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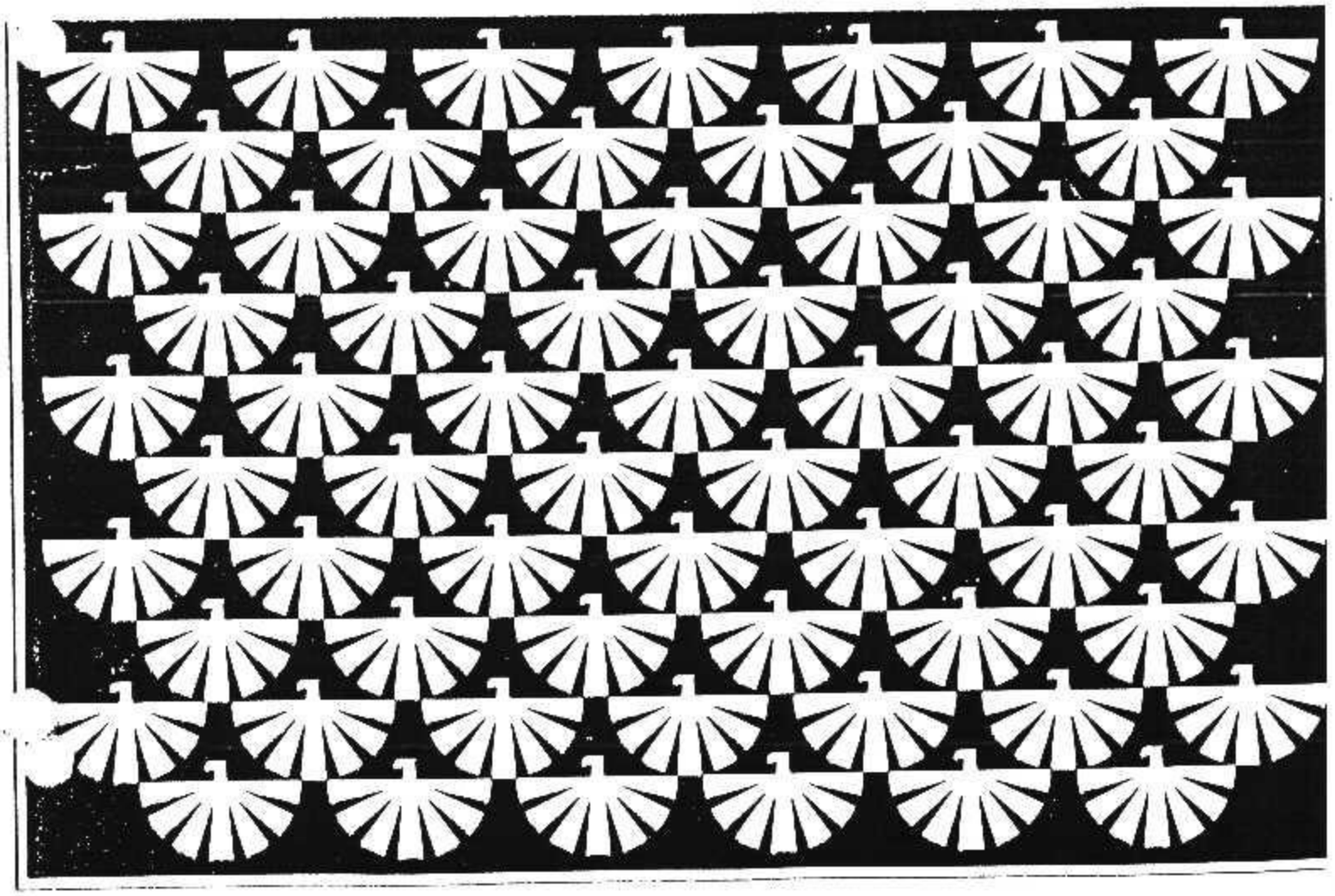
Product Manua

801 Series Inverted Oil System

Manual Issue C



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801 Series Inverted Oil System

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CHRISTEN INDUSTRIES, INC.
AIRCRAFT MANUFACTURING DIVN.
P.O. BOX 547, AFTON, WY 83110
(307) 886-3151

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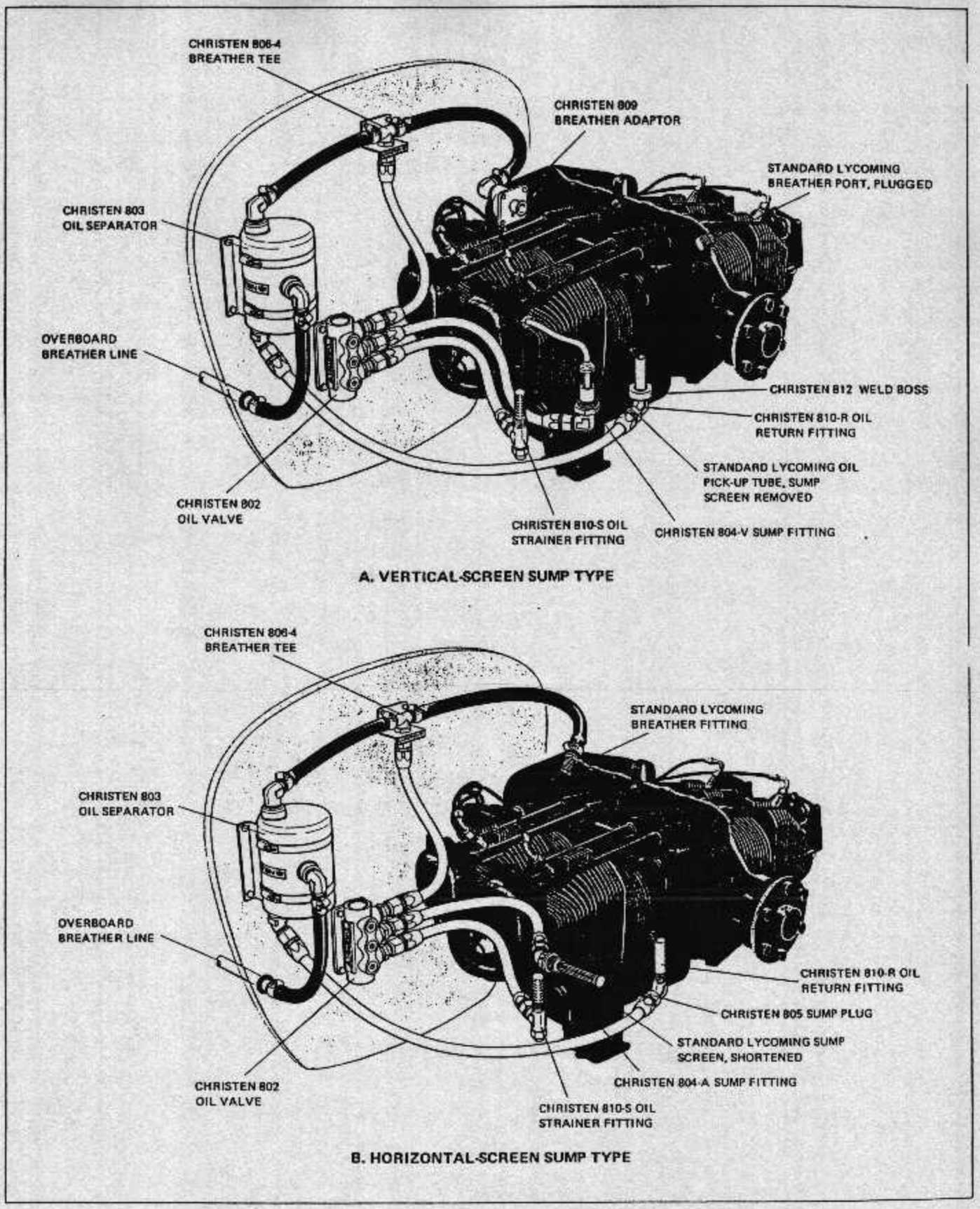


Figure 1-1. Christen 801 Inverted Oil System, Typical Installation

Section 1

GENERAL INFORMATION

1-1 Introduction

This manual provides complete information for installation, operation, and maintenance of the Christen 801 Series Inverted Oil System.

Careful planning is required before proceeding with installation. Because of the great variety of engine configurations and mounting arrangements, component parts and installation details will necessarily vary. To ensure proper operation with a particular aircraft, it is important to first understand how the system functions, and then to proceed with installation planning and actual installation based on system principles as described in Section 2.

1-2 Description

The Christen 801 Inverted Oil System, shown in Figure 1-1, is a kit-form accessory for Lycoming aircraft engines which permits normal engine lubrication, with minimal oil loss, during aerobatic flight. When installed, it becomes a self-contained extension of the normal aircraft engine oil and breather systems. Because the system control valves are gravity-operated, connection to aircraft power sources is not required.

The system functions in all inverted and negative-g flight conditions, and is particularly suited to high-performance aircraft used for unlimited-class aerobatic competition. During inverted flight normal engine lubrication is maintained, so that the aircraft may be flown inverted without time restriction.

The Christen 801 Inverted Oil System is available in a number of configurations, each planned for most effective application to a particular engine type. Two basic variations in the system result from requirements for different system components on vertical-screen sump engines and horizontal-screen sump engines. Figure 1-1A shows the Christen 801 System installed on a typical vertical-screen sump type engine, such as the Lycoming O-290-D. Figure 1-1B shows the Christen 801 System installed on a typical horizontal-screen sump type engine, such as the Lycoming O-360-A4A.

Certain engine types, such as the IO-320-E2A, require an additional port to be installed in the sump. Other engine types, such as the Lycoming O-235 and O-290, require relocating the breather port. Six-cylinder engines use 1-inch diameter breather hose, and 3/4-inch breather hose is used on four-cylinder engines.

In addition to the standard sump modification, an extended sump modification is available for most engine models which relocates sump ports at optimum points for oil pick up and return, thus enhancing system performance by preserving oil pressure for longer periods under aerobatic conditions such as vertical and knife-edge flight.

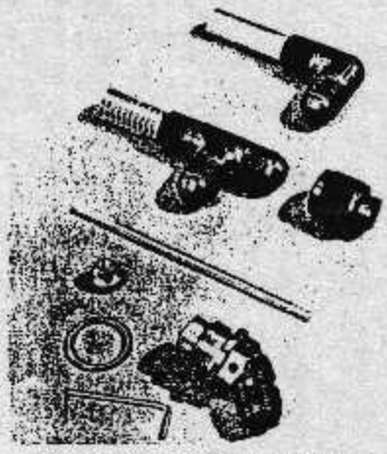
Hoses and fittings for the system are available as Christen kits, or they may be user-supplied.

Christen kits and components are listed in Table 1-1. Kit contents are shown in Figure 1-2. For complete identification and replacement parts breakdown, refer to Section 4.

CHRISTEN 801-4 BASIC SYSTEM KIT

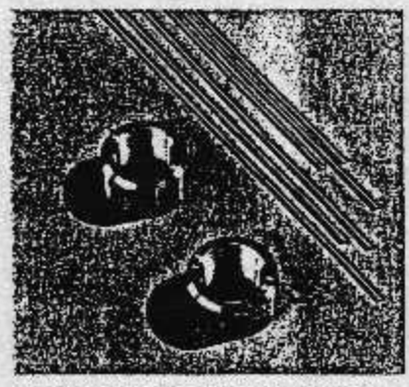
CHRISTEN 807-4 DELUXE HOSE AND FITTINGS KIT

CHRISTEN 811-V SUMP KIT



CHRISTEN 811-A SUMP KIT

CHRISTEN 811-S SUMP KIT



CHRISTEN 812-2 WELD BOSS KIT

CHRISTEN 809-K BREATHER ADAPTER KIT

CHRISTEN 808-4 BASIC FITTINGS KIT

Figure 1-2. Inverted Oil System Kits

Table 1-1. Kit and Component List (Part 1 of 2)

Christen No.	Name	Description/Function	Weight (lb)
801-4	Basic System Kit	For four-cylinder engines. Includes 802 Oil Valve (with plug wrench and plugs for unused ports), 803 Oil Separator, 806-4 Breather Tee.	4.75
801-6	Basic System Kit	For six-cylinder engines. Same as 801-4 Kit, but is supplied with 806-6 Breather Tee.	4.75
802	Oil Valve	Multiple-port gravity-operated ball valve.	1.75
803	Oil Separator	Accumulator chamber for oil in breather line, includes internal gravity-operated ball valve.	2.80
804-A	Sump Fitting	Connects hose at sump screen access port for horizontal screens. Swivel joint permits hose entry at any angle.	0.20
804-S	Sump Fitting	Connects hose at sump screen access port for horizontal screens. (Straight fitting, no swivel joint.)	0.10
804-V	Sump Fitting	Connects hose at sump screen access port for vertical screens.	0.11
805	Sump Plug	Blocks original oil entry point at front end of horizontal sump screen.	0.02
806-4	Breather Tee	Connects engine breather line to Christen 802 and 803, for four-cylinder engines.	0.24
806-6	Breather Tee	Connects engine breather line to Christen 802 and 803, for six-cylinder engines.	0.24
807-4	Deluxe Hose and Fittings Kit	All hoses and fittings required for deluxe show-plane quality installation on four-cylinder engines. Includes Aeroquip braided stainless steel hose for oil lines, MIL-H-6000 rubber-fabric hose for breather lines, thin abrasive cut-off wheel for professional-quality hose cuts. AN and MS fittings, Aeroquip hose end fittings and miniature stainless steel hose clamps.	Excl. hose, 1.53 Aeroquip hose, 0.22 lb/ft Breather hose, 0.28 lb/ft
807-6	Deluxe Hose and Fittings Kit	Same as 807-4, except for six-cylinder engines.	Excl. hose, 1.60 Aeroquip hose, 0.22 lb/ft Breather hose, 0.38 lb/ft
808-4	Basic Fittings Kit	AN and MS fittings for four-cylinder engines.	0.50

Table 1-1. Kit and Component List (Part 2 of 2)

Christen No.	Name	Description/Function	Weight (lb)
808-6	Basic Fittings Kit	AN and MS fittings for six-cylinder engines.	0.53
809	Breather Adapter	Connects breather hose to flange mount on accessory housing.	0.41
809-K	Breather Adapter Kit	Relocates breather port from front to rear of engine (includes Christen 809).	0.53
810-R	Oil Return	Standpipe-type fitting for connection of sump port to Christen 803. Standpipe section limits overboard loss of oil through Oil Separator in event of breather line kinking or blockage with resulting crankcase pressure.	0.13
810-S	Oil Strainer Fitting	Fitting for connection of sump port to Christen 802. Coarse strainer section prevents large debris in sump from blocking oil flow.	0.15
811-A	Sump Kit	For horizontal-screen sump engines. Includes 810-S Oil Strainer Fitting, 810-R Oil Return Fitting, 805 Sump Plug with insertion tool, 804-A Sump Fitting with crush gasket and wrench for swivel clamping screw.	0.36
811-S	Sump Kit	For horizontal-screen sump engines. Includes 810-S Oil Strainer Fitting, 810-R Oil Return Fitting, 805 Sump Plug with insertion tool, 804-S Sump Fitting (straight-type) with crush gasket.	0.33
811-V	Sump Kit	For vertical-screen sump engines. Includes 810-S Oil Strainer Fitting, 810-R Oil Return Fitting, 804-V Sump Fitting (vertical type) with crush gasket and MS20822-10D elbow.	0.50
812	Weld Boss	Welded to sump to provide port with 1/2-inch pipe thread.	0.06
812-1	Weld Boss Kit	One Christen 812 with welding rod.	0.12
812-2	Weld Boss Kit	Two Christen 812's with welding rod.	0.18
813-4	Breather Coil	Insert for breather hose to permit short-radius bends. For four-cylinder engines.	0.12
813-6	Breather Coil	Insert for breather hose to permit short-radius bends. For six-cylinder engines.	0.12

1-3 Application

The standard Christen 801 System can be installed on most Lycoming engine models. Christen kits and components which are either required or optional for standard engine conversions are shown in Table 1-2. Be sure to consider the effect of each available alternative or option when planning an installation for any particular aircraft.

Many engine models not listed in Table 1-2 can be equipped with the Christen 801 System, but special adapters and fittings may be required. Contact the Christen factory for assistance in designing non-standard installations.

Aircraft equipped with constant-speed propellers require evaluation before modification for aerobatic flight. During periods of zero oil pressure, some propeller types decrease pitch, while other types increase pitch. Momentary interruption of engine oil pressure during aerobatic flight, which normally occurs during certain maneuvers (see paragraph 3-5), may produce decreased pitch and cause engine overspeed if the propeller is of the decreasing-pitch type. For safe engine operation during aerobatic flight, therefore, the propeller should be of the increasing-pitch type. A suitable constant-speed propeller of this type, for use with the Lycoming IO-360-A series engine, is the Hartzel part no. HC-C2YK-4CF/FC7666A-2 (Hartzel Propeller Company, Piqua, Ohio 45356).

