ORION SERVICE DIGEST

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ORION

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FRONT AND BACK COVERS Patrol Squadron ELEVEN, with their P-3B Orions, ranges over the Atlantic in the vanguard against submarine-launched attacks on America and her allies. VP-11 is no fledgling. They were first commissioned in 1924 as torpedo bombing squadron VT-19 D14, at Pearl Harbor, Hawaii. The squadron quickly demonstrated its "Can Do" spirit in 1925 when several of its pilots made the first successful night landings on an aircraft carrier underway. Throughout the 1920's and the early 1930's the squadron patrolled the Pacific from their Hawaiian home, first being redesignated VT-6D-14 and then VP-6B. Soon afterward the squadron became VP-6F and swapped their torpedo bombers for flying boats, first operating PM-1's and PD-1's and later flying the venerable PBY Catalina. By 1939 the squadron had acquired the famous Pegasus emblem (shown on the back cover) and yet another designation, VP-23. Still based in the Pacific area, the squadron finally became VP-11 in 1941.

During the difficult days that followed America's entry into World War II, VP-11 patrolled the Pacific day and night. As the tide of battle began to turn, PATRON ELEVEN participated at Guadalcanal, and later patrolled the waters off New Guinea. After re-grouping in 1943, the squadron returned to the Pacific and engaged in the famous "Black Cat" night strikes that sank nearly 100,000 tons of enemy shipping, becoming one of the first patrol squadrons in naval history to earn the Presidential Unit Citation. In December, 1944, after a job well done, VP-11 was decommissioned.

Nearly eight years later PATRON ELEVEN was recommissioned to serve on the other side of the world. The years that followed have found the squadron deployed in North and South Atlantic areas, and in the Carribean and Mediterranean, flying everything from ice patrols to goodwill missions, while still performing their prime mission, ASW surveillance. Highlights for VP-11 since recommissioning include winning the coveted "E" for Excellence award for two successive years, participating in the quarantine of Cuba in 1962, and participation during the Dominican Republic Crisis of 1965. VP-11 transitioned from SP-2H Neptunes to their P-3 Orions in 1966, and today stands ready to carry on the "Can Do" tradition, as recognized by the Secretary of the Navy in awarding the Navy Unit Commendation to PATRON ELEVEN for the period 12 October 1967 to 15 February 1968 during their latest operations in the North Atlantic. The cover picture shows one of PATRON ELEVEN'S Orions flying over Reykjavik Bay, Iceland during their most recent deployment.

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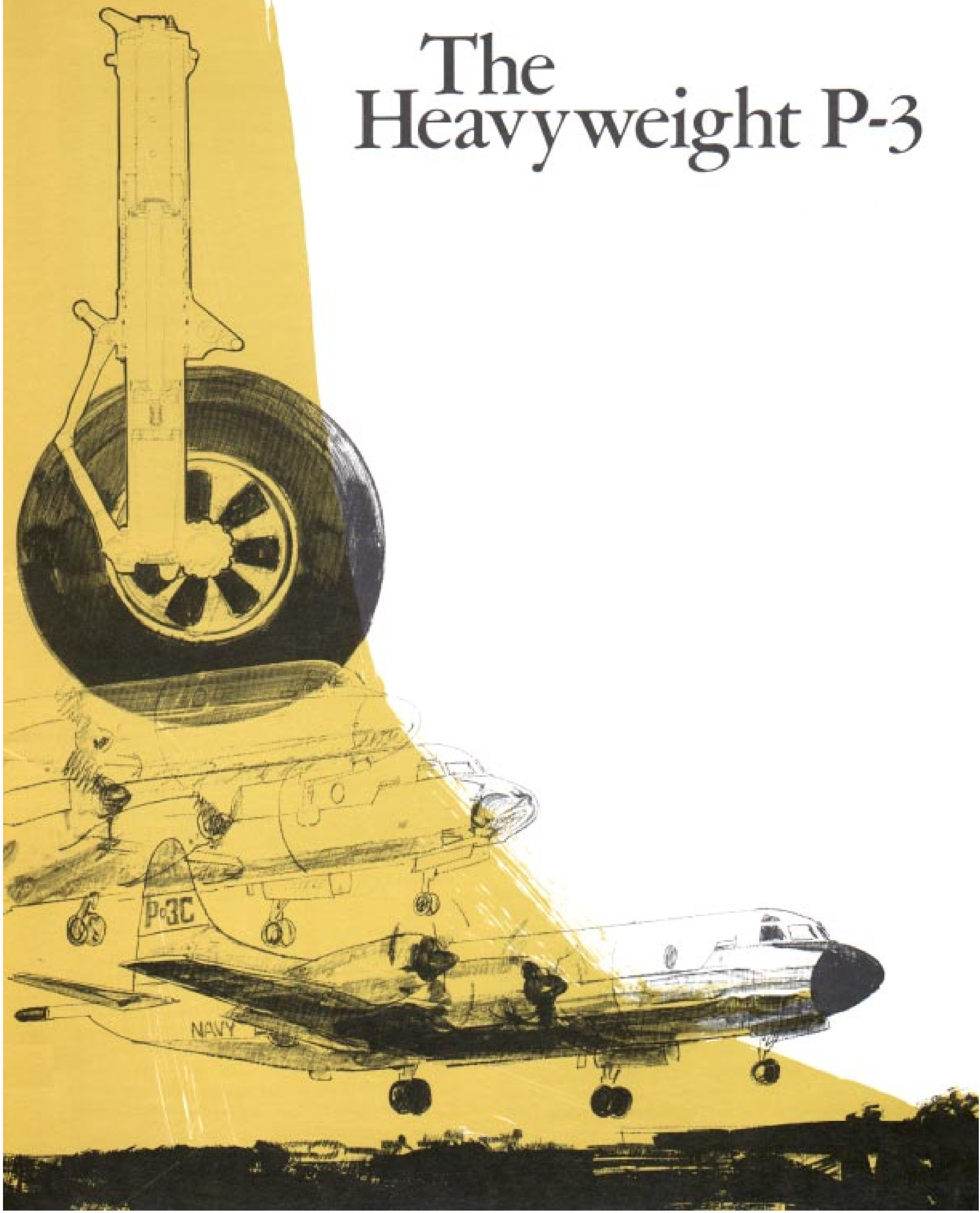
The Heavyweight P-3



