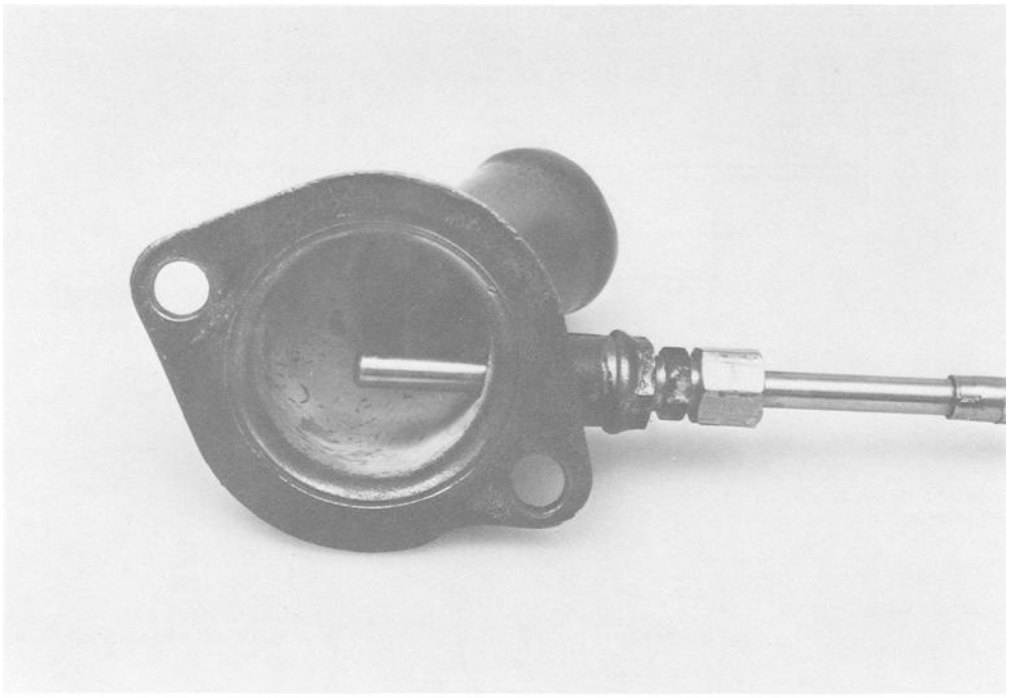


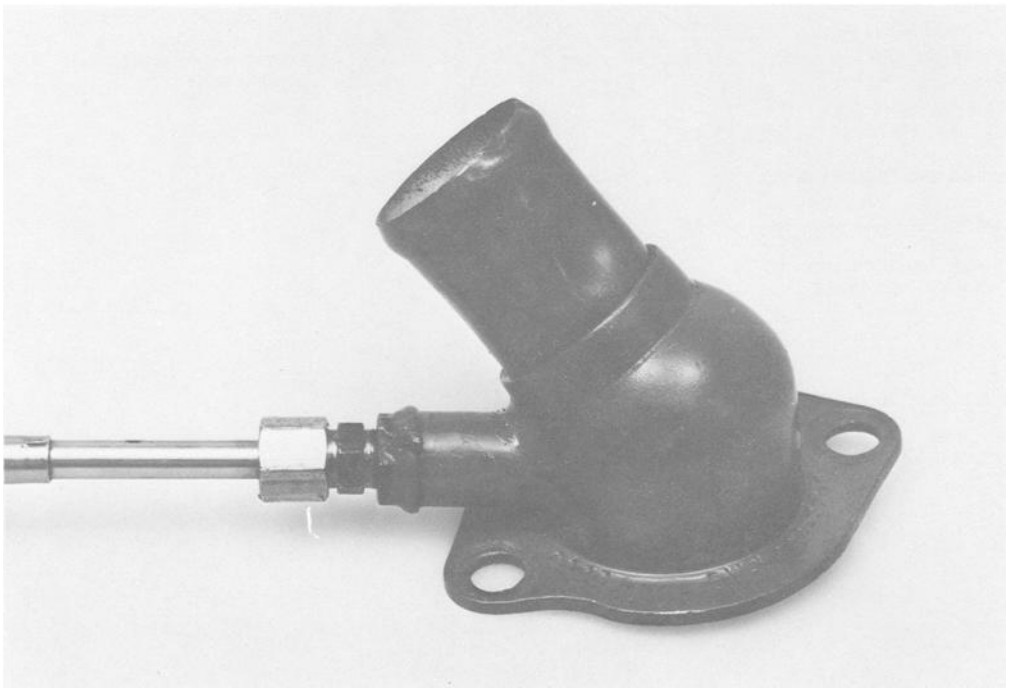
A3.10
ENGINE COOLING SYSTEM, WATER PUMP, MARINE MANIFOLD, THERMOSTAT HOUSING

A3.11
ENGINE COOLING SYSTEM
INTAKE MANIFOLD CAP, BLOWBY HEAT EXCHANGER, FITTINGS AND HOSES

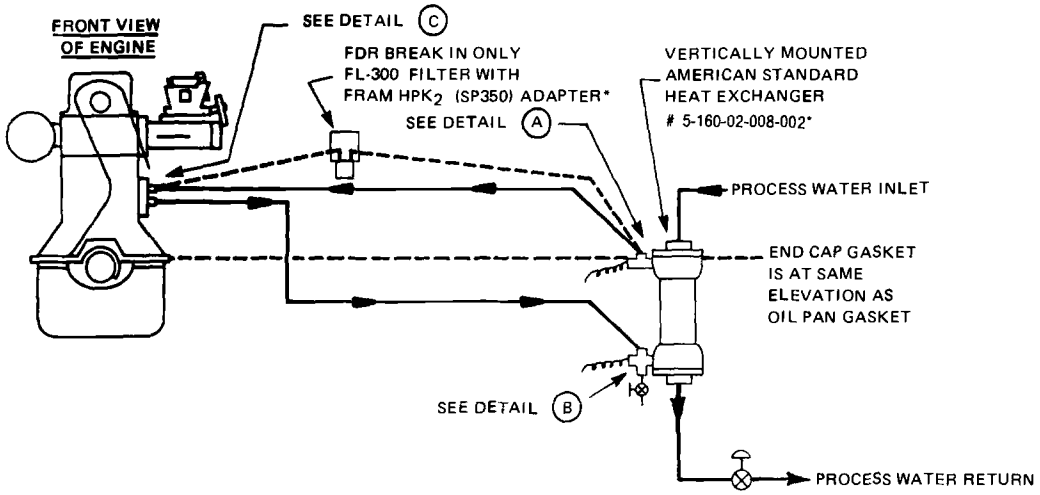


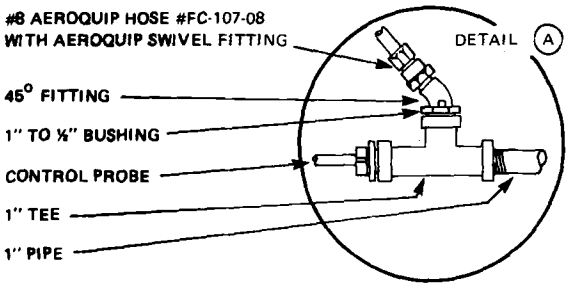
A3.12
ENGINE COOLING SYSTEM
THERMOSTAT HOUSING WITH THERMOCOUPLE

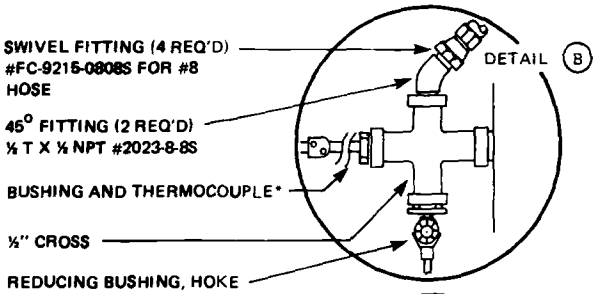


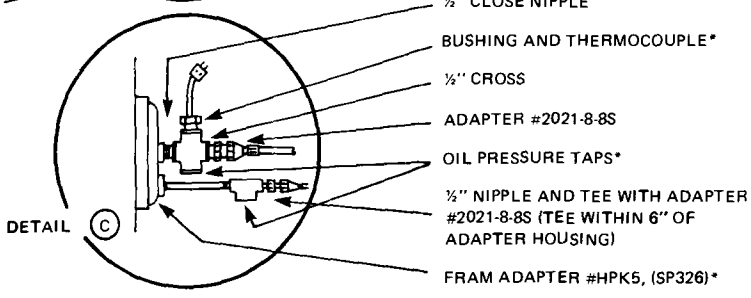


A3.13
OIL COOLING SYSTEM SPECIFICATIONS









SI EQUIVALENTS
½" = 12.7 MM
1" = 25.4 MM
DESIGNATED PIPE

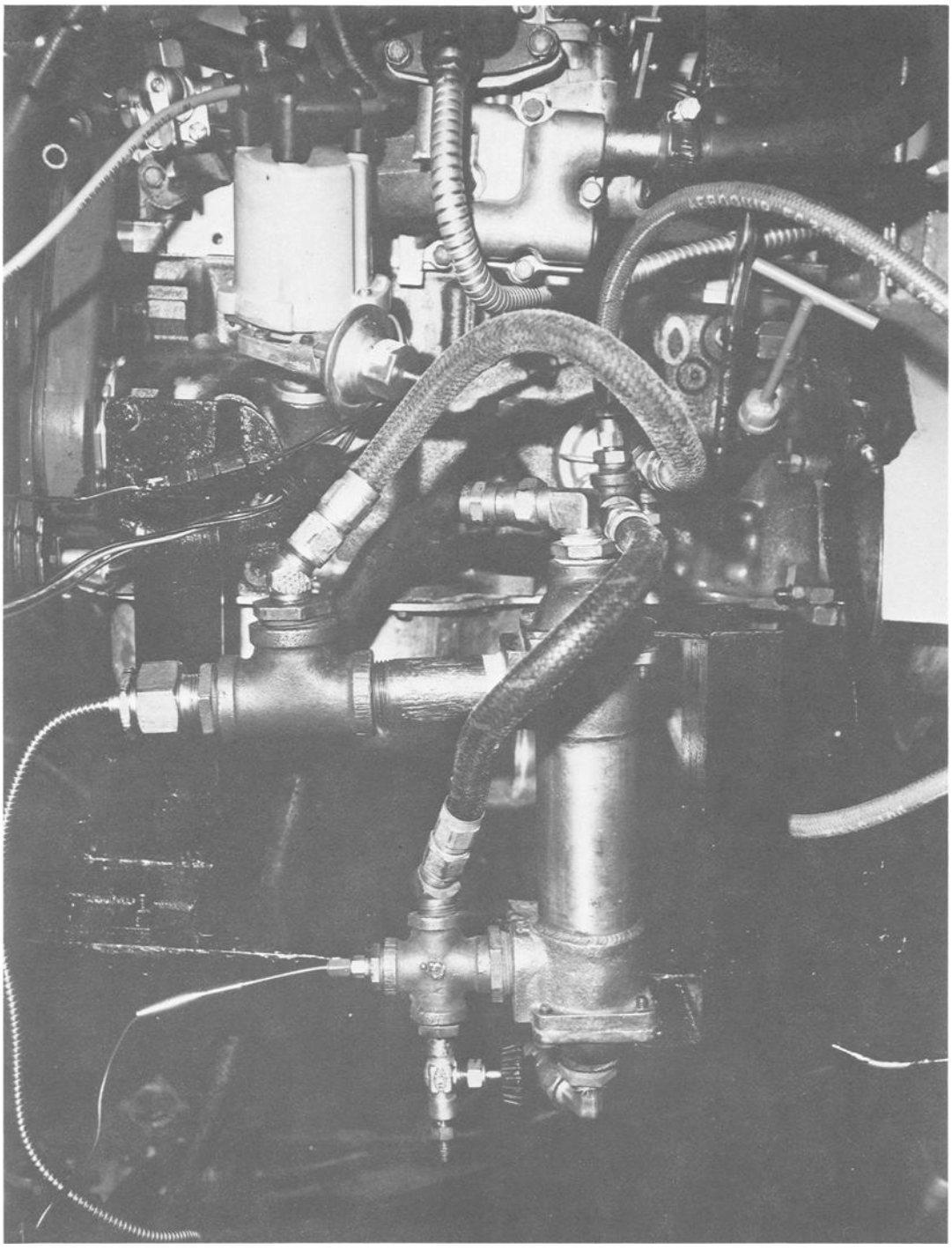
NOTES:

- TOTAL EXTERNAL SYSTEM VOLUME MUST BE 16 ± 2 OZ. (473 ± 59 ML)
- PART NOS. SHOWN ARE AEROQUIP FOR SAE 37° (JIC) FLARE (SEE X 2.1)
- FITTINGS SHOWN IN DETAILS A, B, AND C ARE SUGGESTED ONLY. EXPLICITLY REQUIRED PARTS ARE DESIGNATED*

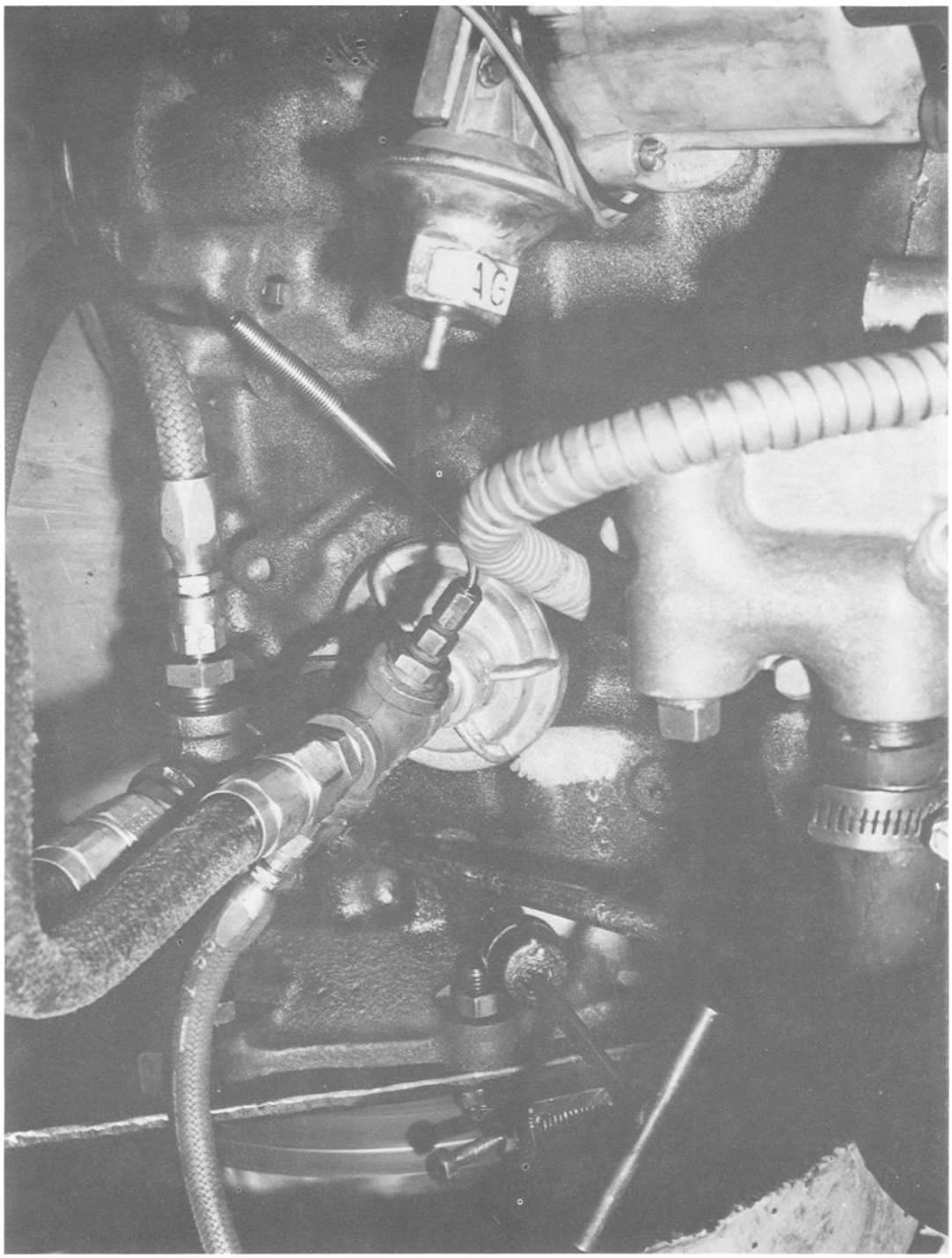
Schedule 40 A.S.A. Pipe Dimensions:

NPT	ID	OD
½"	.62 (15.8 mm)	.84 (21.3 mm)
1"	1.05 (26.6 mm)	1.32 (33.4 mm)

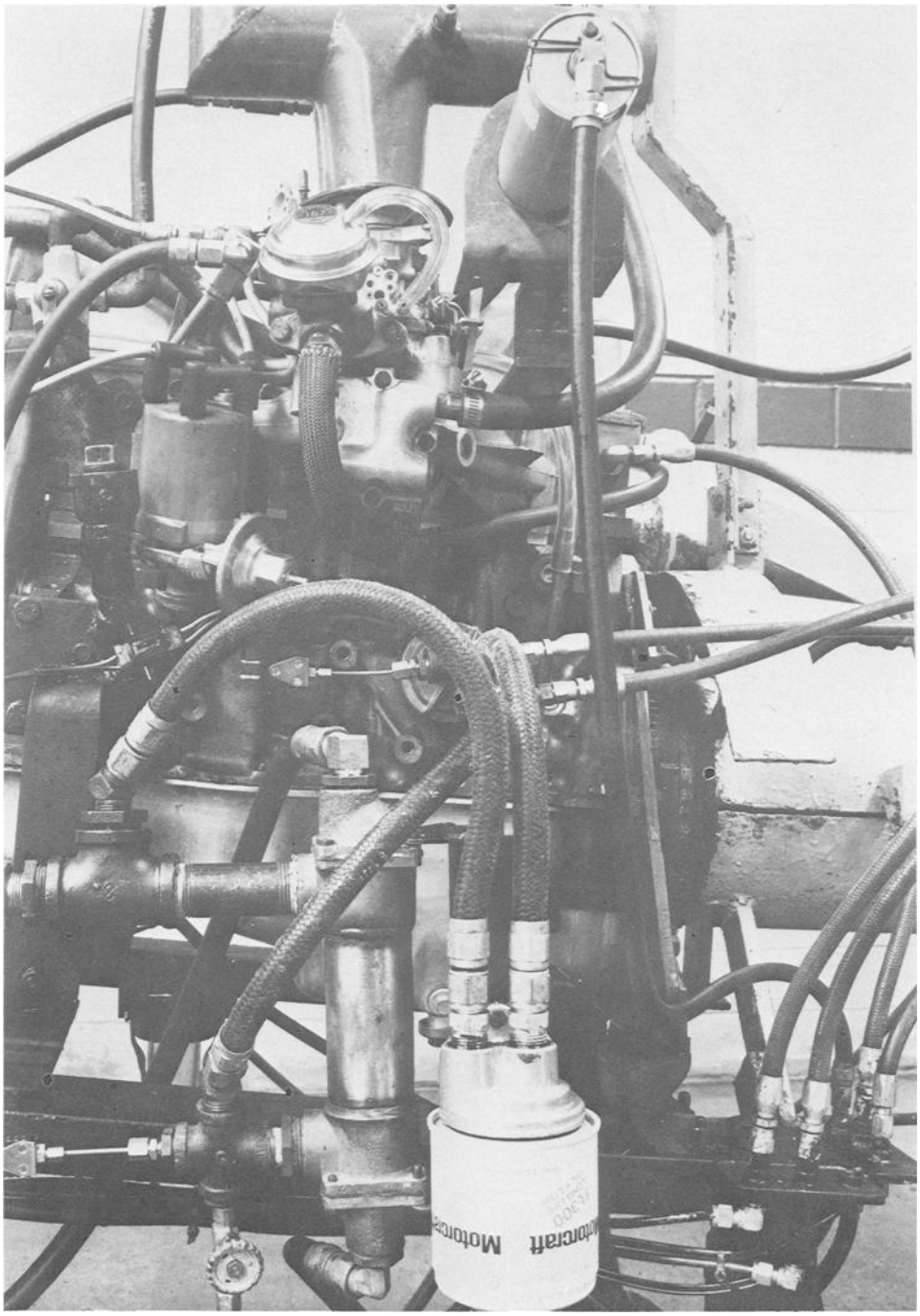
A3.14
OIL COOLING SYSTEM
REQUIRED HEAT EXCHANGER MOUNTING, TYPICAL HOSES AND FITTINGS



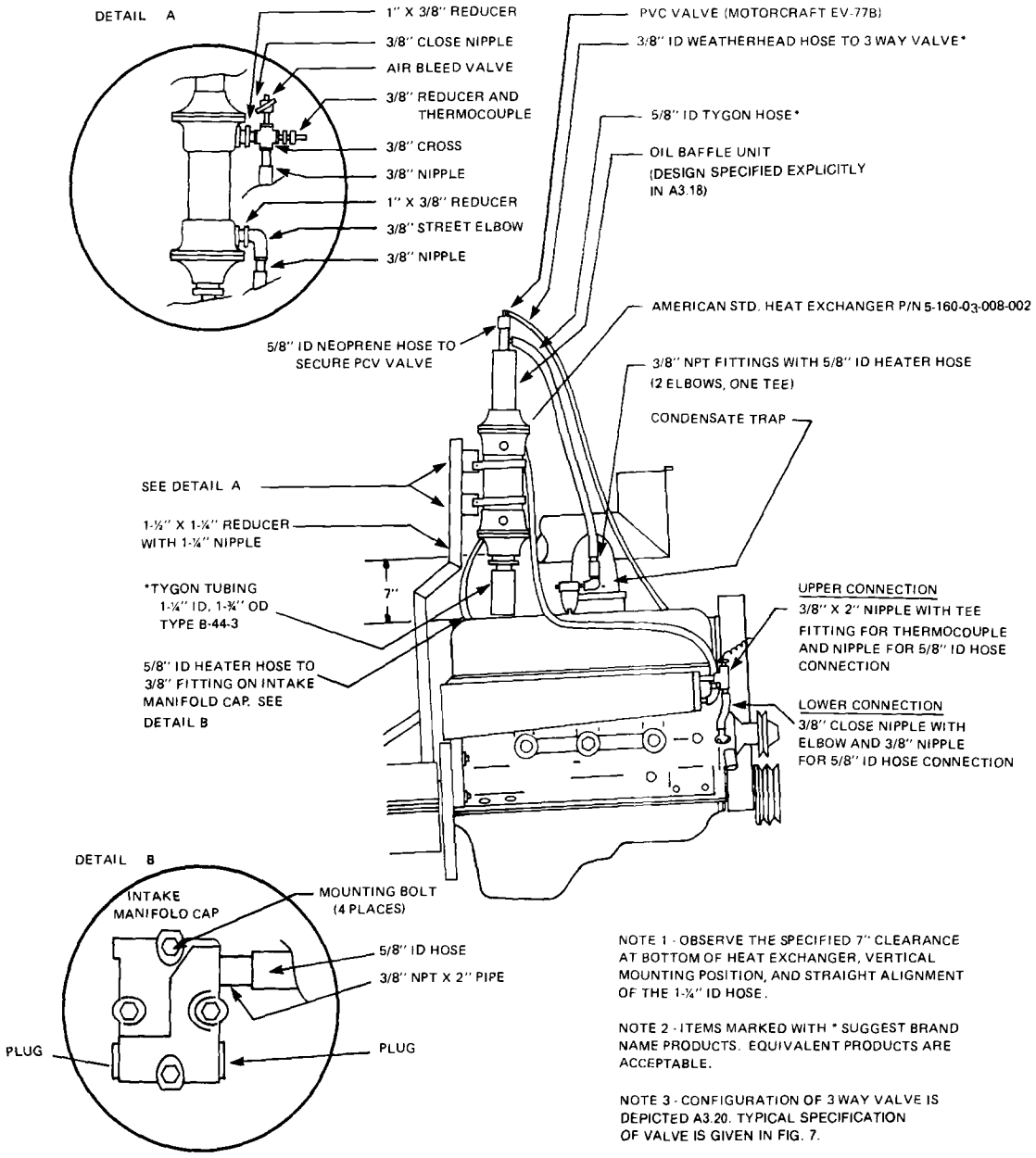
A3.15
OIL COOLING SYSTEM
ADAPTER HOUSING AT ENGINE WITH TYPICAL FITTINGS FOR THERMOCOUPLE AND PRESSURE TAPS



A3.16
OIL COOLING SYSTEM
OIL FILTER FITTED FOR BREAKIN



A3.17
CLOSED CRANKCASE VENTILATION SYSTEM
REQUIRED FITTINGS AND PARTS CONFIGURATION



NOTE 1 - OBSERVE THE SPECIFIED 7" CLEARANCE AT BOTTOM OF HEAT EXCHANGER, VERTICAL MOUNTING POSITION, AND STRAIGHT ALIGNMENT OF THE 1-¼" ID HOSE.

NOTE 2 - ITEMS MARKED WITH * SUGGEST BRAND NAME PRODUCTS. EQUIVALENT PRODUCTS ARE ACCEPTABLE.

NOTE 3 - CONFIGURATION OF 3 WAY VALVE IS DEPICTED A3.20. TYPICAL SPECIFICATION OF VALVE IS GIVEN IN FIG. 7.