1-4 Terminology

For definitions and functional descriptions of Christen kits and components, refer to Table 1-1. Definitions of general terms used in this manual are given below. Refer to Figure 2-12 for hose identification.

Breather line - the hose which is connected to the engine breather port. With the Christen 801 system, there are three breather line segments: breather port to Christen 806-4 or 806-6 Breather Tee, Breather Tee to Christen 803 Oil Separator, and Oil Separator to overboard breather line.

Breather port - the opening at the top of the engine accessory housing or crankcase which vents blow-by gases during normal flight.

Extended sump modification - Christen 801 System configured for oil line connection to relocated sump ports which are installed at optimum points for oil pick up and return.

Inverted oil pickup line - the hose which is connected between the Christen 806-4 or 806-6 Breather Tee and the top port of the Christen 802 Oil Valve. Oil flows through this line only during inverted flight.

Oil feed line - the hose which is connected between the center port on the Christen 802 Oil Valve and the Christen 804-A, 804-S, or 804-V Sump fitting. Oil flows through this line during both normal and inverted flight.

Oil pickup line - the hose which is connected between the Christen 810-S Oil Strainer Fitting in the sump and the bottom port of the Christen 802 Oil Valve. Oil flows through this line only during normal flight.

Oil return line - the hose which is connected between the bottom of the Christen 803 Oil Separator and the Christen 810-R Oil Return Fitting at the oil return port on the sump.

Oil return port - the opening in the sump through which oil from the Christen 803 Oil Separator returns to the sump. The oil return port may be either a selected existing sump drain port or an added port, made using the Christen 812 Weld Boss. The Christen 810-R Oil Return Fitting is installed in the oil return port.

Standard sump modification - Christen 801 System configured for oil line connection to existing sump ports, if possible. (A few sump types require the installation of a single additional port.)

Sump drain port - a normally-plugged opening in the sump.

Sump screen - a perforated sleeve within the engine sump which strains oil flowing toward the engine oil pump. Lycoming engine sumps are equipped either with horizontal or vertical screens. During modification, the sump screen is removed for vertical-screen sump type engines; the sump screen is shortened for horizontal-screen sump type engines.

Sump screen access port - a normally plugged opening in the sump through which the sump screen can be removed.

Table 1-2. Kit Applications (Part 1 of 2)

ENGINE DESCRIPTION				
Sump Type		Lycoming Model	Basic System Kit	Sump
Screen Type	Christen Class			
Vertical	1	O-235 Series, all models O-290 Series, all models	801-4	811-
		O-320-A, B and C Series, all models O-320-E2G IO-320-E1A, E2A O-340-A and B Series, all models	801-4	811-
Horizontal	2	O-320-D and E Series, except E2G IO-320-A1A, A2A IO-320-B, C and D Series, all models LIO-320-B and C Series, all models O-360-A Series, except A1C O-360-B and C Series, except C2B, C2D IO-360-B Series, except B1C, B1E, B2E HO-360-A1A HIO-360-B Series, all models	801-4	811- or 811- (Not
	3	O-360-A1C, C2B, C2D IO-360-B1C, B1E, B2E, E1A, F1A HO-360-B Series, all models	801-4	811 or 811 (Not
	4	IO-360-C and D Series, except C1A (Note 3) LIO-360-C Series, all models TIO-360-A Series, all models HIO-360-A, C and D Series, all models	801-4	811 or 811 (Not
	5	IO-360-A Series, all models	801-4	811 or 811 (Not
	6	O-540 Series, all models IO-540-C1B5, C1C5, C2C, C4B5, C4B5D, C4C5, D4A5, J4A5, N1A5, N1A5D, R1A5, R1A5D	801-6	811 or 811 (Not

Notes: 1. Selection depends on requirements for angular-swivel or straight-type sump fitting.

2. Sump removal is required for att weld bosses.

Table 1-2. Kit Applications (Part 2 of 2)

REQUIRED SYSTEM KITS			OPTIONAL SYSTEM KITS AND COMPONENTS		
Weld Boss Kit (Note 2)		Breather Adapter Kit	Deluxe Hose & Fittings Kit	Basic Fittings Kit	Breather Coil
for Standard Sump Modification	for Extended Sump Modification				
812-1	812-2	809-K	807-4	808-4	813-4
812-1	812-2	None Required	807-4	808-4	813-4
None Required	812-2	None Required	807-4	808-4	813-4
812-2 Extended Modification required Standard Modification not applicable due to sump design.		None Required	807-4	808-4	813-4
812-1 Standard Modification required Extended Modification not applicable due to sump design.		None Required	807-4	808-4	813-4
812-1 Extended Modification required. Standard Modification not applicable due to sump design.		None Required	807-4	808-4	813-4
None Required	(Note 4)	None Required	807-6	808-6	813-6

3. 10-360-C series have special magnesium sump which requires attachment of magnesium weld boss to make new sump port. Christen factory will provide additional information on request.

4. All O-540 and IO-540 Series engines have special magnesium sumps which require attachment of magnesium weld bosses to make new sump ports for extended sump modification. Christen factory will provide additional information on request.

1-5 Principles of Operation

In the standard vertical-screen Lycoming sump, oil circulation is entirely internal, as shown in Figure 1-3A. Oil from the sump passes through the sump screen and flows up through the oil pick-up tube to the engine oil pump and engine lubrication points.

As shown in Figure 1-3B, oil circulation in the standard horizontal-screen Lycoming sump is similar to that of the vertical-screen type, but oil flows into the end of the horizontal sump screen and up through an oil passage to the engine oil pump and engine lubrication points.

When an aircraft using this type engine is inverted, the oil in the sump falls to the top of the crankcase, and oil pressure is lost immediately since there is no longer a supply to the engine oil pump. In addition, substantial oil loss occurs due to direct flow overboard through the breather line at the top of the engine crankcase.

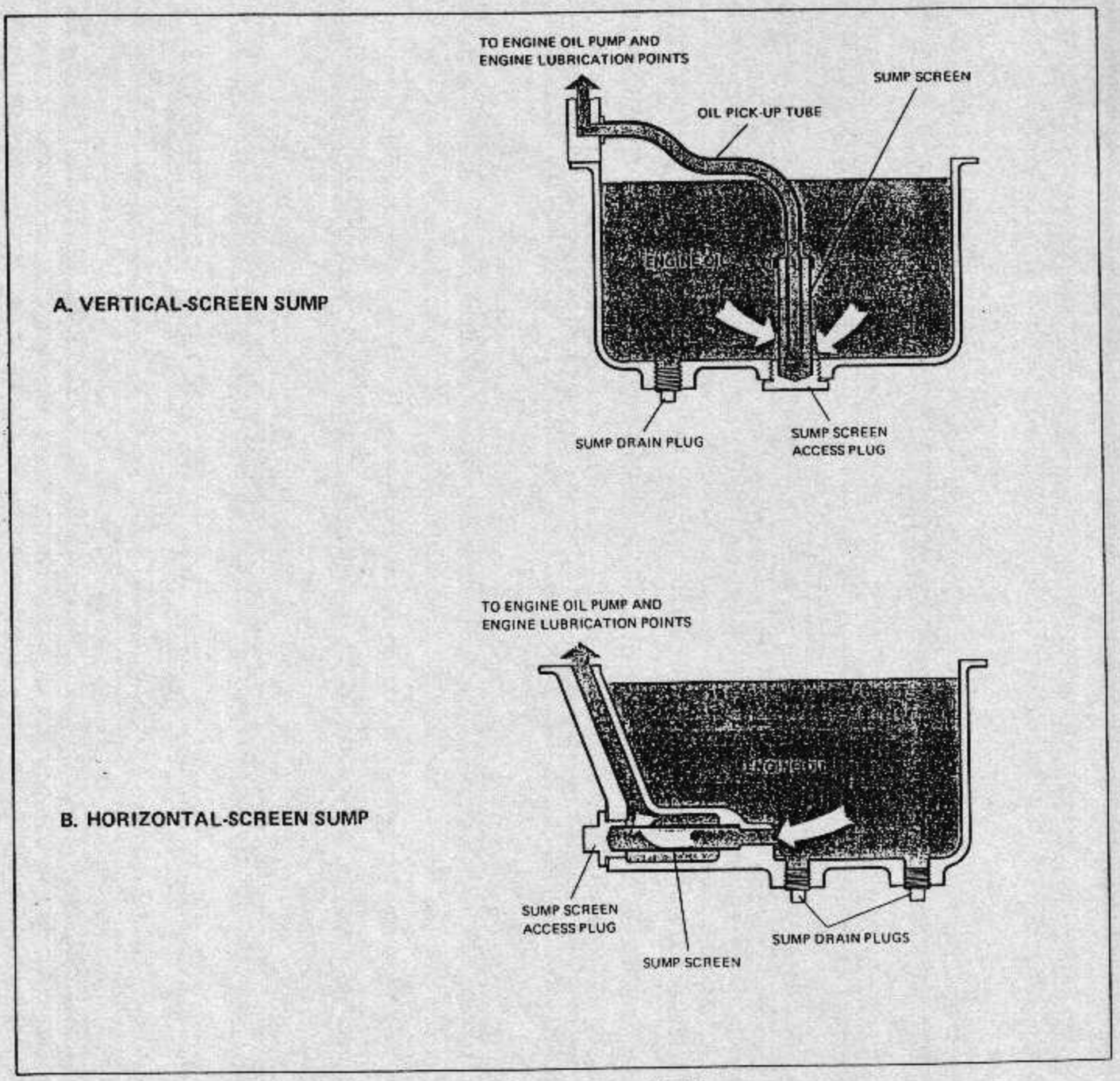


Figure 1-3. Oil Flow, Unmodified Sump

Installation of the Christen 801 System results in the sump modifications shown in Figure 1-4. For most installations, modification consists of adding the fittings shown to existing sump ports, without sump removal or engine disassembly. The sump must be removed, however, for installations requiring the addition of new sump ports using the Christen 812 Weld Boss. The Christen 805 Sump Plug used in the horizontal sump screen type engine is installed, without engine removal, by insertion from the sump screen access port at the rear of the engine.

During normal flight (Figure 1-5A), the weighted ball valve at the top of the Christen 803 Oil Separator is open, allowing blow-by gases from the engine crankcase to be vented from the breather port, through the Christen 806 Breather Tee, to the top of the Oil Separator, and out through the overboard breather line. The top ball valve of the Christen 802 Oil Valve is closed, and the bottom ball valve is open. This permits oil to flow from the sump out through the Christen 810-S Strainer Fitting to the Oil Valve, back through the Christen 804 Series Sump Fitting to the oil

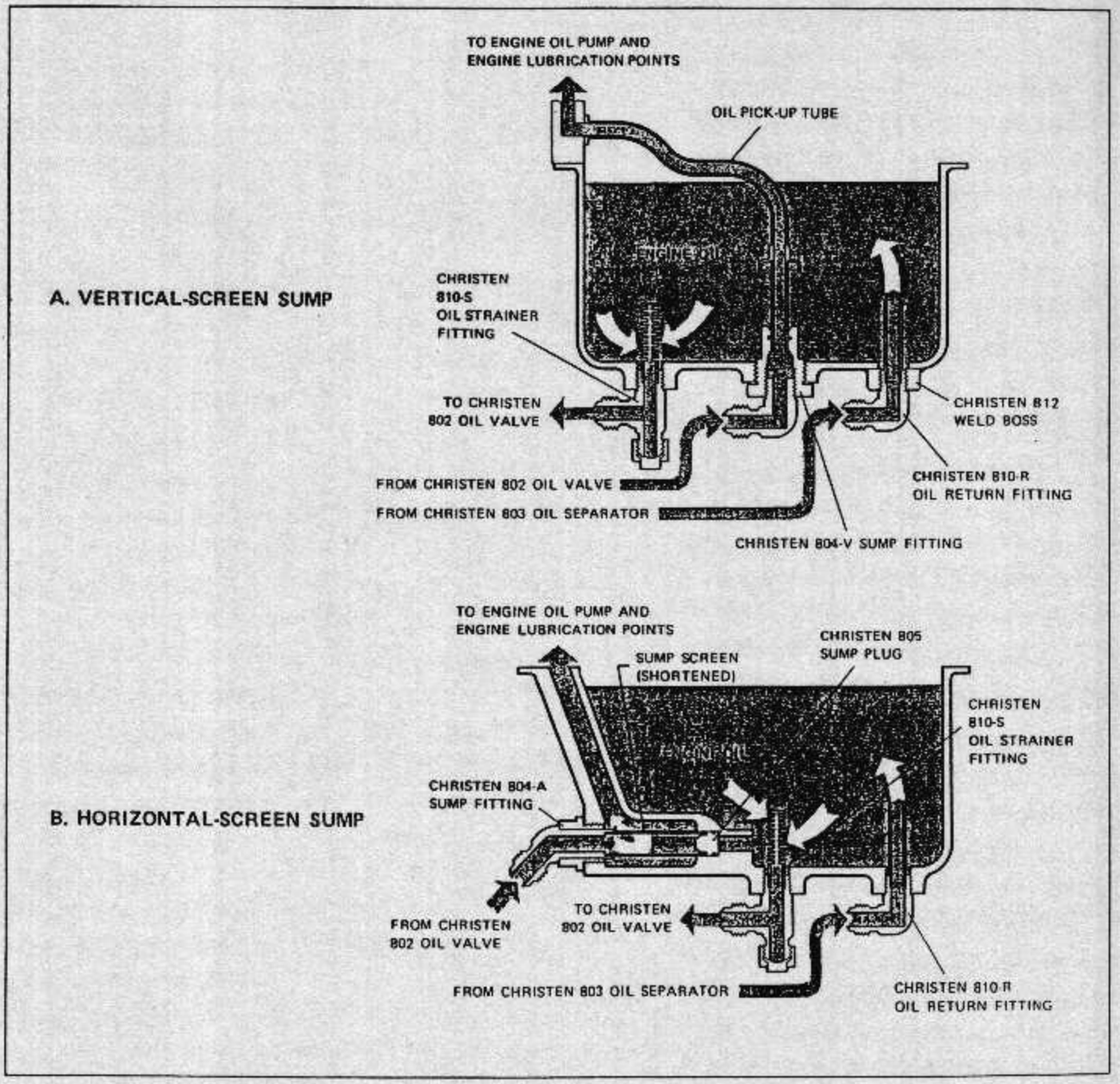


Figure 1-4. Oil Flow, Converted Sump

pump and engine lubrication points.

When the aircraft is inverted (Figure 1-5B), engine oil falls to the top of the engine crankcase. The weighted ball valve in the Oil Separator closes, preventing overboard loss of oil through the top of the Oil Separator. Blow-by gases from the engine crankcase are vented from the sump to the bottom of the Oil Separator and out through the overboard breather line. The top ball valve of the Oil Valve is open, and the bottom ball valve is closed, allowing oil to flow out from the breather port, through the Breather Tee to the Oil Valve, through the Sump Fitting to the oil pump and engine lubrication points.

Any oil in lines which fails to return to the sump during the transition between normal and inverted flight drains into the Oil Separator. This oil then returns to the sump from the bottom of the Oil Separator during periods of normal flight.