INTRODUCTION

WHEN THE P-3 went into operation in mid-1962, it represented a superior new-generation ASW weapon system replacement for the venerable P-2, counting among its more valuable assets the inherent potential for growth. Fifteen years' experience with P-2 development — from P2V-1 through P2V-7 — gave irrefutable proof that the capability for "graceful" growth to incorporate new technology was an essential attribute in a new ASW airframe. Although it is never possible to forecast the exact nature of future technological progress, the P-3 prototype seemed to afford the necessary flexibility and expandability in all of the probable parameters, and subsequent development has confirmed that promise. In addition to the myriad other improvements incorporated through the years, the P-3 has acquired provisions for mine-laying and gained almost total self-sufficiency through the integration of an auxiliary power unit with only local redesign of structural elements. In all, these improvements added some 2500 lbs to the empty weight of the original configuration, while the recommended gross weight maximums remained fixed: 127,500 lb takeoff (P-3A), 105,000 lb landing.

As more and more weight was added, the weapon system capabilities were enhanced in all but one respect — useful load was penalized. Any aircraft that has such ample provisions for fuel and armament storage that both capabilities cannot be fully utilized coincidentally poses something of a dilemma in provisioning for extended missions. A trade-off is required, and generally fuel stores are reduced — accepting a range and endurance penalty — because the armament configuration is often specifically defined by the ASW mission. The only alternative is to accept an overload takeoff and trust that taxi and flight loads can be kept moderate until the excessive fuel weight is expended by the engines. The pressure of operational necessity is often cited as a mandate to ignore the recommended load maximums, and in some locales overload missions become the rule instead of the rare exception.

This is manifest cause for concern to the manufacturer as well as the operator. Quite aside from the possible danger that structural components will be failed outright by excessive stress during ground or flight maneuvers is the additional consideration that the cumulative effect will reduce the life of structural components. To take a single example from the multitude of components involved, wheels that are designed, tested and proven to have a certain "safe-life-span" have an *uncertain* safe-life span if operated extensively at over-load conditions. The only certainty is that the wheel's potential for service is less than the designer provided, and there is no way to prescribe accurately a specific time at which wheels should be inspected and/or retired from service to avoid a wheel-failure incident or accident.

Thus, there was already considerable reason to institute design changes in early 1966 when the empty weight of the P-3C configuration was first calculated. Although the added weight of the new equipments was quite small in relationship to the advance in technological efficiency provided, range and endurance to exploit the A-NEW technology fully would not be realized unless the airframe's load carrying capabilities were enhanced too. A project was initiated to review the total design and rework those elements necessary to increase the P-3 useful load capability. As a result, recommended maximum takeoff weight gained 6000 lb (from 127,500 to 133,500); landing weight gained 9000 lb (from 105,000 to 114,000).* In addition, a new maximum overload takeoff weight, carrying external stores, was established at 142,000 lb.

The changes were implemented in ECP - P-3 494. As might be expected, a fair share of these changes affected landing gear assemblies and the fuel system, but many structural elements at scattered locations throughout the airframe (mostly the wing) were also singled out for redesign to accommodate the higher loads.

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* *There is an appreciable divergence between the loads criteria utilized by our design groups and the values cited above, which were taken from the NATOPS Flight Manual, October 1967 Revision. We have cited the NATOPS values in this article for the sake of simplicity, but for those more directly interested in engineering aspects we should explain that this sentence, based on the design criteria of ECP-494, would read in part: "— to increase the P-3 maximum flight design gross weight 7,800 lb. (from 127,200 to 135,000); the landing design gross weight 12,560 lb. (from 91,320 to 103,880).*

First Engineering Test Flight of YP-3C
(just off-shore of Catalina Island)

Thus, ECP-494 not only afforded solutions for the existing problem of too-frequent overload operation, but also obviated some foreseeable problems of future development when new and heavier avionics and armament are introduced. The decision was made to incorporate all of the redesigned elements at the earliest opportunity on the P-3B production line (BUNO 153442 and subsequent).