SI EQUIVALENTS

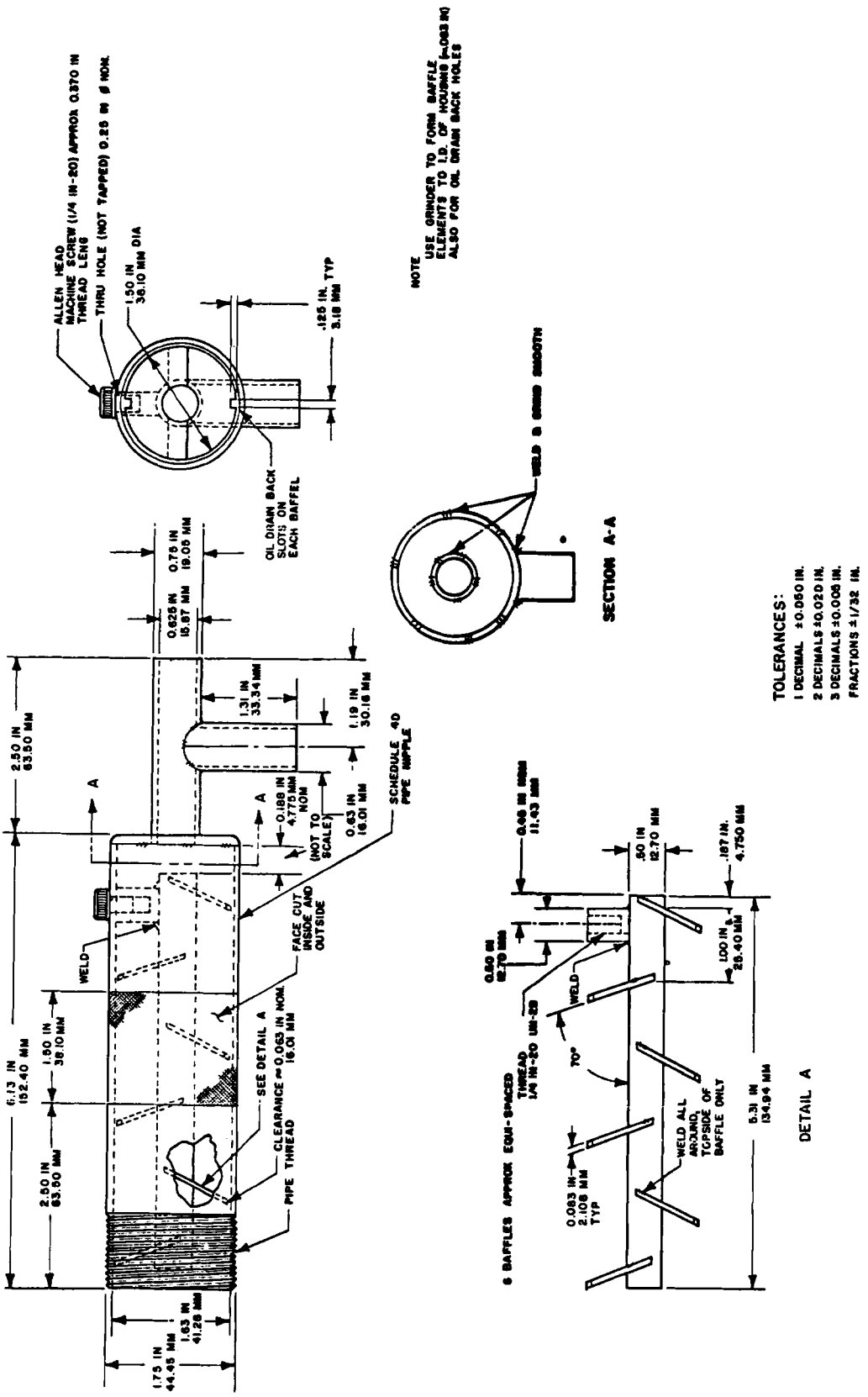
INCHES	3/8	5/8	1	1-⅛	1-½	1-¾	2	7
MILLIMETERS	9.5	15.9	24.5	31.8	38.1	44.4	50.8	177.8

Schedule 40 A.S.A. Pipe Dimensions

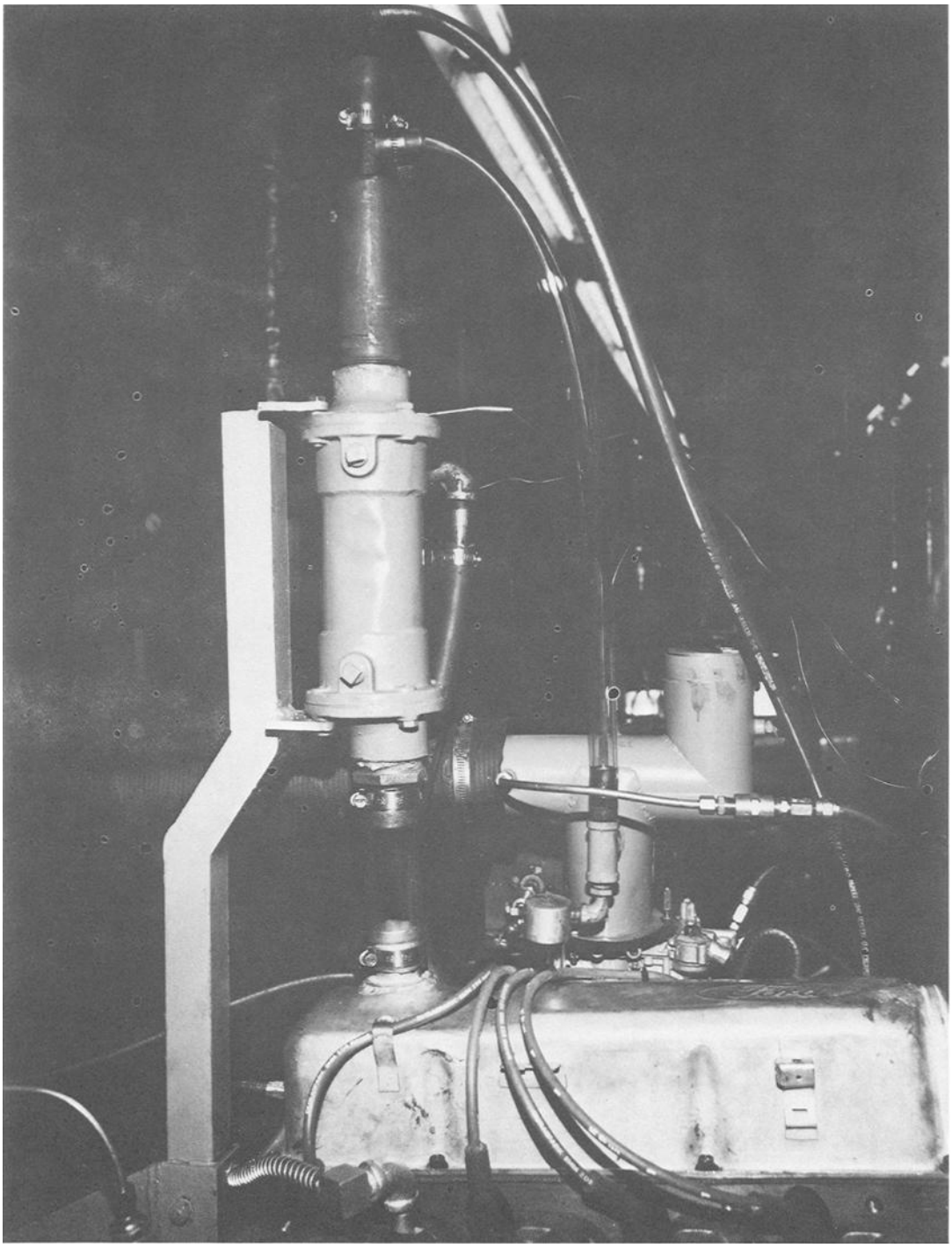
	OD		OD	
NPT nominal	in	mm	in	mm
⅜"	.675	17.14	.493	12.52
1"	1.315	33.40	1.050	22.64
1¼"	1.660	42.16	1.380	35.05
1½"	1.900	48.26	1.610	40.89

A3.18

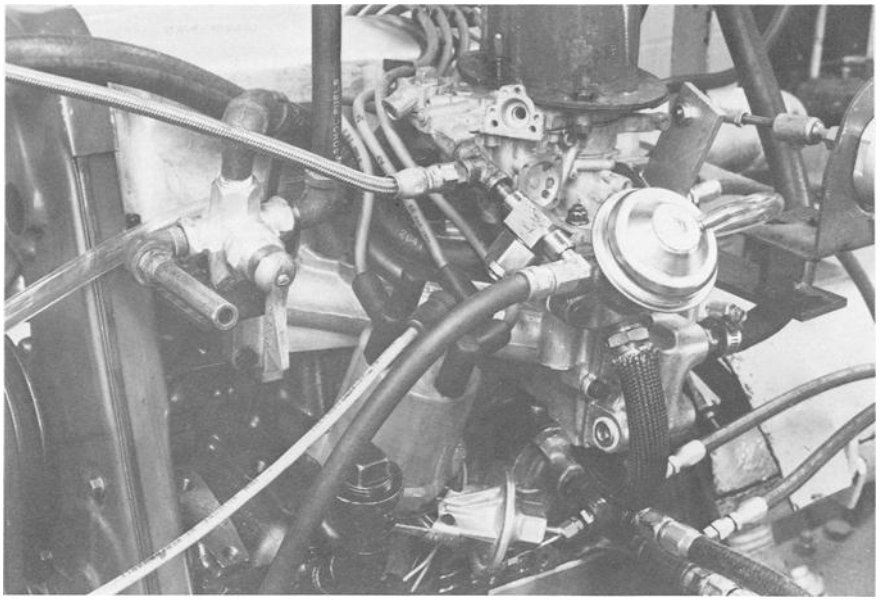
FABRICATED OIL SEPARATOR FOR ENGINE VENTILATION SYSTEM



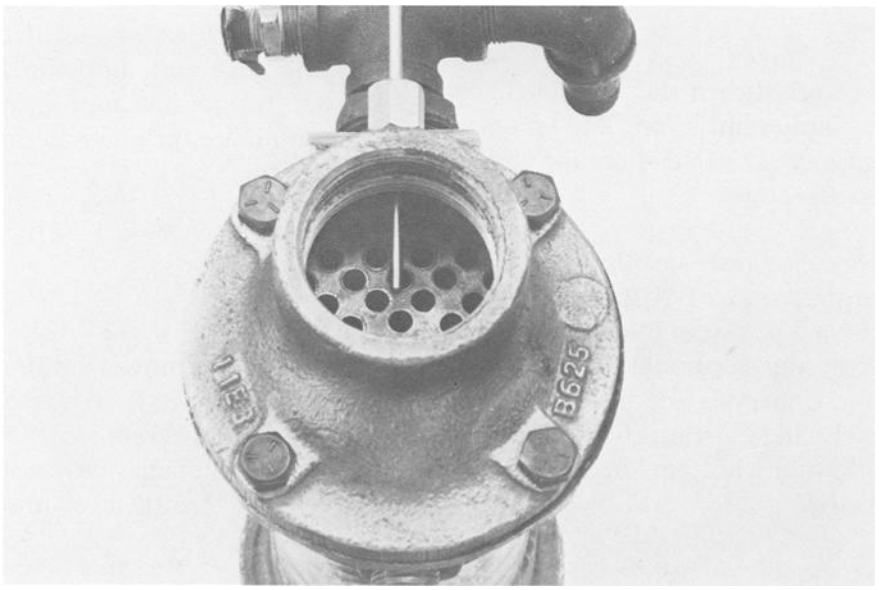
A3.19
ENGINE VENTILATION SYSTEM
BLOWBY HEAT EXCHANGER AND FITTINGS



A3.20
ENGINE VENTILATION SYSTEM
THREE-WAY VALVE



A3.21
ENGINE VENTILATION SYSTEM
BLOWBY HEAT EXCHANGER WITH THERMOCOUPLE INSTALLED



A3.22 Carburetor Modification Details

(THE HOLLEY 6500 FEEDBACK; FORD P/N EOZE-SB, MOTORCRAFT P/N CA-2353, NUMBER ON CARBURETOR BODY R-9218.)

Note: Essentially, the modifications provide for (1) external adjustment of the main metering system, (2) elimination of secondary metering, accelerating pump and choke functions, and (3) the necessary adaptation of the inlet air horn. Attention to detail is essential in order to achieve acceptable fuel distribution.

A3.22.1 — Remove the entire choke assembly including choke plates. Plug all holes left from linkages.

A3.22.2 — Remove the bowl vent solenoid assembly, and the bowl vent diaphragm and activator assembly tap and plug the bowl vent hole with a 3/8" (9.5 mm) pipe plug.

A3.22.3 — Tap and plug the choke vacuum passage in the main body with a #6-32 set screw. (Main body, left side).

A3.22.4 — Tap and plug the vacuum passage located to the left of the choke vacuum passage. On the underside of the main body plug the vacuum passage to the choke and the vacuum passage to the bowl vent solenoid with #6-32 set screws.

A3.22.5 — Remove and discard the enrichment valve plunger and diaphragm. Tap and plug vacuum passage to enrichment valve operating rod with 1/4-20 Allen Head set screw.

A3.22.6 — Cut away the bowl vent (in front of air horn) to allow installation of carburetor air horn adapter. Do not cut away vent housing above the air bleed. After cutaway is complete, install a thin brass plate to the underside of the cutaway vent. Attach the plate using existing rivets in the area. Drill a 1/32" (0.79 mm) hole in the plate to serve as a bowl vent orifice.

A3.22.7 — Remove the idle mixture adjustment screw plug. After removing the screw and spring cut the housing flush to match front surface of carburetor. This will allow adjustment of the idle mixture.

A3.22.8 — Remove the plug and set screw from the access hole to the enrichment valve. (Top middle of air horn).

A3.22.9 — Drill and tap the enrichment valve access passage for a 5/16-24 SAE bolt approximately 1/2 in. long. Drill and tap a #8-32 thread through the center of the bolt.

A3.22.10 — Fabricate a high-speed fuel mixture screw with a #8-32 thread and tapered end as shown on enclosed diagram. Install the mixture screw with a typical spring as shown.

A3.22.11 — Drill the enrichment valve housing to allow adjusting screw to pass through it. Reinstall the enrichment valve housing as it serves as a shield for the mixture adjusting screw.

A3.22.12 — Modify the power valve by removing the inner pin and spring. Tap and plug each side of the upper hole with a #6-32 set screw [3/16 in. long (4.8 mm)]. Do not change the diameter of the through passage or upper hole.

A3.22.13 — Plug the secondary high speed orifice and the secondary jet. Do this by drilling and tapping them both and plugging them with 4/40 set screws. Install the appropriate primary high speed bleed orifice, primary jet and main well tube as follows:

H.S. Bleed Orifice	Metering Jet	Main Well Tube
175	203	93

A3.22.14 — Remove the throttle positioner assembly, and reinstall the secondary operating return spring. To prevent operation of the secondary throttle plate remove actuating finger and stop on primary throttle mechanism.

A3.22.15 — Remove accelerator pump diaphragm, cover and spring. Plug off the ac-

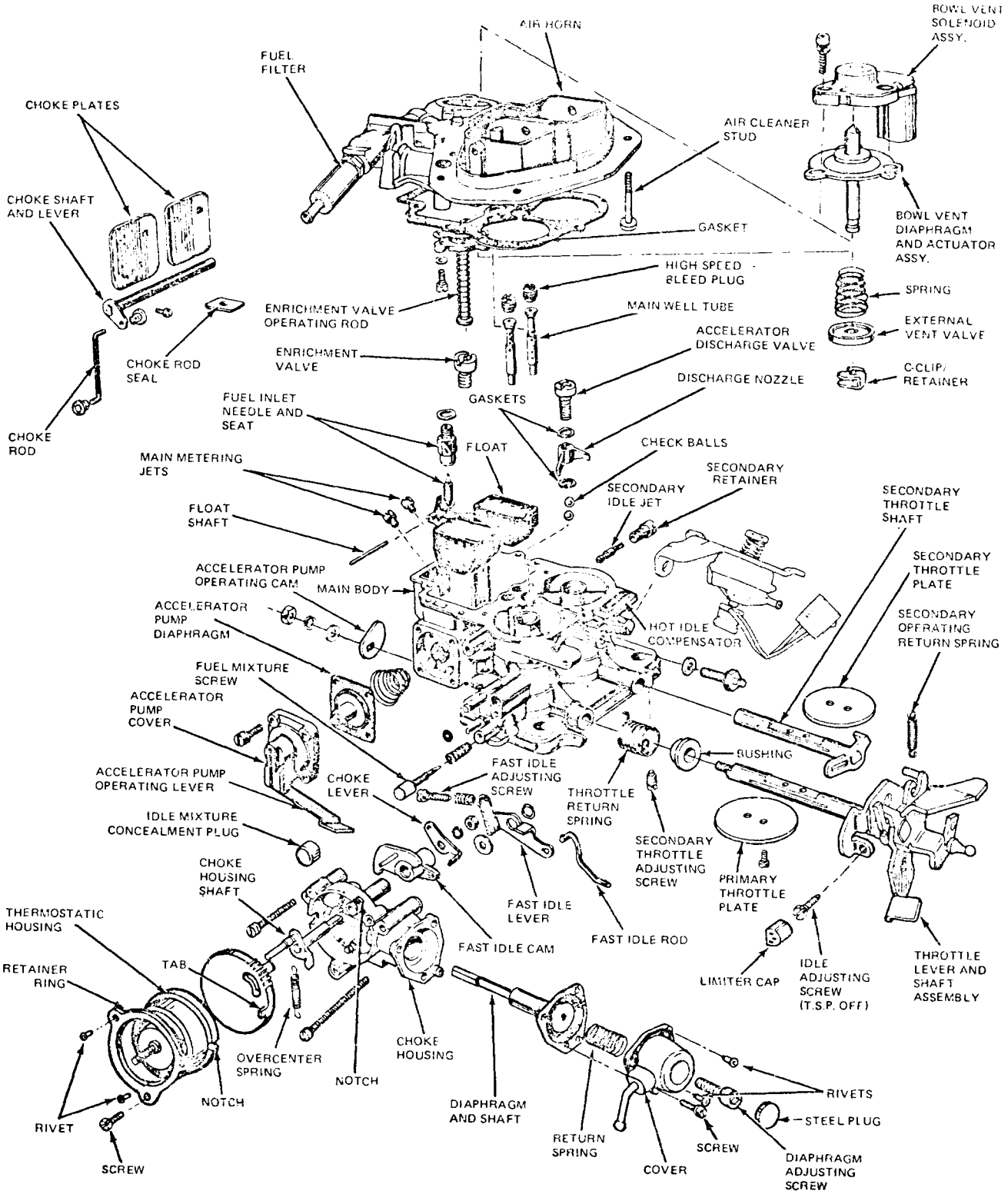
celerator pump fuel passage with a #6-32 set screw. Plug the passage from the bowl to the pump with lead shot. Remove the accelerator discharge valve, nozzle and check balls. Tap to #¼-20 and install one check ball and #¼-20 Allen Head set screw. This allows quick disassembly, cleaning and reassembly.

A3.22.16 — Install mixture adjustment screw assembly, float and needle assembly, and adjust using following specifications:

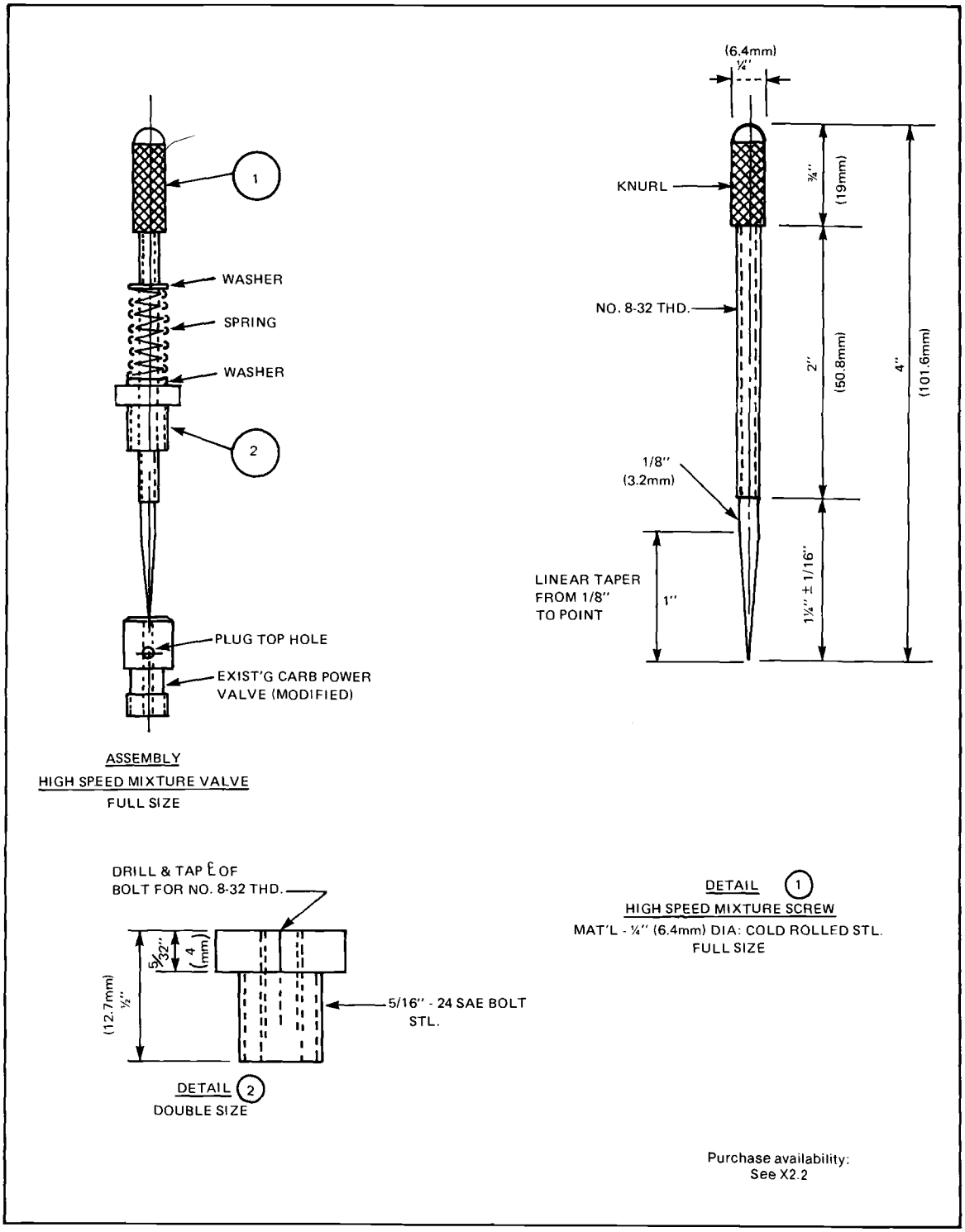
- Dry float level (to inverted) 9/16 inch.
- Float drop 1 inch (float should not touch bottom of carburetor bowl).
- Idle mixture adjustment screw backed off 2 turns from stop (initial approximate setting).
- Main metering adjustment screw backed off 2 turns from stop (initial approximate setting).

After reassembly of carburetor modification is complete.