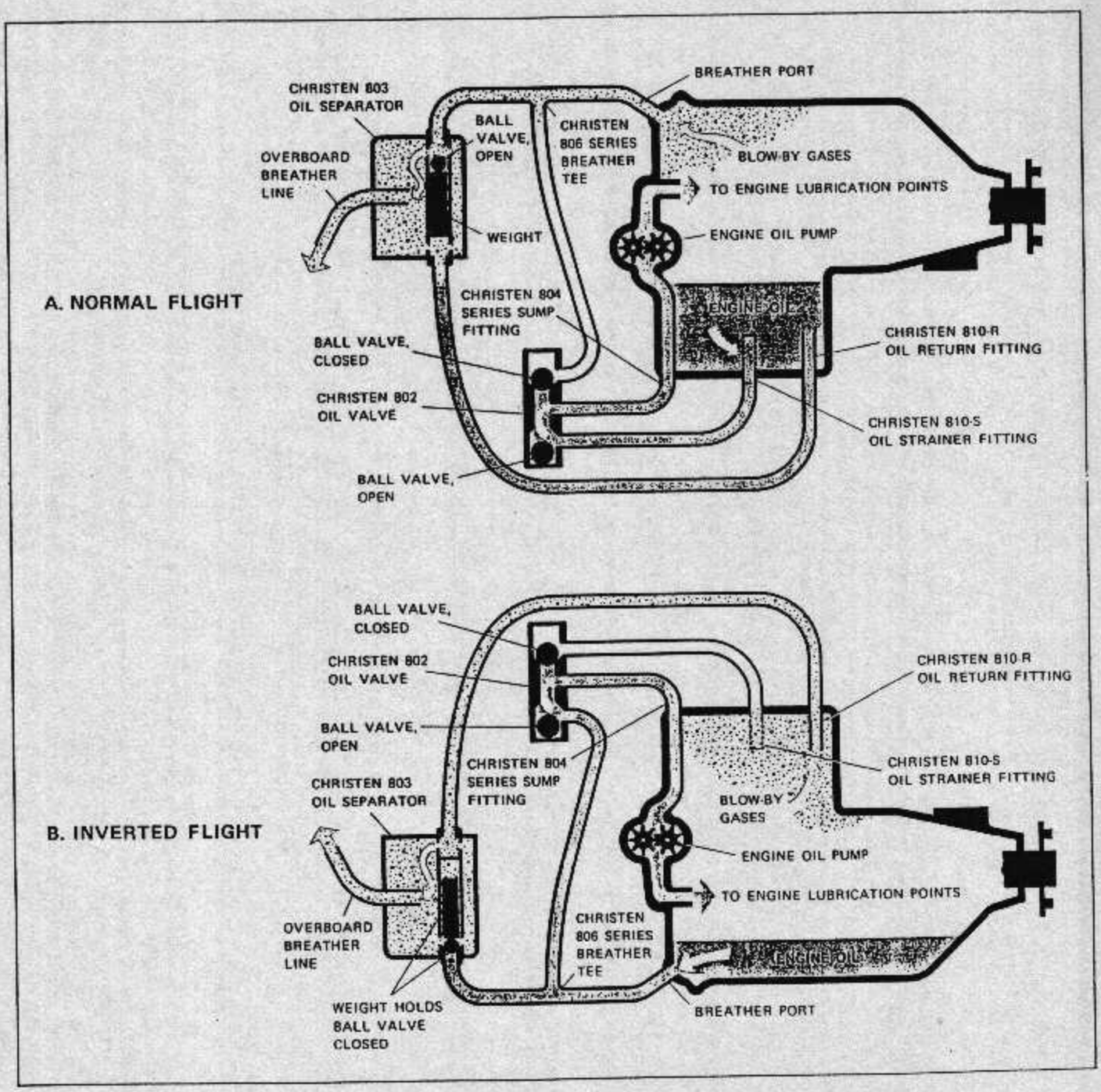


Figure 1-5. System Operation

Section 2

INSTALLATION

2-1 General

The Christen 801 Inverted Oil System is intended for installation on a wide variety of aircraft types and can be applied to numerous Lycoming engine models. The instructions for installation included in this section are therefore general in nature, and the specific design of an installation for a particular aircraft must be individually planned.

Determination of component mounting locations is particularly important to ensure optimum operation. Although some compromise may be required in laying out an installation for a particular aircraft, the general planning rules given in paragraph 2-2 should be followed as closely as possible.

Study the entire installation procedure given in this section before designing the actual installation layout. Since nearly all operating malfunctions which occur on new installations are due either to layout errors or minor assembly errors, it may also be useful to study the trouble-shooting information given in paragraph 3-6.

A satisfactory layout for a typical aerobatic aircraft, the Pitts Special S-1S, is shown in Figure 2-1. The main external components such as the Christen 803 Oil Separator, Christen 802 Oil Valve, and Christen 806 Breather Tee, are mounted either on the firewall or on the engine mount as shown.

2-2 Layout Planning Requirements

The location of each component, the routing of each hose, and the final selection and location of fittings must be planned carefully before commencing installation of the Christen 801 System. Proper performance can be assured by following several general rules:

1. Oil Separator. The Christen 803 Oil Separator must be mounted (a) as high as possible, and (b) as far as possible toward the side of the engine opposite the oil return port on the sump.

   The bottom of the Oil Separator must be at least two inches above the top of the sump, and the centerline of the Oil Separator must be located at least 10 inches from the sump centerline on the side opposite the oil return port.

   The height requirement ensures rapid emptying of the Oil Separator following the transition from inverted to normal flight. The side location requirement prevents loss of oil during some types of maneuvers such as knife-edge flight; if the Oil Separator and oil return port were located on the same side, oil could then run out of the oil return port, filling the Oil Separator, with consequent loss through the overboard breather line.

2. Oil Valve. For horizontal-screen sump engines, the Christen 802 Oil Valve must be located such that its center port is horizontally aligned with the sump screen access port. For vertical-screen sump engines, the Oil Valve must be located such that its center port is aligned horizontally with the bottom surface of the sump. The Oil Valve itself is equipped with alternate ports to permit hose fittings to be attached either along its front or side (unused ports are blocked with plugs supplied).

3. Fittings. Avoid 90° fittings in oil lines. This is particularly important for the fitting at the bottom of the Oil Separator, which must be either straight or 45° maximum to ensure rapid return of oil to the sump from the Oil Separator. If the Oil Separator is not

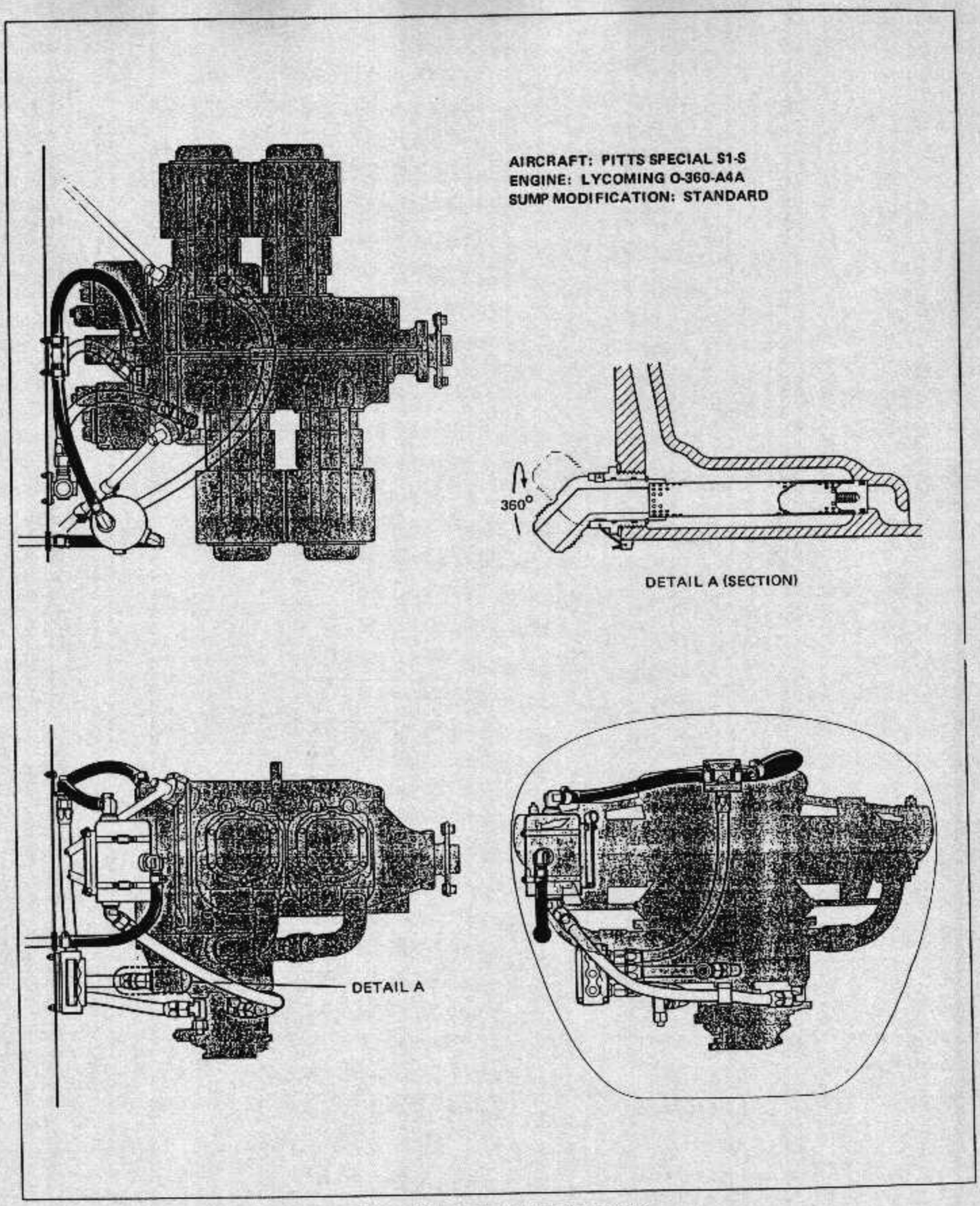


Figure 2-1. Typical Installation Detail

emptied rapidly during periods of normal flight, it may fill to capacity during a series of inverted-to-normal maneuvers, with resultant loss of oil through the overboard breather line. The fittings at the top and side ports of the Oil Separator are non-critical and may be of the 90° type.

NOTE

The fittings in the bottom of the sump normally must be 90° because of clearance conditions.

4. Hoses. All hose lengths should be as short as possible. All hoses should be routed and clamped in positions which provide smooth, sweeping curves. Sharp bends should be avoided to prevent collapse of hose walls and restrictions to oil flow.

If a bend radius of less than four inches is required in the breather hose (MIL-H-6000 type), hose collapse can be prevented by installing a Christen 813-4 or 813-6 Breather Coil. Obstruction of the breather hose will result in crankcase pressure which may force oil

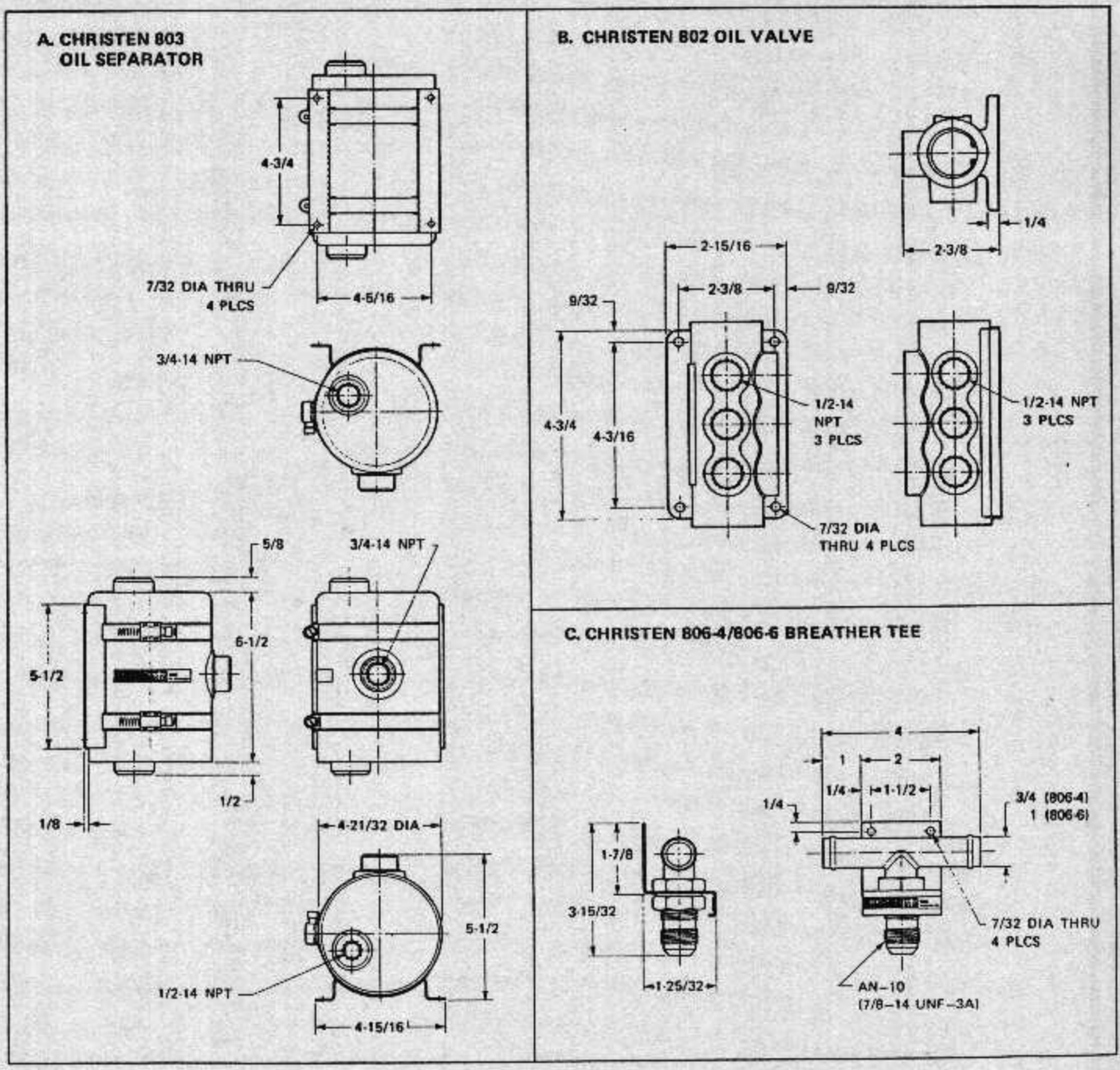


Figure 2-2. Component Dimensions (Part 1 of 2)

out the oil return port to the Oil Separator, with resulting oil losses through the overboard breather line. During inverted flight, an obstruction in the breather hose between the engine and the Breather Tee will result in reduced oil pressure.

The hose from the bottom of the Oil Separator must extend in a continuous downward slope to the bottom of the sump. An elevated section in this hose run may prevent rapid emptying of the Oil Separator and thereby result in excessive oil loss.

5. Layout Obstructions. The engine and engine compartment should be inspected for obstructions which may affect installation of the oil system. For engines equipped with accessories or parts which prevent normal installation, modifications will be required. Before proceeding with non-standard modifications, be sure the modification plan is compatible with the operating principles of the system and that care is taken to ensure the mechanical integrity of the engine and airframe. Dimensions for each component are shown in Figure 2-2.

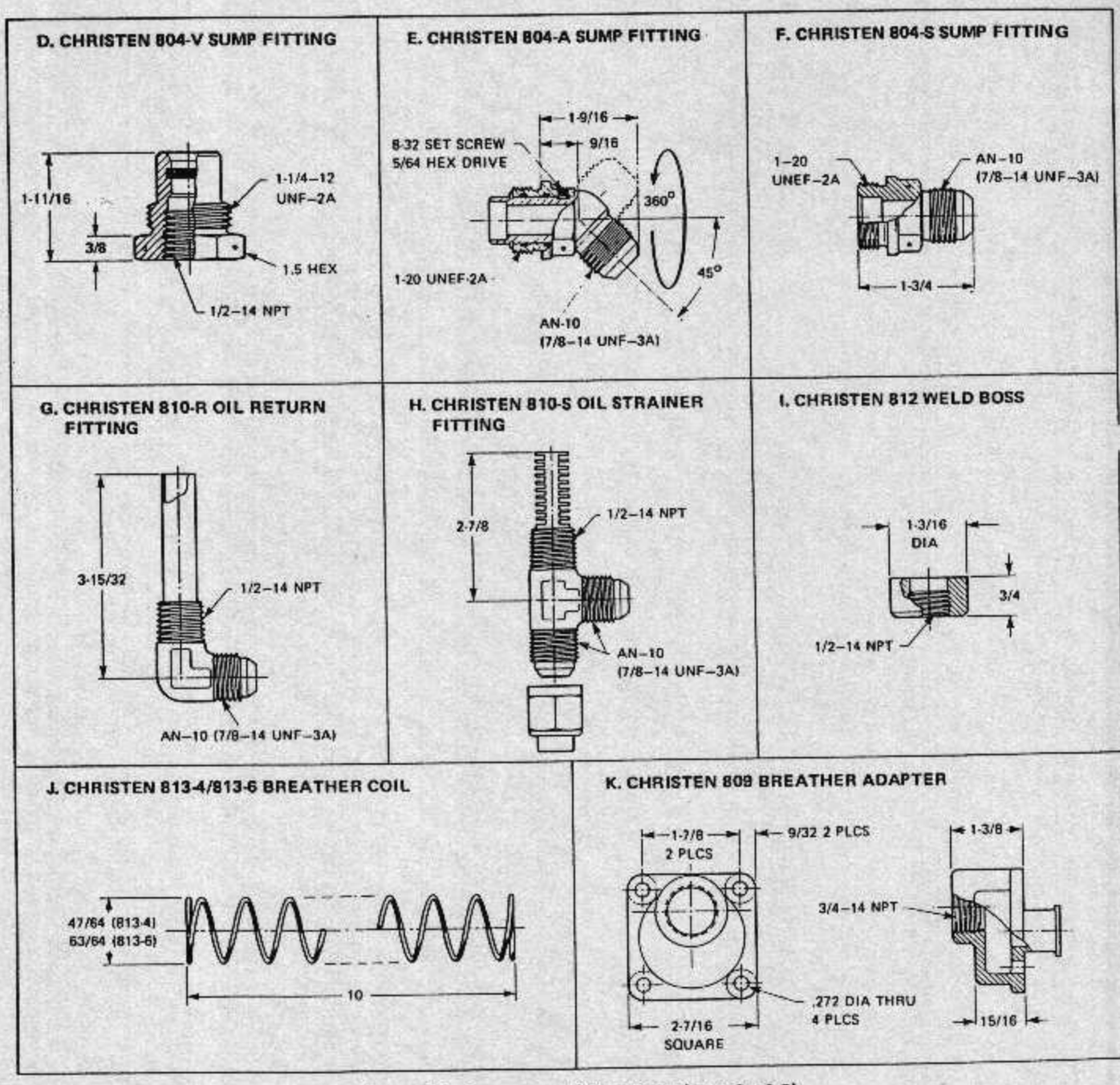


Figure 2-2. Component Dimensions (Part 2 of 2)

2-3 Breather Fitting Requirements

An appropriate breather fitting must be provided to permit connection of either 3/4-inch I.D. hose (four-cylinder engines) or 1-inch I.D. hose (six-cylinder engines) to the crankcase breather port at the top rear of the crankcase. The crankcase breather port on larger Lycoming engines uses a 3/4 NPT thread. Smaller Lycoming engines use a 1/2 NPT thread. The correct fitting for these engines is listed in Table 2-1; these fittings are normally supplied with the engine by Lycoming.