For some time there will certainly be an admixture of "low-gross-weight" (LGW) and "high-gross-weight" (HGW) aircraft within the fleet, and in cases where the proper replacement components cannot be obtained, there will also be a few "hybrid" aircraft which incorporate some, but not all, of the redesigned components.

In itself, this situation poses no great handicap in maintenance or operation and it is advantageous inasmuch as no items of existing inventory are rendered obsolete. There is, however, an appreciable and growing potential for confusion if both maintenance and operating personnel do not have a true perspective of the differences between the older and the newer design. It is the purpose of this article to describe the changes in functional capabilities, and to discuss those aspects of operation and maintenance which may generate unnecessary confusion and controversy.

There are, of course, a number of static structural elements which are strengthened in diverse ways as a part of ECP-494. To line personnel, these are of academic interest only, and aside from the brief descriptions given in Figure 1, we will not discuss them in this article. Changes to tires, wheels, brakes, and landing gear struts together with the incorporation of fuel dump provisions are of direct interest to line personnel, and these we will describe in appropriate detail and consider from both the maintenance and operational viewpoints.

THE "SOFT" MAIN LANDING GEAR STRUT

BACKGROUND The earliest design-development efforts for the P-3 prototype were concerned with analyzing the various major components of the L-188 Electra transport aircraft to determine what, if any, changes were necessary to meet the requirements of the P-3. These studies showed that the original design of the landing gear could be adopted by the P-3 practically without change. Aside from the obvious

APPENDIX C

STRUCTURAL DESCRIPTION

INTRODUCTION

THIS APPENDIX IS PRESENTED TO DESCRIBE THE STRUCTURAL CHANGES MADE FOR THE INCREASED GROSS WEIGHT VERSION (ECP 494) OF THE AIRPLANE, SN 5239 AND UP. THE EXTERIOR AND MOST OF THE INTERIOR OF THE AIRPLANE REMAIN UNCHANGED. THESE SERIALS WILL HAVE THE ALLISON T56-A-14 ENGINE DRIVING A FOUR-BLADED HAMILTON STANDARD, FULL FEATHERING REVERSIBLE PITCH PROPELLER, DESIGNATION 54H60-77.

THE DESIGN GROSS WEIGHTS OF THESE AIRPLANES ARE AS FOLLOWS:

BASIC LANDPLANE TAKEOFF DESIGN GROSS WEIGHT ______ 139760 LB

BASIC FLIGHT DESIGN GROSS WEIGHT ______ 135000 LB

BASIC LANDPLANE LANDING DESIGN GROSS WEIGHT ______ 103880 LB

MINIMUM FLYING WEIGHT ______ 72541 LB

MAJOR STRUCTURAL CHANGES ARE LISTED BELOW.

FUSELAGE

Forebody

THE ESCAPE AND SERVICE HATCH SUPPORT STRUCTURE ON THE LEFT SIDE HAS BEEN STRENGTHENED BY REPLACING SOME OF THE ORIGINAL RIVETS WITH THE NEXT LARGER SIZE.

THE FORWARD OBSERVER WINDOW AREA HAS BEEN STRENGTHENED WITH HEAVIER GAGE STRINGERS, STRONGER ATTACHMENTS CONSISTING OF INCREASED DIAMETER RIVETS WITH HI-LOKS AT A FEW SKIN JOINTS AND ADDED INTERMEDIATE STIFFENERS AT THE CUTOUT CORNERS.

THE LOWER BULKHEAD AT FS 288 HAS BEEN STRENGTHENED BY WIDENING A FORMER FLANGE AND REPLACING RIVETS WITH HI-LOKS.

THE TURBINE EXHAUST DOOR AREA HAS BEEN REINFORCED BY THE ADDITION OF A DOUBLER ABOVE THE DOOR.

FUSELAGE TRANSVERSE SKIN JOINTS IN THE PROPELLER PLANE HAVE BEEN REINFORCED WITH LARGER RIVETS AND REDUCED RIVET SPACING.

THE AREA ABOVE THE BOMB BAY SECTION AFT OF FS 458 HAS BEEN STRENGTHENED BY INCREASING SKIN AND STRINGER GAGES, EXTENDING LENGTHS OF BACKUP RINGS AT FS 477-FS 515.

Midbody (FS 571 TO FS 695)

THE TOP SECTION OF THE MIDBODY HAS BEEN STRUCTURALLY IMPROVED BY ADDING SEVERAL STRINGER CLIPS TO THE FORMERS AND INCREASING THE GAGES OF SOME STRINGERS.