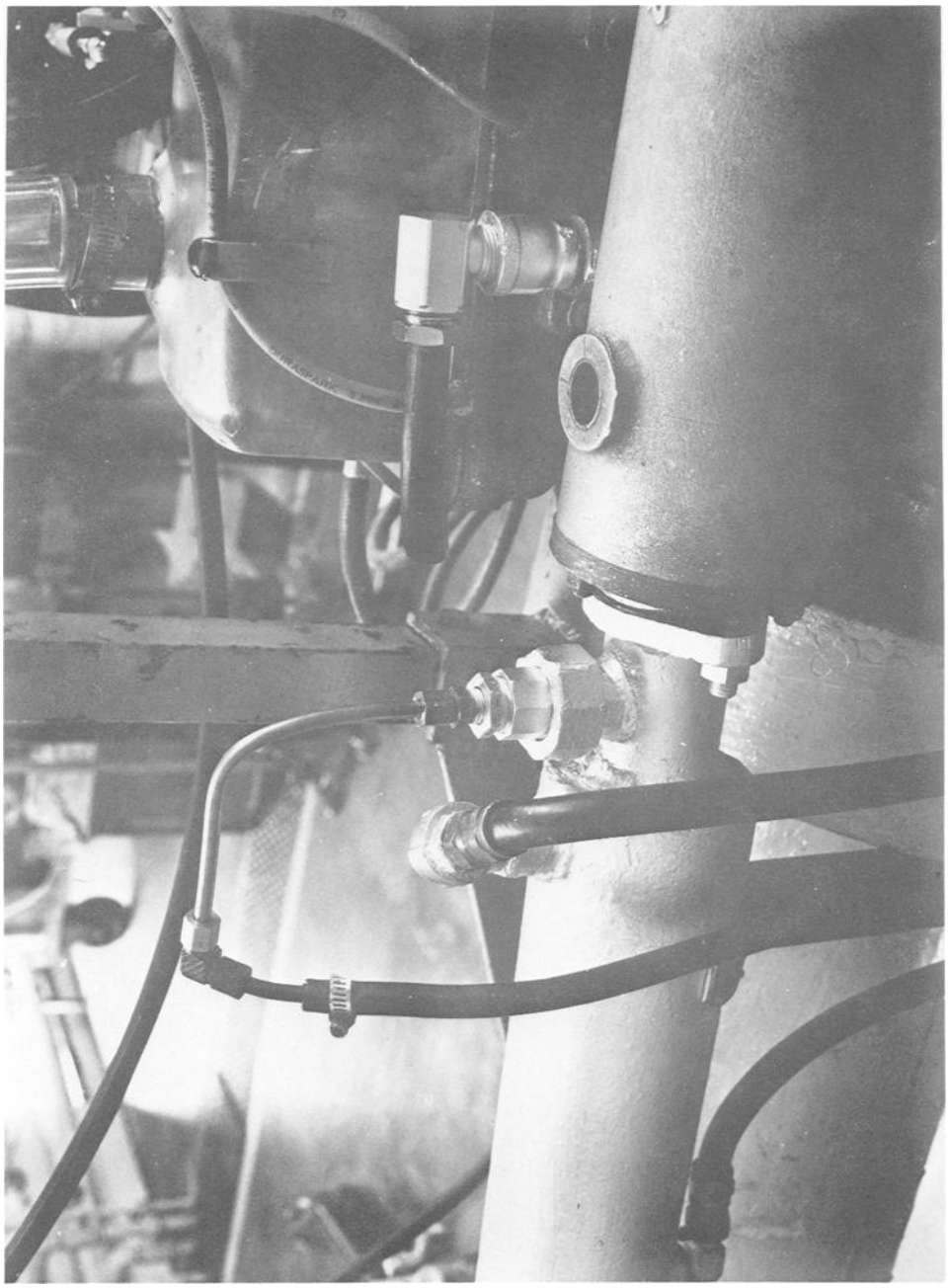
A3.23
CARBURETOR ILLUSTRATION HOLLEY MODEL 5200



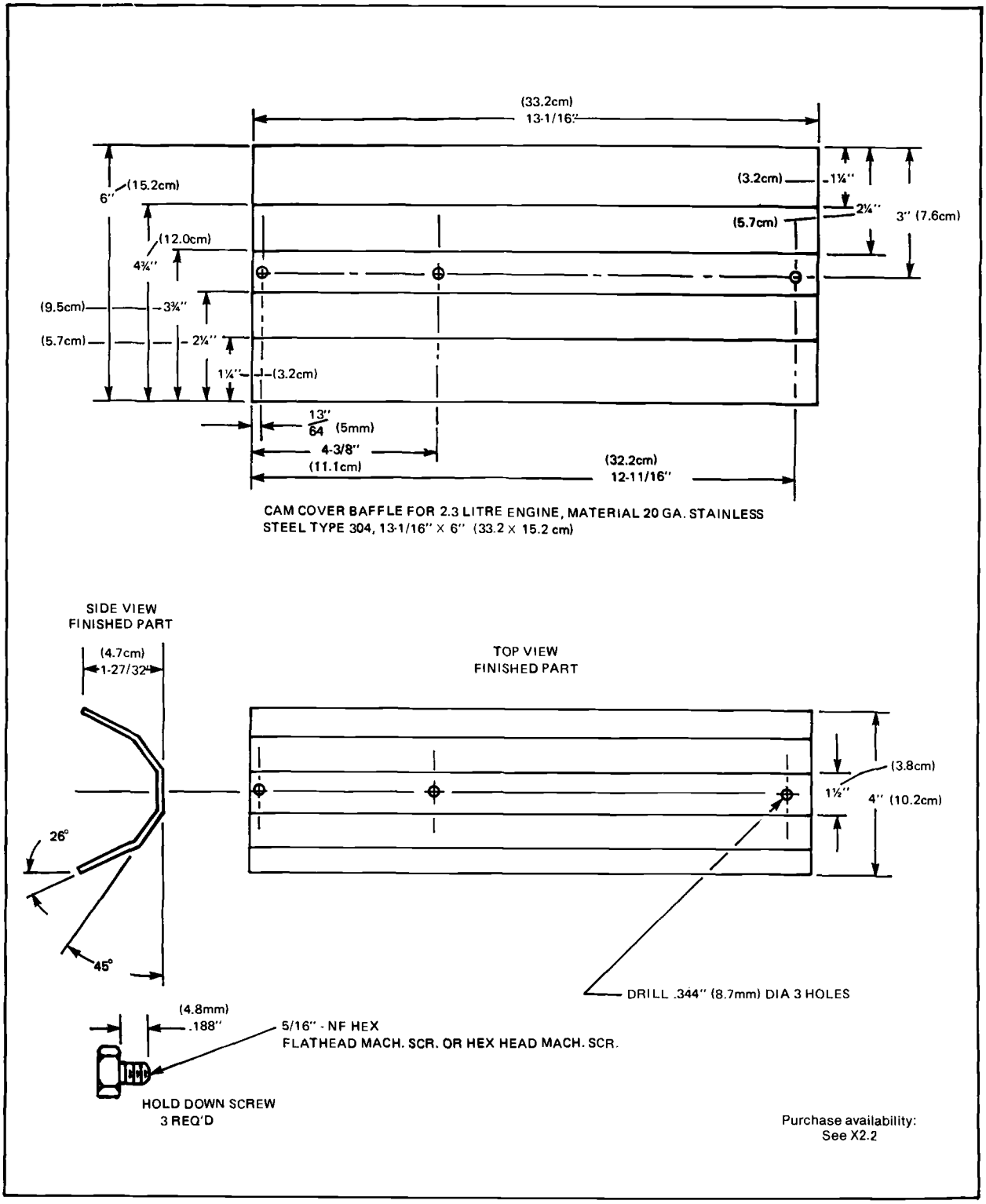
A3.24
CARBURETOR MIXTURE ADJUSTMENT SCREW



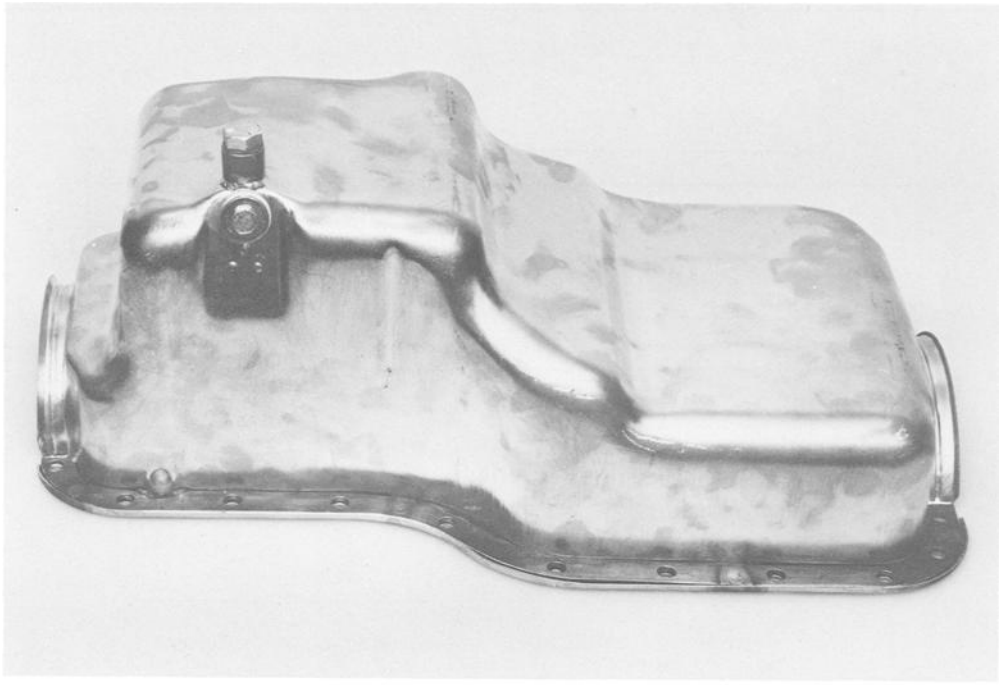
A3.25
EGR FITTINGS AT MARINE MANIFOLD

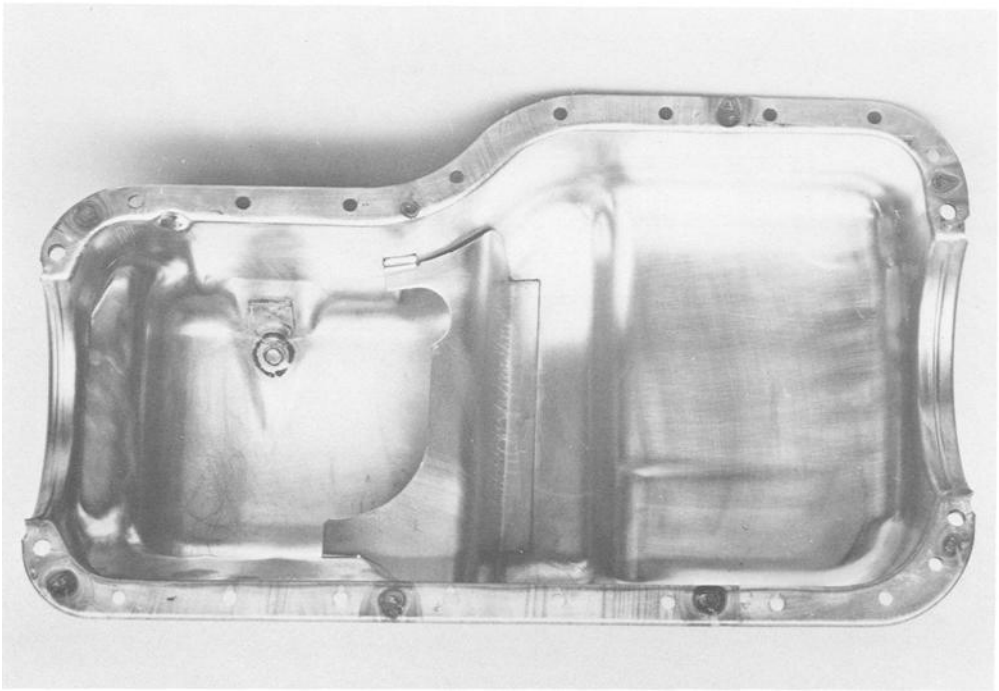


A3.26
CAMSHAFT BAFFLE FABRICATION

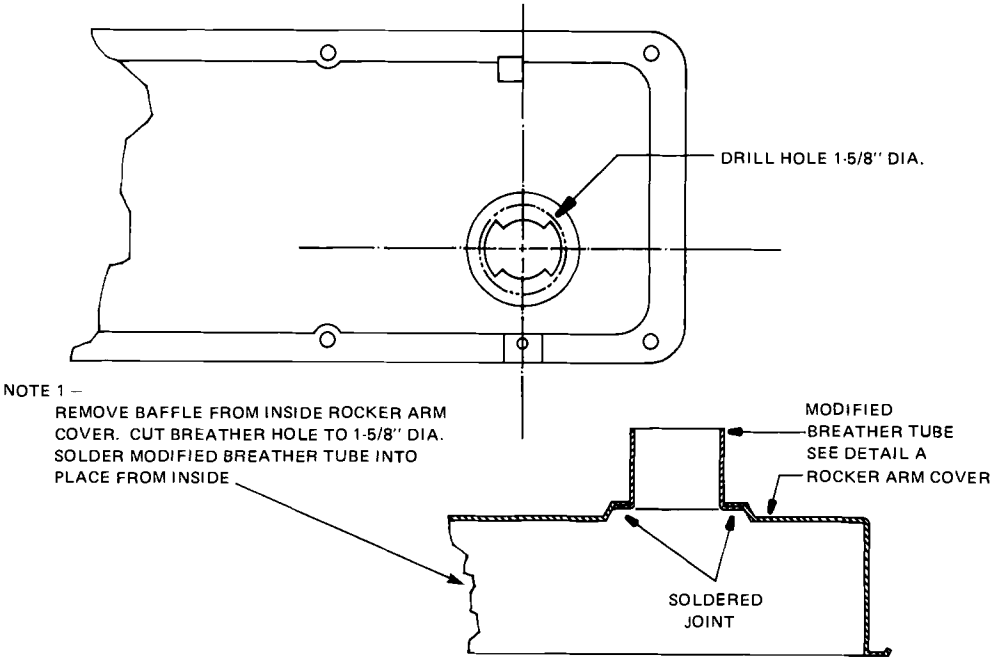


A3.27
ENGINE OIL PAN WITH FABRICATED DRAIN PLUG

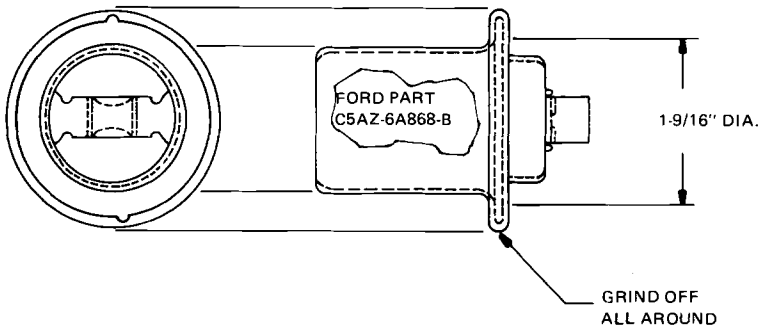


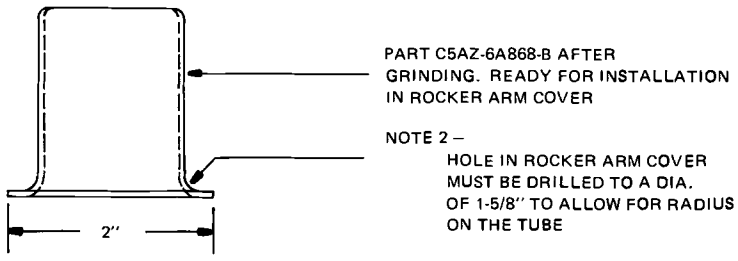


A3.28
ROCKER ARM COVER MODIFICATION



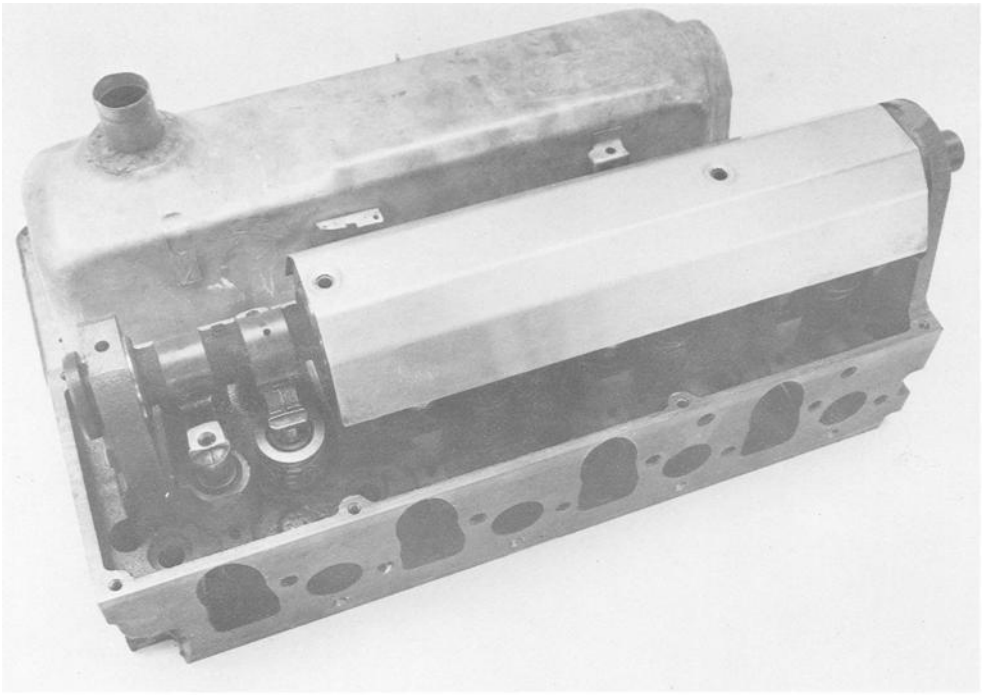
DETAIL A

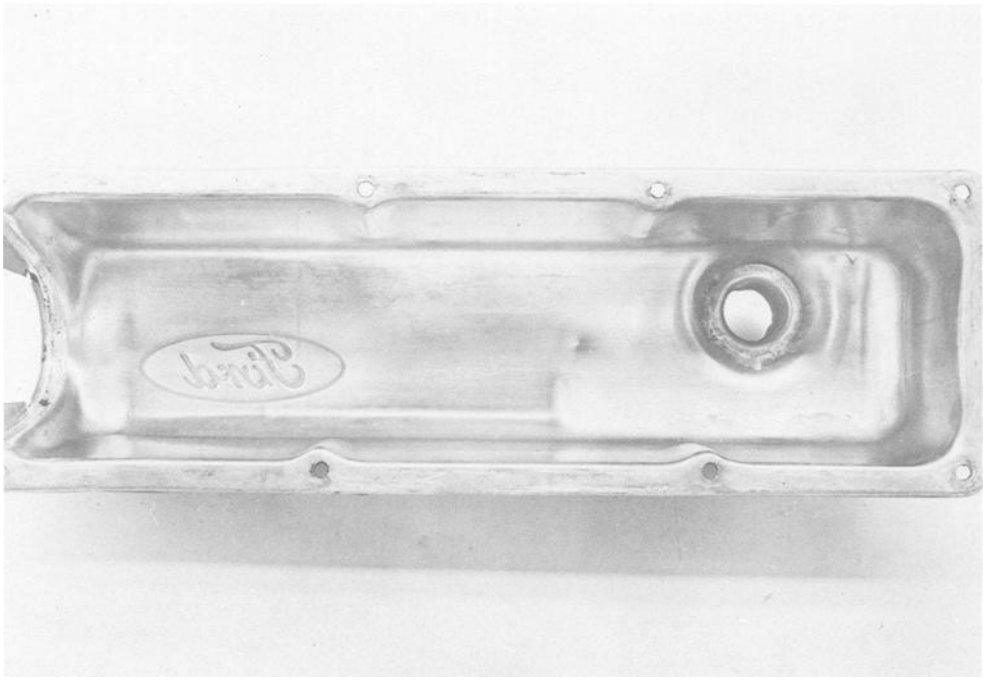




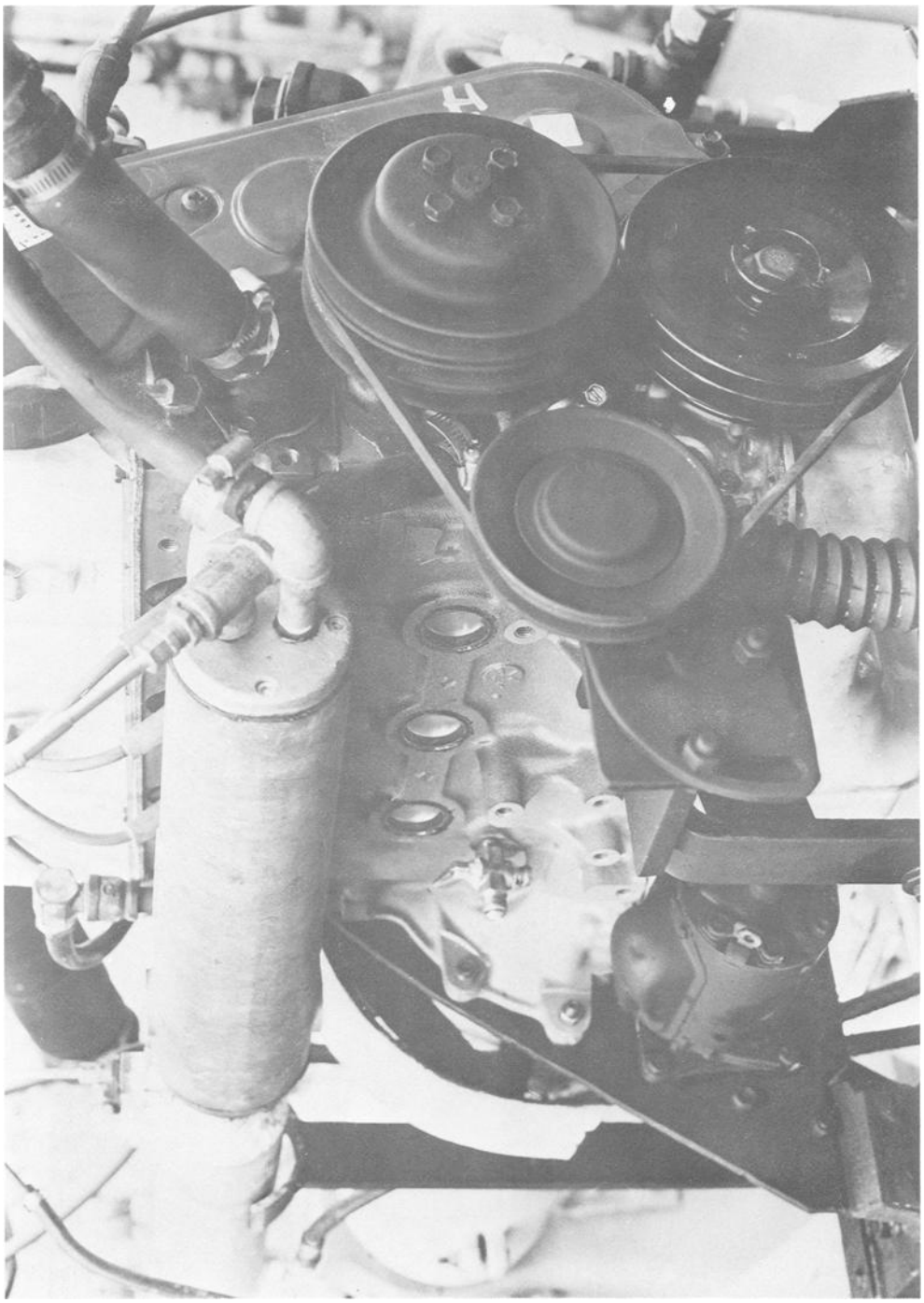
Purchase availability:
See X2.2

A3.29
ROCKER ARM COVER AND CAM BAFFLE

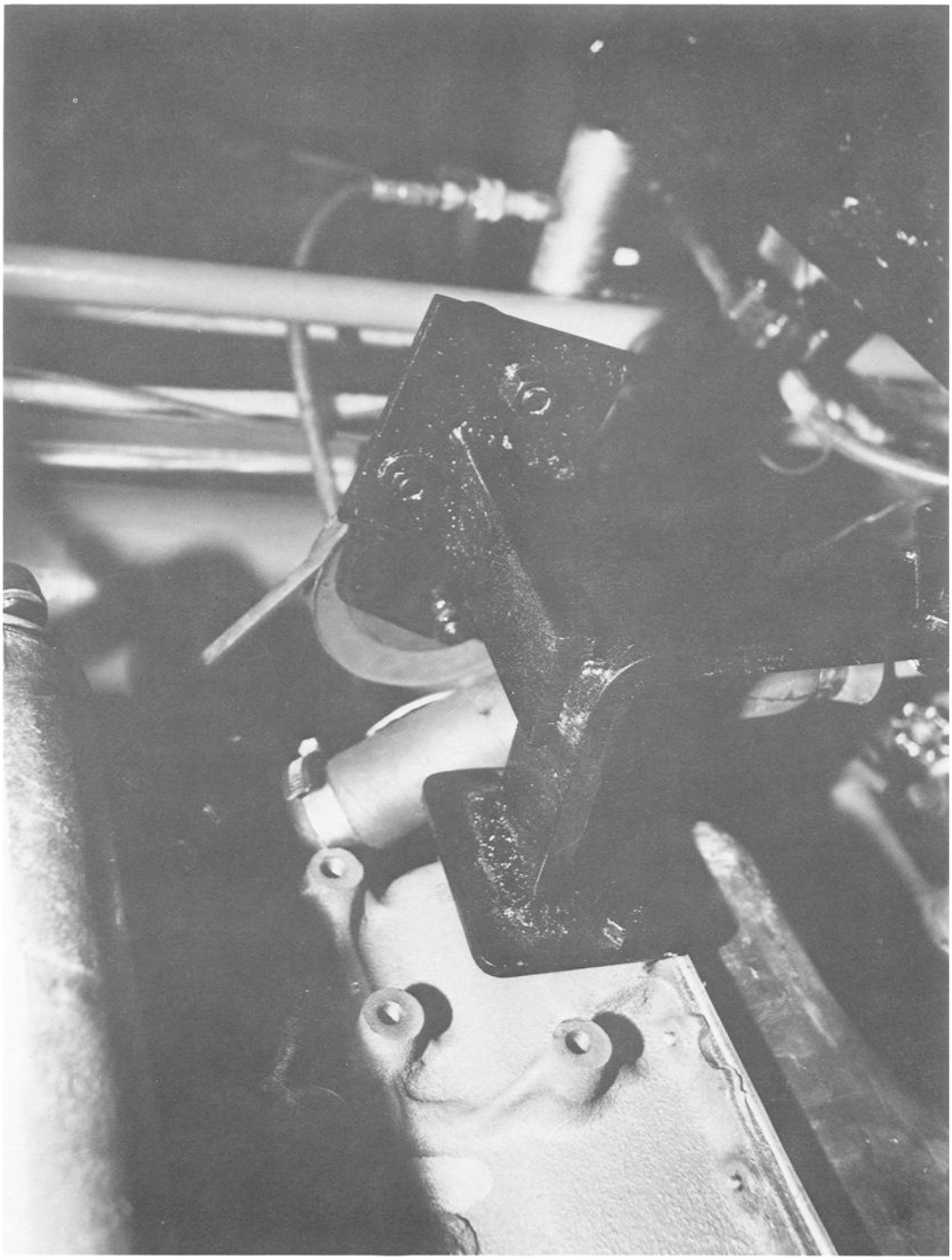




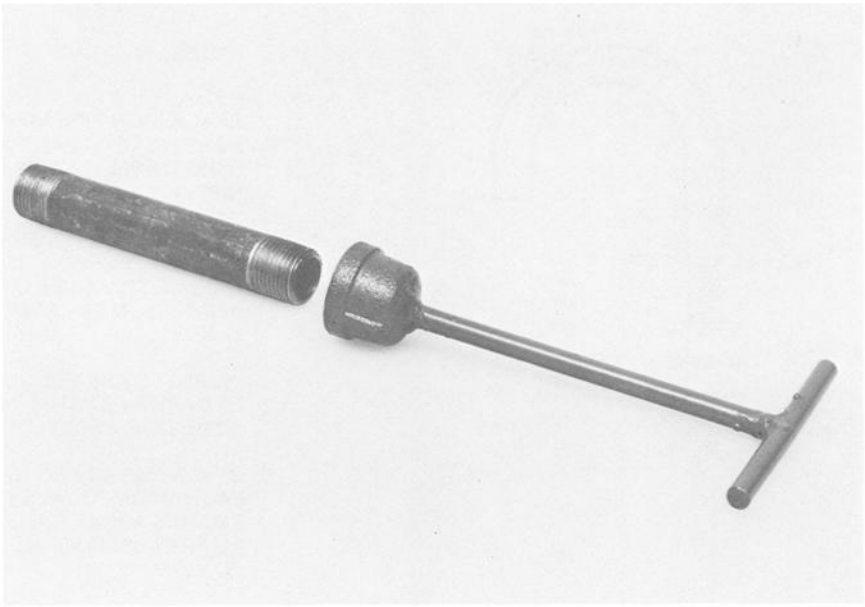
A3.30
PULLEY AND V-BELT ARRANGEMENT

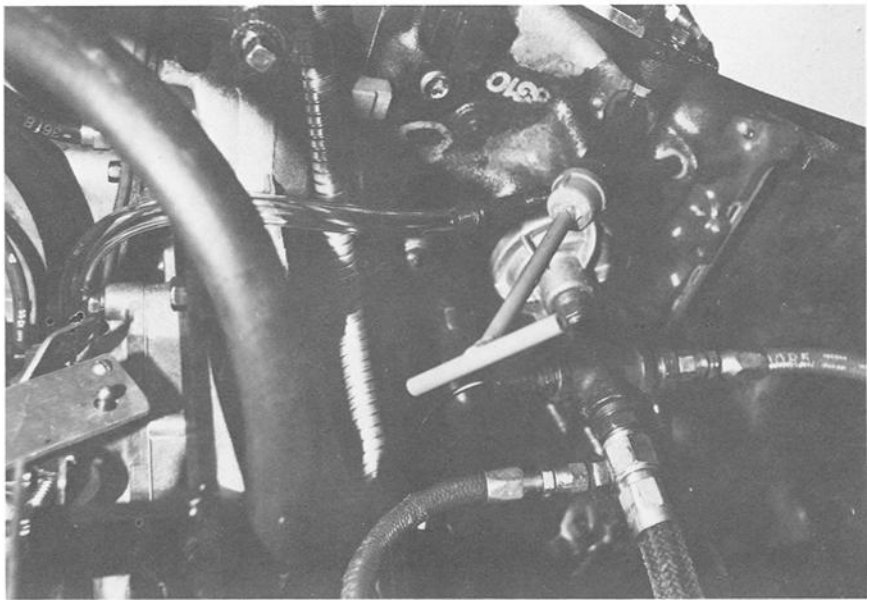


A3.31
TYPICAL IDLER PULLEY, REAR VIEW

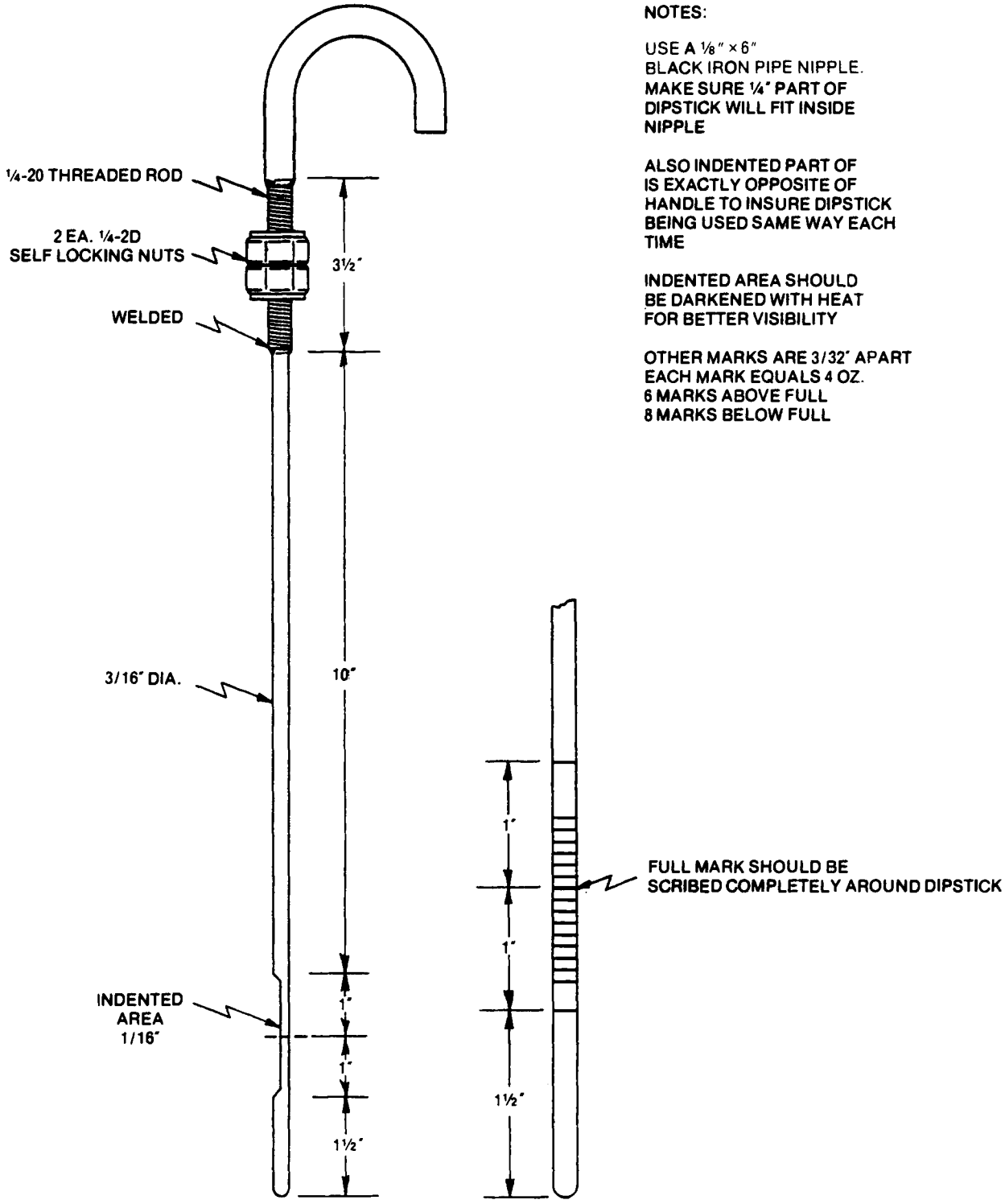


A3.32
CRANKCASE OIL FILL TUBE AND CAP





A3.33
REQUIRED ADJUSTABLE DIPSTICK FABRICATION



NOTES:

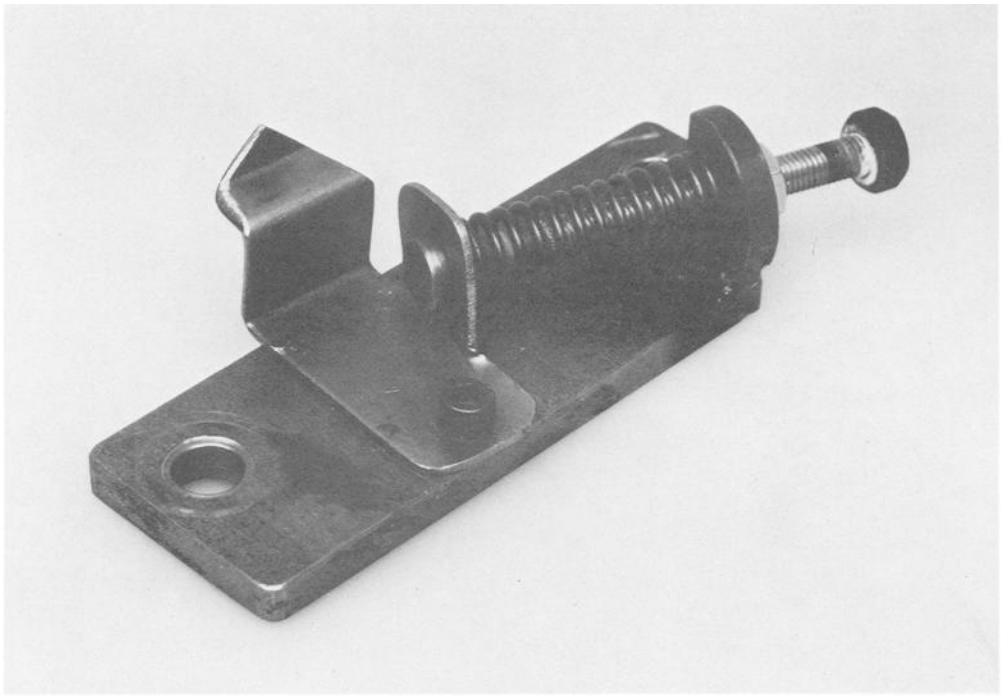
USE A ⅛" × 6" BLACK IRON PIPE NIPPLE. MAKE SURE ¼" PART OF DIPSTICK WILL FIT INSIDE NIPPLE