Engine models supplied with a breather port at the front of the crankcase, the O-235 series and O-290 series, require relocation of the breather to the accessory housing. A Christen 809-K Breather Adapter Kit is required.

2-4 Sump Modification Requirements

There are six classes and two types of sump modifications, determined by Lycoming engine model, as listed in Table 1-2.

Class 1 sumps include all vertical-screen sumps and are suitable either for standard or extended modification. Modification requirements for Class 1 sumps are shown in Figure 2-3.

Class 2 sumps have (a) horizontal sump screen, (b) deep sump profile, (c) either horizontal or vertical induction, and (d) two drain ports. Modification requirements for Class 2 sumps are shown in Figure 2-4.

Class 3 sumps have (a) horizontal sump screen, (b) deep sump profile, (c) horizontal induction, and (d) single drain port. Modification requirements for Class 3 sumps a shown in Figure 2-5. Because of sump design characteri tics, only the extended modification is applicable to Class sumps.

Class 4 sumps have (a) horizontal sump screen, (b) shallo sump profile, and (c) horizontal induction from rear. Mod fication requirements for Class 4 sumps are shown in Figur 2-6. Because of sump design characteristics, the extende modification version is not available for Class 4 sumps.

NOTE

The IO-360-C1A has a special magnesium sump; modification requires magnesium weld boss. Contact Christen factory for information.

Class 5 sumps have (a) horizontal sump screen, (b) shallow sump profile, (c) horizontal induction from front. Modification requirements for Class 5 sumps are shown in Figure 2-7. Because of sump design characteristics, only the extended modification is applicable to Class 5 sumps.

Class 6 sumps are used on six-cylinder engines, and include (a) horizontal sump screen, (b) deep sump profile, and (c) vertical induction. Modification requirements for Class 6 sumps are shown in Figure 2-8.

NOTE

All O-540 and IO-540 Series engines have special magnesium sumps; for extended modification magnesium weld bosses are required. Contact Christen factory for information.

Table 2-1. Breather Fitting Chart

Application	Fitting		
	Size	Angle	Part Identification
All 4-cylinder, except O-235 and O-290.	1/2 NPT to 3/4-in. hose	Straight 60°	Lycoming 71140 Lycoming 72413
All six-cylinder	3/4 NPT to 1-in. hose	Straight (short) Straight (long) 45°	Lycoming 72996 Lycoming 71651 AN844-16D

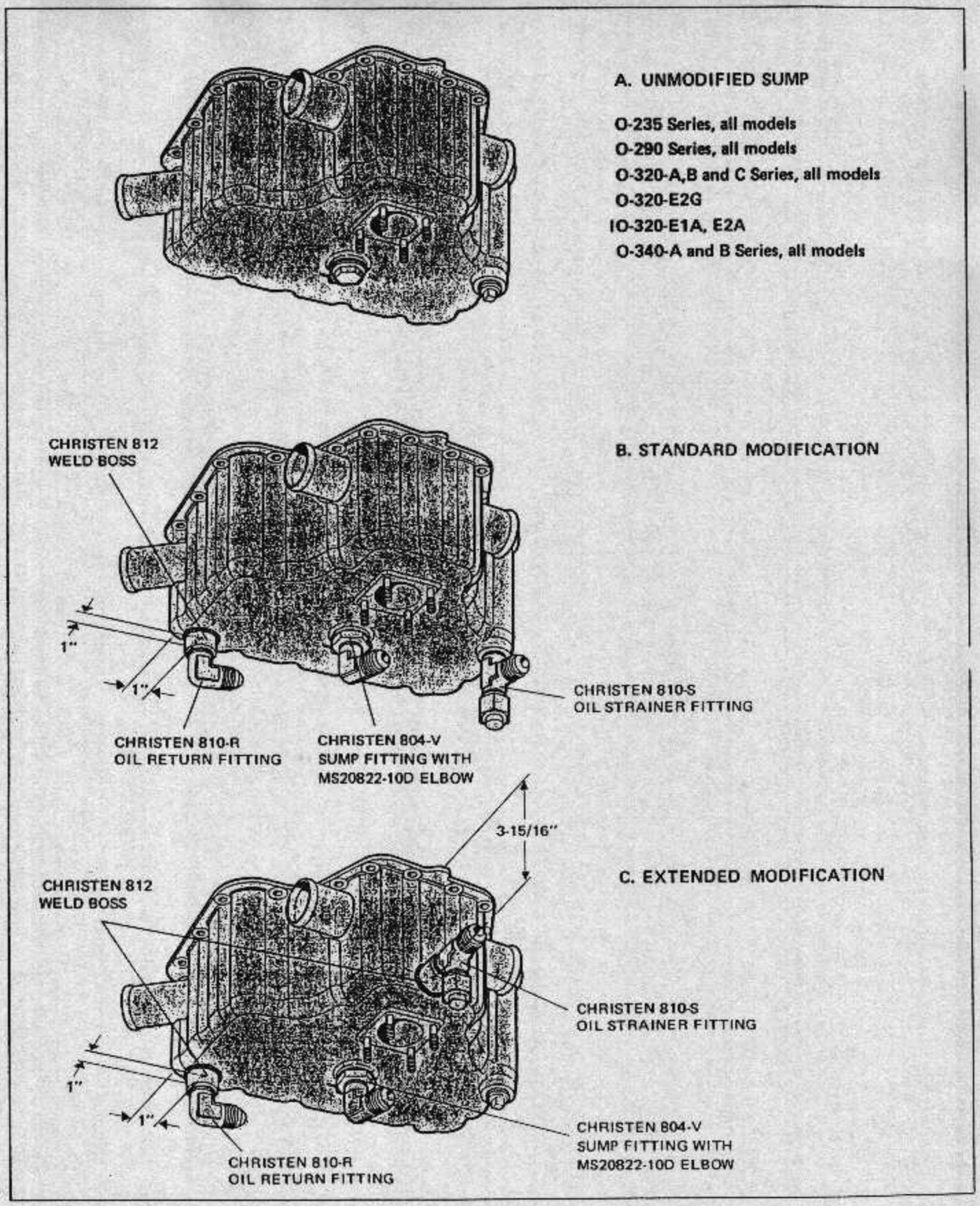
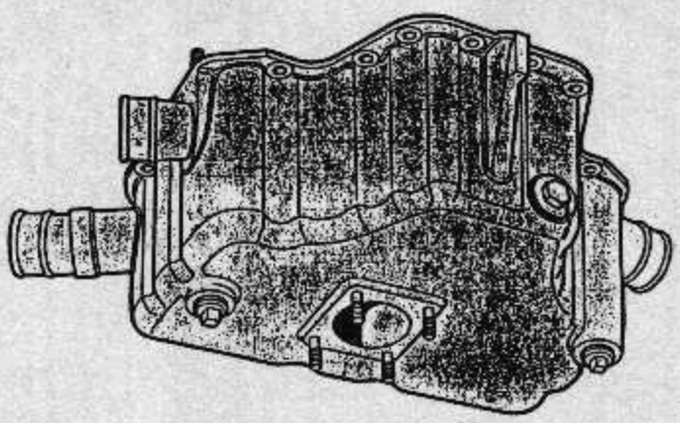
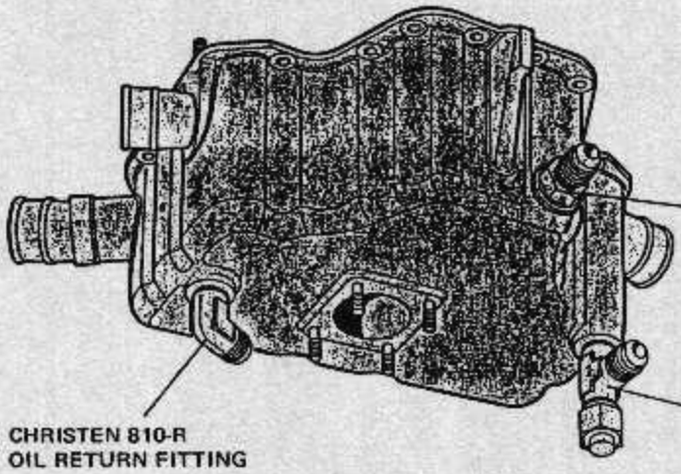


Figure 2-3. Class 1 Sump Modification



A. UNMODIFIED SUMP (Vertical Induction)

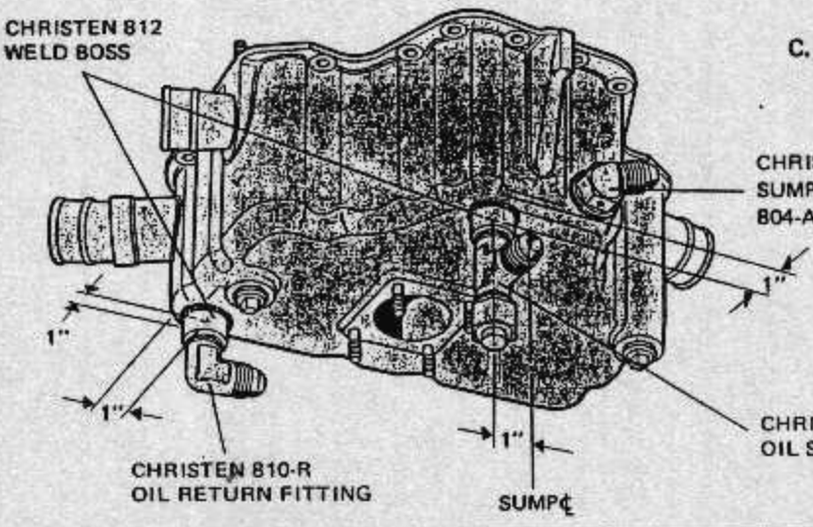
O-320-D and E Series, except E2G
IO-320-D Series, all models
O-360-A Series, except A1C, A1G, A1G6, A1H, A2G, A2H, A4G, A4J
O-360-B and C Series, except C2B, C2D
IO-360-B Series, except B1C, B1E, B2E
HO-360-A1A



B. STANDARD MODIFICATION
(Vertical Induction)

CHRISTEN 804-S OR 804-A
SUMP FITTING OPTIONAL,
804-S SHOWN

CHRISTEN 810-S
OIL STRAINER FITTING

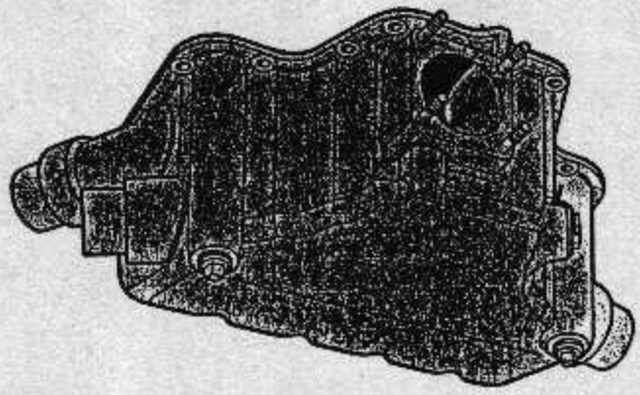


C. EXTENDED MODIFICATION
(Vertical Induction)

CHRISTEN 804-S OR 804-A
SUMP FITTING OPTIONAL,
804-A SHOWN

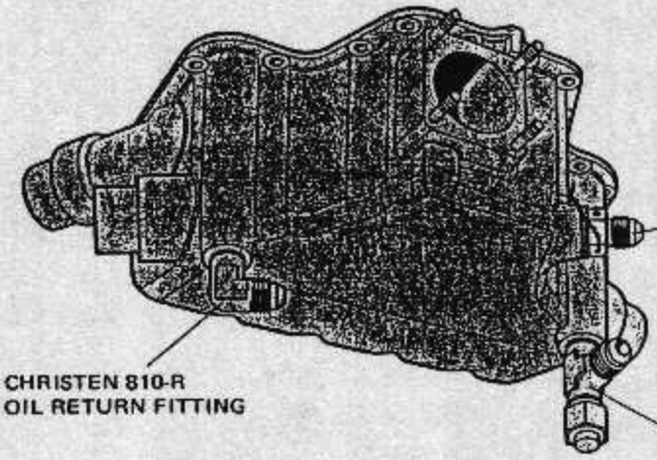
CHRISTEN 810-S
OIL STRAINER FITTING

Figure 2-4. Class 2 Sump Modification (Part 1 of 2)

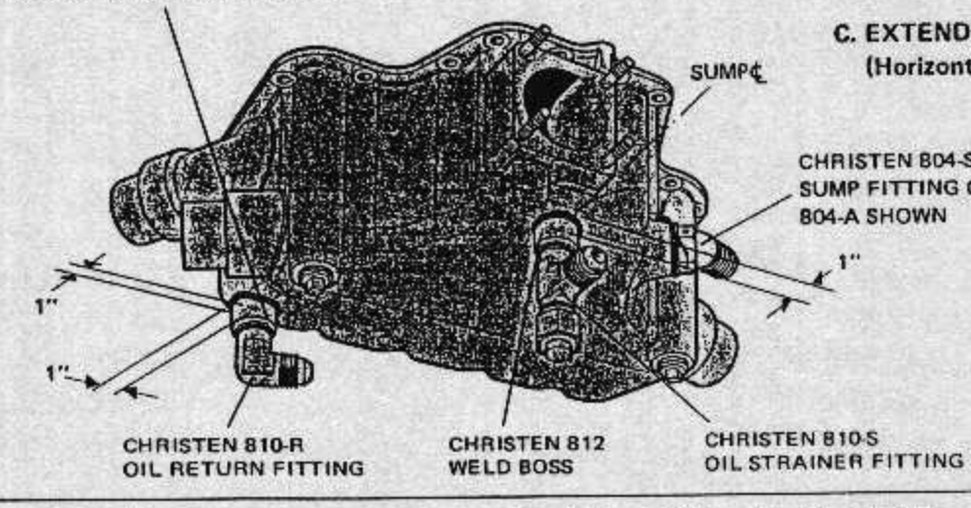


A. UNMODIFIED SUMP
(Horizontal Induction)

IO-320-A1A, A2A
IO-320-B and C Series, all models
LIO-320-B and C Series, all models
O-360-A1G, A1G6, A1H, A2G, A2H, A4G, A4J,
HIO-360-B Series, all models

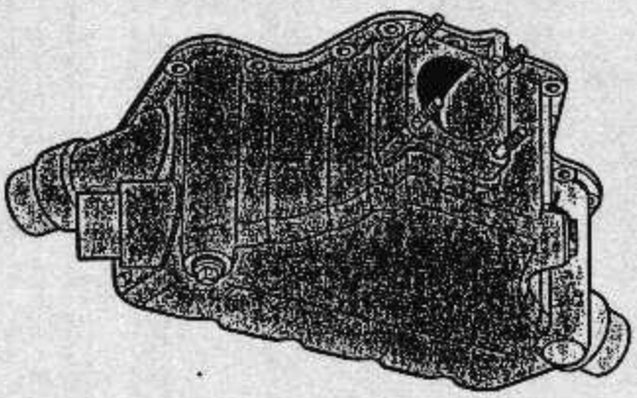


B. STANDARD MODIFICATION
(Horizontal Induction)



C. EXTENDED MODIFICATION
(Horizontal Induction)

Figure 2-4. Class 2 Sump Modification (Part 2 of 2)