Aftbody

THE REAR EMERGENCY EXIT AREA HAS BEEN STRENGTHENED BY INCREASING STRINGER GAGES, ADDING STRAPS ON OUTER FLANGE OF RINGS AND REPLACING THE RIVETS IN THE SKIN SPLICE AREA ABOVE THE DOOR WITH LARGER RIVETS.

MISCELLANEOUS SKIN JOINTS HAVE BEEN STRENGTHENED BY INCREASING RIVET SIZE OR REDUCING RIVET SPACING. MANY STRINGER-TO-RING CLIPS HAVE BEEN ADDED NEAR THE TOP OF THE SHELL FROM FS 749-825 AND FS 901-958.

Empennage

THE HORIZONTAL STABILIZER LOWER SURFACE SKINS AND FRONT SPAR WEB THICKNESSES WERE INCREASED.

WING

FRONT BEAM WEB AND CAP THICKNESSES NEAR THE ENGINE NACELLES WERE INCREASED.

MAIN WING BOX UPPER AND LOWER SURFACE THICKNESSES WERE INCREASED. THE SPANWISE SPLICES BETWEEN PLANKS 2 AND 5 AT WS 209 WERE REINFORCED. ASSOCIATED RIVET PATTERNS WERE SLIGHTLY MODIFIED.

THE WING TANK RIB AND LOWER RIB CAP AT BL 65 WAS STRENGTHENED.

A VERTICAL POST WAS ADDED TO THE AFT PORTION OF THE RIB AT WS 167 TO STRENGTHEN THE UPPER CAP MEMBER.

A SPANWISE STRUT WAS ADDED AT WS 167 TO 209 NEAR PLANKS 3 AND 4 TO CONNECT THE INBOARD AND OUTBOARD MAIN LANDING GEAR RIBS FOR INCREASED STRENGTH.

DOUBLERS AND FAIRINGS WERE ADDED TO SUPPORT THE FUEL DUMP APPARATUS FROM TANK NO. 5 TO THE UPPER SKIN SURFACE AFT OF THE REAR SPAR.

LANDING GEAR

Nose Landing Gear STRUT AND TIRE PRESSURES WERE INCREASED.

Main Landing Gear NEW LARGER CAPACITY WHEEL BRAKES AND TIRES (WITH HIGHER TIRE PRESSURES) WERE INSTALLED. A RELIEF PISTON AND ASSOCIATED STRUCTURE WAS ADDED TO THE STRUT (TO SOFTEN INITIAL TOUCH DOWN LOADS).

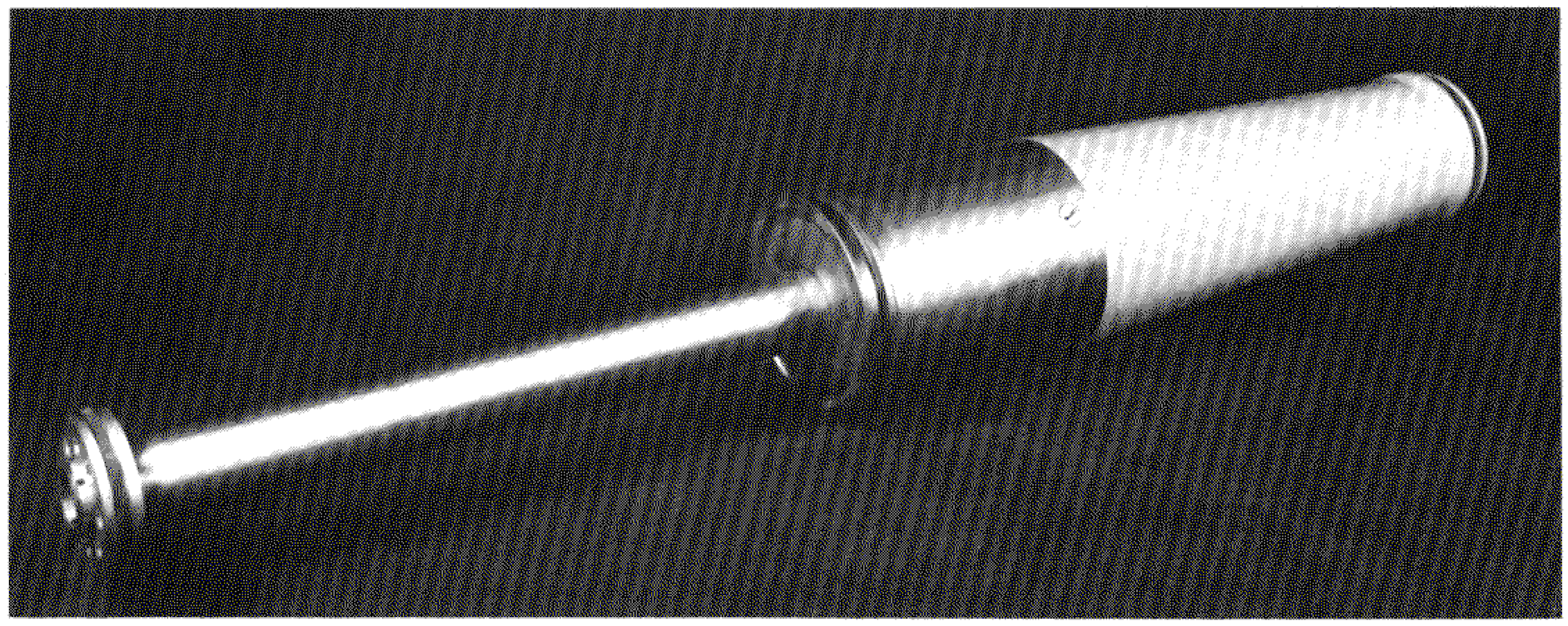
Figure 1 P-3 Airframe Structural Modifications Implemented by ECP-494 economic advantages realized by utilizing an existing design, many thousands of operating hours on the L-188 had proven the design to be an exceptionally good one.