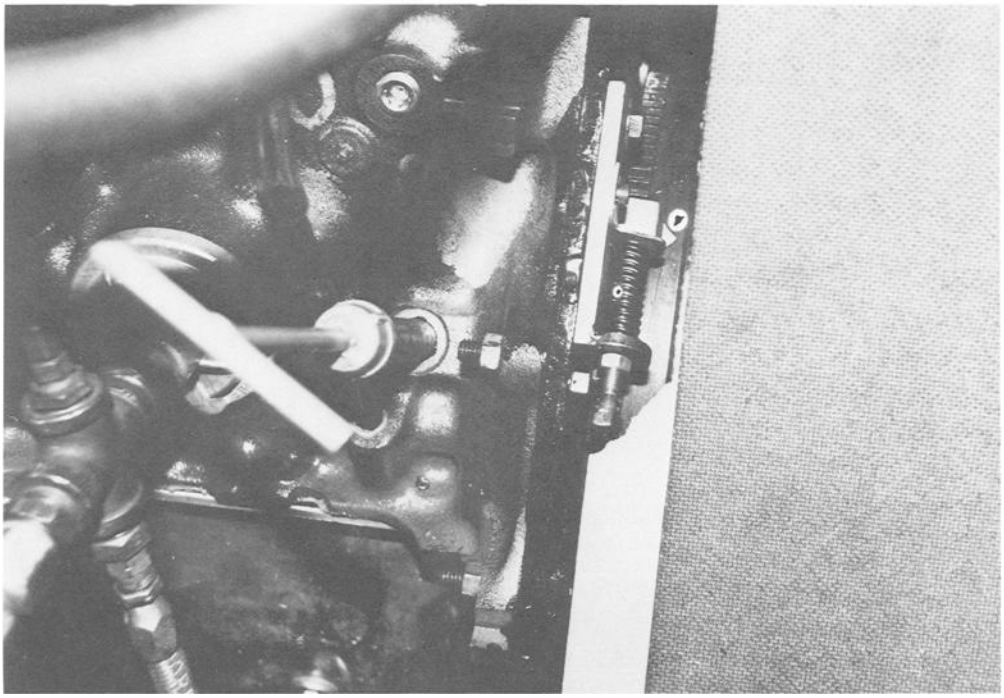
ALSO INDENTED PART OF IS EXACTLY OPPOSITE OF HANDLE TO INSURE DIPSTICK BEING USED SAME WAY EACH TIME

INDENTED AREA SHOULD BE DARKENED WITH HEAT FOR BETTER VISIBILITY

OTHER MARKS ARE 3/32" APART EACH MARK EQUALS 4 OZ.
6 MARKS ABOVE FULL
8 MARKS BELOW FULL

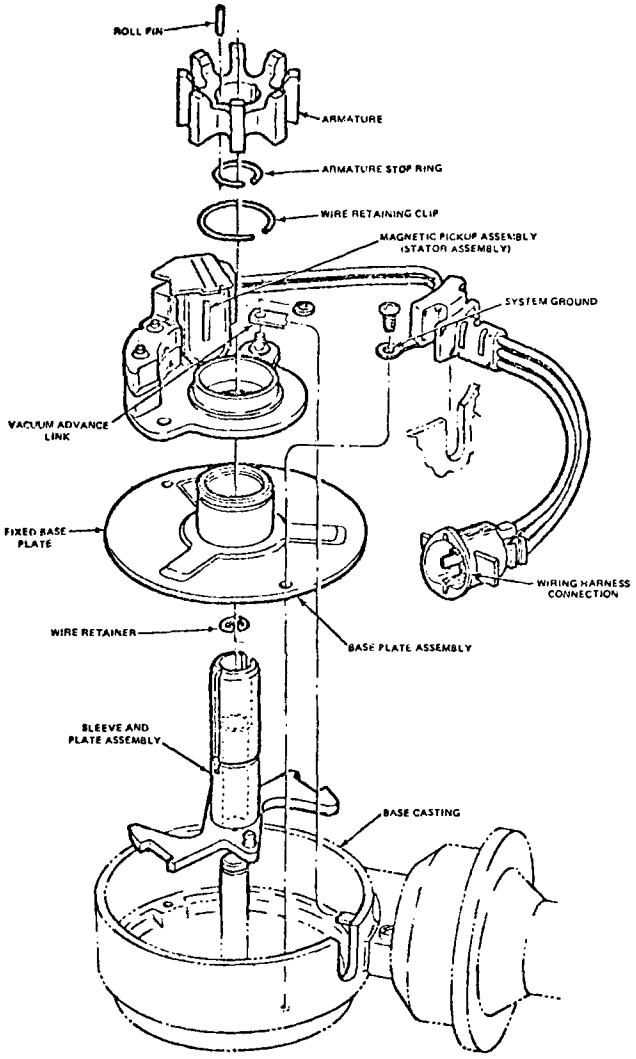
A3.34
TYPICAL FLYWHEEL TIMING INDEX

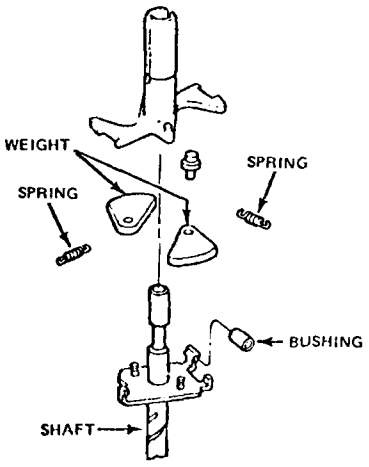




A3.35
DISTRIBUTOR MODIFICATION

Distributor Modification for 36 ± 1° Mechanical Advance



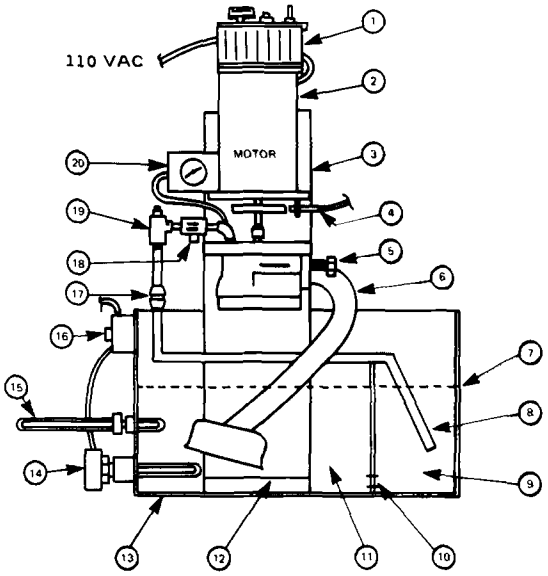


Centrifugal Advance Mechanism

Modification of Mechanical Advance Mechanism

1. Remove drive gear and screws holding base plate assembly to allow shaft to be lifted upward.
2. Remove and discard the plastic bushing from the stop peg on drive shaft.
3. Use a portable high speed grinder to enlarge the travel limit slot of the sleeve and plate assembly. Approximately 1/16 inch (1.59 mm) should be ground off so that travel in "advance" direction is increased.
4. Check progress by trial and error testing on a distributor machine.
5. Adjust springs so that "retard" with decreasing rpm results in 36° spread between 2500 and 750 engine rpm. At 2500 rpm the mechanism should be at the travel limit established by grinding the slot.

A3.36
OIL PUMP CALIBRATION APPARATUS



NOTE 1 - DAYTON DC MOTOR MODEL 2Z846 IS SUGGESTED. (¾hp @ 2500 rpm, rpm 0-2500, FRAME 56/56C, DAYTON ELECTRIC MFG. CO. CHICAGO, ILL. 60648).

NOTE 2 - INVALCO MODEL W3/0750 IS SUGGESTED, 1-13 gpm, ss, C-E INVALCO, COMBUSTION ENGINEERING INC., P. O. BOX 556, TULSA, OKLAHOMA, 74101.

NOTE 3 - ORIFICE IS 0.180 ± 0.0005 in. (4.572 ± 0.013mm) dia., ¼ in. (6.4 mm) DEEP, MACHINED FROM BRASS.

NOTE 4 - TO ELIMINATE AERATION THE OIL IS RETURNED TO A SEPARATE COMPARTMENT VIA THE ½ in. ID TUBING. THE OIL RETURNS TO THE PICK-UP COMPARTMENT VIA THE HOLES INDICATED. A TRANSPARENT SECTION IN THE DISCHARGE TUBE IS HELPFUL IN IDENTIFYING EXCESSIVE AERATION.

NOTE 5 - OPERATING CONDITIONS: SPEED 1250 ± 10 rpm, TEMPERATURE 125 ± 5°F (51.7 ± 2.8°C), FLOW RATE 6.6 ± 0.1 gpm (0.416 ± 0.006 dm^3/s AT 60 ± 1 psi (413.7 ± 6.9 kPa).

NOTE 6 - PURCHASE AVAILABILITY:
SEE X2.2

(1) MOTOR CONTROLLER WITH SPEED ADJUSTMENT.

(2) PERMANENT MAGNET VARIABLE SPEED DC MOTOR (SEE NOTE 1).

(3) MOTOR AND PUMP MOUNTING PEDESTAL.

(4) 60 TOOTH SPEED PICK-UP ASSEMBLY.

(5) RELIEF VALVE ADJUSTER.

(6) OIL PICK-UP TUBE MOUNTED TO THE OIL PUMP.

(7) OIL LEVEL.

(8) ½ in. (12.7 mm) ID DISCHARGE TUBE.

(9) SUMP DISCHARGE COMPARTMENT.

(10) OIL RETURN HOLE 1 in. (25.4 mm) DIA. 2 PLACES.

(11) PICK-UP COMPARTMENT OF SUMP ASSEMBLY.

(12) BASE OF MOTOR AND PUMP MOUNTING PEDESTAL.

(13) SECTIONED VIEW OF SUMP ASSEMBLY.

(14) 110v IMMERSION HEATER

(15) THERMOMETER

(16) TEMPERATURE CONTROL FOR HEATER.

(17) ¼" PIPE TO ½" TUBING UNION.

(18) TURBINE FLOW METER (OPTIONAL) (SEE NOTE 2).

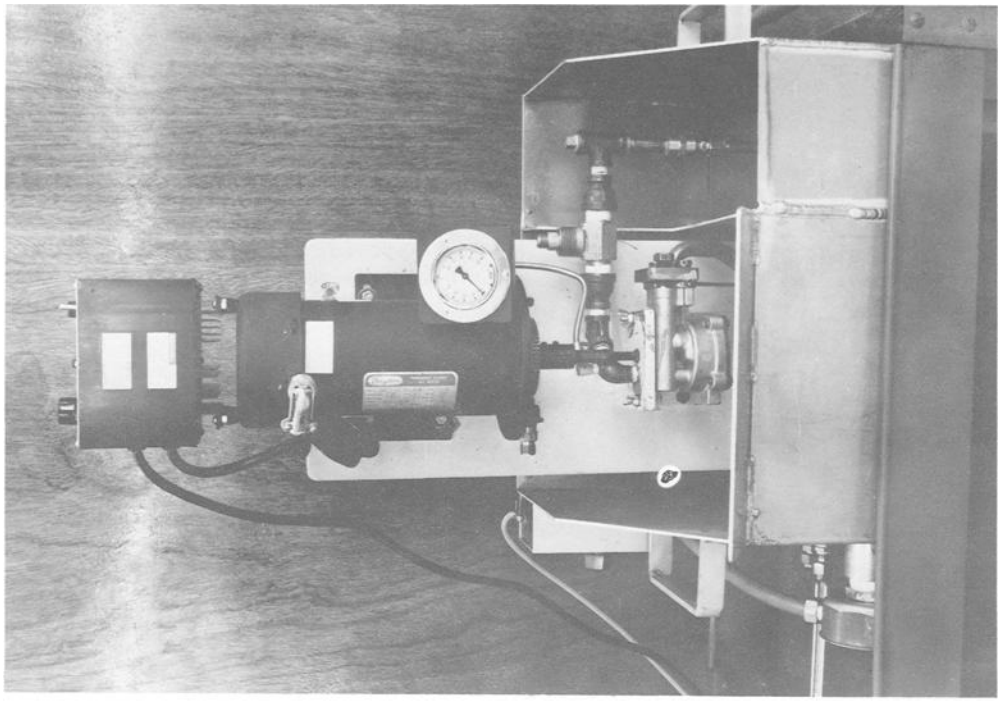
(19) ¼" TEE FITTING WITH 0.180 in. ORIFICE THREADED IN LOWER BRANCH, WITH PLUG IN UPPER BRANCH. (SEE NOTE 3)

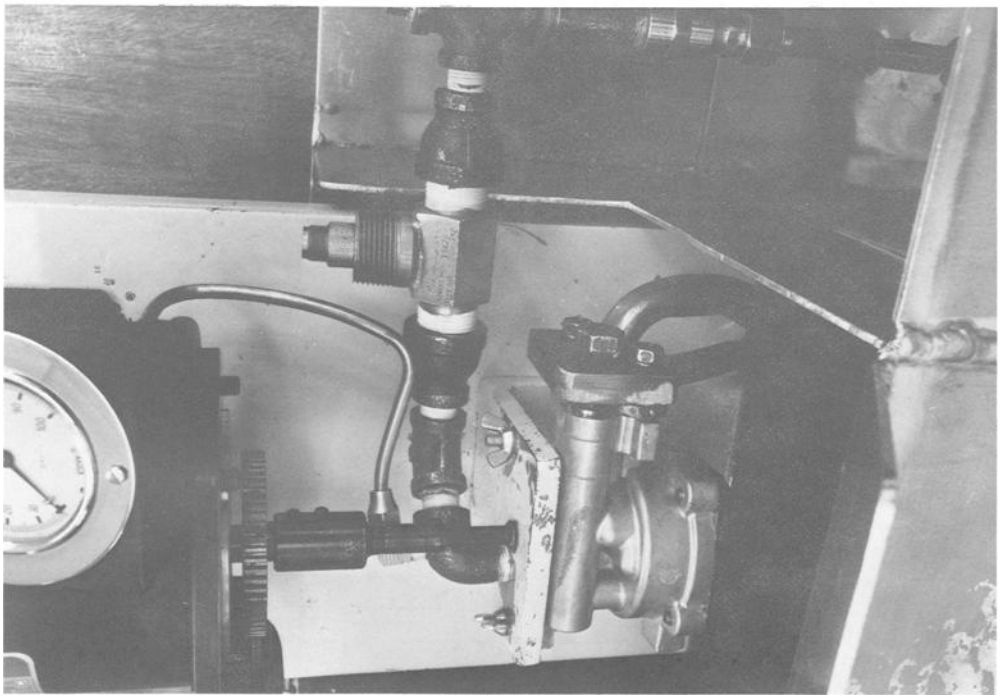
(20) OIL PRESSURE GAGE 1% ACCURACY, 1 psi RESOLUTION (6.9 kPa).

Schedule 40 A.S.A. Pipe Dimensions

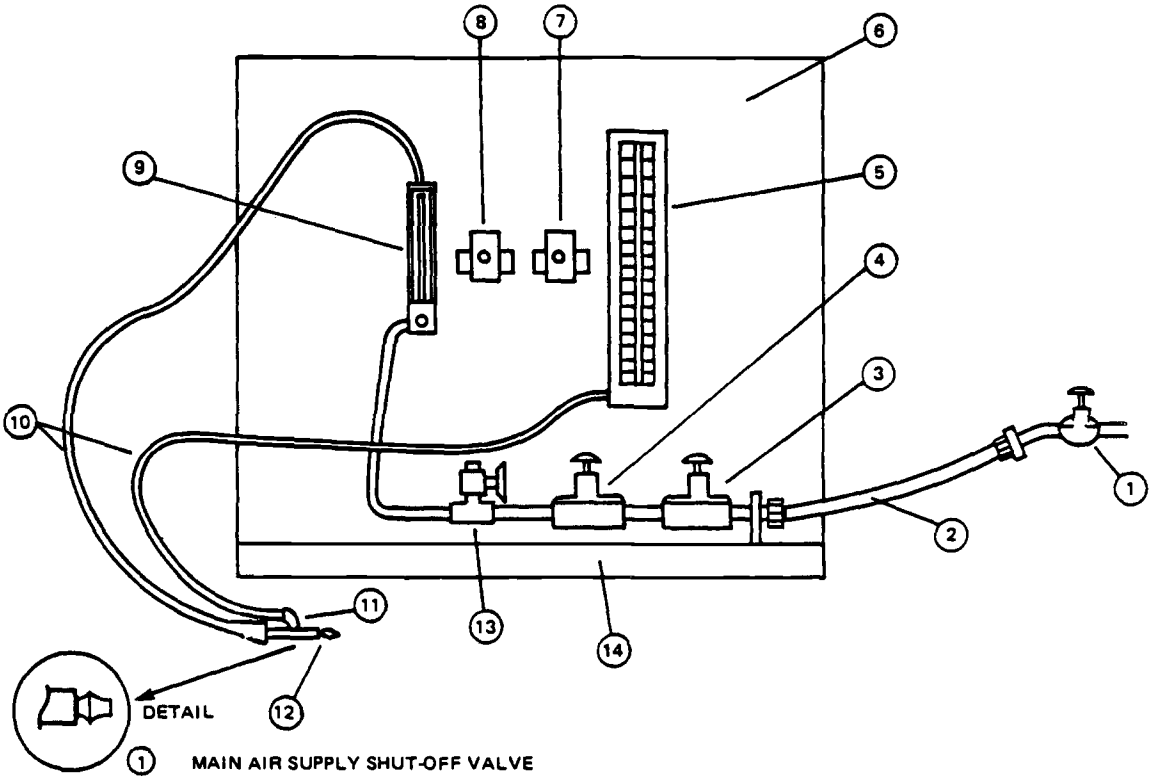
NPT nominal	OD		ID	
	in	mm	in	mm
¼	.540	13.72	.364	9.24
½	.840	21.34	.622	15.80

A3.37
OIL PUMP CALIBRATION APPARATUS





A3.38
REQUIRED CAM LOBE FLOW RATING APPARATUS



(1) MAIN AIR SUPPLY SHUT-OFF VALVE

(2) CONNECTING HOSE

(3) HIGH PRESSURE REGULATOR
FISHER #GTFR6-78 SUGGESTED[1]

(4) LOW PRESSURE REGULATOR
MOORE 40-2 NULLMATIC 14870-281 SUGGESTED[2]

(5) WATER COLUMN MANOMETER 0-20 in (0-5.0 kPa)

(6) SUPPORTING BACKBOARD

(7) LOW CALIBRATION CAM ORIFICE (PARTIALLY PLUGGED)

(8) HIGH CALIBRATION CAM ORIFICE (NEW CAM LOBE)

(9) FLOW ROTOMETER
BROOKS SHO-RATE WITH TUBE #R-2-15-C AND
SAPHIRE BALL, 5003 SCCM, #1355CB1C7AAA IS SUGGESTED[3]

(10) CONNECTING HOSE, 5/16 in ID (7.9 mm)

(11) ELBOW FITTING SOLDERED INTO SIDE OF PUSH ROD AS PRESSURE TAP

(12) ORIFICE PROBE, 302 FORD PUSH ROD WITH BALL END MACHINED
TO FORM PROBE POINT AS SHOWN IN THE DETAIL INSET

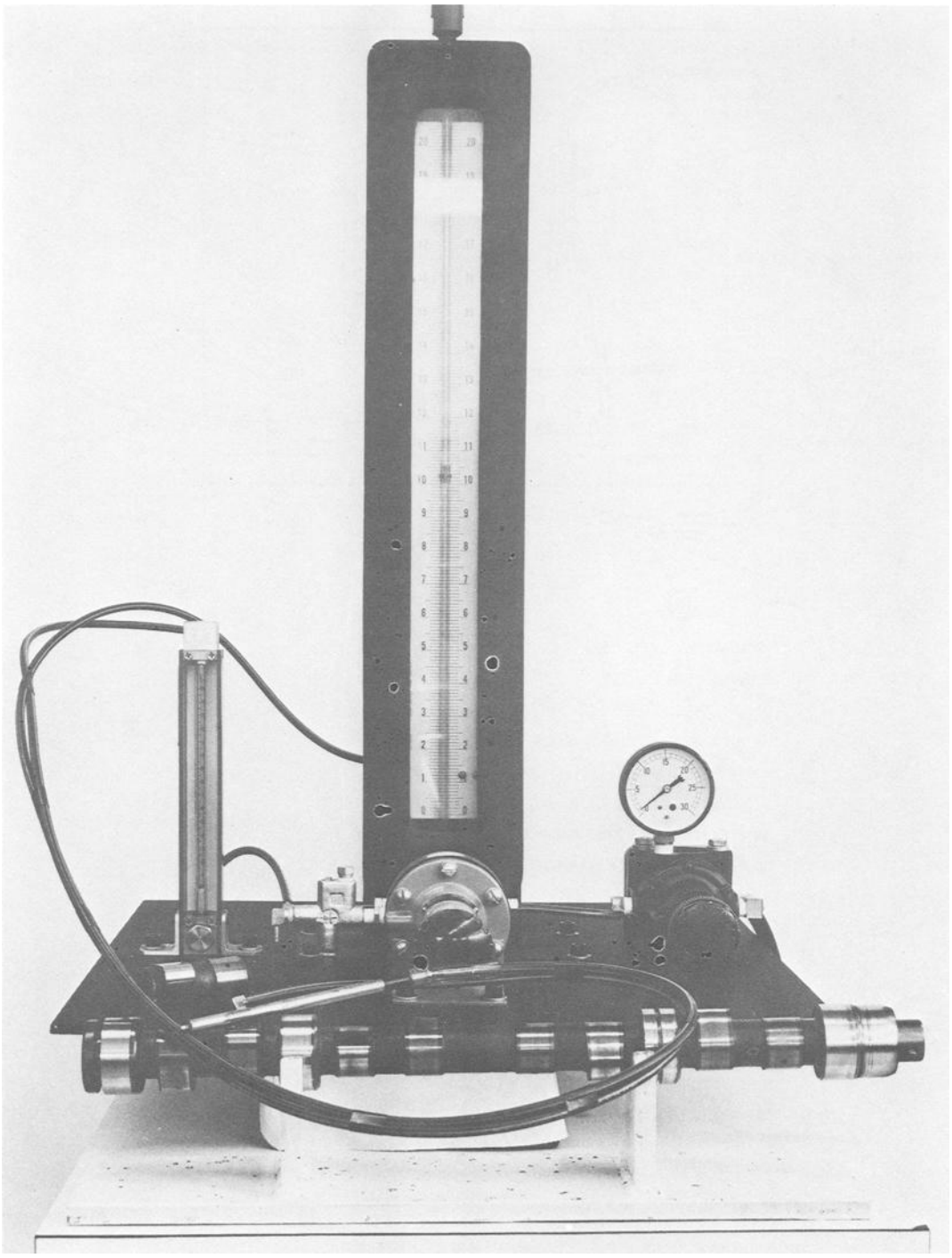
(13) NEEDLE VALVE (VENT TO ALLOW IMPROVED REGULATOR RESPONSE)

(14) BASE SUPPORT PLATE

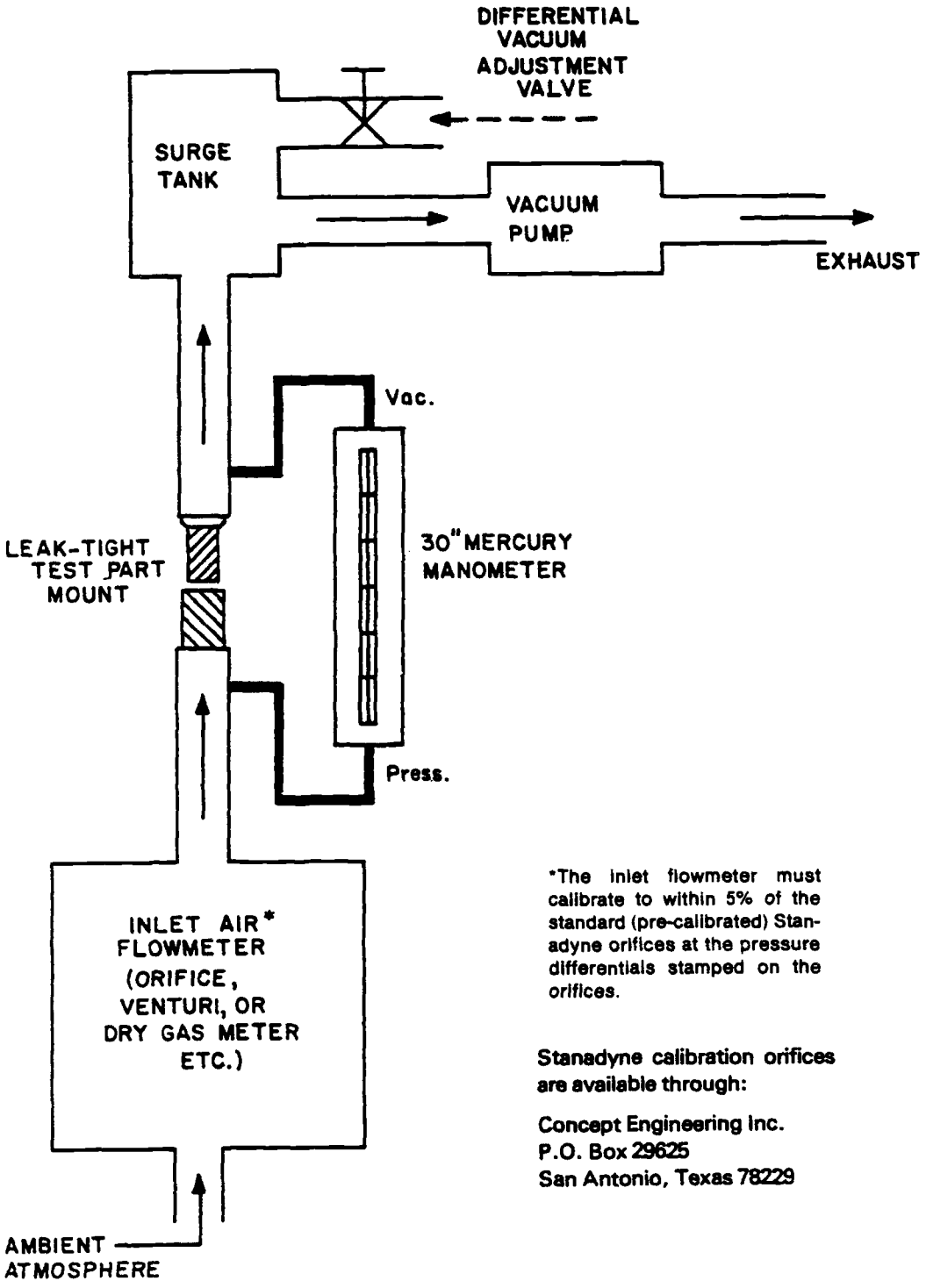
1 AVAILABLE FROM FISHER CONTROLS, MARSHALLTOWN, IOWA 50158
2 AVAILABLE FROM MOORE PRODUCTS CO., SPRINGHOUSE, PA. 19477
3 AVAILABLE FROM BROOKS INSTRUMENT DIV. EMERSON ELECTRIC CO. HATFIELD, PA.19440

An assembled apparatus is available for purchase: See X2.2

A3.39
TYPICAL CAM LOBE FLOW RATING APPARATUS



A3.40
PCV VALVE FLOW TEST STAND

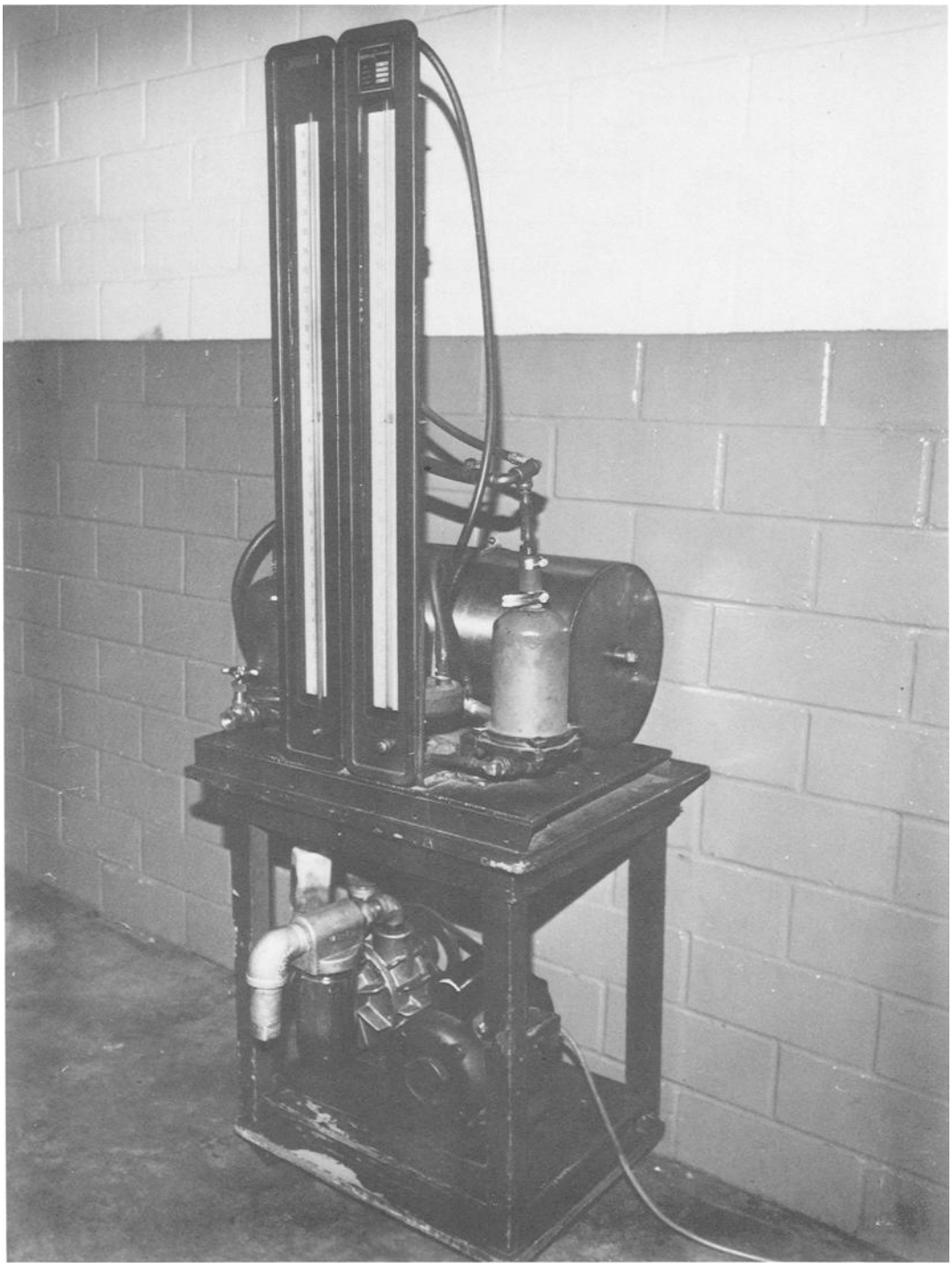


*The inlet flowmeter must calibrate to within 5% of the standard (pre-calibrated) Stanadyne orifices at the pressure differentials stamped on the orifices.