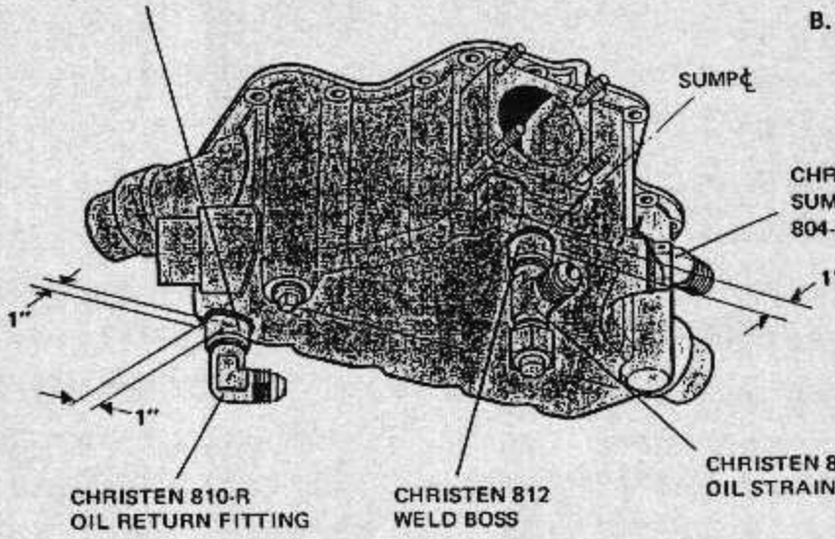


A. UNMODIFIED SUMP

O-360-A1C, C2B, C2D
IO-360-B1C, B1E, B2E, E1A, F1A
HO-360-B Series, all models

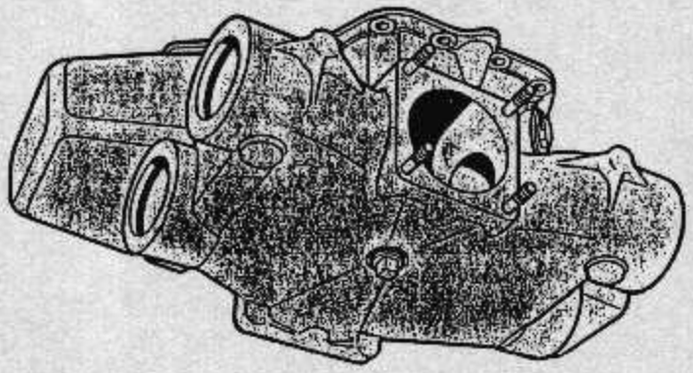
CHRISTEN 812 WELD BOSS - BEFORE WELDING
CUT UNCHAMFERED END OF BOSS AT APPROPRIATE
ANGLE TO ALIGN THREADED HOLE PERPENDICULAR
TO SUMP MOUNTING FLANGE.

B. EXTENDED MODIFICATION
(NOTE 1)



NOTE 1. NOT AVAILABLE IN STANDARD MODIFICATION DUE TO ENGINE SUMP DESIGN

Figure 2-5. Class 3 Sump Modification

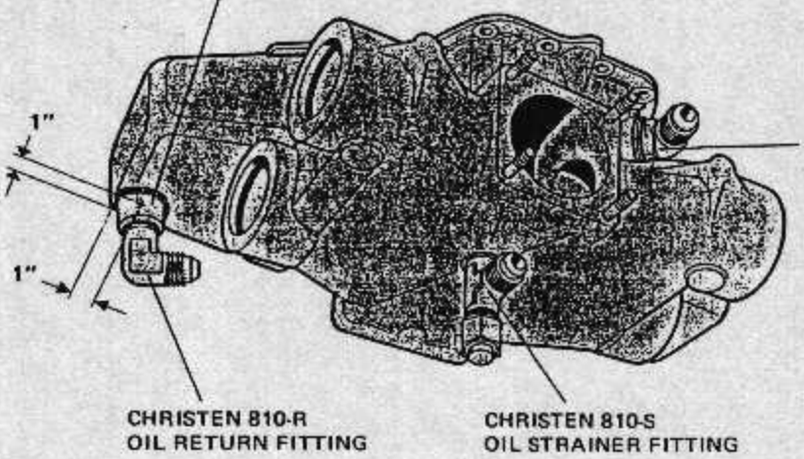


A. UNMODIFIED SUMP

IO-360-C and D Series, (Note 1)
LIO-360-C Series, all models
TIO-360-A Series, all models
HIO-360-A,C and D Series, all models

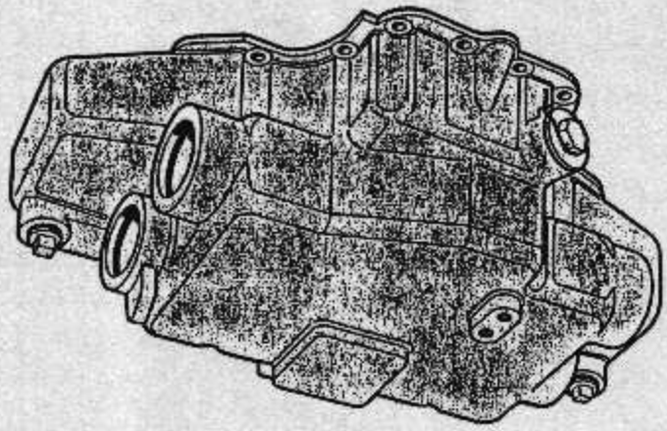
CHRISTEN 812 WELD BOSS - BEFORE WELDING
CUT UNCHAMFERED END OF BOSS AT APPROPRIATE
ANGLE TO ALIGN THREADED HOLE PERPENDICULAR
TO SUMP MOUNTING FLANGE. (NOTE 1)

B. STANDARD MODIFICATION
(NOTE 2)



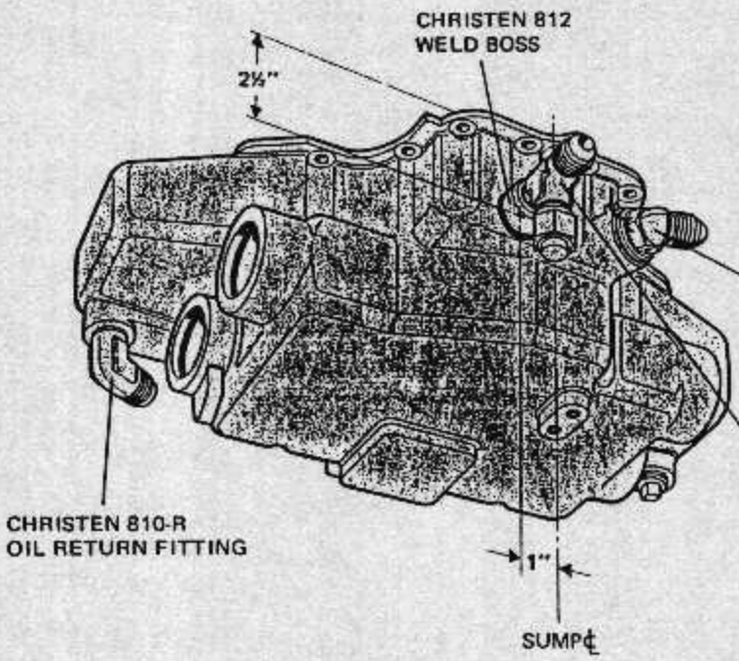
1. 10-360-C SERIES HAVE SPECIAL MAGNESIUM SUMP. MODIFICATION REQUIRES MAGNESIUM WELD BOSS. CHRISTEN FACTORY WILL SUPPLY INFORMATION ON REQUEST.
2. NOT AVAILABLE IN EXTENDED MODIFICATION DUE TO ENGINE SUMP DESIGN.

Figure 2-6. Class 4 Sump Modification



A. UNMODIFIED SUMP

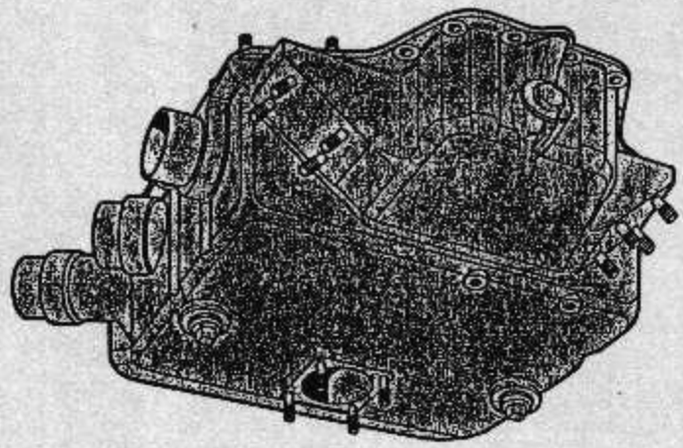
IO-360-A Series, all models



B. EXTENDED MODIFICATION
(NOTE 1)

NOTE 1. NOT AVAILABLE IN STANDARD MODIFICATION DUE TO ENGINE SUMP DESIGN

Figure 2-7. Class 5 Sump Modification

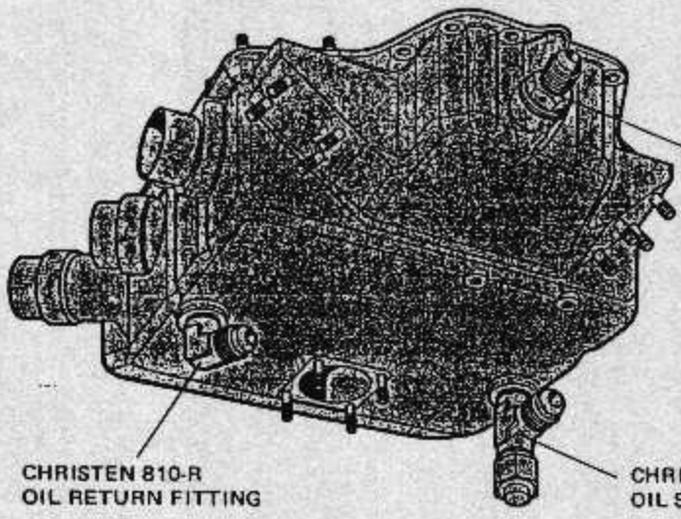


A. UNMODIFIED SUMP

O-540 Series, all models

IO-540-C1B5, C1C5, C2C, C4B5, C4B5D, C4C5, D4A5, J4A5, N1A5, N1A5D, R1A5, R1A5D

B. STANDARD MODIFICATION (NOTE 1)



NOTE 1. ALL O-540 AND IO-540 SERIES ENGINES HAVE MAGNESIUM SUMPS. EXTENDED MODIFICATION REQUIRES MAGNESIUM WELD BOSSES. CHRISTEN FACTORY WILL SUPPLY INFORMATION ON REQUEST.

Figure 2-8. Class 6 Sump Modification

2-5 Pipe-Thread Fitting Requirements

CAUTION

Use care when installing threaded fittings in aluminum. Aluminum pipe threads are subject to damage from overtightening and from the use of poor thread compounds.

When installing any component fittings which use pipe threads, an anti-seizing lubricating type of thread compound should be applied such as Tite-Seal Gasket & Joint Sealing Compound (Radiator Specialty Co., 1400 West Independence Boulevard, Charlotte, NC 28202).

Do not use Teflon pipe tape for aluminum threads, as threads can cut through the tape and thread damage may occur.

In addition, care must be taken not to overstress threads when aligning angle-type fittings. Pipe threads will seal with only moderate force when using an appropriate type of pipe joint compound. If such fittings cannot be turned to the desired angle using only moderate force, remove the fitting and tap the hole threads slightly deeper. Use appropriate care to prevent metal chips from entering the engine crankcase, sump, or oil system components when tapping.

2-6 Installation Procedure

When planning has been completed, proceed as follows for installation. Some steps apply to all installations; some steps apply only to certain installation types.

1. Remove drain plugs from sump and thoroughly drain all engine oil.

2. For systems requiring the installation of Christen 812 Weld Bosses, remove the sump. Locate suitable boss positions as shown in the sump modification illustrations, Figures 2-3 through 2-8, and drill 3/4-inch hole for each boss. The Weld Bosses are attached as shown in Figure 2-9, using the AA4043 (5% silicon aluminum alloy) rods supplied. Shaping of the base of the Weld Boss may be required to provide a snug fit against the surface of the sump.

CAUTION

Welding operations must be performed by a qualified welder, experienced in aluminum welding. The sump casting must be properly preheated before welding to avoid cracking caused by weld stresses.

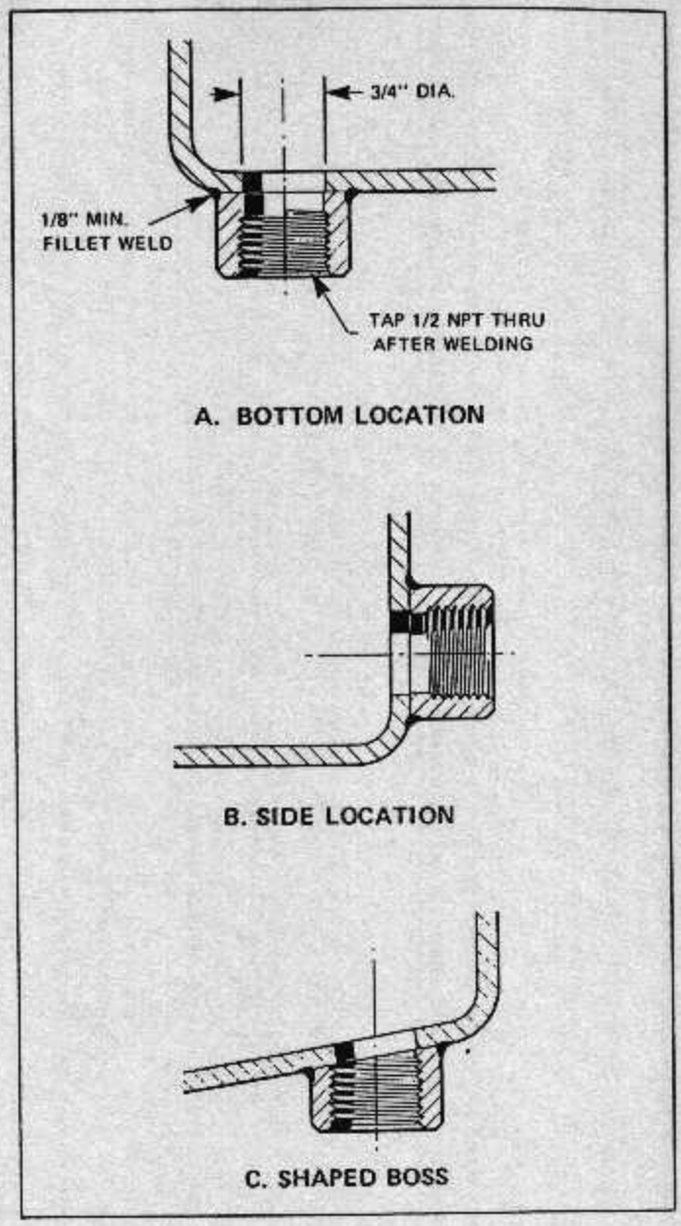


Figure 2-9. Weld Boss Installation

After welding, run a 1/2 NPT tap into the Weld Boss to clean and retap the threads. Thoroughly clean metal chips, weld splatter, and other debris from the sump, repaint as necessary, and reinstall the sump. Use a new sump gasket and new lockwashers.

3. For horizontal-screen sump engines (classes 2 through 6), install the Christen 805 Sump Plug and the Christen 804-A or 804-S Sump Fitting. Proceed as follows:

   a. Remove and discard sump screen access plug at rear of sump (Figure 2-10A).

   b. Remove sump screen.

c. With installation tool (supplied with the Christen 805 Sump Plug) loosely screwed into the rear of the Sump Plug, as shown in Figure 2-10B, insert the Sump Plug through sump screen access port. Press the plug firmly into position, so that it is firmly seated against the shoulder that originally retained the front end of the sump screen. The compression of the sump plug O-ring can be felt as the plug is inserted. Unscrew and withdraw the installation tool, taking care not to withdraw the Sump Plug.