At that time, one of the designers of the L-188 gear had devised a promising new concept to alleviate a problem common to all heavy-aircraft main gear struts,* i.e., the wearing and disturbing shock of touch-down. Laboratory tests had indicated a marked improvement, and further evaluation was being conducted on instrumented aircraft in daily service with airlines. Although the instrument data and the airline flight crews were rapidly proving the "soft" landing gear to be well and truly named, there were some factors which militated against its immediate adoption on the P-3: a slight cost increase, and a "design philosophy" consideration in exchanging a thoroughly proven design for one with less service experience. Then, too, passenger comfort on a military aircraft is not a prime consideration as it is with an airline transport.

* *Subject design is covered by U.S. Letters Patent No. 3,140,-084 — dated 7 July, 1964.*

In considering the best means of adapting the P-3 design for a 9000-lb increase in recommended landing weight, the "soft gear" modification offered a perfectly tailored improvement. In addition to minimizing the wearing effect of the greater touch-down shock on tires, wheels, strut and wing structure, the intricate complex of sophisticated new electronic equipment would be better protected.

Another attractive feature of the soft landing gear modification lies in the fact that it is just that — a modification, and actually a very simple one in respect to installation. The assembly shown in Figure 2 is mounted inside the oleo piston at the factory on all new landing gear, and it can be installed on delivered aircraft in a few hours and without dismounting the landing gear strut. No machining, refinishing, or other complex processes are required. A new strut-inflation placard is provided in the modification kit which is to be affixed at the time modification is accomplished, and observed in strut servicing thereafter.