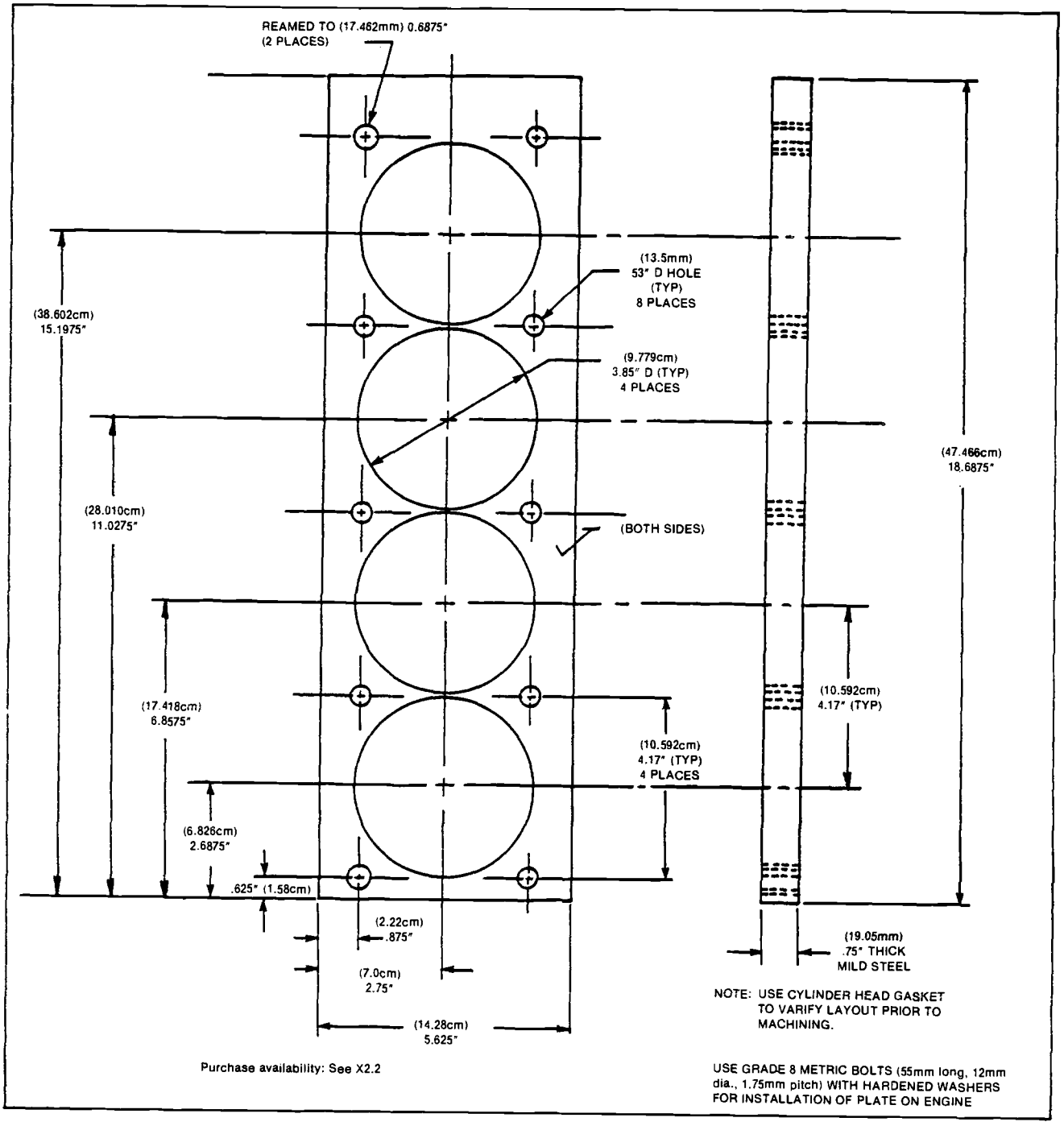
Stanadyne calibration orifices are available through:

Concept Engineering Inc.
P.O. Box 29625
San Antonio, Texas 78229

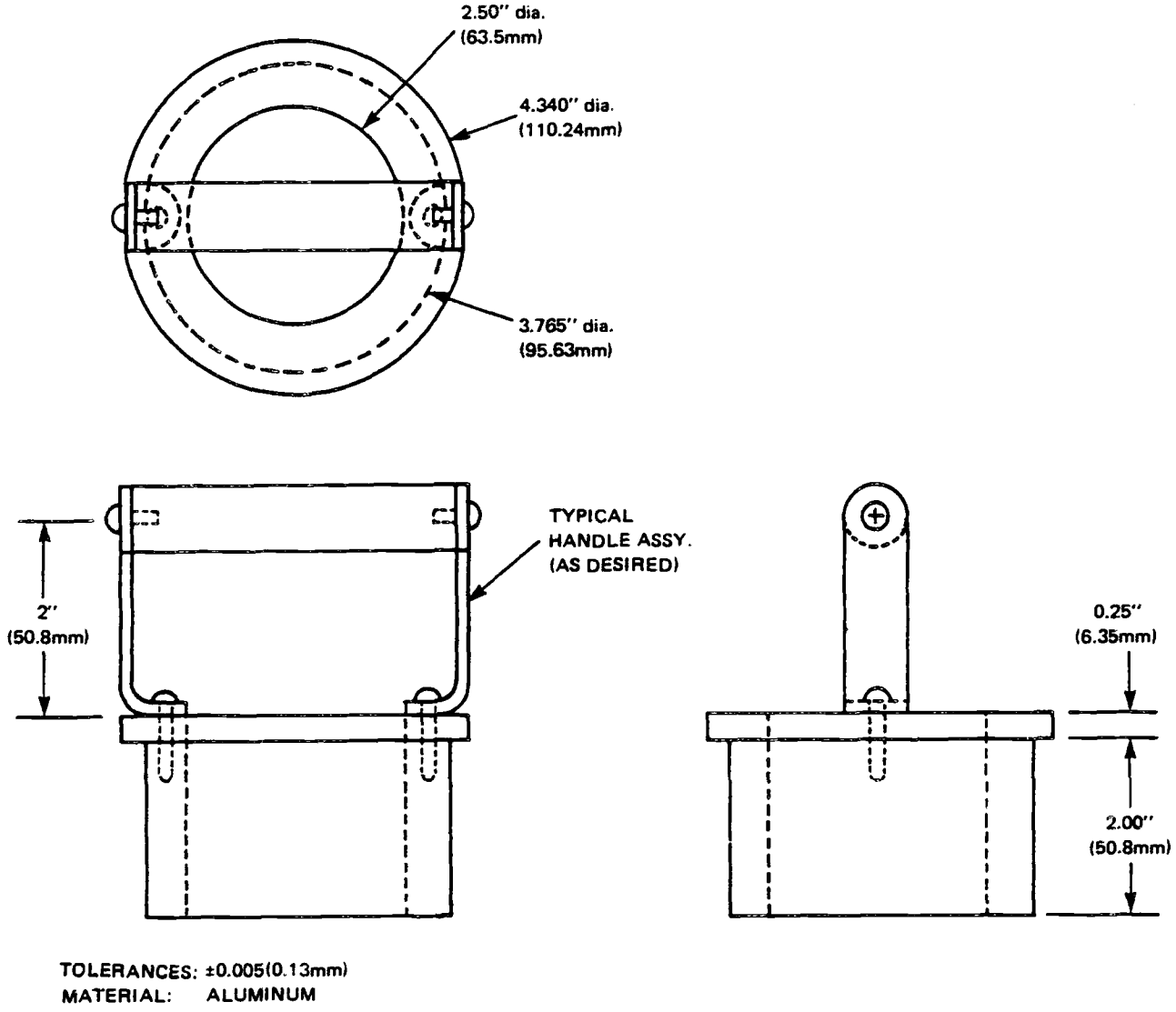
A3.41
TYPICAL PCV VALVE FLOW APPARATUS



A3.42
CYLINDER BLOCK PRE-STRESS PLATE

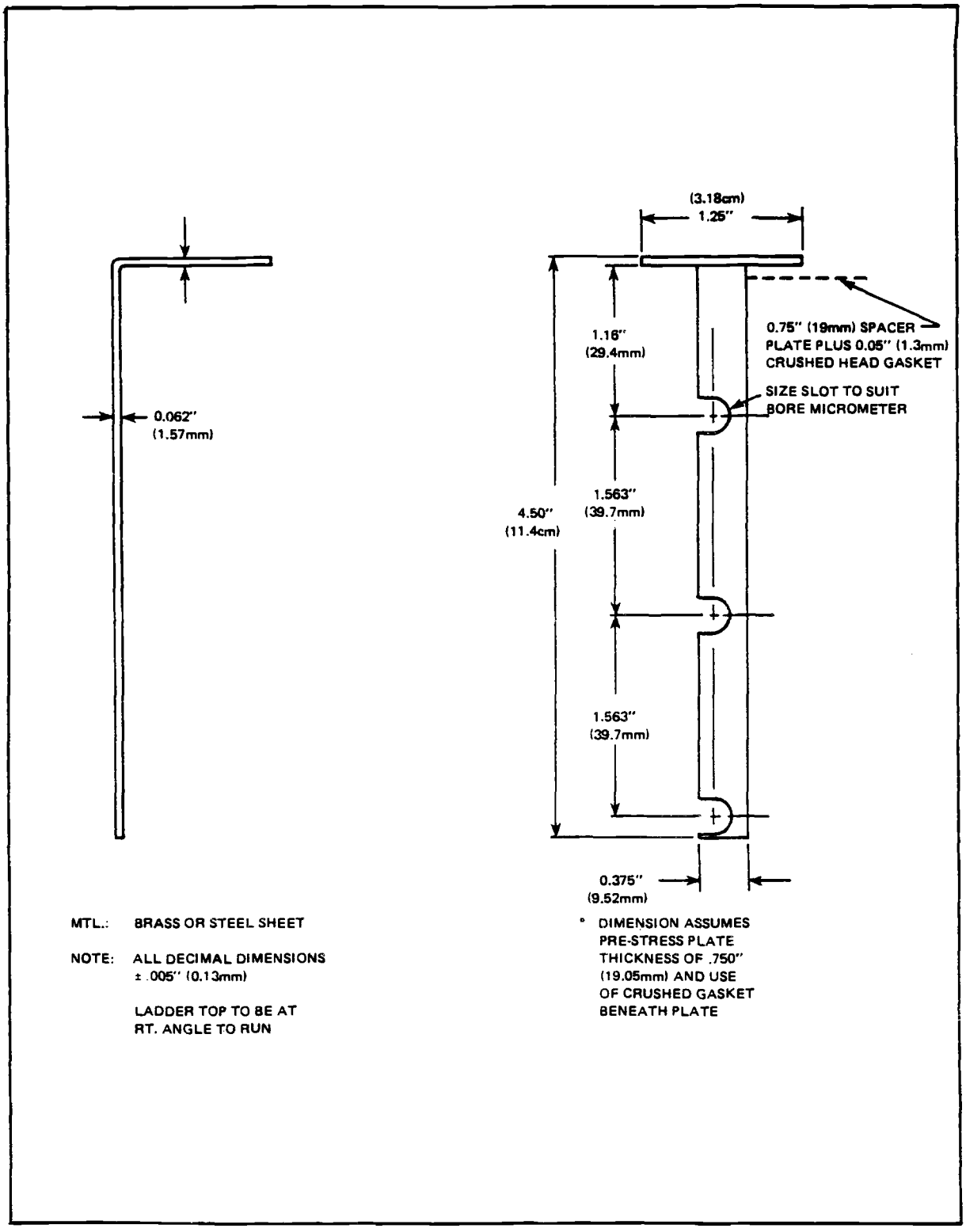


A3.43
PISTON RING POSITIONER



TOLERANCES: ±0.005(0.13mm)
MATERIAL: ALUMINUM

A3.44
POSITIONING LADDER FOR BORE MICROMETER



MTL.: BRASS OR STEEL SHEET

NOTE: ALL DECIMAL DIMENSIONS
± .005" (0.13mm)

LADDER TOP TO BE AT
RT. ANGLE TO RUN

° DIMENSION ASSUMES
PRE-STRESS PLATE
THICKNESS OF .750"
(19.05mm) AND USE
OF CRUSHED GASKET
BENEATH PLATE

A4. Ford 2.3 L Engine Part Number Listing

Description of Part	Engineering No.	Service No.	Motorcraft No.
Complete 2.3 1 test engine	BX-152-01		
Complete Test Parts Kit	Z-50-11		
Short block		D8FZ6009A	
Engine block (bare)		D9FZ6010B	
Cylinder head (completely assembled)	D9EE6049JC	D9FZ6049B	
Cylinder head (bare)		D9FZ6049A	
Camshaft	D42E6251AA	D7FZ6250A	
Cam Follower		D8FZ6564A	
Intake Valve, std		D9ZZ6507A	
.015 in. o.s.		D6FZ6507C	
Exhaust Valve, std		D6FZ6505A	
.015 in. o.s.		D6FZ6505C	
Valve Spring		D4FZ6571A	
Valve Seal			
Hydraulic Lash Adjuster		D6FZ6500A	
Timing Belt	D9EE6268A5A	D4FZ6268A	
Piston	(PC-1946)	D4FZ6108A(STD)	
Piston Ring Set	D9JL6148B	D4FZ148A(Z)	
Connecting Rod		D7FZ6200A	
Connecting Rod Bearing	D42E6211AA	D9ZZ6211A	
Main Bearing	D42E6333AB	D9ZZ6333A	
Main Bearing, Upper Thrust	D42E6337AB	D9ZZ6337A	
Main Bearing, Lower Thrust	D42E6A339AB	D9ZZ6337G	
Front Seal Housing		D4FZ6700A	
Oil Pump	D8EE6600AA	D5FZ6600A	
Oil Pickup Tube (screen)		D5FZ6622C	
Oil Pump, w/Tube	D8EE6600AA		
Oil Pump Relief Valve Plunger			
Oil Pump Relief Valve Spring	D42E6670AC		
Oil Pump Relief Valve Plug		C20Z6A616A	
Dipstick Tube		D7FZ6754A	
Oil Pan	D8BE6675CC	D8BZ6675A	
Rocker Arm Cover		D9FZ6582A	
Rocker Arm Cover Extension Pipe	C5AZ6A868B		
Dipstick	D60E6750AA	D60Z6750A	
Cylinder Block Freeze Plugs		D7AZ6026A	
Thermostat Housing		D8FZ8592A	
Intake Manifold		D9FZ9425A	
Water Pump		D8FZ8501A	PW158
Water Pump Pulley	D42E8509AB	D4FZ8509A or B	
Crankshaft Pulley	D42E6312CD	D4FZ6A313A	
Carburetor Spacer Plate		D7FZ9A589A	CM2404
PCV Valve	DSDE6A666BA	D8TZ6A666A	EV-77B
Crankcase Vent Hose	D2TE6A664BA	D1TZ6A664A	
EGR Valve	D52E9D475H2B	D5FZ9D475N	CX6
EGR Tube	D42E9D477CA	D4FZ9D477A	
EGR Elbow Fitting		N855-076-551	
Carburetor 1980 California	E9ZE9510SB		CA2353
Distributor	D7EE12127DA	D7FZ12127D	DA1543
Distributor Rotor		D7FZ12200C	DR308
Distributor Cap		D7FZ12106A	DH368

Description of Part	Engineering No.	Service No.	Motorcraft No.
Ignition Coil		D5AZ12029A	DG314
Secondary Ignition Wire Set		D8PZ12259A	WR3936
Electronic Ignition Module	D8VE12A199AC	D9VZ12A199A	DY184C
Primary Wiring Harness	D7JL12A200A		
Spark Plug			AWRF-42
Starter		D8FZ11002B	SA729
Flywheel		D4FZ6375A	
Oil Filter		D4ZZ6731B	FL-300
Tool Kit		T74P 6000-LB	
Gaskets			
Rocker Cover	D9ZE6584AA	D5FZ6584A	
Oil Pan			
Left Rail	D4E6710AA		
Right Rail	D42E6711AA	D4FZ6781A	
Front end	D42E6722AB		
Rear end	D9EE6723A2A		
Intake Manifold	D42E9439AA	D4FZ9441A	
Exhaust Manifold	D9EE9448BA	D9FZ9448B	
EGR Valve	D43E9D476AA	D4FZ9D476A	
Carburetor Spacer Plate to Intake Manifold	D42E9C477AB	D4FZ9C477A	
Carburetor Spacer (fiber)	D42E9447AB	D4FZ9447A	CG403
Intake Manifold Cap	not to be used	D8FZ9E436A	
Thermostat Housing	D42E8255AA	D4FZ8255A	
Water Pump	D42E8507AB	D4FZ8507A	
Fuel Pump	D42E9417AA	C3AZ9417C	
Front Cover	D42E6020AB	D4FZ6020A	
Crankshaft Front Seal	D42E6700A1A	D4FZ6700A	
Crankshaft Rear Seal	D42E6701AA	D4FZ6701A	
Auxiliary Shaft Seal	D42E6700A1A	D4FZ6700A	
Oil Pump Tube	D42E6625CB	D4FZ6626A	
Cylinder Head	D52E6051BA	D5FZ6051A	
Overhaul Set		D6FZ6079A and D6PZ6E078A	
Valve Grind Set		D6FZ6079A	

A5. Operational Data Log Sheets—

A5.1 — Oil Sampling, Addition, and Leveling Data Record
A5.2 — Routine Engine Operation Data Log and Special Maintenance Data Log

A5.1
SEQUENCE V-D TEST
OIL SAMPLING, ADDITION AND LEVELING PROCEDURE
ORIGINAL DATA RECORD

Test No. _____

Client Oil Code _____

Lab. Oil Code _____

Test Cycles -	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
Test Hours -	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192
Specific Action Time, Hours -	11:25	23:25	35:25	47:25	59:25	71:25	83:25	95:25	107:25	119:25	131:25	143:25	155:25	167:25	179:25	191:25
1. Take purge sample, oz.	5		5		5		5		5		5		5		5	5
2. Replace purge sample	x		x		x		x		x		x		x		x	x
3. Take Sample for analysis, oz.	2		2		2		2		2		2		2		2	2
4. Add new oil, oz.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	7
5. Shut engine down.		x		x		x		x		x		x		x		x
6. Check oil level after 20 minutes.		x		x		x		x		x		x		x		x
7. Record dipstick oil level, oz. ("O" for full, "H" for high, "L" for low; record no. of oz. high, or low).		☐		☐		☐		☐		☐		☐		☐		☐
8. Restart engine 5 min. before official beginning of Stg. I.		x		x		x		x		x		x		x		
9. If level is high in step 7 record amount of leveling sample drained to bring engine to full. If none drained enter 0.		☐		☐		☐		☐		☐		☐		☐		
10. Final Oil Level Enter "O" for full or enter number of ounces low (L).		☐		☐		☐		☐		☐		☐		☐		
11. Operator's Initials.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Notes:
- Limit of maximum allowable consumption is based on the final oil level (line 10 of the data log). Rates of consumption which lower the final oil level to more than 8 oz. low are excessive and the test is invalidated.
- For the final test report calculate the daily oil consumption via the following formula which accounts for the 2 oz. sample taken and variations in the "final oil level":
  Consumption for a given 24 hr. period (oz.) equals 8 minus the "final oil level" of the previous period minus the amount drained in step 9 for the current period plus the current "final oil level."

A5.2
ROUTINE ENGINE OPERATION DATA LOG AND SPECIAL MAINTENANCE DATA LOG

SEQUENCE V-D TEST

Oil Code _____ Stand _____ Engine _____ Engine Run _____ Fuel Code _____ Dyno Constant _____ Date _____

		Cycle 1				Cycle 2				Cycle 3				Cycle 4				Cycle 5				Cycle 6				Soak
Phase		1		2	3	1		2	3	1		2	3	1		2	3	1		2	3	1		2	3	
Duration, min		60	60	75	45	60	60	75	45	60	60	75	45	60	60	75	45	60	60	75	45	60	60	75	10	35
Observer																										
Time																										
Total Test Hours																										
Speed, rpm																										
Load	pounds																									
	bhp																									
Oil	Engine out, °F																									
	Engine in, °F																									
	ΔT (Out-In), °F																									
	Pump Gallery, psi																									
	Engine Gallery, psi																									
	ΔP (Pump-Engine) psi																									
	Cyl. Head Gallery, psi																									
	ΔP (Engine-Head) psi																									
	Cooling, min																									
Water	Out, °F																									
	In, °F																									
	ΔT (out-in), °F																									
	Flow, gpm																									
Carb Air	Temp, °F																									
	Dew point, °F																									
	Grains/lb																									
	Pressure, in. H_2O																									
Blowby Coolant, °F																										
Blowby Gas, °F																										
Marine Manifold Coolant, °F																										
Intake Vacuum, in. Hg																										
Ignition Timing, °BTDC																										
Barometric Pressure, in. Hg																										
Blowby	ΔP, in. H_2O																									
	Rate, cfm																									
	Temp, °F																									
	Corr. factor																									
	Rate, cfm (corr.)																									
Crankcase Pressure, in. H_2O																										
Fuel	Pressure, psi																									
	Flow, pph																									
Exhaust Gas Analysis	O_2, %																									
	CO, %																									
	NO_x																									
EGR Function Check																										
Ex. Back Pressure, in. H_2O																										
Special Maintenance Record																										

2.) 2 oz sample for analysis taken

3.) 5 oz running oil addition.

1.) 5 oz purge taken and returned

1.) 5 oz running oil addition
2.) Shutdown engine after 10 min. of Stg. 3.
3.) Read dipstick exactly 20 min. after shutdown
4.) Restart engine 5 minutes before beginning of Stg. 1.
5.) *Drain calculated amount of leveling sample to bring engine to "Full"*

Note A2 — This form is shown at 50% reduction. Original forms suitable for use as copy masters are available the ASTM TMC.

SPECIAL MAINTENANCE RECORD — TROUBLE RECORD — UNSCHEDULED SHUTDOWN RECORD

Item No.	Stg.	Test Hrs.	Time	Complete Description of the Problem and Actions Taken	IF SHUTDOWN			Observer
					Authorized By	Shutdown Time	Restart Time	

NOTE: THE FOLLOWING MUST BE RECORDED:
- All Stand Maintenance
- All Parts Replacements
- All Instrument Calibration Adjustments
- Test Operation Out of Limits

A6. Rating Worksheets —

A6.1 — Sludge Rating of Rocker Arm Cover

A6.2 — Sludge Rating of Front Seal Housing

A6.3 — Sludge Rating of Oil Pan

A6.4 — Sludge Rating of Valve Deck

A6.5 — Sludge Rating of Underside of Block

A6.6 — Varnish Rating of Piston Skirts and Rating for Ring Sticking

A6.7 — Varnish Rating of Rocker Arm Cover

A6.8 — Varnish Rating of Cam Cover Baffle

A6.9 — Varnish Rating of Cylinder Walls (BRT)

A6.10 — Varnish Rating of Oil Pan

A6.11 — Miscellaneous Ratings

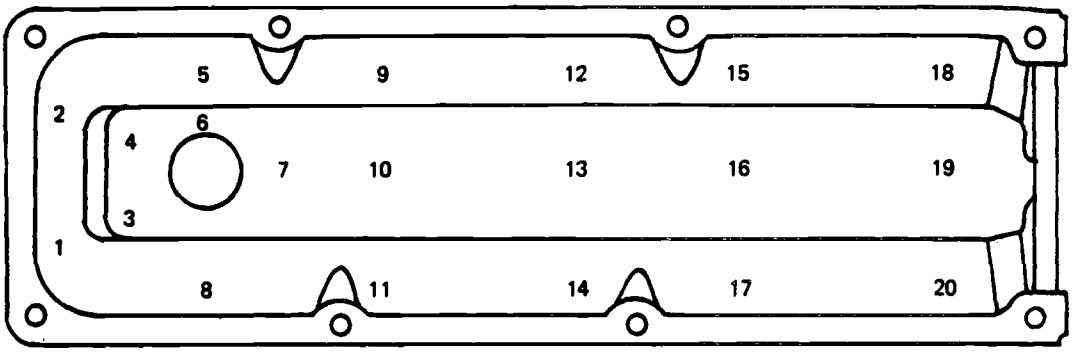
A6.12 — Intake Valve Deposit Rating

Note A3 — The individual sheets listed above and shown sequentially on the immediately following pages are utilized according to instructions given in Section 13.