NOTE

Steps d through h below describe a sequence which is required to adjust the length of the sump screen to provide a snug fit between the rear of the Sump Plug and the front recess on the Sump Fitting. This procedure is used with either the Christen 804-A or 804-S Sump Fittings. Use care during this sequence to avoid shortening the sump screen by an excessive amount.

d. For the 804-A, shorten the sump screen by cutting off 11/16-inch from one end. For the 804-S, shorten the sump screen by cutting off 3/16-inch from one end. Clean the screen to remove chips and filings.

e. Place the sump screen into the recess in the front of the Christen 804-A or 804-S Sump Fitting and insert the screen through the sump screen access port (without the copper crush gasket supplied). The front end of the sump screen will ride into place over the rear pilot hub of the previously installed Sump Plug. Screw in the Sump Fitting (finger-tight) until the sump screen is firmly seated between its recess at the front of the Sump Fitting and the rear of the Sump Plug.

f. Measure the gap between the front of the Sump Fitting flange and the face at the access port. Determine the remaining length the sump screen should be shortened to reduce the gap to approximately 3/64 inch, or about half the

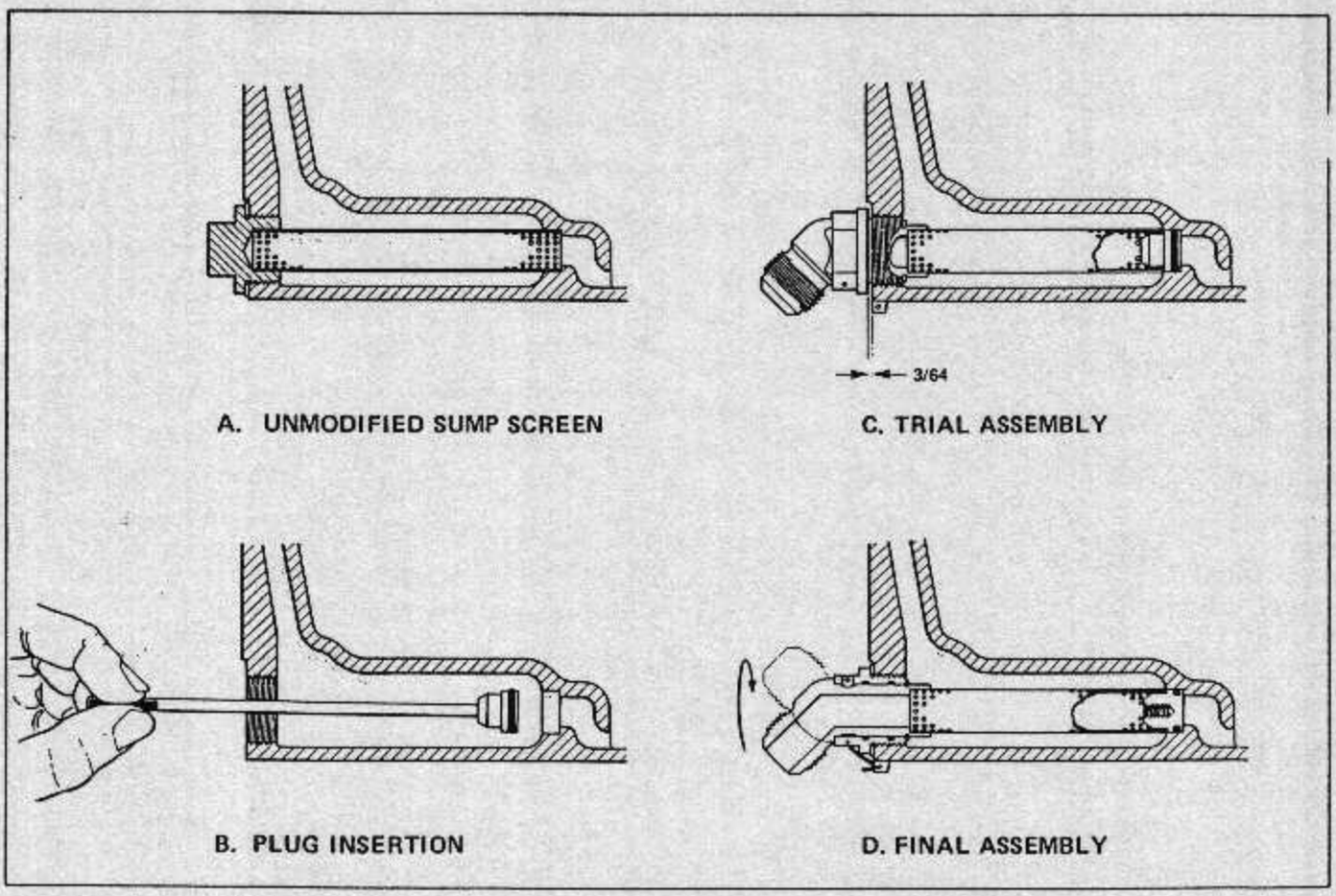


Figure 2-10. Installation of Christen 805 Sump Plug and 804-A Sump Fitting

original thickness of the crush gasket, as shown in Figure 2-10C.

g. Again remove the sump screen and, using caution not to remove too much material, shorten the sump screen by an amount slightly less than the length determined in step f. Thoroughly clean the sump screen.

h. Repeat steps e, f, and g until the required gap is produced.

i. Install sump screen, crush gasket, and Sump Fitting. Tighten Sump Fitting firmly to compress gasket, then safety-wire in place as shown in Figure 2-10D.

j. For systems using the Christen 804-A Sump Fitting, position this fitting by loosening the setscrew in the side of the Sump Fitting and swivelling the rear portion of the fitting to the required final angle. Considerable force may be required to swivel the fitting due to the friction of the internal O-ring seals and the clamping action against the sump screen. A hose fitting may be temporarily installed on the Sump Fitting to increase leverage. Tighten the setscrew to lock the angle.

4. Securely mount the Christen 802 Oil Valve in position on the engine mount or firewall. Verify that the center port is horizontally aligned with the Sump Fitting.

5. Securely mount the Christen 803 Oil Separator in position on the engine mount or firewall. When mounting the Oil Separator on a tubular engine mount using cushioned clamps, it may be necessary to drill additional holes in the Oil Separator mounting bracket. Verify that the bottom of the Oil Separator is as high as possible (at least two inches above the top of the sump) and as far as possible to the side opposite the oil return port (centerline of Oil Separator at least 10 inches from engine sump centerline).

6. Securely mount the Christen 806-4 or 806-6 Breather Tee on the engine mount or firewall.

7. Except for O-235 and O-290 engines, install the required breather fitting in the breather port at the rear of the crankcase. Refer to paragraph 2-3 and Table 2-1 for requirements.

8. For O-235 and O-290 engines, relocate the breather port at the rear of the engine using the Christen 809-K Breather Adapter Kit:

a. Remove original breather hose and fitting at front of crankcase.

b. Install MS29013-6D plug in original breather port.

c. Remove vacuum pump or cover on pad at upper right side of accessory housing at rear of engine. If vacuum pump is removed, relocate as required.

d. Install Christen 809 Breather Adapter on accessory housing using gasket supplied.

e. Install AN842-12D elbow in Breather Adapter.

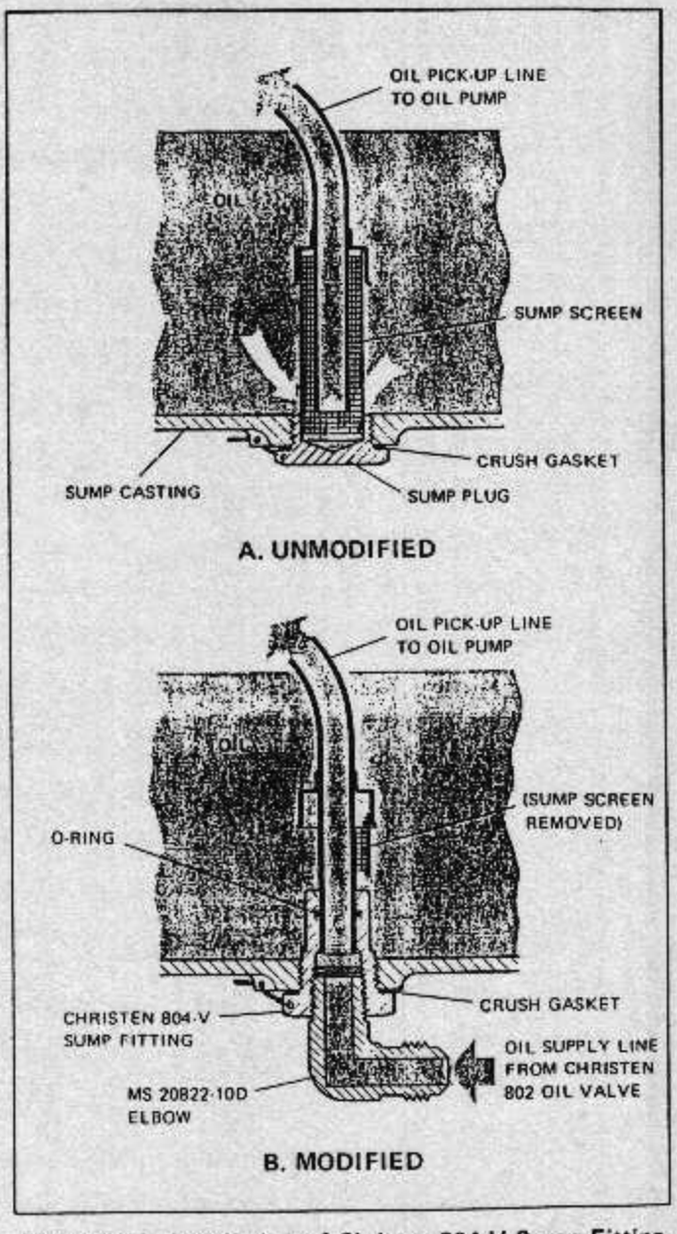


Figure 2-11. Installation of Christen 804-V Sump Fitting

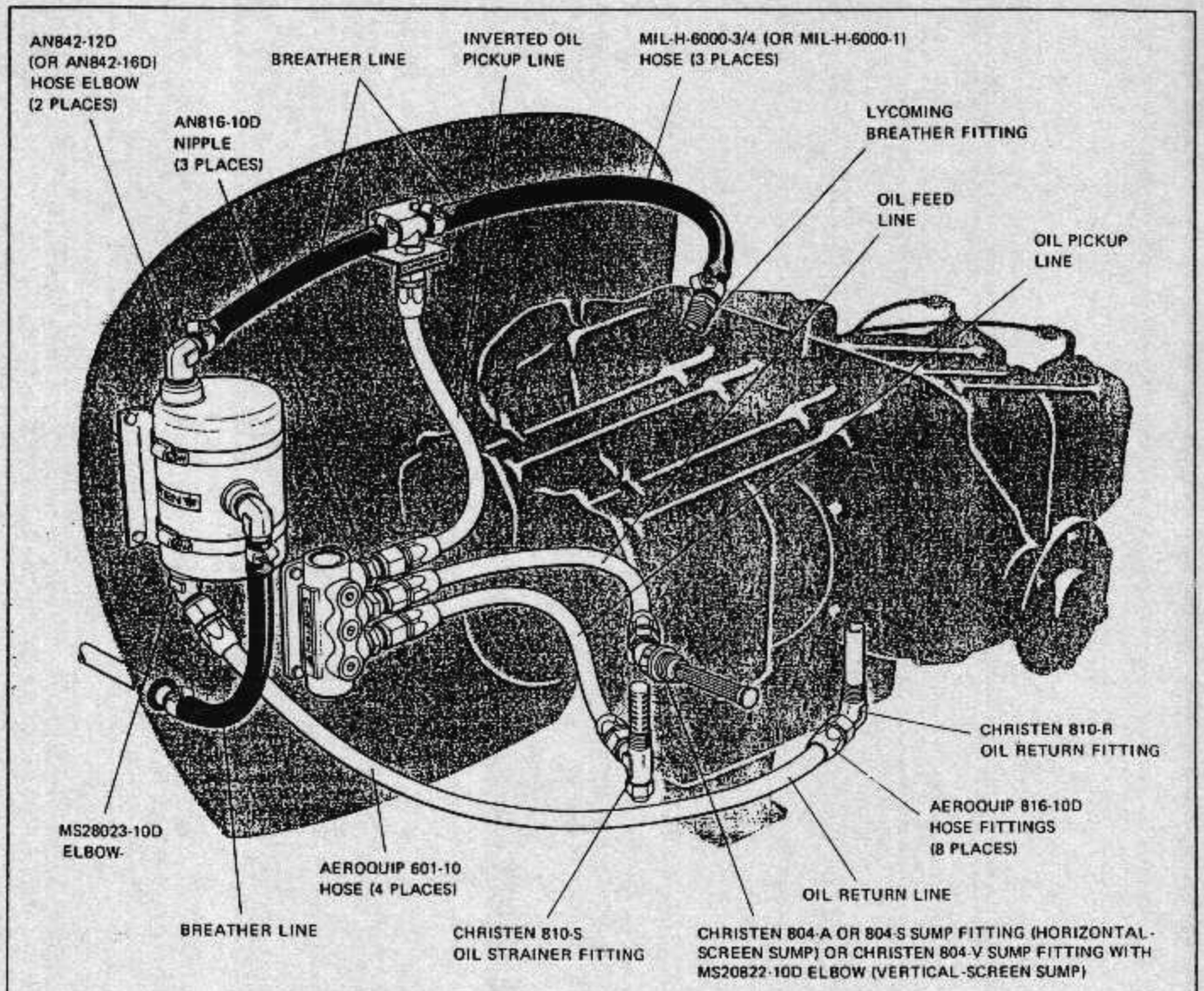
9. For vertical-screen sump engines (Class 1), refer to Figure 2-11, and install the Christen 804-V Sump Fitting as follows:

   a. Remove and discard sump screen access plug.

   b. Remove and discard sump screen.

   c. Verify that the internal O-ring is in place in the Christen 804-V Sump Fitting. Apply a coating of engine oil to the O-ring to act as a lubricant during insertion.

   d. Place crush gasket over the Sump Fitting and install in original sump screen access port.



Christen Part No.	Description	Type	Location
50006-010	Nipple (3)	AN816-10D	802 Oil Valve
50007-010	90° Elbow	MS20822-10D	Sump, oil return from Separator (Used with 804-V Sump Fitting only)
50008-010	45° Elbow	MS20823-10D	803 Oil Separator, bottom port
50010-012 or -016	Hose Elbow(2)	AN842-12D or -16D	803 Oil Separator, top and side ports

Figure 2-12. Fitting and Hose Locations

e. Tighten Sump Fitting to compress gasket, then safety-wire in place.

f. Install MS20822-10D elbow and set position toward Christen 802 Oil Valve.

10. Install remaining required fittings in all engine and component ports. Normal fitting locations for typical installations are shown in Figure 2-12. Follow techniques discussed in paragraph 2-5, as required.

NOTE

The fittings and hoses referenced in steps 11 through 14 are items supplied in the Christen 807 and 808 kits. Equivalent FAA-approved fittings and hoses of other types may be used.

11. Measure, cut, and install breather-line hose (MIL-H-6000 type) using miniature worm-drive hose clamps.

NOTE

Three hose lengths are required: crankcase breather port to Breather Tee, Breather Tee to upper port of Oil Separator, and side port on Oil Separator to overboard breather line.

Use care during installation to ensure large-radius curves without sharp bends or kinks. Observe hose marking stripes during installation to avoid helical twists. To prevent hose collapse on bends of less than 4-inch radius, install Christen 813-4 Breather Coil for 3/4 inch hose, or Christen 813-6 Breather Coil for 1-inch hose.

12. Measure and cut hose for remaining oil lines. Typical hose layout is shown in Figure 2-12. To determine exact cutting length for hose using Aeroquip 816-10D hose fittings, allow exactly 1 inch for each hose fitting.

NOTE

Four hose lengths are required: Oil Strainer Fitting outlet to lower Oil Valve port, Sump Fitting to center Oil Valve port, bottom of Breather Tee to upper Oil Valve port, and lower Oil Separator port to Oil Return Fitting.

For steel-braided hose, such as Aeroquip 601 hose included with the 807 Deluxe Hose and Fittings Kit, use the Christen 50037-001 abrasive cutting wheel supplied to ensure clean, professional-quality cuts.

WARNING

Thin abrasive wheels are fragile tools; handle with care to prevent breakage. Inspect for cracks or other damage before using. Wear safety goggles during use and don't stand in line with the wheel when the grinder is first turned on. Avoid lateral forces on the wheel during cutting.

Mount the abrasive wheel on a medium- or high-speed shop grinder with 5/8 inch diameter shaft. Hold the hose squarely across the cutting wheel, and slowly press the hose into the cutting wheel.