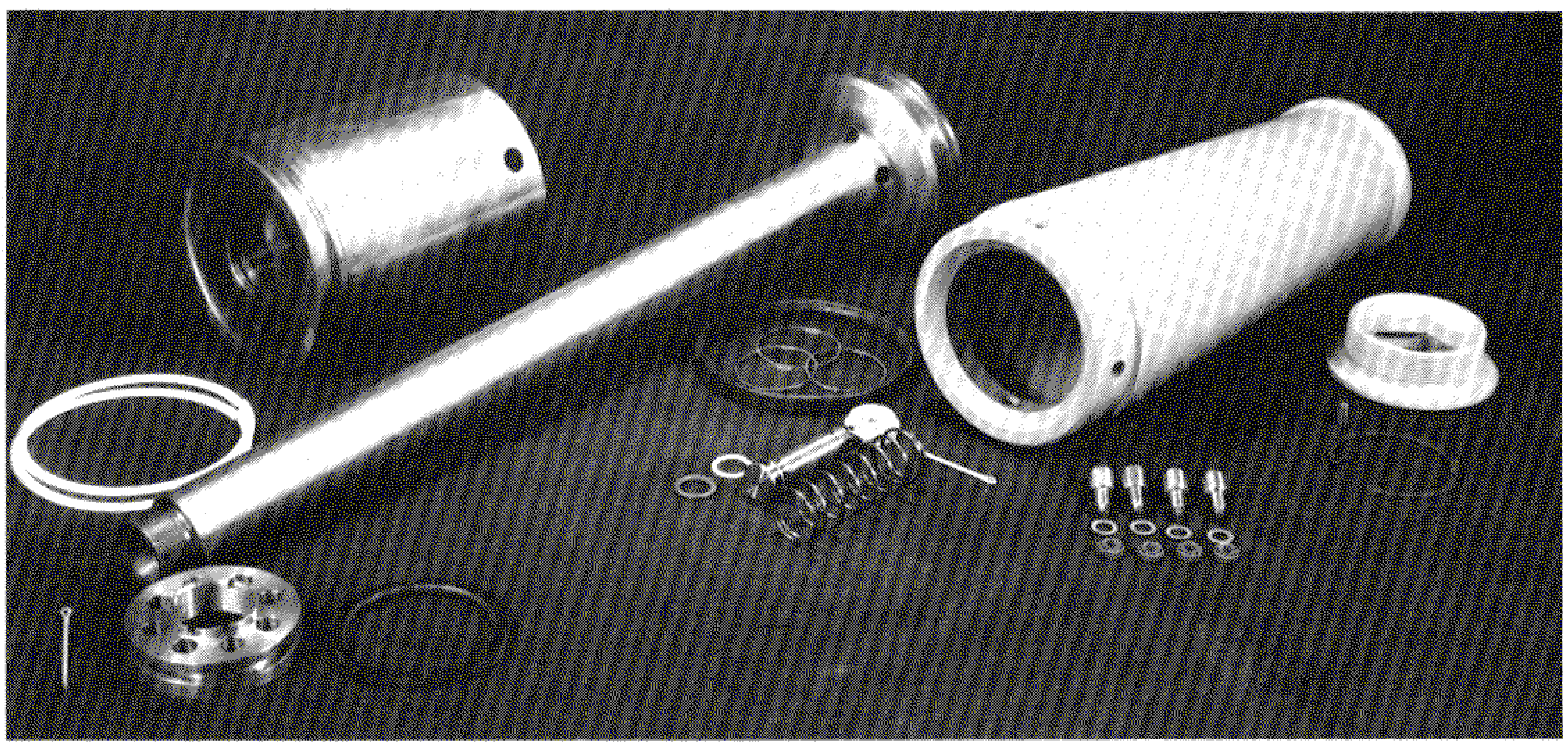
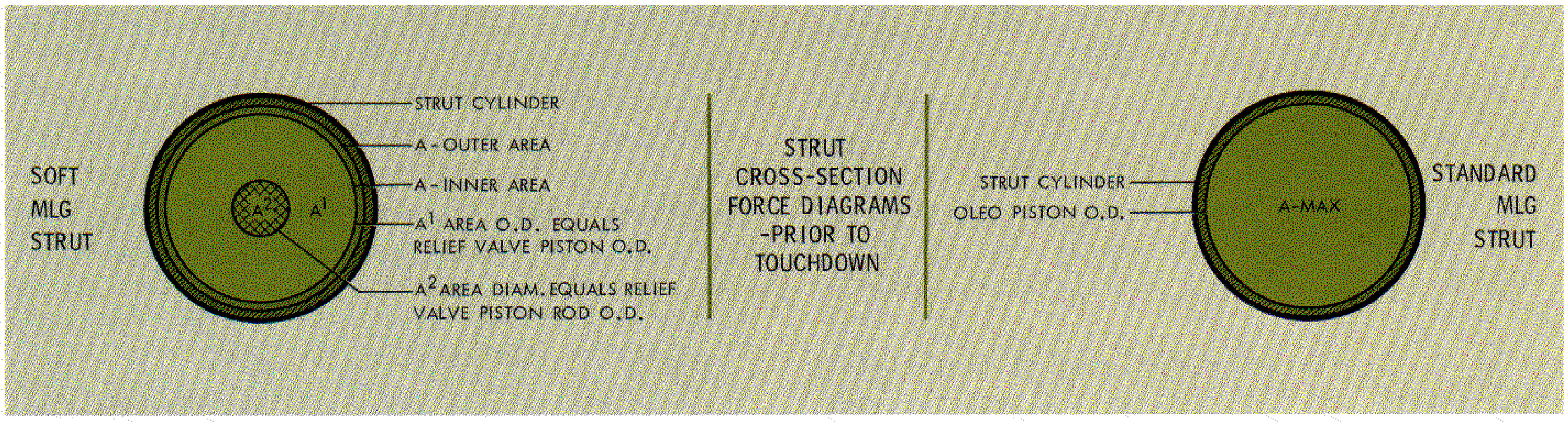


Figure 2
Sub-assembly — Added to Standard MLG Strut to Provide "Soft-Gear" Characteristics. A new orifice-plate (not shown) is also provided.

Figure 3
Schematic Views Showing Comparison of
Standard vs Soft MLG Action at Touchdown



THEORY OF OPERATION Although there is a wide diversity in the details of design of the oleo shock struts on heavy aircraft, conventional designs can be said to share the same basic operating principles as are illustrated in the simple Figure 3 diagrams. While airborne with gear down, gravity and the force of a high pneumatic precharge pressure hold the piston static at full extension. Within a fraction of a second following the instant at which first contact with the runway is made, a heavy reactive force is developed and transmitted to the airframe.

This force is actually the resultant of two readily-apparent forces: One, a horizontal force, is induced by the inertia of the tires and wheel assemblies being accelerated violently from rest ("spin-up"). The other, a vertical force, is due to the piston assembly being violently accelerated into the cylinder, first moving from rest against the thrust of a large pneumatic force, and then continuing against a degree of hydraulic damping in combination with a growing pneumatic force.

Note that the resultant of these two obvious forces is directed diagonally aft and upward, tending to bend the oleo piston at the point it bears on the aft wall of the cylinder entrance. The resulting high friction augments the vertical "shock" component, and it continues as quite an intense increment of that component throughout the wheel spin-up interval.