A6.1
SLUDGE RATING OF ROCKER ARM COVER

RATING WORK SHEET NO. 1

SLUDGE RATING OF ROCKER ARM COVER



NOTE: SITES ON VERTICAL SURFACES AT MID-POINT

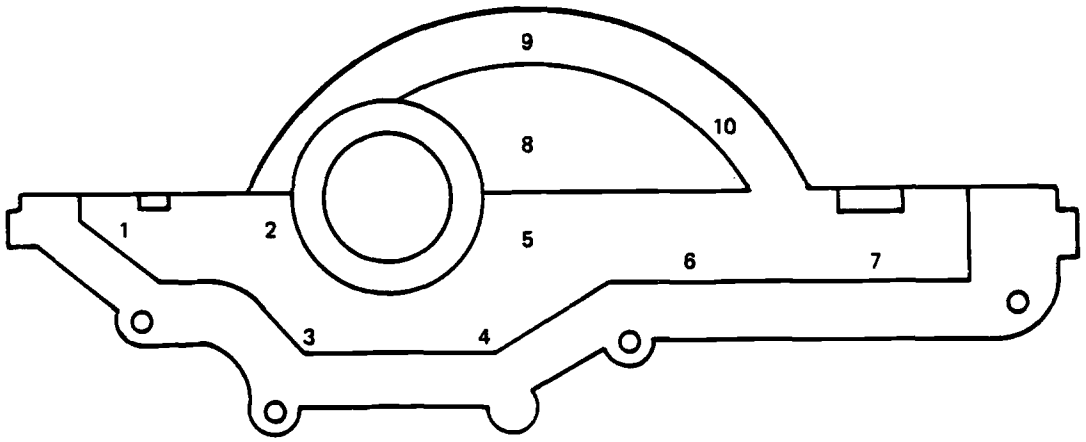
DEPTH SCALE	SITE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL CHECKS	% COVERED	VOLUME FACTOR
CLEAN																							
¼A																							
½A																							
¾A																							
A																							
AB																							
B																							
BC																							
C																							
D																							
E																							
F																							
G																							
H																							
I																							
																				GRAND TOTAL			

INSPECTOR _____ DATE _____ SLUDGE MERIT RATING _____

A6.2
SLUDGE RATING OF FRONT SEAL HOUSING

RATING WORK SHEET NO. 2

SLUDGE RATING OF FRONT SEAL HOUSING



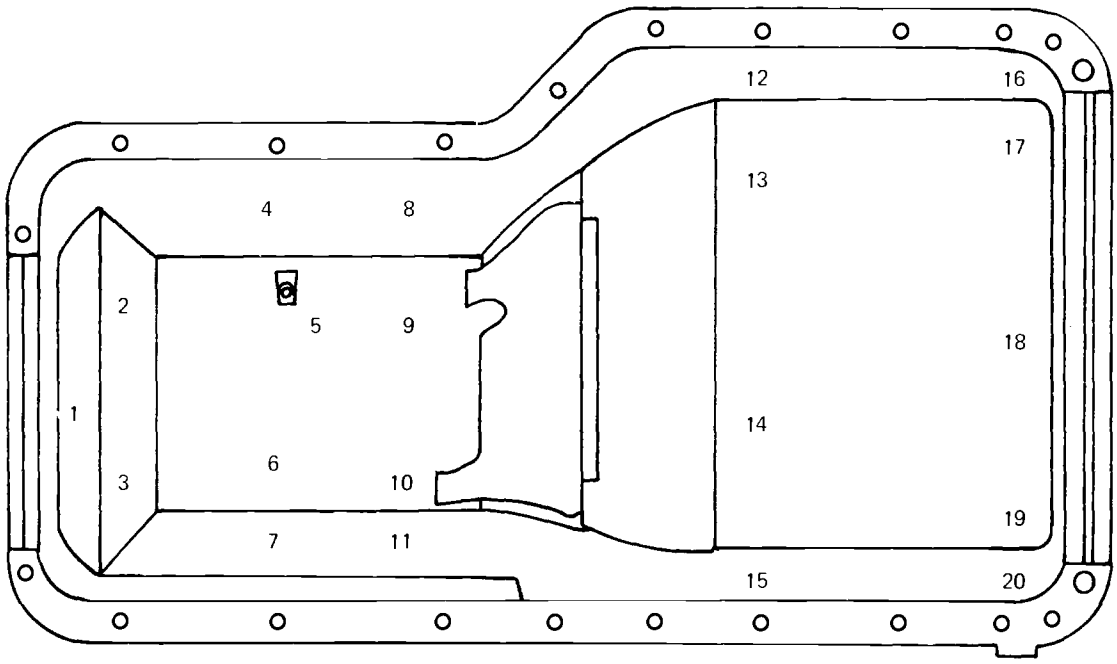
DEPTH SCALE	SITE 1	2	3	4	5	6	7	8	9	10	TOTAL CHECKS	% COVERED	VOLUME FACTOR
CLEAN													
¼A													
½A													
¾A													
A													
AB													
B													
BC													
C													
D													
E													
F													
G													
										GRAND TOTAL			

INSPECTOR_____ DATE_____ SLUDGE MERIT RATING_____

A6.3
SLUDGE RATING OF OIL PAN

RATING WORK SHEET NO. 3

SLUDGE RATING OF OIL PAN



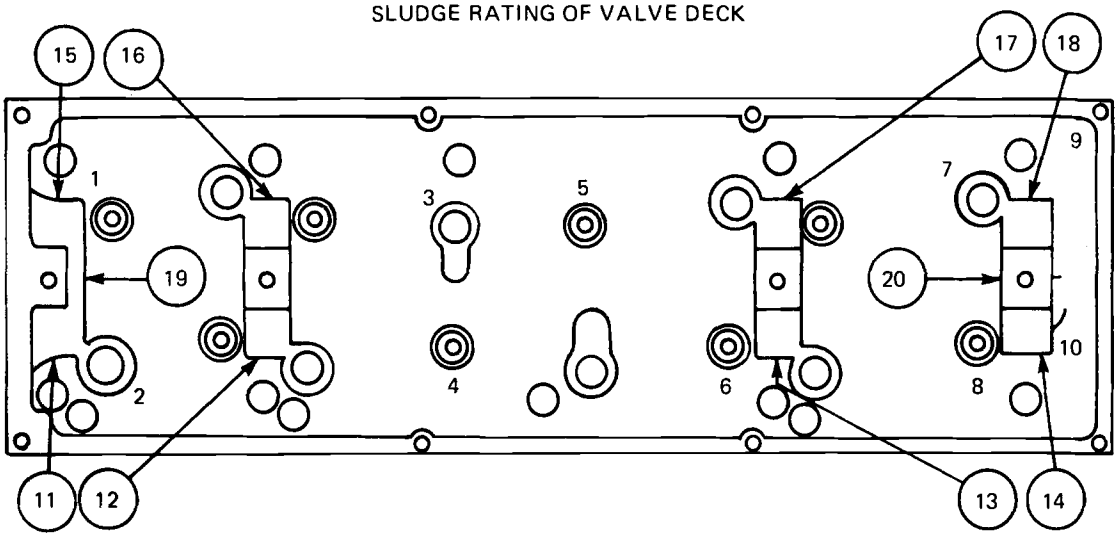
DEPTH SCALE	SITE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL CHECKS	% COVERED	VOLUME FACTOR
CLEAN																							
¼A																							
½A																							
¾A																							
A																							
AB																							
B																							
BC																							
C																							
D																							
E																							
F																							
G																							
																				GRAND TOTAL			

INSPECTOR _____ DATE _____ SLUDGE MERIT RATING _____

A6.4
SLUDGE RATING OF VALVE DECK

RATING WORK SHEET NO. 4

SLUDGE RATING OF VALVE DECK



NOTE: THE RATINGS OF POINTS 11, 12, 13, 14, 15, 16, 17 AND 18 ARE TAKEN AS SHOWN WITH THE EDGE OF THE SLUDGE GAGE RESTING ON THE GASKET MOUNTING SURFACE OF THE HEAD.

THE RATINGS OF POINTS 19 AND 20 ARE TAKEN AS SHOWN AT THE MIDPOINT OF THE MACHINED SURFACE, BELOW THE CAM BEARING.

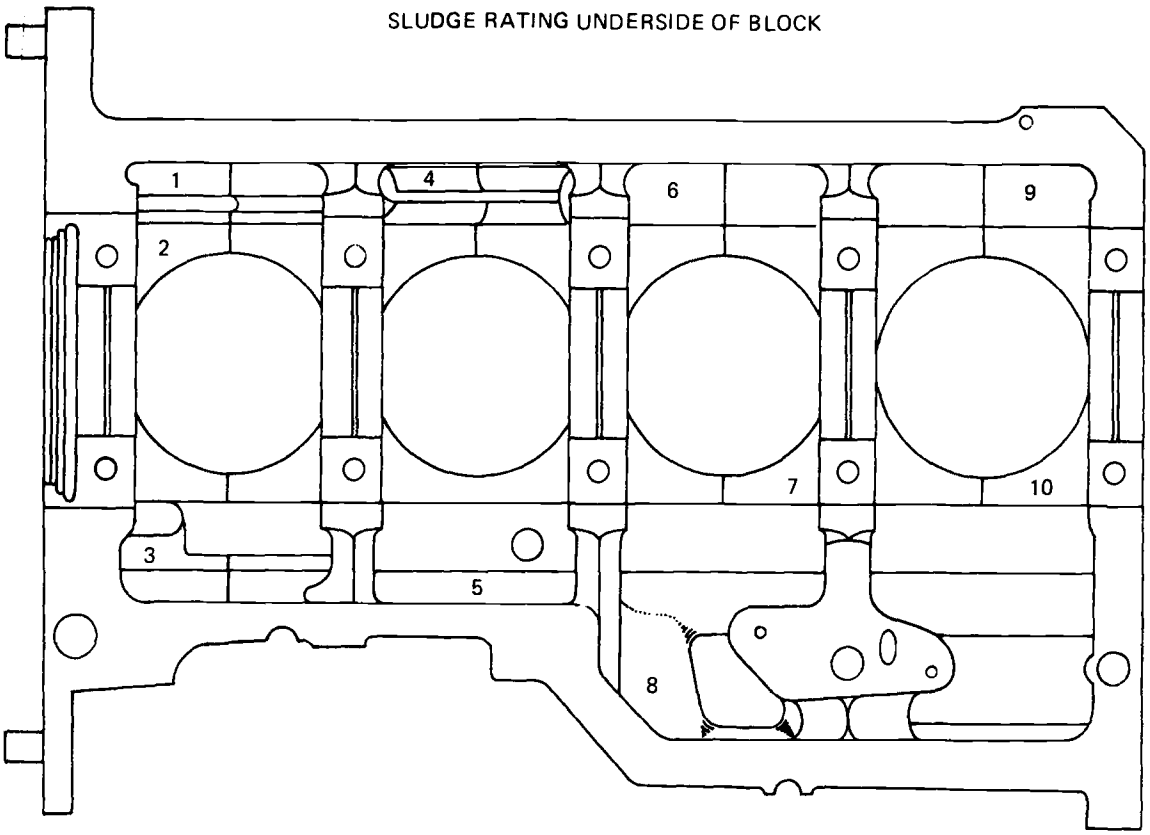
DEPTH SCALE	SITE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL CHECKS	% COVERED	VOLUME FACTOR
CLEAN																							
¼A																							
½A																							
¾A																							
A																							
AB																							
B																							
BC																							
C																							
D																							
E																							
F																							
G																							
																				GRAND TOTAL			

INSPECTOR _____ DATE _____ SLUDGE MERIT RATING _____

A6.5
SLUDGE RATING OF UNDERSIDE OF BLOCK

RATING WORK SHEET NO. 5

SLUDGE RATING UNDERSIDE OF BLOCK



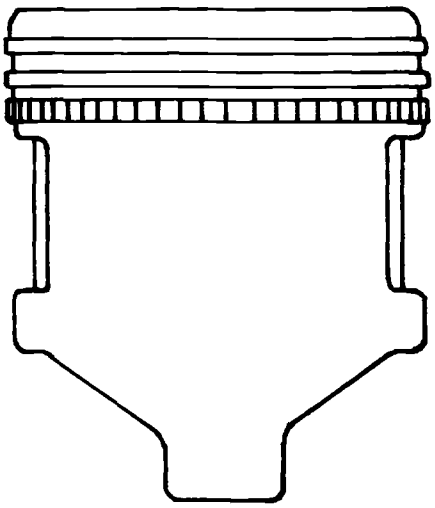
DEPTH SCALE	SITE 1	2	3	4	5	6	7	8	9	10	TOTAL CHECKS	% COVERED	VOLUME FACTOR
CLEAN													
¼A													
½A													
¾A													
A													
AB													
B													
BC													
C													
D													
E													
F													
G													
GRAND TOTAL													

INSPECTOR _____ DATE _____ AVG. MERIT RATING _____

A6.6
VARNISH RATING OF PISTON SKIRTS AND RATING FOR RING STICKING

RATING WORK SHEET NO. 6

VARNISH RATING OF PISTON SKIRTS
AND RING STICKING



VARNISH

PISTON NO.	THRUST	ANTI-THRUST	AVERAGE
1			
2			
3			
4			
TOTAL			
AVERAGE			

STICKING

PISTON	TOP	2ND	OIL
1			
2			
3			
4			
TOTAL			

O = FREE
S = STUCK
T = TIGHT

NOTE: TIGHT RATINGS NOT TO BE USED FOR OIL RINGS.

INSPECTOR: _____

DATE: _____

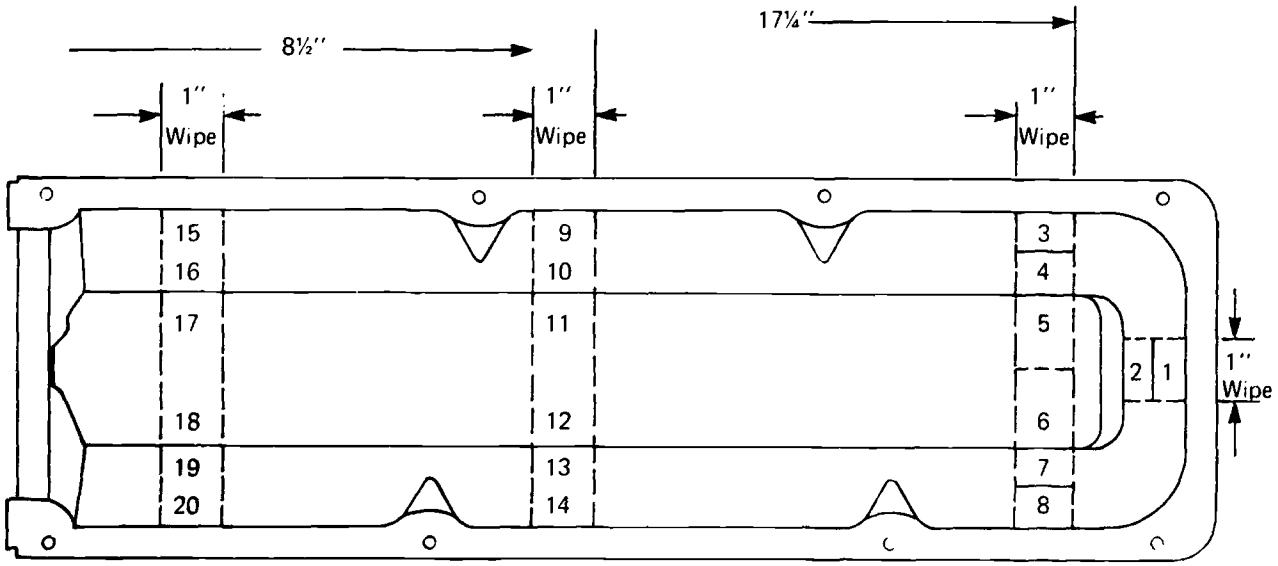
AVG. VARNISH RATING _____

NO. OF STUCK COMP. RINGS _____

A6.7
VARNISH RATING OF ROCKER ARM COVER

RATING WORK SHEET NO. 7

VARNISH RATING OF ROCKER ARM COVER



AREA	RATING
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

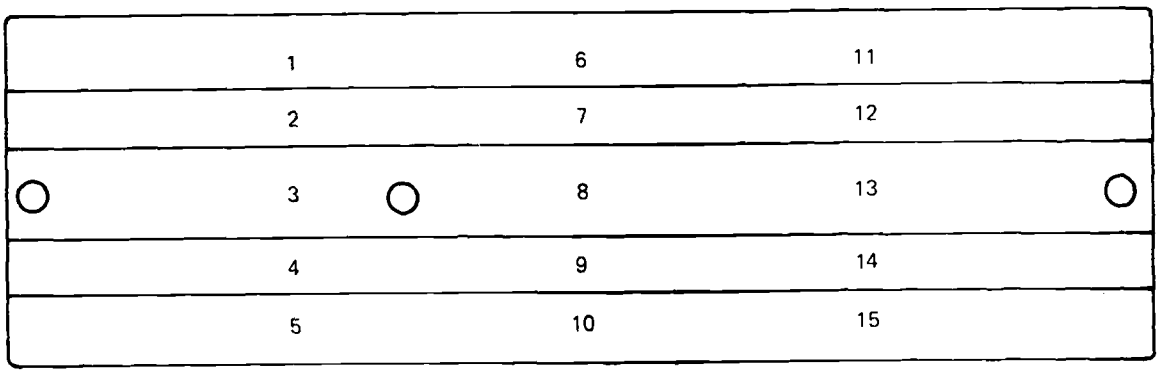
AREA	RATING
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
TOTAL	

INSPECTOR_____ DATE_____ AVG. RATING = $\frac{\text{TOTAL}}{20}$ = _____

A6.8
VARNISH RATING OF CAM COVER BAFFLE

RATING WORKSHEET NO. 8

VARNISH RATING OF CAM COVER BAFFLE



AREA	RATING
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
TOTAL	

INSPECTOR _____

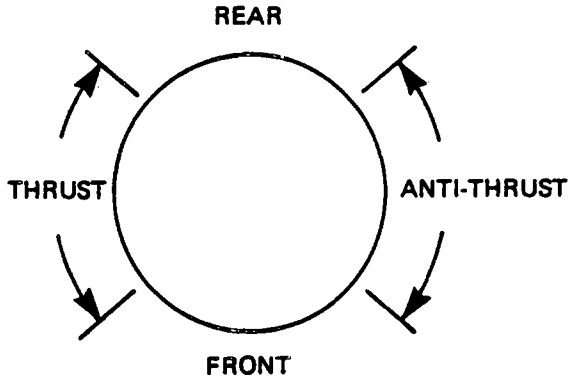
DATE _____

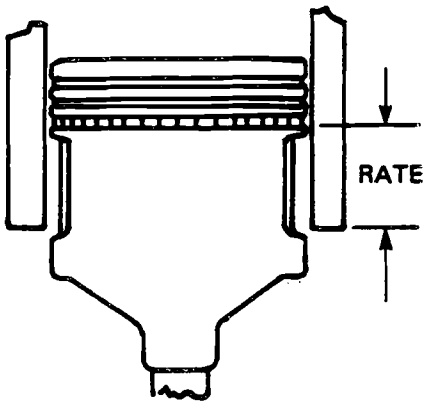
VARNISH RATING = $\frac{\text{TOTAL}}{15}$ = _____

A6.9
VARNISH RATING OF CYLINDER WALLS (BRT)

RATING WORK SHEET NO. 9

VARNISH RATING OF CYLINDER WALLS





CYLINDER NO.	AREA				AVERAGE
	THRUST	ANTI-THRUST	FRONT	REAR	
1					
2					
3					
4					
				TOTAL	

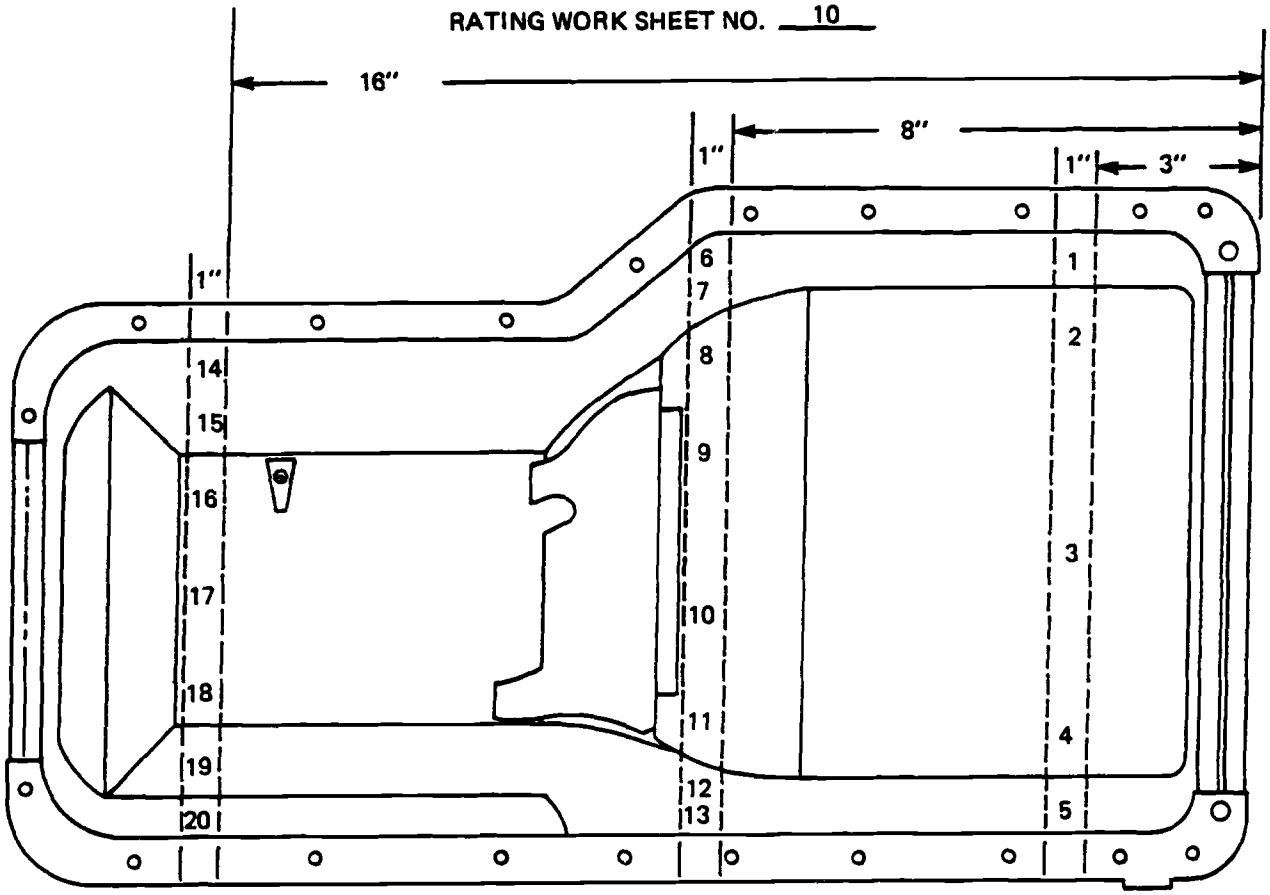
INSPECTOR _____

DATE _____

VARNISH RATING = $\frac{\text{TOTAL}}{4}$ = _____

A6.10
VARNISH RATING OF OIL PAN

RATING WORK SHEET NO. 10



AREA	RATING
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
SUB TOTAL	

AREA	RATING
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
SUB TOTAL	

TOTAL _____

VARNISH RATING = $\frac{\text{TOTAL}}{20}$ = _____

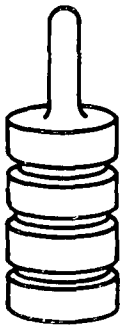
INSPECTOR _____

DATE _____

A6.11
MISCELLANEOUS RATINGS

RATING WORK SHEET NO. 11

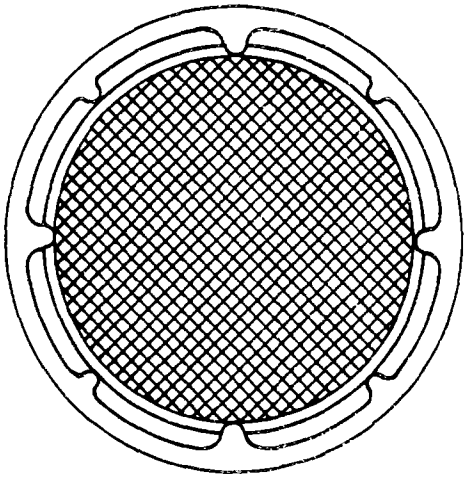
OIL PUMP RELIEF VALVE



VARNISH RATING _____

OIL RINGS, OIL SCREEN, PCV VALVE, OIL PUMP RELIEF VALVE, CAM LOBE HOLES, LASH ADJUSTERS.

OIL SCREEN



% CLOGGING = _____

OIL RINGS

PISTON NO.	% CLOGGING
1	
2	
3	
4	
TOTAL	

% CLOGGING = $\frac{\text{TOTAL}}{4}$ = _____

CAM LOBE OIL HOLE CLOGGING

LOBE #	1E	1I	2E	2I	3E	3I	4E	4I
BASELINE FLOW								
FINAL FLOW								
Δ FLOW								
% REDUCTION*								
CLOGGED (✓)								

LASH ADJUSTERS

ADJUSTER	1E	1I	2E	2I	3E	3I	4E	4I	TOTAL
STUCK BODIES									
CLOGGED									

PCV VALVE

ΔP	FLOW RATE		Δ	% *
IN HG	INITIAL	FINAL	RATE	CLOGGING
18				
8				

* $\left(\frac{\Delta}{\text{INITIAL}}\right)$ X 100 = %

INSPECTOR: _____

DATE: _____

A6.12
INTAKE VALVE DEPOSIT RATING

RATING WORK SHEET NO. 12

INTAKE VALVE DEPOSITS

VALVE	RATING
1	
2	
3	
4	
TOTAL	

AVG. RATING = $\frac{\text{TOTAL}}{4}$ = _____

INSPECTOR _____

DATE _____

A7. Final Report Forms —

A7.1 — Final Test Report Sheet

A7.2 — Reference Oil Test Report Sheet

A7.3 — Piston Skirt Varnish Ratings

A7.4 — Test Operational Summary

A7.5 — Supplemental Operational Data

A7.6 — Special Maintenance Record

A7.7 — Oil Consumption Record

A7.8 — Blowby Data Plot

A7.9 — Oil Analysis Data

A7.10 — Wear Measurement Record

A7.11 — Rocker Arm Cover and Cam Baffle Photographs

A7.12 — Oil Pan and Oil Screen Photographs

A7.13 — Front Seal Housing and Intake Valve Photographs

A7.14 — Piston Skirt Photographs

A7.15 — Cam Lobe Photographs

A7.16 — Follower Arm Photograph

Note A4 — The individual sheets and photograph views listed above are shown sequentially on the immediately following pages and are utilized according to instructions given in Section 14.

A7.1
FINAL TEST REPORT SHEET

FINAL TEST REPORT - SEQUENCE V-D TEST

CLIENT OIL CODE	LAB OIL CODE	SAE GRADE

STAND NO.	STAND RUN NO.	ENGINE NO.	ENGINE RUN NO.

FUEL BATCH	DATE STARTED	DATE COMPLETED	TEST HOURS

CALIBRATION TEST NO.	CALIBRATION OIL CODE	DATE CALIBRATED

SLUDGE DEPOSITS

Rocker Arm Cover	
Front Seal Housing	
Oil Pan	
Valve Deck Area	
Underside of Block	
Avg. Sludge	

VARNISH DEPOSITS

Piston Skirts	
Rocker Arm Cover	
Cam Cover Baffle	
Cylinder Wall (BRT)	
Oil Pan	
Avg. Varnish	

CLOGGING

Oil Ring, %	
Oil Screen, %	
PCV Valve at 18", %	
PCV Valve at 8", %	
Camshaft Lobe Holes, No.	

WEAR

Top Ring Gap Inc. Max. Mils.	
Top Ring Gap Inc. Avg. Mils.	
Rod Brg. Wt. Loss. Max. Mg.	
Rod Brg. Wt. Loss. Avg. Mg.	
Cam Follower Wt. Loss Max. Mg	
Cam Follower Wt. Loss Avg. Mg	
Cam Lobe Wear Max. Mils.	
Cam Lobe Wear Avg. Mils.	

ADDITIONAL INFORMATION

Stuck Comp. Rings, no.	
Stuck Oil Rings, no.	
Stuck Lash Adj Bodies, no.	
Stuck Lash Adj Plungers, no.	