13. Thoroughly clean each hose length and attach hose fittings.

For Aeroquip 601 hose, attach Aeroquip 816-10D hose fittings as follows: (a) Unscrew the hose end sections of the fitting (red anodized). (b) Insert hose in socket with twisting, pushing motion until hose is in line with back of socket threads. (c) Mark hose position at rear of socket using grease pencil or tape. (d) Without getting oil in cutting spur of nipple, lubricate inside of hose and nipple threads using SAE 30 oil. (e) Insert nipple and engage socket threads. (f) Making sure hose is not pushed out of socket, tighten the assembly. The final allowable gap between nut faces is .031 inch. (g) Verify that hose has remained in correct original position by checking mark on hose.

14. When all hose fittings are attached, thoroughly clean each hose section and install as required. Be sure hose routing is as smooth as possible, free from sharp bends, and free from helical twisting. Securely tighten all fittings.

15. Inspect all work for accuracy and mechanical integrity.

Section 3

OPERATION AND MAINTENANCE

3-1 Engine Oil Requirements

Severe stresses are imposed on any engine in aerobatic flight. Competition aerobatics, in particular, imposes unusual engine loads resulting from high rpm, high g-loads, severe gyroscopic propeller moments, and brief periods of zero oil pressure.

The Christen 801 System maintains oil pressure during all periods of inverted flight and during most negative-g maneuvers. However, certain maneuvers or combinations of maneuvers will result in occasional periods of reduced oil pressure, as discussed further in paragraph 3-5.

For protection of any engine used under high-stress conditions of aerobatic flight, a quality grade of aircraft engine oil of a type designed to provide high lubricity, such as Christen Blue Max, should always be used. Christen Blue Max Aircraft Engine Oil is specifically formulated to provide maximum lubricity at high temperatures and zero oil pressure. Laboratory tests have shown that the lubricity of Christen Blue Max is many times that of conventional aircraft oils in heavily loaded bearings during periods of zero oil pressure.

When using Christen Blue Max for normal flight with an oil filter, oil should be changed after 50 hours operation. When the aircraft is regularly and frequently used for aerobatic flight, or if operated without an oil filter, oil should be changed after 25 hours operation.

3-2 Initial Ground Operating Check

The following procedure is used to check out new Christen 801 System installations. It should also be performed after any major repairs or changes to the system.

1. Add required quantity of engine oil.
2. Start engine. Oil pressure should rise to approximately normal readings after 10 or 15 seconds. Slight variation of oil pressure from normal readings on the standard unmodified engine is acceptable. Operating oil pressure is readjusted in step 5 below.

CAUTION

If oil pressure fails to rise after 30 seconds, shut off engine. Refer to paragraph 3-6 for trouble-shooting procedures.

3. While engine is idling, inspect all oil lines and fittings for leaks. If leaks are noted, tighten fittings or take other corrective action, as appropriate.
4. Allow engine to warm up.
5. When engine is at normal operating temperature, reset the pressure relief valve for engine manufacturer's recommended oil pressure reading. The pressure relief valve is usually located above the right rear cylinder and is adjusted either by turning an external screw or by adding internal shim-washers, depending on engine model. This adjustment compensates for the pressure losses caused by oil flow through system hoses and the Oil Valve.

3-3 Initial Flight Test

CAUTION

Ground checks (paragraph 3-2) verify correct operation of parts of the oil system which function during normal flight attitudes only. With a new installation, the initial flight to test inverted oil circulation should be limited to about 15 minutes, to guard against possible excessive oil loss from system leaks.

1. Fly aircraft at safe aerobatic altitude and roll to inverted flight attitude. Oil pressure will drop while oil lines purge, but should rise to normal in about 5 seconds. If oil pressure does not rise to normal within 15 seconds, roll immediately to normal flight attitude.

2. Failure of oil pressure during initial inverted flight is typically caused by the difficulty of getting oil flow started in dry hoses and passages. Try to start system circulation with a short series of steep dives and climbs, then roll to inverted flight attitude. If oil pressure again fails to rise within 15 seconds, return to normal flight. Inverted flight trials may be repeated a few times. Try a series of abrupt inverted high-g dives and climbs. If inverted oil pressure still fails to rise, land aircraft and troubleshoot system (paragraph 3-6).

3. When normal oil pressure is initially developed during inverted flight, try a short sequence of alternating inverted and normal flight attitudes. The slight flicker in oil pressure during the transition between normal and inverted flight is normal and occurs as the balls in the Oil Valve switch oil circulation paths.

NOTE

Because of the longer oil pickup flow path, oil pressure inverted may be 5 to 10 pounds less than oil pressure during normal flight.

4. Land aircraft and thoroughly inspect all hoses, fittings, and components for evidence of oil leakage. Take corrective action, if required.

5. For any engine which is either new or recently overhauled, fly in the inverted attitude for a sufficient period of time so that oil circulation will flush metal chips or other contaminating debris through the system. Short periods of normal flight should be alternated with longer periods of inverted flight to operate the ball valves during flushing. Flushing reduces the possibility of foreign material blocking one of the ball valves in the Christen 801 System. Valve blockage will cause failure of oil pressure during inverted flight.

3-4 Normal Oil Level

The Christen 803 Oil Separator collects oil remaining in the system hoses immediately following a normal-to-inverted or inverted-to-normal flight transition. The oil returns to the sump, by gravity flow, during periods of normal flight. A sequence of rapidly executed maneuvers may cause oil to collect in the Oil Separator faster than it can return to the sump. Oil will be lost through the overboard breather lir when the oil in the Oil Separator rises above the overboaru breather port in the Oil Separator.

For any particular installation, variations such as (a) the size and characteristics of the engine, (b) installation details of the Christen system (hose length, hose bend radii, component position), and (c) aerobatic flight sequences normally performed, combine to establish what can be considered the normal oil level for the engine. Oil quantities in excess of the normal oil level are usually lost quickly during an aerobatic sequence, but once the normal level is reached, oil losses are extremely low. For example, in a Pitts Special S-1S aircraft equipped with a Lycoming O-360-A4A, 180 hp engine with the Christen 801 Inverted Oil System, oil capacity is 8 quarts, but normal oil level is between 6 and 7 quarts, and oil is typically added only when the level falls below 6 quarts.

When operating at normal oil level during conventional aerobatic flight of the type performed in air show demonstrations or for aerobatic instruction, oil losses should not occur. During extremely severe aerobatic sequences of the type performed in unlimited-class competition, losses should not exceed about 1/2 quart per 10 minute flight sequence.

Proceed as follows to determine normal oil level:

1. Starting with engine at recommended oil capacity (typically 8 quarts for the Lycoming O-360-A4A, four-cylinder 180 hp engine used in the Pitts Special S-1S), fly an aerobatic sequence of about 5 or 10 minutes.

2. Land and check oil level. As much as 1 quart of oil loss may be observed.

3. Fly another aerobatic sequence similar to that used in step 1. Land and check oil level again.

4. Continue this procedure until oil losses per flight are abruptly reduced. Typically, with a 180 hp Lycoming engine, this level is between 6 and 7 quarts.

5. This establishes the normal operating level. When oil is added beyond this normal operating level, the excess can be expected to be thrown off fairly quickly.

3-5 Operating Notes

OIL PRESSURE DURING WARM-UP

In standard unmodified Lycoming aircraft engines, oil pressure is typically high while engine oil is cold, and the pressure drops to normal operating range after the engine warms up. In an engine modified to use the Christen 801 System, oil pressure characteristics are affected by the longer flow path of oil through the system hoses and Oil Valve.

Depending on the particular installation, oil pressure may be either (a) relatively low for a cold engine, rising to normal when hot, (b) constant at normal operating value when the engine is either cold or hot, or (c) high for a cold engine, falling to normal when hot. These effects may vary somewhat depending on the viscosity of oil used and the ambient temperature, but the changed oil pressure characteristics during warm-up should be considered normal.

PRESSURE DIFFERENCE INVERTED

In some installations, oil pressure during inverted flight may regularly be 5 to 10 pounds less than oil pressure during normal flight. This condition is caused by the larger oil pressure drop through the longer oil pickup flow path in inverted flight (i.e., breather line plus inverted oil pickup line).

OIL PRESSURE INDICATION FLICKER

After installation and checkout of the Christen 801 System, engine oil pressure will normally be maintained during all positive-g and negative-g maneuvers. During the transition from normal to inverted flight, a slight variation in oil pressure indication usually occurs as the valve-balls operate in the Christen 802 Oil Valve. This pressure variation is indicated by a slight flicker in pressure indicated on the oil pressure gauge, usually from 10 to 30 psi. This flicker normally lasts about a second, after which the regular inverted flight oil pressure should be maintained.

Some engines have a restricted orifice fitting at the oil pressure gauge port to prevent major loss of oil in the event of an oil pressure line failure. In some cases, this restrictor dampens the oil pressure gauge reaction to oil pressure change, and causes the gauge to substantially lag actual pressure. The normal flicker of oil pressure when transitioning from upright to inverted flight and vice versa may therefore appear as a prolonged pressure change indication lasting up to two or three seconds in engines which are equipped with the restricted orifice fitting. Such indications result from the operation of the oil pressure gauge connection, and are not an indication that the oil system is malfunctioning. (However, if no restrictor is used in the gauge line, slow changes in oil pressure indicate a possible malfunction which should be investigated.)

COLD WEATHER OPERATION

In very cold weather, it is important to use the proper viscosity engine oil and to run the engine sufficiently long to bring the engine oil to the normal operating temperature. Cold oil will not circulate well in cold lines and other engine parts, so the flow of oil from the engine sump through the external hoses and components of the Christen 801 System will be severely impeded until the oil, the engine, and all external system parts are warmed up. Once the engine oil itself is warm, the aircraft should be flown inverted for an extended period to allow the oil to thoroughly warm up the Oil Separator and associated external lines. When all system components are warm, the system function and oil pressure should operate normally. It may be necessary when operating in extremely cold weather to modify or partially bypass the engine oil cooling system to keep the oil at normal operating temperature.

MOMENTARY LOSS OF OIL PRESSURE

Oil pressure may be interrupted momentarily in certain aircraft attitudes or during certain combinations of maneuvers. These attitudes and maneuver combinations are generally of the type which can only be maintained for short periods of time, so there is no serious effect on engine performance. The effect is normal and should not be construed as a system malfunction.

The main cause of momentary loss of oil pressure is that in certain attitudes, the oil in the sump (or at the top of the crankcase during inverted flight) is placed so that it cannot be drawn into the oil pickup line (or breather line, for inverted flight). For example, during a vertical or steep inverted dive the engine oil will fall to the front or top-front of the engine so that neither the breather line nor the oil feed line at the sump has an available supply of oil.

A secondary cause of oil pressure loss is that conditions may occur which result in uncertain closure of the ball valves in the Oil Valve. For example, if an abrupt entry into knife-edge flight is made from a zero-g condition, it is possible for both balls in the Oil Valve to be jarred from their proper positions, with a resultant interruption in oil flow in the oil pickup line.

Oil pressure is usually maintained by the existing oil in the oil feed line for a short period of time after the oil supply is interrupted in some aerobatic attitudes.

These effects vary depending on the engine type, quantity of oil in the engine, and the design of the particular installation. The extended sump modification maintains oil pressure during many situations that would result in oil pressure loss using only the standard sump modification.

Pressure loss as discussed above may be observed in the following circumstances:

1. Vertical flight, straight down.
2. Inverted flight, steep dive.
3. Zero-g periods.
4. Knife-edge flight (occasional only with extended sump modification).

OIL LOSS FROM UNUSUAL MANEUVERS

If the Christen 801 System is functioning properly, only very small losses from normal oil level will occur, as discussed in paragraph 3-4.

Certain uncommon aerobatic maneuvers, if performed for an extended period of time or in rapid repetitive sequences, may result in abnormal oil losses. For example, if an aircraft performs a lengthy series of vertical roll-type maneuvers in rapid succession, from inverted flight entry and with inverted recovery, oil which accumulates in the Oil Separator has no opportunity to return to the engine sump. As a result, the oil eventually flows overboard through the breather line. Such a series of maneuvers would be performed rarely, and then only in unusual competition practice and not in a competition sequence. The oil loss problem in such practice can be eliminated simply by bringing the aircraft to the normal upright attitude occasionally to allow oil accumulated in the Oil Separator to return to the engine sump.

3-6 Troubleshooting

The Christen 801 System functions on the basis of simple principles. If oil system malfunctions are noted, inspect the system, keeping in mind its basic principles of operation. Remember that it is possible to misinterpret characteristics of normal operation; refer to paragraph 3-5. Possible problems and causes which may occur are tabulated below:

NORMAL FLIGHT OK, LOW OIL PRESSURE INVERTED

1. Some installations may operate inverted with oil pressure 5 to 10 pounds below normal-flight oil pressure. This is not a malfunction condition; see paragraph 3-5.
2. Operation in cold weather with insufficient warm-up or excessive oil viscosity. See paragraph 3-5.
3. Damaged and leaking valve seats in Oil Valve. Tes valve and reseat balls as described in paragraph 3-7.
4. Damaged and leaking valve seat in Oil Separator. Reseat ball as described in paragraph 3-7.
5. Faulty seal at Sump Plug, allowing air to be drawn into system. Inspect Sump Plug O-ring for damage. Be sure Sump Plug is properly seated. See paragraph 2-6 and Figure 2-10.
6. Sluggish pressure indication resulting from restrictor-type fitting on oil pressure gauge port. See paragraph 3-5.
7. Accumulated engine oil sludge or foreign material in Oil Valve prevents free operation of balls. Disassemble and clean thoroughly.
8. Collapsed breather hose. Reroute or replace hose. Install Christen 813-4 or 813-6 Breather Coil, as required.
9. Obstruction in breather hose or Breather Tee. Disa semble and clean thoroughly.
10. Sludge or foreign material in Oil Separator causing faulty valve sealing. Disassemble and clean thoroughly.

LOW OIL PRESSURE IN NORMAL FLIGHT

1. Sump screen clogged. Disconnect hose at Sump Fitting, remove Sump Fitting, extract sump screen, and clean thoroughly.
2. Obstruction in Oil Valve. Disassemble and clean thoroughly.
3. Defective oil pump: defective pressure gauge. Test and repair as required.
4. Oil pressure not checked and adjusted after system installation. Adjust as described in paragraph 3-2.
5. Damaged seats in Oil Valve. Reseat balls as described in paragraph 3-7.

EXCESSIVE OIL LOSS

1. Performance of unusual aerobatic maneuver series in rapid succession without enough time in normal flight for oil to drain from Oil Separator. See paragraph 3-5.

2. Oil level maintained above normal aerobatic oil level. See paragraph 3-4.

3. Oil Separator mounted too low. Reposition Oil Separator and extend hose lengths, as required. See paragraph 2-2.

4. Oil Separator not mounted as far as possible to the side opposite the oil return port in the sump. Reposition as required. See paragraph 2-2.

5. Oil return hose between bottom of Oil Separator and sump not routed in smooth, continuously downward direction. Reroute hose, as required.

6. Restrictive 90^{0} fitting installed at bottom of Oil Separator. Replace restrictive fitting with straight or 45^{0} fitting.

7. Restriction in breather hose causing crankcase pressure which forces oil overboard through oil return line and Oil Separator. Clean or replace. Install Christen 813-4 or 813-6 Breather Coil, as required.

3-7 Reseating Valve Balls

Marginal operation of valves may result from nicks in the valve seats which cause leakage when the valve should be closed. Such nicks can be caused by mishandling or by small chips of metal being caught between the ball and the seat as the valve operates during initial run-in of a new or newly-overhauled engine.

NOTE

Valves may be tested for suspected leakage as follows:

(1) Verify that unused ports are plugged.

(2) Hold the valve so that its axis is vertical and cover the lower port using a finger.

(3) Suck on the center port to produce partial vacuum, then place the tongue over the center port to retain vacuum; ball valve sealing should be sufficient to retain the partial vacuum for 2 to 3 seconds.

(4) Invert the valve and repeat steps 2 and 3 above.

To reseat the valve if seat nicks and leakage are found, proceed as follows:

1. Disassemble the valve and remove the ball. For the Christen 802 Oil Valve, remove an end retaining ring, then strike the Oil Valve sharply against a padded bench top to drive the end cap out of the valve body.

2. Thoroughly clean all oil passages, including ball and valve seat.

3. Place the ball in position on its seat; place a brass, aluminum, or other soft metal rod against the ball and tap the rod with a single, sharp hammer blow to reshape the valve seat to the ball. For the Christen 803 Oil Separator Valve the metal rod must be placed against the sliding weight that is internal to the Oil Separator.

4. For the Oil Valve, inspect the O-ring and replace if damaged. Coat the O-ring with light oil or grease and reassemble the valve. The end cap should snap into the valve body. Be sure the retaining ring is fully seated in its groove.