As the aircraft weight settles, the rate is controlled by hydraulic "snubbing" as oil is metered through an orifice against a rapidly rising pneumatic pressure. Thereafter during roll-out and taxi, the full weight of the aircraft is supported by the highly compressed pre-charge gas, with comparatively minor piston excursions (induced by irregularities in the taxi way) being controlled in rate by hydraulic snubbing.

The most severe "jolt" — the one the soft landing gear is designed to alleviate — occurs during the first few inches of piston travel. The lower part of the soft gear modification assembly comprises a "relief piston" which utilizes the oleo as a travelling cylinder that runs full-stroke during the initial 3½-inch travel of the oleo piston. Figure 6 shows these components.

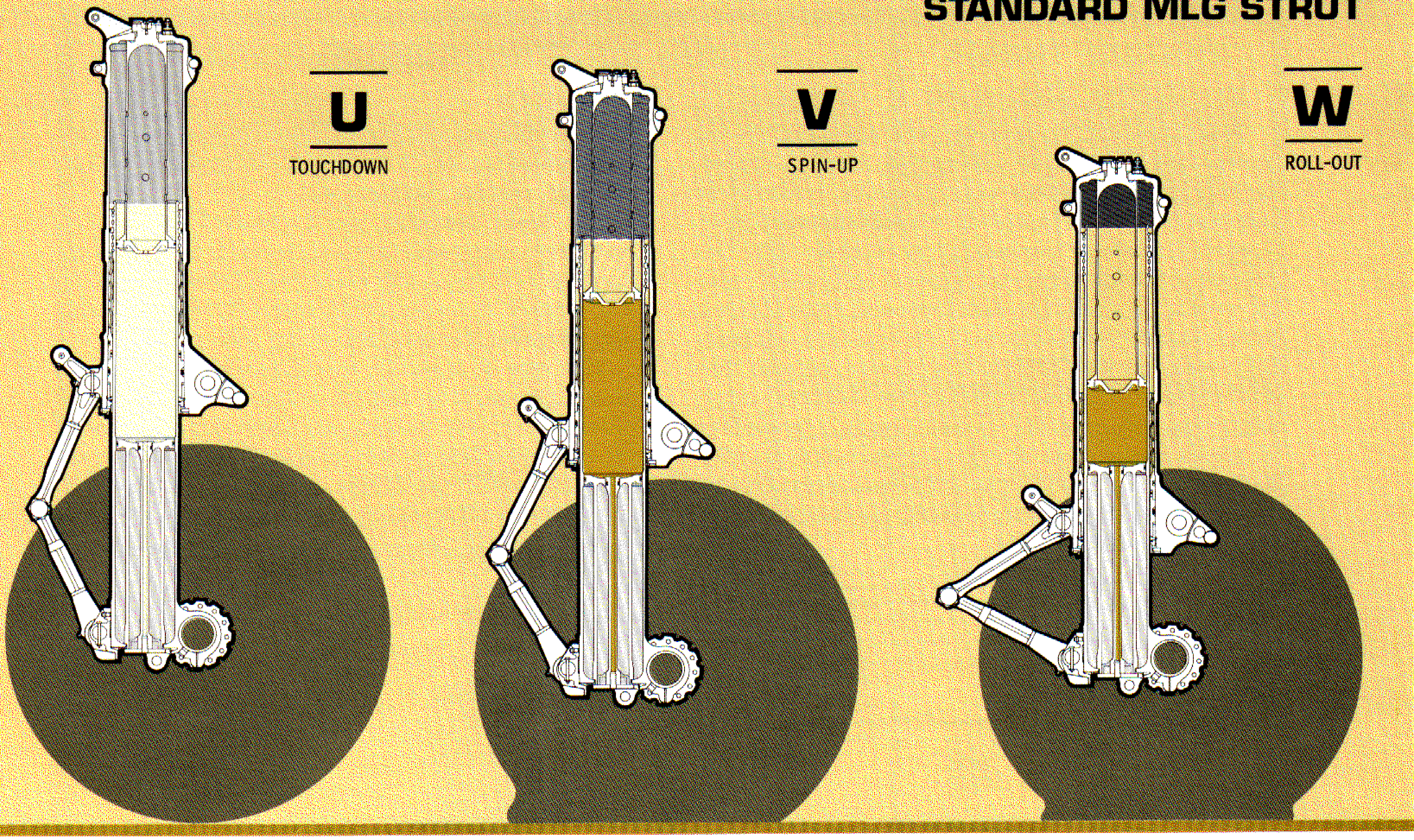
While airborne (see Figure 3X), the strut pressure chamber's effective area, which was maximum (A-max) and constant on the conventional landing gear, is divided into two major areas — A-outer and A-inner — with a further subdivision of A-inner — A^1 and A^2. The pressure of the pre-charge acts only on the A-outer area (about 20% of the total) to hold the oleo at full extension. The large A-inner area is entirely ineffective, except that the small central A^2 area holds the relief piston in position, bottomed on the orifice plate.