OPRV Varnish, Body	
Intake Valve Deposits, Avg.	
Blowby, cfm, Avg.	
Oil Consumption, qts.	

This test of the oil indicated above was conducted according to the provisions of the Sequence V-D Test procedure and all currently applicable Information Letters. The detail remarks provided in this report describes the deviations and any unusual features associated with this test. In my opinion this was a valid test.

_____ _____
Date

_____
Testing Laboratory

A7.2
REFERENCE OIL TEST REPORT SHEET

REFERENCE OIL TEST REPORT - SEQUENCE V-D TEST

BLIND OIL CODE	INDUSTRY OIL CODE	LAB OIL CODE

STAND NO.	STAND RUN NO.	ENGINE NO.	ENGINE RUN NO.
FUEL BATCH	**DATE STARTED**	**DATE COMPLETED**	**TEST HOURS**

SLUDGE DEPOSITS

Rocker Arm Cover	
Front Seal Housing	
Oil Pan	
Valve Deck Area	
Underside of Block	
Avg. Sludge	

VARNISH DEPOSITS

Piston Skirts	
Rocker Arm Cover	
Cam Cover Baffle	
Cylinder Wall (BRT)	
Oil Pan	
Avg. Varnish	

CLOGGING

Oil Ring, %	
Oil Screen, %	
PCV Valve at 18", %	
PCV Valve at 8", %	
Camshaft Lobe Holes, no.	

WEAR

Top Ring Gap Inc. Max. Mils.	
Top Ring Gap Inc. Avg. Mils.	
Rod Brg. Wt. Loss. Max. Mg.	
Rod Brg. Wt. Loss. Avg. Mg.	
Cam Follower Wt. Loss Max.Mg	
Cam Follower Wt. Loss Avg.Mg	
Cam Lobe Wear Max. Mils.	
Cam Lobe Wear Avg. Mils.	

ADDITIONAL INFORMATION

Stuck Comp. Rings, no.	
Stuck Oil Rings, no.	
Stuck Lash Adj. Bodies, no.	
Stuck Lash Adj. Plungers,no.	

OPRV Varnish, Body	
Intake Valve Deposits, Avg.	
Blowby, cfm, Avg.	
Oil Consumption, qts.	

Target/Reference Statistics

Oil: _____ Date: _____ Test No: _____

	Target	S	AL ±	Δ	Δ/S
AS					
PV					
AV					
ACW					
MCW					

_____
Testing Laboratory

_____
Engineer

A7.3
PISTON SKIRT VARNISH RATINGS

SEQUENCE V-D

Client Oil Code_____Lab Oil Code_____Test No._____

VARNISH RATING OF PISTON SKIRTS

PISTON NO.	THRUST	ANTI-THRUST	AVERAGE
1			
2			
3			
4			
TOTAL			
AVG.			

$$\text{Varnish Rating} = \frac{\text{Average Thrust} + \text{Average Antithrust}}{2} = \_\_\_\_\_$$

_____
Testing Laboratory

A7.4
TEST OPERATIONAL SUMMARY

SEQUENCE V-D TEST OPERATIONAL SUMMARY

TEST NUMBER				DATE COMPLETED								
CLIENT OIL CODE				LABORATORY OIL CODE								
		STAGE I			STAGE II			STAGE III				
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Speed, rpm												
Load, bhp												
Oil	Cooler into engine, °F											
	Engine ΔT (Out-In), °F											
	Pump Gallery, psi											
	Engine Gallery, psi											
	ΔP (Pump-Engine), psi											
	Cyl. Head Gallery, psi											
	ΔP (Engine-Head), psi											
	Cooling, min											
Water	Jacket Outlet, °F											
	ΔT (Out-In), °F											
	Flow, gpm											
	Blowby Heat Exch., °F											
	Marine Manifold, °F											
Carb. Air	Temperature, °F											
	Humidity, grains/lb											
	Pressure, in. H_2O											
Blowby Temperature, °F												
Blowby Rate, cfm												
Crankcase Pressure, in. H_2O												
Ignition Timing, °BTDC												
Intake Manifold Vacuum, in. Hg												
Fuel Flow, lb/hr												
Exhaust Back Press., in. H_2O												
Exhaust Gas Analysis	O_2, %											
	CO, %											
	NO_x, ppm											

Testing Laboratory

A7.5
SUPPLEMENTAL OPERATIONAL DATA

SEQUENCE V-D

SUPPLEMENTAL OPERATIONAL DATA

Client Oil Code_____ **Lab Code**_____ **Test No.**_____

Item	Remarks or Deviation

_____
Testing Laboratory

A7.6
SPECIAL MAINTENANCE RECORD

SEQUENCE V-D TEST SPECIAL MAINTENANCE RECORD

(✓) Part Replacement	(✓) Stand Maintenance	(✓) Unscheduled Shut-down	Test Hours	Stage	Down Time, hrs:min	Lost Time, min	Problem statement/Action taken/Comments

Client or Reference Oil Code _____

Lab Oil Code _____

Test Number _____

_____
Testing Laboratory

A7.7
OIL CONSUMPTION RECORD

SEQUENCE V-D

Oil Code_____Lab Oil Code_____Test No._____

OIL CONSUMPTION RECORD

Quantity of oil drained after breakin_____Oz.

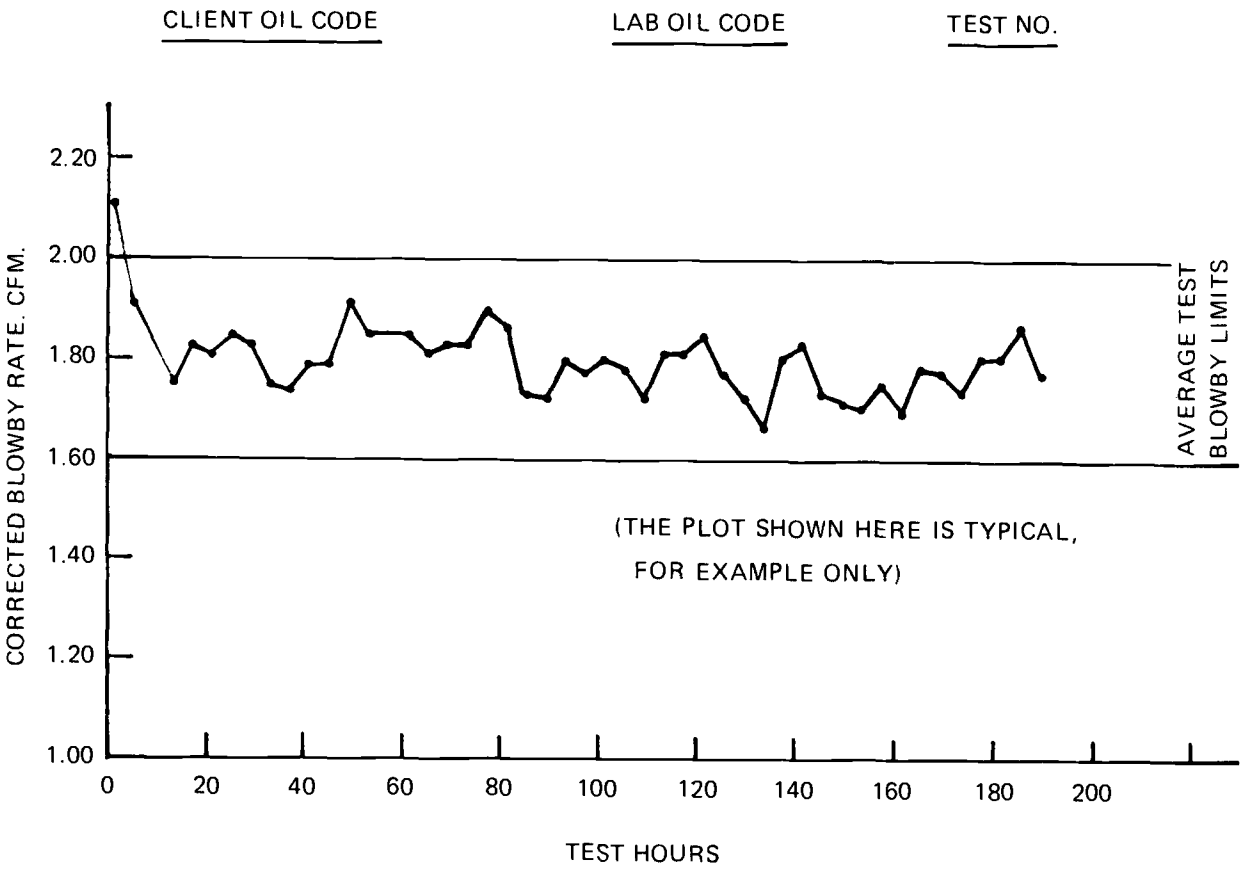
Cycle	Engine Hours	Oil Consumption Oz.	Measured Oil Level
6	23 Hrs. 35 Min.		
12	47 " 35 "		
18	71 " 35 "		
24	95 " 35 "		
30	119 " 35 "		
36	143 " 35 "		
42	167 " 35 "		
48	191 " 35 "		

Total_____

Oil Consumption (Quarts) = $\frac{\text{Total}}{32}$ =_____

_____
Testing Laboratory

A7.8
BLOWBY DATA PLOT



Note: The plotted data are taken at the designated time during each Stage I of the test as recorded on the operational data log sheets. Additional blowby measurements are excluded from the blowby plot and are also excluded from the provisions of 15.2.2.3. Additional blowby measurements must be reported as supplemental operational data (A7.5) with detailed explanation provided.

A7.9
OIL ANALYSIS DATA

OIL ANALYSIS - SEQUENCE V-D

Client Code: _____ Lab Code: _____

Test No: _____ Completion Date: _____

Test Hrs.	Fe PPM	Cu PPM	Si PPM	Vis. 40°C cSt	Fuel Dilution % Vol.
				ASTM D445	ASTM D322
0*					
12					
36					
60					
84					
108					
132					
156					
180					
192					

* New Oil

_____
Testing Laboratory

A7.10
WEAR MEASUREMENT RECORD

WEAR MEASUREMENTS - SEQUENCE V-D

Client Code:_____ Lab Code:_____

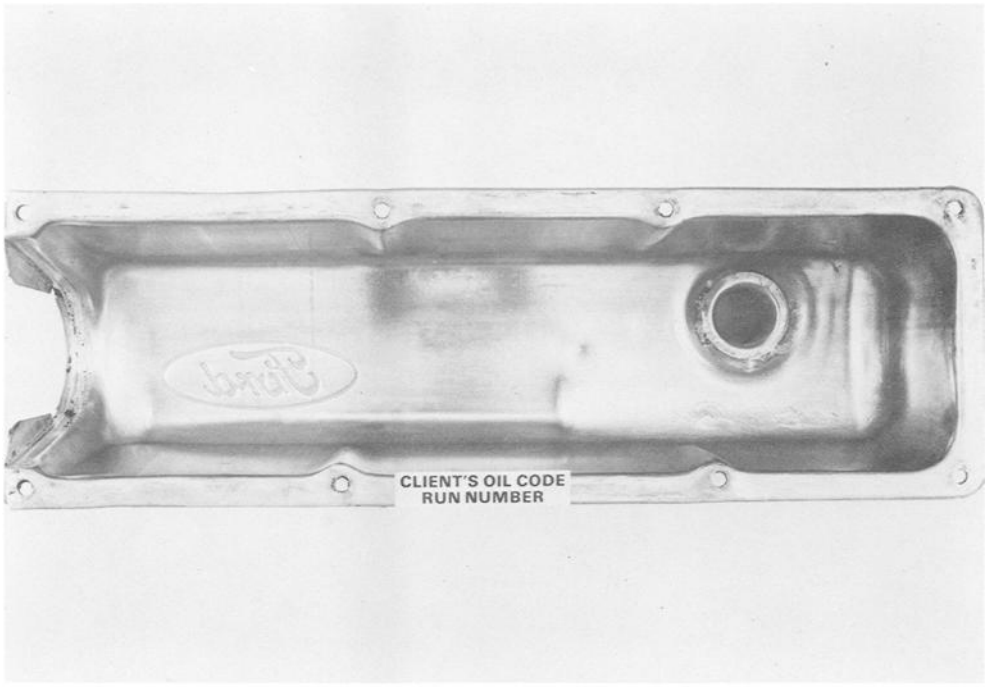
Test No.:_____ Completion Date:_____

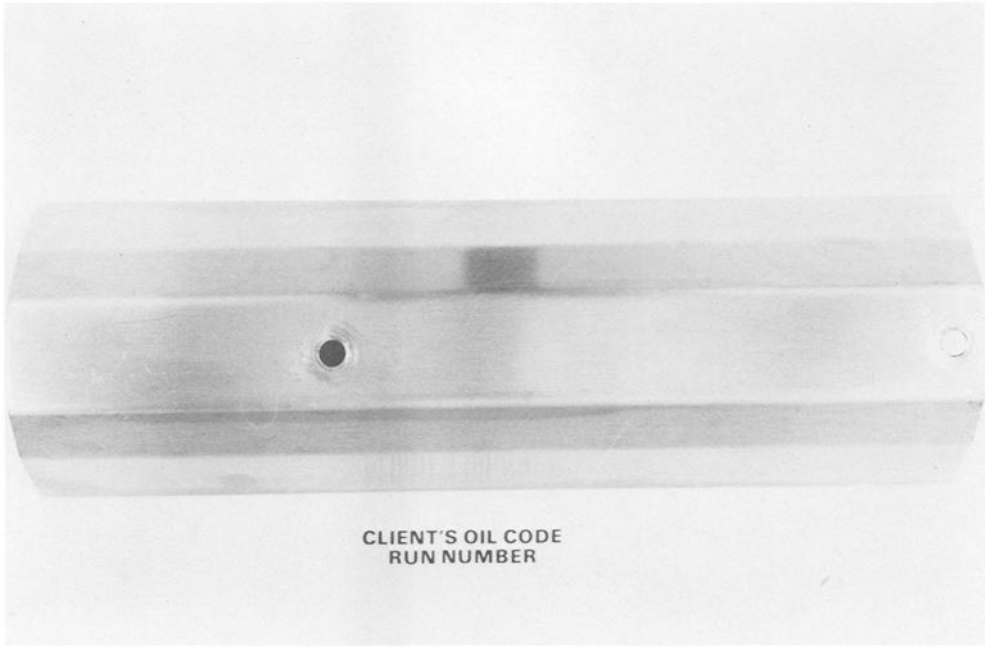
Valve Train Inspection Detail

Position No.	Cam Lobe Wear, in.	Lobe Orifice Plugging (% air flow loss)	Follower Weight Loss, Grams	Valve Spring Load, lb.
1 (1E)				
2 (1I)				
3 (2E)				
4 (2I)				
5 (3E)				
6 (3I)				
7 (4E)				
8 (4I)				
Avg.				

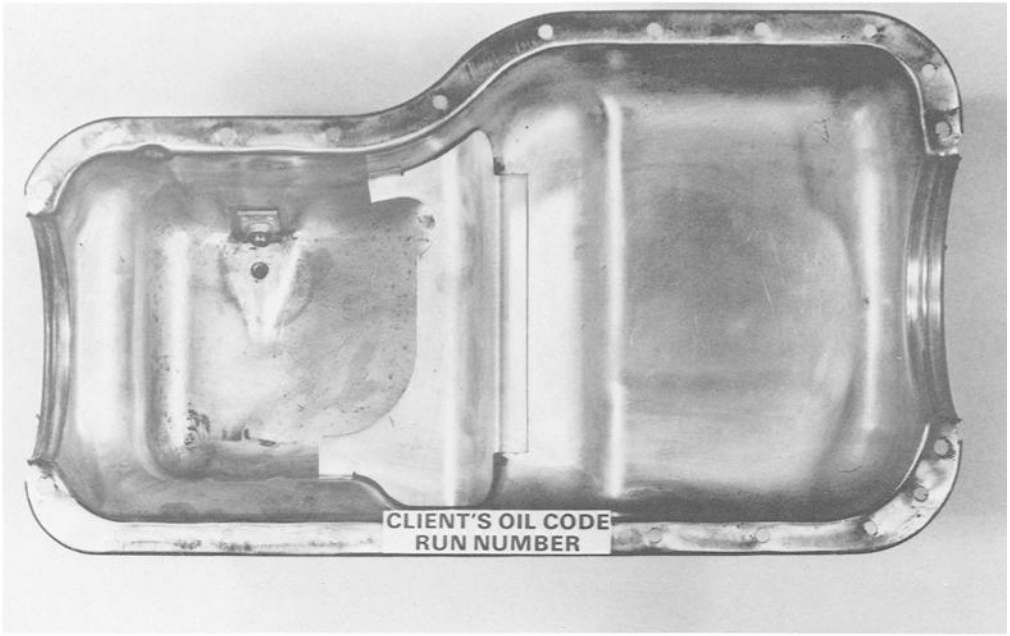
_____
Testing Laboratory

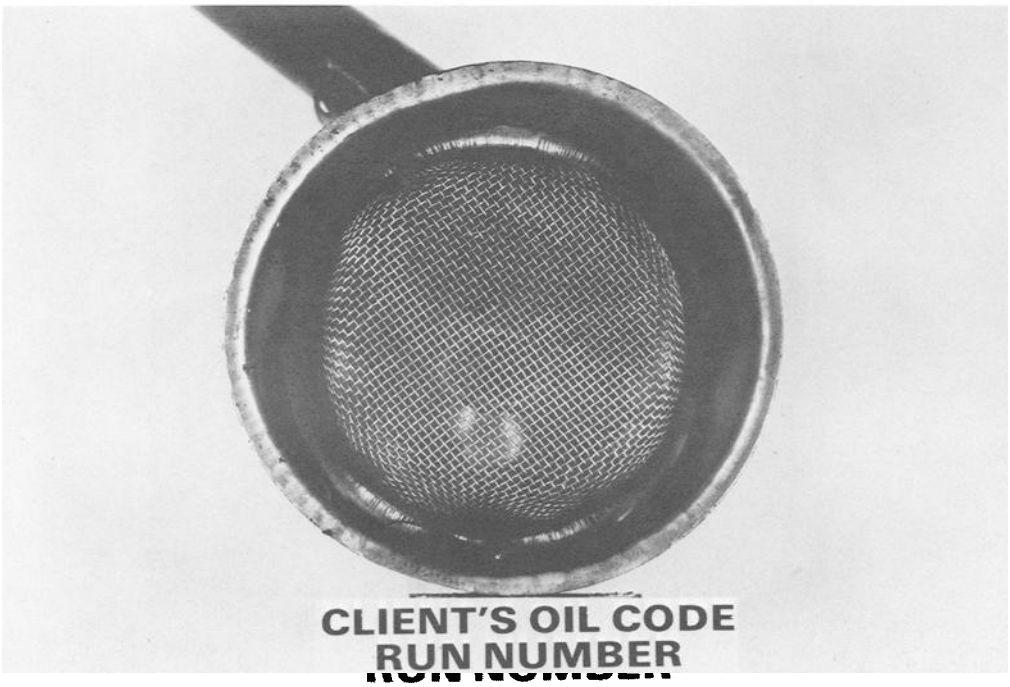
A7.11
ROCKER ARM COVER AND CAM BAFFLE PHOTOGRAPHS



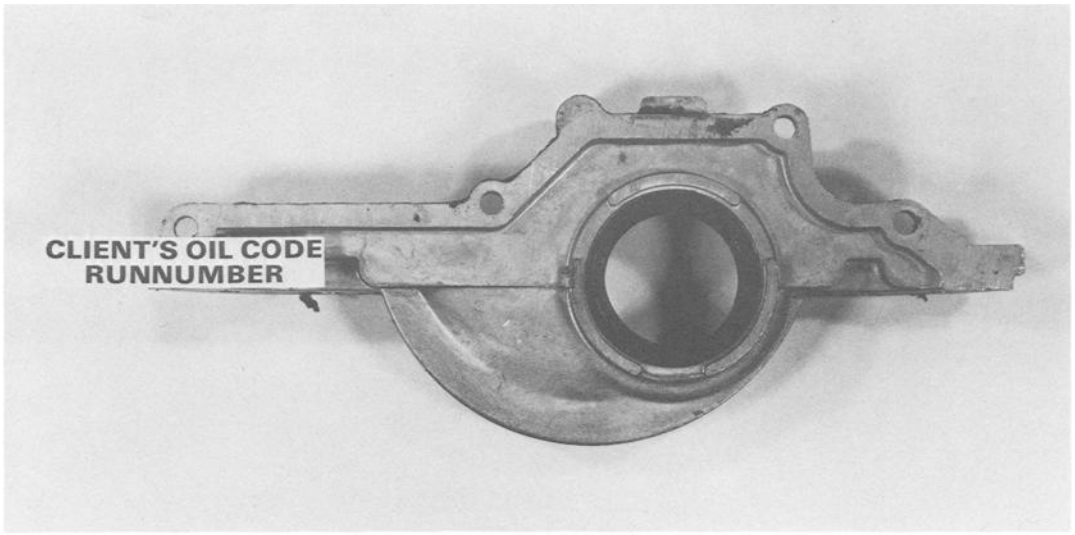


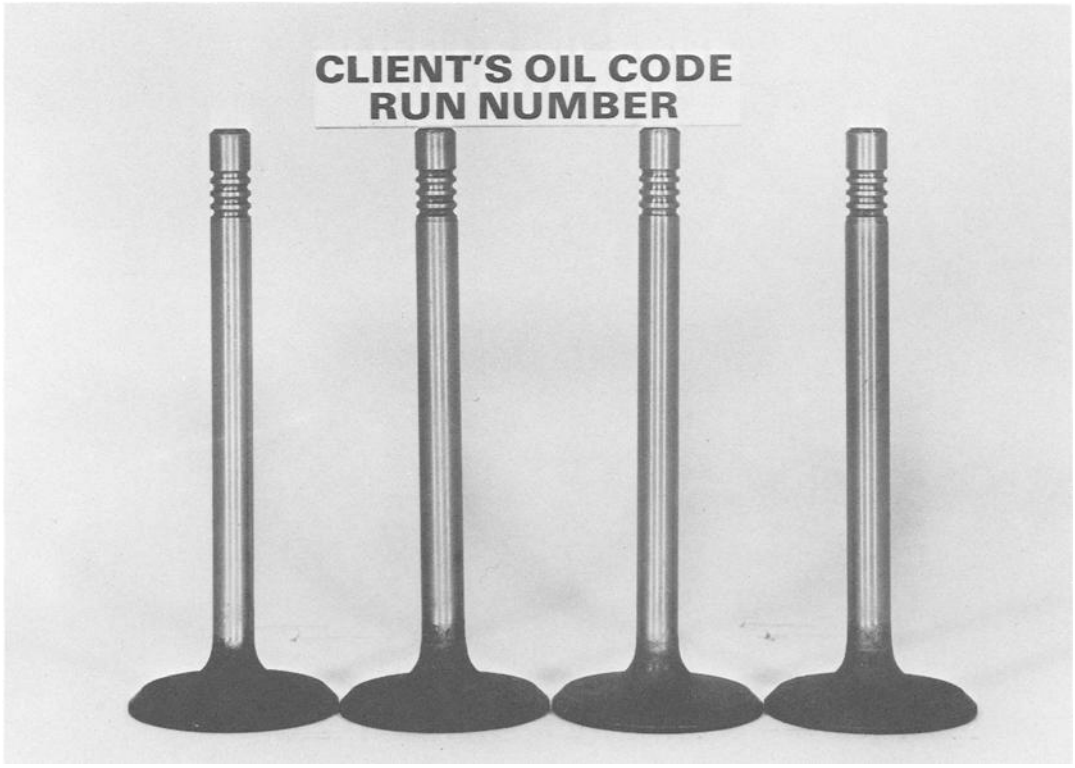
A7.12
OIL PAN AND OIL SCREEN PHOTOGRAPHS





A7.13
FRONT SEAL HOUSING AND INTAKE VALVE PHOTOGRAPHS





A7.14
PISTON SKIRT PHOTOGRAPHS

Note: Designations 2AT, 1WT, etc. exemplify the required labeling.

A7.15
CAM LOBE PHOTOGRAPHS

Note: View is from thrust side of camshaft lobe

A7.16
FOLLOWER ARM PHOTOGRAPH

Note: Best and worst follower determination is based on the measured weight loss of the followers.

A8. Safety Precautions

A8.1 General —

A8.1.1 — The operating of engine tests can expose personnel and facilities to a number of safety hazards. It is recommended that only personnel who are thoroughly trained and experienced in engine testing should undertake the design, installation and operation of engine test stands.

A8.1.2 — Each laboratory conducting engine tests should have their test installation inspected and approved by their Safety Department. Personnel working on the engines should be provided with the proper tools, be alert to common sense safety practices, and avoid contact with moving and/or hot engine parts. Guards should be installed around all external moving or hot parts. When engines are operating at high speeds, heavy duty guards are required and personnel should be cautioned against working alongside the engine and coupling shaft. Barrier protection should be provided for personnel. All fuel lines, oil lines, and electrical wiring should be properly routed, guarded, and kept in good order. Scraped knuckles, minor burns and cuts are common if proper safety precautions are not taken. Safety masks or glasses should always be worn by personnel working on the engines and no loose or flowing clothing should be worn near running engines.

A8.1.3 — The external parts of the engine and the floor area around the engines should be kept clean and free of oil and fuel spills. In addition, the working areas should be free of all tripping hazards. In case of injury, no matter how slight, first aid attention should be applied at once and the incident reported. Personnel should be alert for leaking fuel or exhaust gas. Leaking fuel represents a fire hazard and exhaust gas fumes are noxious. Containers of oil or fuel cannot be permitted to accumulate in the testing area.

A8.1.4 — The test installation should be equipped with a fuel shut-off valve which is designed to automatically cut off the fuel supply to the engine when the engine is not running. A remote station for cutting off fuel from the test stand is recommended. Suitable interlocks should be provided so that the engine is automatically shut down when any of the following events occur: dynamometer loses field current, engine overspeeds, exhaust system fails, room ventilation fails or the fire protection system activates. Fixed fire protection equipment should be provided.

A8.1.5 — ASTM Sequence Tests use chemicals to clean engines between tests. Some of these chemicals require that personnel wear face masks, dust breathers, and gloves as exothermic reactions are possible. Emergency showers and face rinse facilities should be provided when handling such materials.

A8.2 Physical and Chemical Hazards List —

A8.2.1 Hazardous Chemicals and Materials —

- Gasoline
- Oil samples
- Stoddard Solvent
- Pentane
- Organic degreaser (S-26)
- Ethyl Acetate
- Cooling system cleanser (oxalic acid)

A8.2.2 Physical Hazards —

- Hot engine parts (EGR valve + tube, exhaust pipe)
- Rotating engine/test stand parts (belts, pulleys, shafts)
- Engine honing machine operation

A8.3 Hazard Statements —

A8.3.1 Gasoline — (unleaded)

Danger! Extremely Flammable. Vapors Harmful If Inhaled. Vapors May Cause Flash Fire.

Keep away from heat, sparks and open flames.
Keep containers closed; use positive shut off valves on fuel lines.
Use with adequate ventilation.
Avoid buildup of vapors and eliminate all sources of ignition, especially non-explosion proof electrical apparatus and heaters.
Avoid prolonged breathing of vapor.
Avoid prolonged or repeated skin contact.
In case of spillage soak up with clay or diatomaceous earth, or similar materials.
In case of fire use water spray, foam, dry chemical or CO_2.

A8.3.2 Stoddard Solvent —

Caution! Combustible Vapor Harmful.

Keep away from heat, sparks, open flame.
Use with adequate ventilation.
Avoid breathing vapor or spray mist.
Avoid prolonged or repeated contact with skin.
In case of spillage soak up with clay, diatomaceous earth, or similar materials.
In case of fire use foam, dry chemical, or CO_2.

A8.3.3 Oxalic Acid (Cooling System Cleanser) —

Caution! Toxic Substance. Avoid Contact With Eyes, Skin and Clothing.

Do not inhale dust.
Keep away from feed or food products.
In case of contact flush skin or eyes with water.
If swallowed, induce vomiting immediately by giving Ipecac Syrup.

A9. Glossary

A9.1 Blowby — That portion of the combustion reactants and unburned air-fuel mixture which leak into the engine crankcase during operation of the engine.

A9.2 Clogging — Restriction of a flow path due to the accumulation of debris along the flow path boundaries.

A9.3 Corrosion — Any observed chemical attack on the metal parts. Rust is a special case of the corrosion of iron.