5. Recheck the valve for leakage before installation. Perform all ground and flight tests given in paragraphs 3-2 and 3-3 as a performance check.

3-8 Service Requirements

As a result of simple, straightforward design with few moving parts, the Christen Inverted Oil System normally requires no maintenance. Time between engine overhauls is not affected by the Christen 801 System; follow engine manufacturer's recommendations to determine overhaul schedule.

During major overhauls or when repairs require sump removal, inspect sump for excessive deposits of sludge, varnish, or foreign material. If sump is dirty, remove and thoroughly clean all hoses and components; then use compressed air blast for drying and cleanout before reassembly.

Table 4-1. Hose and Fittings Kits

Christen Part No.	Description	Quantity per Kit			
		Deluxe Kits		Basic Kits	
		807-4	807-6	808-4	808-6
50006-010	Nipple (AN816-10D)	3	3	3	3
50008-010	Elbow, 45° (MS20823-10D)	1	1	1	1
50013-010	Hose fitting (Aeroquip 816-10D)	8	8	–	–
50012-010	Hose, wire braided (Aeroquip 601-10)	10 Ft	10 Ft	–	–
50010-012	Hose elbow, 90° (AN842-12D)	2	–	2	–
50010-016	Hose elbow, 90° (AN842-16D)	–	2	–	2
50037-001	Grinding Wheel	1	1	–	–
50040-012	Clamp, miniature worm-drive	6	–	–	–
50003-016	Clamp, worm-drive	–	6	–	–
50043-012	Hose, fuel & oil (MIL-H-6000-3/4)	5 Ft	–	–	–
50043-016	Hose, fuel & oil (MIL-H-6000-1)	–	5 Ft	–	–

Section 4

REPLACEABLE PARTS LIST

4-1 Part Identification

The following illustrations and parts lists identify replaceable parts used on the Christen 801 Inverted Oil System. These parts are available either for repair or custom installation.

Christen Product No.	Name	Figure
802	Oil Valve	4-1
803	Oil Separator	4-2
806-4/806-6	Breather Tee	4-3
809-K	Breather Adapter Kit	4-4
811-A/811-S/811-V	Sump Kit	4-5

The hose and fittings kits contain standard parts and non-repairable parts and are not illustrated in this manual. Kit contents are listed in Table 4-1.

Non-repairable parts (other than those listed in Figures 4-1 through 4-5), such as the Breather Coil, are not illustrated; order such parts by Christen Product No. listed below.

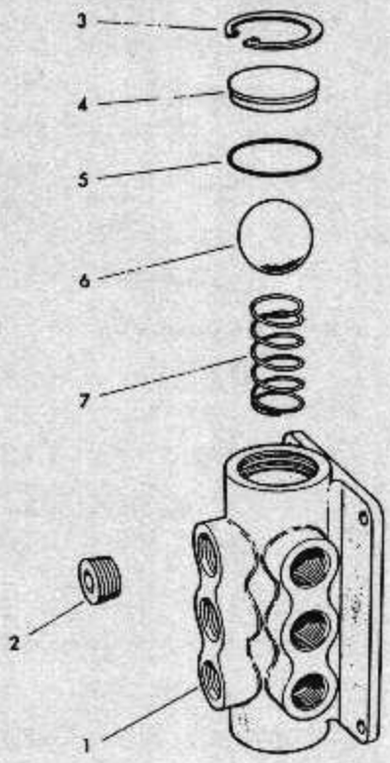
Description	Christen Product No.
Weld Boss (1 ea)	812-1
Weld Boss (2 ea)	812-2
Breather Coil (3/4-inch hose)	813-4
Breather Coil (1-inch hose)	813-6

4-2 Ordering Information

With all parts orders, be sure to include (a) Christen Part No., and (b) Description of Part. If part number is not known, include complete description, location, and part application with inquiry. For hoses and fittings, give Christen, AN, MS or MIL designation, if known.

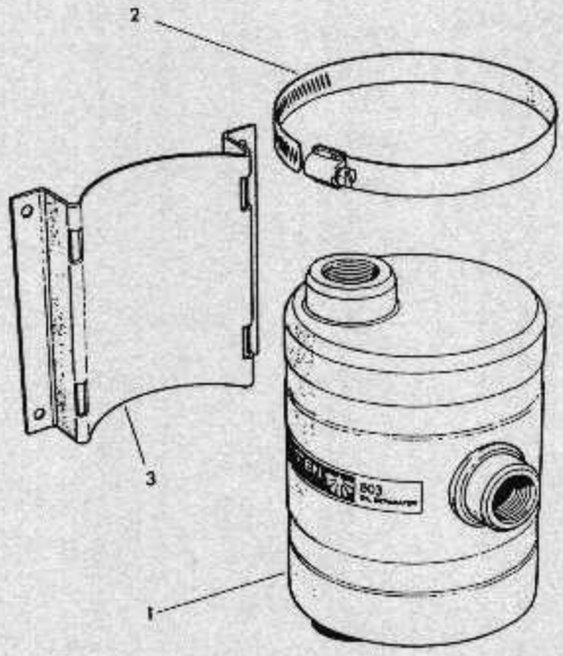
Order blanks and price lists are available on request. Shipments are normally made by parcel post or air parcel post, as specified. Place all orders directly to the Christen plant:

Christen Industries, Inc.
1048 Santa Ana Valley Road
Hollister, California 95023
Telephone (408) 637-7405



Index No.	Description	Christen Part No.	Quantity
1	Valve body assembly	30051-501	1
2	Plug, hex drive	50039-005	3
3	Retaining ring, internal	50024-026	2
4	Body plug	30003-001	2
5	O-ring	50004-027	2
6	Ball, corrosion resistant	50023-043	2
7	Spring, compression	50015-854	1
(Not shown)	Wrench, hex socket	50026-029	1

Figure 4-1. Christen 802 Oil Valve



Index No.	Description	Christen Part No.	Quantity
1	Can Assembly	30009-501	1
2	Clamp, worm drive	50003-072	2
3	Bracket	30008-001	1

Figure 4-2. Christen 803 Oil Separator

Index No.	Description	Christen Part No.	Quantity	Used On
1	Tee assembly, 3/4" hose	30080-501	1	806-4
1	Tee assembly, 1" hose	30080-502	1	806-6
2	Nut, flared tube bulkhead	50031-010	1	806-4/-6
3	Gasket	50041-010	1	806-4/-6
4	Bracket assembly, 806-4	30073-501	1	806-4
4	Bracket assembly, 806-6	30073-502	1	806-6

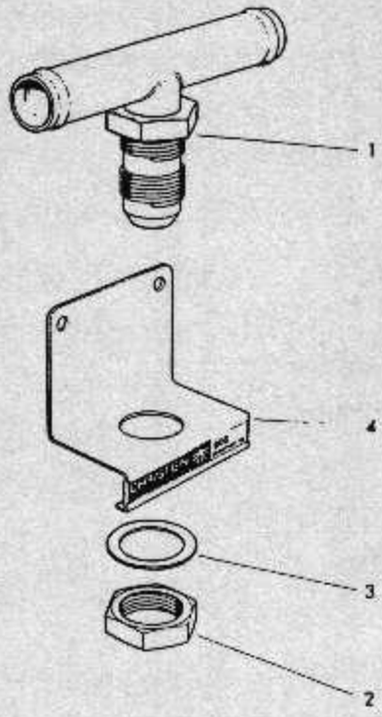
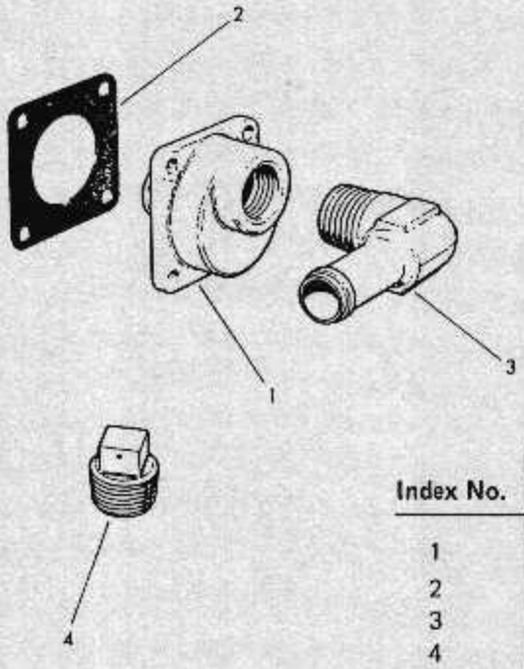
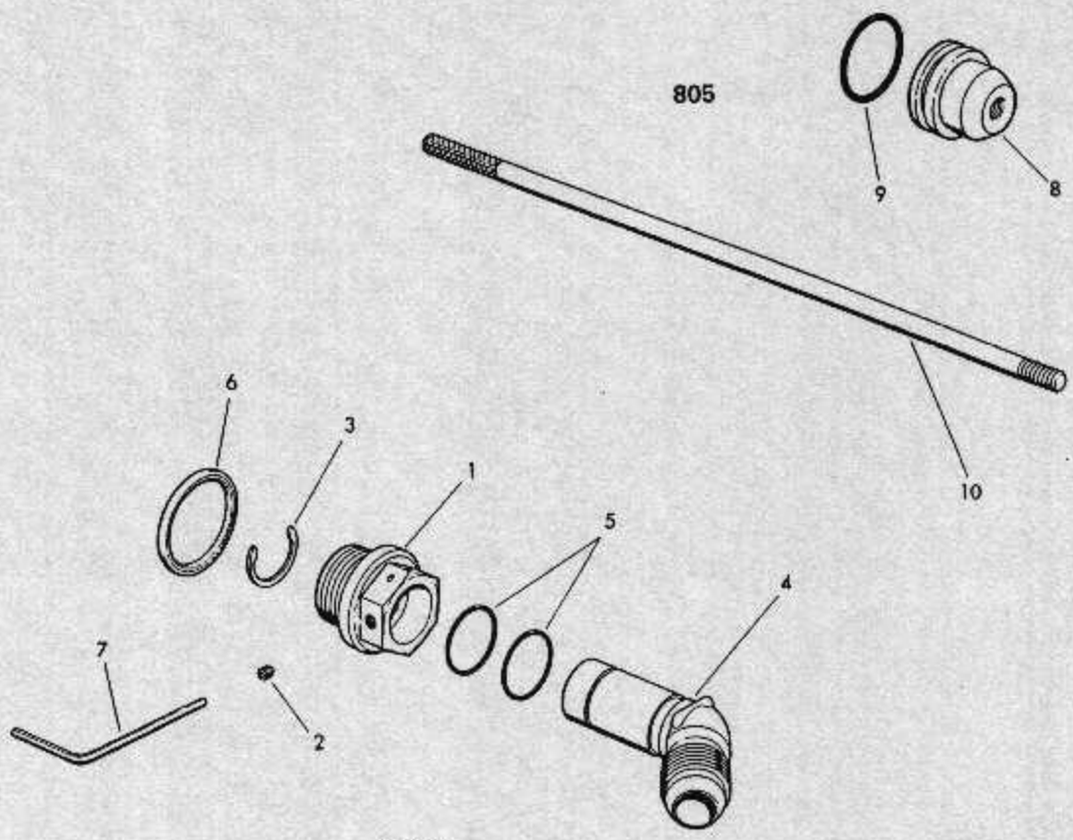


Figure 4-3. Christen 806-4/806-6 Breather Tee



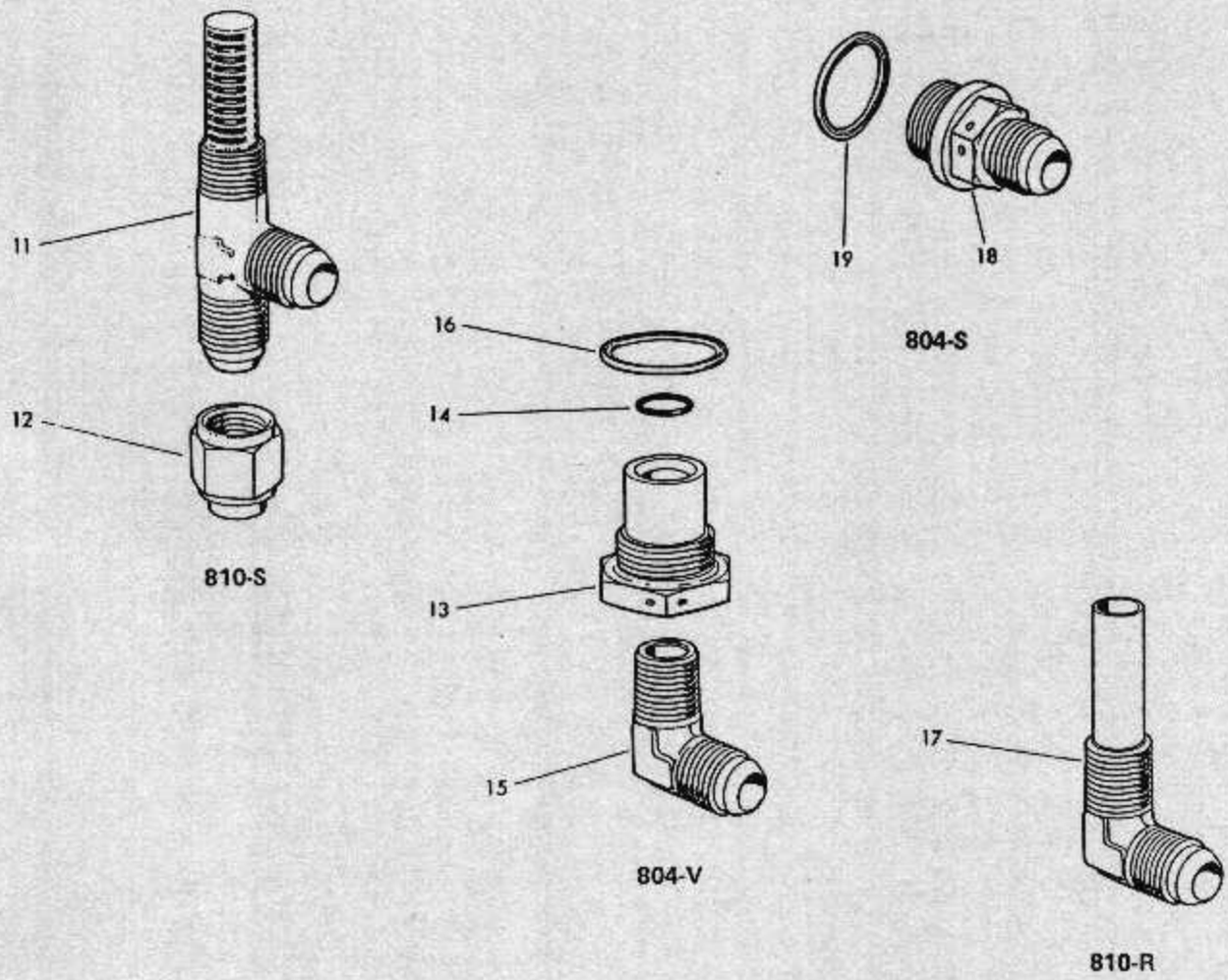
Index No.	Description	Christen Part No.	Quantity
1	Breather Adapter Assembly	30116-501	1
2	Gasket	30143-001	1
3	AN842-12D Hose elbow	50010-012	1
4	Plug MS20913-6D	50053-006	1

Figure 4-4. Christen 809-K Breather Adapter Kit



Index No.	Description	Christen Part No.	Quantity	Used On
1	Sump bushing	30043-001	1	811-A
2	Setscrew, cup point	50016-065	1	811-A
3	Retaining ring, external	50020-016	1	811-A
4	Sump elbow	30048-001	1	811-A
5	O-ring	50004-018	2	811-A
6	Gasket	50042-016	1	811-A
7	Wrench, hex socket	50026-009	1	811-A
8	Sump plug	30002-001	1	811-A/-S
9	O-ring	50004-111	1	811-A/-S
10	Insertion tool	30075-001	1	811-A/-S

Figure 4-5. Christen 811A/811S/811V Sump Kit (Part 1 of 2)



Index No.	Description	Christen Part No.	Quantity	Used On
11	Strainer fitting assembly	30107-503	1	811-A/-S/-V
12	Cap, pressure seal	50034-010	1	811-A/-S/-V
13	Sump fitting	30104-001	1	811-V
14	O-ring	50004-112	1	811-V
15	MS20822-10D Elbow, 90°	50007-010	1	811-V
16	Gasket	50042-020	1	811-V
17	Oil Return Fitting	810-R	1	811-A/-S/-V
18	Sump fitting	804-S	1	811-S
19	Gasket	50042-016	1	811-S

Figure 4-5. Christen 811A/811S/811V Sump Kit (Part 2 of 2)