A9.4 Lash Adjuster, stuck — One whose fulcrum does not return to its maximum upward travel position when the cam follower arm is removed from the fulcrum.

A9.5 Comp. Ring, free — One that falls of its own weight from side to side in its own groove.

A9.6 Comp. Ring, stuck — One that is either partially or completely bound in its groove.

A9.7 Comp. Ring, tight — One that offers resistance to movement in its groove, but which can be pressed into or out of the groove under finger pressure without springing back.

A9.8 Detonation — An abnormal combustion phenomenon that is characterized by an audible pinging or knocking sound resulting from shock waves propogated from the combustion area.

A9.9 Oil Ring, stuck — One that cannot be manually rotated 360 degrees in the ring groove.

A9.10 Rumble — An abnormal combustion phemomenon that is characterized by an audible throbbing sound resulting from crankshaft vibration.

A9.11 Rust — The chemical combination of oxygen with ferrous engine parts, including other iron complexes not removable by organic solvents.

A9.12 Scoring — A condition resulting from metal to metal contact or foreign matter causing surface roughness in the direction of relative motion characterized by dragging and smearing of the material of one or both surfaces.

A9.13 Scuffing — Adhesive wear which is the result of progressive removal of material from a rubbing surface caused by localized welding and subsequent fracture.

A9.14 Sludge — A deposit, principally composed of engine oil and fuel debris, which does not drain from engine parts but can be removed by wiping with a soft cloth.

A9.15 Varnish — A hard, dry, generally lustrous oil insoluble deposit which cannot be removed by wiping with a soft cloth.

A9.16 Wear — The loss or relocation of material from two or more surfaces in relative motion.

X1. Suggested Engine Measurement Sheets —

X1.1 — Bore, Piston and Ring Measurement Data

X1.2 — Crankshaft, Bearing Clearance, and Miscellaneous Measurement Data

X1.3 — Camshaft Measurement Data

X1.4 — Hardness Measurement Data

X1.5 — Weight Measurement Data

X1.6 — Cylinder Head Measurement Data

X1.7 — PCV Valve Flow Measurement Data

Note X1 — The individual sheets listed above and shown sequentially on the immediately following pages may be utilized according to the requirements of Section 10.

X1.1 BORE, PISTON AND RING MEASUREMENT DATA

SEQUENCE V–D TEST

ENGINE MEASUREMENT RECORDS

FORD 2.3 LITRE ENGINE

ENG. NO. _____

TEST: _____

DATE: _____

CYLINDER BORE MEASUREMENTS

Cylinder	1			2			3			4		
Location	Top	Mid.	Bot.	Top	Mid.	Bot.	Top	Mid.	Bot.	Top	Mid.	Bot.
Long. Dia.												
Trans. Dia.												
Δ												
Max. Δ												
Microfinish												

Limit .0010 in. (.025 mm) Max. Δ Limit .0015 in. (.038mm)

PISTON SELECTION

Cyl.	Mid. & Bottom Avg. Dia.	Less 0.0014 - 0.0022 in. (.036 - .056 mm) Clearance	Selected Piston	
			Diameter	Taper
1				
2				
3				
4				

Bores & Pistons Measured by_____

PISTON RING LAND DATA

Max. Limit .0015 in. (.038 mm)

	Second Ring Land Diameters		
Cyl. No.	Long.	Trans.	Out of Rd.
1			
2			
3			
4			

COMPRESSION RING GAPS

Gaps Ground by _____

Cyl. No.	Top & Mid. Avg. Dia.	Avg. Ring Land Dia.	Land-Wall Clearance	Second Ring Gap	Gap Area	Top Ring Gap
1						
2						
3						
4						

REGAP HISTORY AND RING WEAR DATA

Cyl. No.		Gap @ Hrs.	Opened To	Gap @ Hrs.	Opened To	Gap @ 192 Hrs.	Inc. Due To Wear
1	Top						
	Second						
2	Top						
	Second						
3	Top						
	Second						
4	Top						
	Second						

Rework by _____

X1.2 CRANKSHAFT, BEARING CLEARANCE, AND MISCELLANEOUS MEASUREMENT DATA

SEQUENCE V-D TEST
ENGINE MEASUREMENTS RECORD
FORD 2.3 LITRE ENGINE

Eng. No. _____
Test No. _____
Date _____

CRANKSHAFT MEASUREMENTS

By _____

(60.914 - 60.935 mm) Std. Spec. 2.3982 - 2.3990				Fitted Brg. Clearance
Main Bearing Journals				
No.	Horiz.	Vert.	Out Rd.	
1				
2				
3				
4				
5				

Main and Rod Out Rd. Limit .0006 in. (.015 mm)

(51.979 - 51.999 mm) Std. Spec. 2.0464 - 2.0472				Fitted Brg. Clearance
Connecting Rod Journals				
No.	Horiz.	Vert.	Out Rd.	
1				
2				
3				
4				

Plastigage Rod and Main Bearing Clearances Spec: 0.0008" - 0.0015"

OIL PUMP MEASUREMENTS

Pump No. _____	
	Specification
Oil Pump Rotor End Clearance _____	.004 in. (.10 mm) Max.
Oil Pump Outer Race-Housing Clearance _____	.001 - .013 in. (.02 - .33 mm)
Oil Pump Output Pressure (Bench Test) _____	59 - 61 psi (406.7 - 420.5 kPa)
By _____	

CAMSHAFT END PLAY

____	0.001 - 0.007 in. (0.02 - 0.18 mm) Specification

CON ROD OIL ORIFICE

No.	(1.57 - 1.73 mm) .062 - .068 Specification
1 _____	
2 _____	
3 _____	
4 _____	

X1.3 CAMSHAFT MEASUREMENT DATA

SEQUENCE V-D TEST
ENGINE MEASUREMENTS RECORD
FORD 2.3 LITRE ENGINE

Eng. No. _____
Test No. _____
Date _____

CAMSHAFT NO. _____

Camshaft Lobe Orifice Diameters

Acceptance Specifications:
0.047 - 0.055 in.
(1.19 - 1.40 mm)

Position		Dia.
1	(1E)	
2	(1I)	
3	(2E)	
4	(2I)	
5	(3E)	
6	(3I)	
7	(4E)	
8	(4I)	

Camshaft Oil Delivery Groove

Depth: Max. _____ Min. _____ Acceptance Specifications: 0.035 - 0.051 in. (0.89 - 1.30 mm)

Calculated Avg. _____

Width _____ Acceptance Specifications: 0.095 - 0.105 in. (2.41 - 2.67 mm)

Camshaft Journal Through Hole Diameter

Dia. _____ Acceptance Specifications: 0.116 - 0.124 in. (2.95 - 3.15 mm)

Measured by _____

Camshaft Lobe Measurements

Acceptance specifications:
1.4200 - 1.4290 in. (36.07 - 36.30 mm)

		MIDDLE OF LOBE
No. 1 Exhaust	Before	
	After	
	Difference	
No. 1 Intake	Before	
	After	
	Difference	
No. 2 Exhaust	Before	
	After	
	Difference	
No. 2 Intake	Before	
	After	
	Difference	
No. 3 Exhaust	Before	
	After	
	Difference	
No. 3 Intake	Before	
	After	
	Difference	
No. 4 Exhaust	Before	
	After	
	Difference	
No. 4 Intake	Before	
	After	
	Difference	

Before Measurements by _____

After Measurements by _____

Max. diff. _____ Min. diff. _____
Avg. diff. _____

X1.4 HARDNESS MEASUREMENT DATA

SEQUENCE V-D TEST
ENGINE MEASUREMENTS RECORD
FORD 2.3 LITRE ENGINE

Eng. No. _____
Test No. _____
Date _____

HARDNESS—ROCKWELL "C"

Camshaft No. _____ Follower Set No. _____

Position No.	**Camshaft Lobes** 180° from Max. Lift Point	**Cam Followers** Pad Surface Pivot End
1 (1E)		
2 (1I)		
3 (2E)		
4 (2I)		
5 (3E)		
6 (3I)		
7 (4E)		
8 (4I)		
	Test Specification 50 min.	Test Specification 57 min.

Measured by _____

X1.5 WEIGHT MEASUREMENT DATA

SEQUENCE V-D TEST
ENGINE MEASUREMENTS RECORD
FORD 2.3 LITRE ENGINE

Eng. No. _____
Test No. _____
Date _____

ROD BEARING WEIGHTS

ID _____

Rod. No.	Weight Before Test	Weight After Test	Loss	Total
1 Top				
1 Bottom				
2 Top				
2 Bottom				
3 Top				
3 Bottom				
4 Top				
4 Bottom				

Before Measurements by _____ Avg. loss _____
After Measurements by _____

CAM FOLLOWER WEIGHTS

ID _____

	1. 1E	2. 1I	3. 2E	4. 2I
Before				
After				
Difference				
	5. 3E	6. 3I	7. 4E	8. 4I
Before				
After				
Difference				

Before Measurements by _____ Max. difference _____
Min. difference _____
After Measurements by _____ Avg. difference _____

X1.6 CYLINDER HEAD MEASUREMENT DATA

SEQUENCE V-D TEST
ENGINE MEASUREMENTS RECORD
FORD 2.3 LITRE ENGINE

Eng. No. _____
Test No. _____
Date _____

VALVE SPRING MEASUREMENTS

Head No. _____

Position No.	Spring Free Length	Spring Out-of Square	Spring Force at 1.16 in. (29.46 mm)	Assembled Spring Height
1 (1E)				
2 (1I)				
3 (2E)				
4 (2I)				
5 (3E)				
6 (3I)				
7 (4E)				
8 (4I)				
Specifications	Approx. 1.82 in. (48 mm)	Max: 5/64 in. (2 mm)	167 ± 8 lb. (75.7 ± 3.6 kg)	1.56 ± 0.03 in. (39.6 ± 0.8 mm)

Measured by _____

VALVE STEM TO GUIDE CLEARANCE

Cylinder		Valve Guide Dia.	Valve Stem Dia.	Difference
1	Exh.			
	Int.			
2	Exh.			
	Int.			
3	Exh.			
	Int.			
4	Exh.			
	Int.			

Total Clearance measured must be.
Exhaust — .0019 - .0032 in. (0.048 - 0.081 mm)
Intake — .0014 - .0027 in. (0.035 - 0.068 mm)

Measured by _____

X1.7 PCV VALVE FLOW MEASUREMENT DATA

SEQUENCE V-D TEST
ENGINE MEASUREMENTS RECORD
FORD 2.3 LITRE ENGINE

Eng. No. _____
Test No. _____
Date _____

EV-77B PCV VALVE FLOW MEASUREMENT

Observer	Differential Pressure, in Hg		0	2	4	6	8	10	12	14	16	18	20
	Before Test	ΔP											
		CFM											
	After Test	ΔP											
		CFM											

X2 Procurement of Materials

The itemized information presented here is not intended to represent an exclusive or complete listing of required materials. This information is presented for the sake of convenience only.

X2.1 Aeroquip Hose and Fittings — Aeroquip hose and fittings are specified for the external oil cooling system. Aeroquip products are available through local distributors or:

Aeroquip Corporation
Van Wert, Ohio 45891

X2.2 Hardness Tester Fixtures and Other Special Test Hardware — Available from:

Concept Engineering Inc.
P.O. Box 29625
San Antonio, Texas 78229
Attn: Mr. John W. Knight
Telephone: (512) 349-4300

X2.3 Fuel — For procurement of fuel, communications may be referred to:

Phillips Petroeum Company
13-D3 Phillips Building
Bartlesville, Oklahoma 74004
Attn: Mr. George Donovan
Telephone: (918) 661-5423

For ordering fuel, purchase orders should be directed to:

Phillips Petroleum Company
367 Adams Building
Bartlesville, Oklahoma 74004
Attn: Harry L. Colopy
Telephone: (918) 661-4196

X2.4 Water-Cooled Exhaust Manifolds — The exhaust manifold utilized for test purposes is manufactured by:

Edelbrock, Inc.
4411 Coral Circle
El Segundo, California 90245
Telephone: (213) 322-7310

X2.5 Engine Coolant Flowmeters — Barco flowmeters may be ordered under part number BR 12705-16-31. Barco master read-out units may be ordered from the same source. Orders should be directed to:

Aeroquip Corporation
AMB Division/Industrial Products
300 Southeast Avenue
Jackson, Michigan 49203

X2.6 Intake Air Humidity Instrumentation — An instrument such as the Alnor 7300 Dewpointer has been found satisfactory. Available from:

Illinois Testing Laboratory Inc.
420 North LaSalle Street
Chicago, Illinois 60610

Instrumentation manufactured by EG&G and Foxboro has also been considered suitable.

X2.7 Blowby Meter — Information regarding the specified blowby meter may be obtained by contacting:

Research Laboratories
General Motors Technical Center
Fuels and Lubricants Department 21
Warren, Michigan 48090
Attn: R. H. Kabel
Telephone: (313) 575-2827

X2.8 Heat Exchangers — Orders for American Standard and Ross heat exchangers may be placed with your area representative for these products. One such representative is:

Kinetics Engineering Corporation
2300 West Loop South, Suite 280
Houston, Texas 77027
Attn: Earl Harris
Telephone: (713) 621-9711

X2.9 Fuel Flow Measurement — A model 10,000 Flo-tron linear mass flowmeter may be utilized for monitoring fuel flow. Ordering information can be obtained from:

Flo-tron, Inc.
495 East 30th Street
Paterson, New Jersey 07504

X2.10 Exhaust Gas Analysis Instrumentation — Exhaust gas analysis equipment which meets the procedural requirements may be obtained from the following manufacturers:

For carbon monoxide:

Beckman Model 865 (0-10%)
Beckman Instruments, Inc.
Fullerton, California 92634
Horiba Mexa 221 (0-10T), Horiba, Inc.
1021 Duryea, Irving Industrial Complex
Irving, California 92714
Intertech Type CG-CO-T
Model 5611-131 (0-10%)
Intertech Corporation
Princeton, New Jersey 08540

For oxygen:

Beckman Model 715 Process Oxygen Monitor
Scott Oxygen ANALYZER Model 250
Scott Environmental Systems
Division of ETC, Countyline Industrial Park
South Hampton, Pennsylvania 08966

Teledyne 320 B/RC
Teledyne Analytical Instruments, Inc.
333 West Mission Drive
San Gabriel, California 91776
Telephone: (213) 283-7181

For oxides of nitrogen: Beckman Model 951

X2.11 Exhaust Gas Analysis Instrumentation Calibration — Information regarding calibration gases for exhaust gas analysis equipment may be obtained from:

Scott Environmental Technology, Inc.
Route 611
Plumbsteadville, Pennsylvania 18949

X2.12 Magnehelic Pressure Gages — Available through:

Dwyer Instrument Co.
P. O. Box 373
Michigan City, Indiana 46360

X2.13 Condensate Traps — Meriam Instrument's Model 932S trap has been found appropriate for use with engine test stands.

Meriam Instrument
10920 Madison Ave.
Cleveland, Ohio 44102
Telephone: (216) 281-1100

X2.14 Engine Coolant — Ordering information for Nalcool 2000 Engine Cooling System Treatment may be obtained from:

Nalcol Chemical Company
Industrial Division, Specialty Chemicals
180 North Michigan Avenue
Chicago, Illinois 60601

The treatment is available in cases containing 12 1-pint bottles and in 5-, 15-, and 55-gal non-returnable steel drums.

X2.15 Cooling System Flushing Agents — Flush and neutralizer may be obtained in bulk form from several sources, or "DuPont Heavy-Duty Cooling System Cleanser and Neutralizer" may be used. Contact suppliers of DuPont products for ordering information. Maintain specified ratios of cleanser/system capacity and neutralizer/system cleanser when using pre-packaged material.

X2.16 Protective Oils — Both Rubilene S-315 and Rubilene 1200 are available from local distributors for the Atlantic Richfield Company. EF-411 and Vacmul 3-D are available from local distributors of Mobil products.

X2.17 Piston Ring Grinder — Information regarding a suitable piston ring grinder may be obtained from:

Sanford Manufacturing Company
P. O. Box 1124
Rahway, New Jersey 07065
Purchasers should specify the Ford 2.3 litre engine application for this equipment.

X2.18 Hardness Tester — A suitable hardness tester may be ordered from:

King Tester Corp.
510 Feheley Drive
King of Prussia, Pennsylvania 19406
Attn: Jas. Mullen
Telephone: (215) 279-6010

X2.19 Pistons and Rings — Piston and pin sets must be ordered from:

Dana Corp., Perfect Circle
P. O. Box 666
Pueblo, Colorado 81002
Attn: Sue Christie
Telephone: (303) 948-3311

Rings must be ordered from:

Dana Corp., Perfect Circle
P. O. Box 1166
Richmond, Indiana 47374
Attn: Ms. Cleo Teel/Joan Innis
Telephone: (317) 966-8111

X2.20 Connecting Rod Heater — The Sunnen Model CRH-50 rod heater provides a convenient and effective means of installing piston pins with minimum heat exposure to the rods.

Sunnen Inc.
7910 Manchester
St. Louis, Mo. 63143
Telephone: (314) 781-2100

X2.21 Tygon Hose — Tygon hose of formulation No. B-44-3 is stable in the temperature range—40°F to 215°F (-40°C to -102°C). Tygon hose is available through Local Cadillac Plastic Co. distributors or:

The Norton Company
12 East Ave.
Tallmadge, Ohio 44278 (1-800-321-9634)

X2.22 Norgren Miniature Filter/Line Trap. Model F-04 — Available through:

Leo J. Schindler Co., Inc.
Box 35363
Dallas, TX 75235

X2.23 Rating Lamps — Ratings lamps meeting specifications are available from:

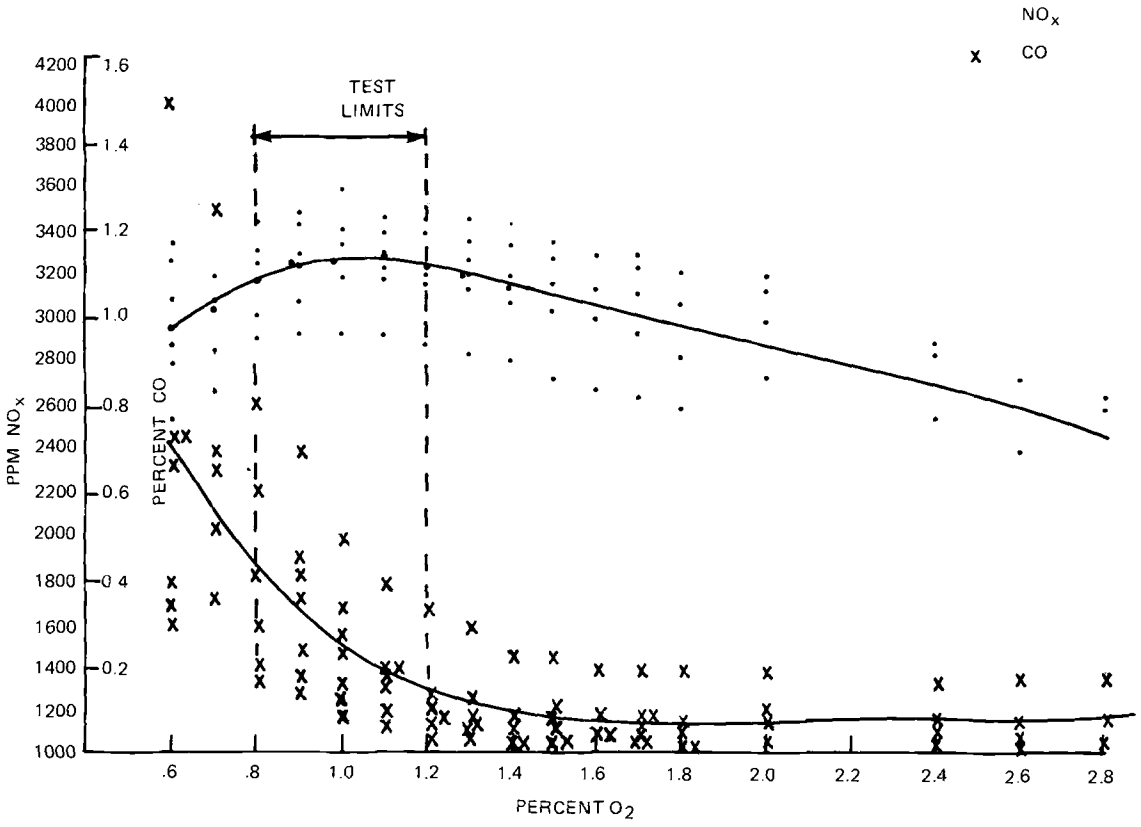
Dazor Manufacturing Corporation
4455 Duncan Avenue
St. Louis, Missouri 63110

X3. Typical Analysis of Phillips "J" Fuel

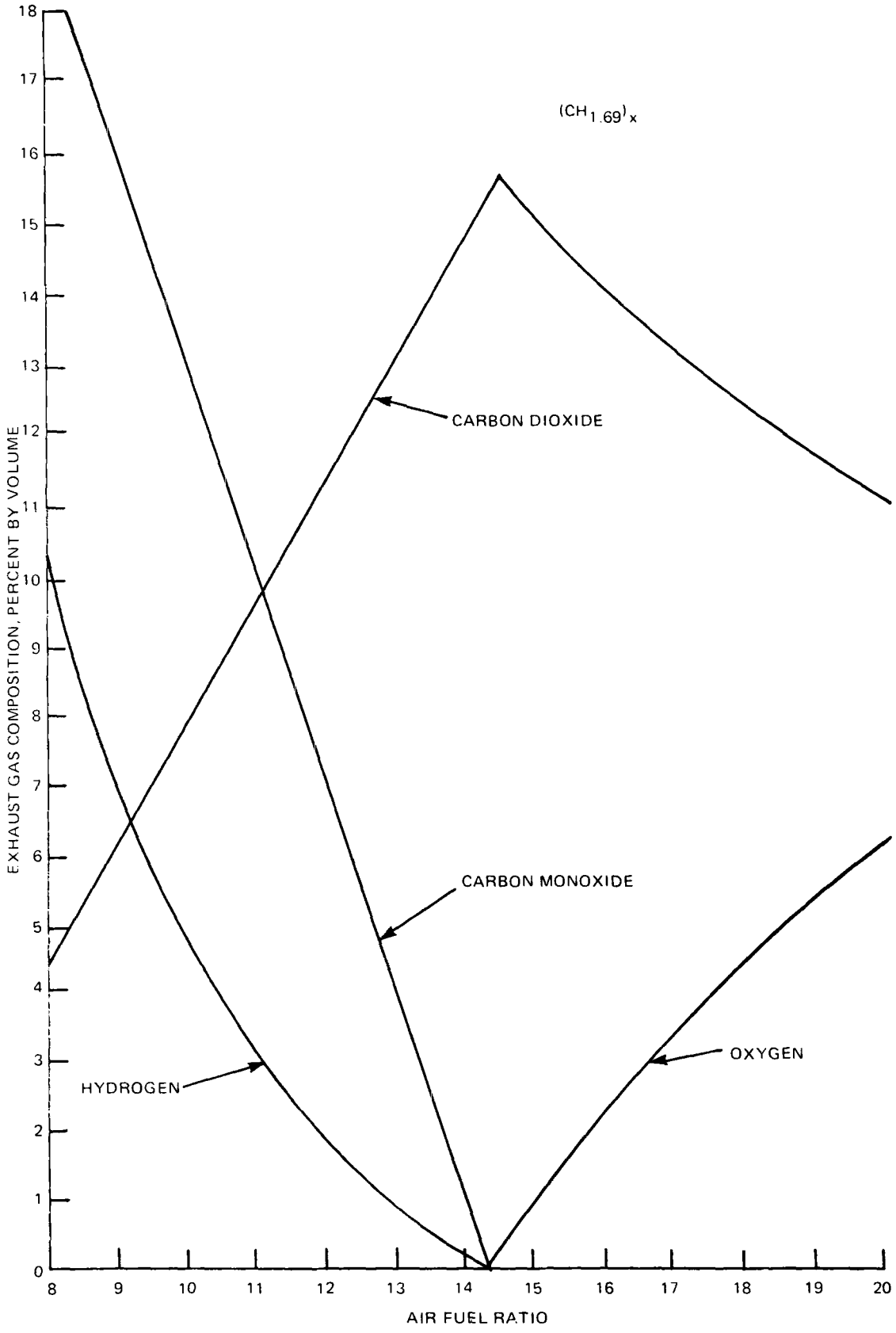
	Batch 7	Batch 8
X3.1 —		
Gravity API, 60°F (15.6°C)	53.3	52.6
Gravity, Specific, 60°F/60°F	0.7657	0.7686
Pounds per Gallon, 60°F	6.375	6.399
Color	Undyed	Undyed
Doctor Test	Negative	Negative
X3.2 —		
Copper Corrosion, 3 hrs. at 212°F (100°C)	1-A	1-A
Reid Vapor Pressure	8.0	8.5
Research Octane Number	95.9	96.6
Motor Octane Number	84.4	85.2
(R + M)/2	90.5	90.9
X3.3 —		
Total Sulfur, Wt. %	0.011	0.009
Gum, mg/100 ml	0.8	0.2
Oxidation Stability, Min.	1600+	1600+
Lead, gms/gal	Less than 0.001	Less than 0.001
Phosphorous, gms/gal	Less than 0.001	Less than 0.001
Iron, ppm	Less than 0.1	Less than 0.1
X3.4 —		
Distillation, % Evap.,°F, (°C)		
IBP	89 (31.7)	96 (35.6)
10%	120 (48.9)	128 (53.3)
50%	222 (105.6)	226 (107.8)
90%	320 (160.0)	320 (160.0)
E.P.	414 (212.2)	417 (213.9)
Recovery, %	98.5	98.0
Residue, %	0.5	1.0
X3.5 —		
PONA, Vol. %		
Parafins + Naphthenes	42.8	42.0
Olefins	11.6	11.0
Aromatics	45.6	47.6

X4 SIGNIFICANCE OF EXHAUST GAS ANALYSIS

X4.1 NO_X AND CO EXHAUST GAS CONCENTRATIONS—STAGES I AND II PHILLIPS "J" BATCHES 7 AND 8



X4.2 THEORETICAL EXHAUST GAS RELATIONSHIPS PHILLIPS "J" REFERENCE FUEL



X5. Description of Scott Quarterly Gas Audit Service

X5.1 — Four times a year (once every three months), Scott can prepare for each subscriber to the Carbon Monoxide (CO) Audit Service, one cylinder containing approximately 200 cubic feet of a CO in nitrogen mixture. Scott's exclusive Acublend ™ process can be employed to guarantee that the CO concentration in each subscriber's cylinder is within ±1 percent of the others. The CO concentration for each quarterly service and each cylinder will be known precisely by Scott.

X5.2 — Cylinders for all subscribers will be shipped simultaneously each quarter on a prescheduled date. The subscribers will only know that the cylinder contains a CO in nitrogen mixture in the concentration range of 0.1 percent to 0.4 percent by volume. Upon receipt of the cylinder it will be the subscriber's responsibility to analyze the cylinder using the instruments employed during the low temperature sludge and varnish tests and report the analytical results to Scott within one week following receipt of the cylinder. Report forms designed for this purpose will be provided with each cylinder. To obtain maximum benefit from the service, it is recommended that the cylinder be analyzed by introducing the gas through both the calibration port and sample inlet system of the analyzer. The report form will have provisions to report the two analyses independently.

X5.3 — Upon receipt of the analytical results, Scott will prepare and submit a formal report to each subscriber showing the test results of each laboratory. The report will also provide Scott's analysis of each cylinder, a chart showing the distribution of analysis received, and the results of a statistical analysis showing the average, median, range, standard deviation, and standard error of the results reported.

X5.4 — A decal and analysis tag showing Scott's analysis and the group average will be provided with each copy of the final report. These tags are provided for installation on each subscriber'scylinder so that they may be used as primary calibration standards until returned to Scott.

X5.5 — Each subscriber will be able to increase his analytical accuracy and isolate problem areas by comparing his test results with the average of the industry. In the majority of cases, it is anticipated that differences in analytical results obtained when introducing the gas at the sample inlet and calibration ports will be a consequence of operating procedures, leaks in the sampling system or losses resulting from improper design of the same. Differences between a specific laboratory and the industrial average will in general indicate deficiencies in the analyzer or the quality of the gas mixtures used to calibrate the same.

X5.6 — A similar service is available using oxygen instead of carbon monoxide. For further information, inquiries should be addressed to:

Scott Environmental Technology, Inc.
Route 611
Plumsteadville, Pennsylvania 18949