At the instant of touchdown (Figure 3X), the oleo breakaway force, i.e., the force required to move the oleo from rest, is equal to the pre-charge pressure acting on the small A-outer area only. Thus, the tires are enabled to deflect the oleo piston upwards quite easily against the force of a pre-charge pressure that is only about 20% as effective as on the standard strut.

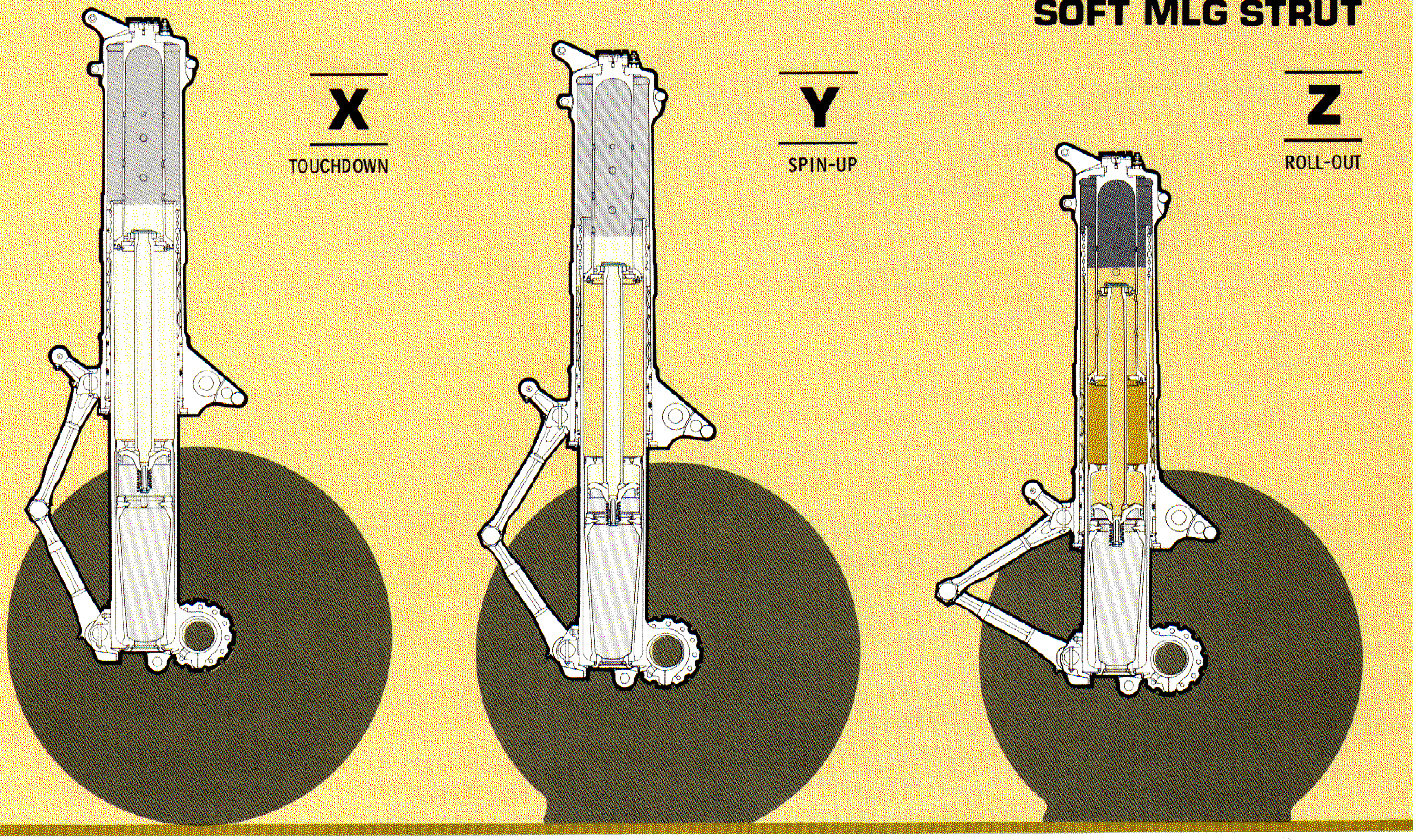
During the first 3½ inches of travel of the oleo piston, oil below the orifice plate is forced through the orifice into the upper chamber; oil from the upper chamber flows through the hollow relief piston rod to fill the expanding cavity below the diaphragm. In this interval, although the amount of oil forced through the metering orifice is essentially the same on both types of strut, the pre-charge pressure increases very little in the soft strut, and the damping effect of hydraulic "snubbing" is reduced accordingly. Thus, the tire friction on the runway is usually less during the initial 3½-inch oleo travel, wheel acceleration is more gradual and the reactive force tending to generate friction between oleo piston and cylinder is moderated proportionally.

When the lower relief piston land bottoms on the oleo piston, the upper land is lifted off the orifice plate. At this point hydraulic snubbing and the accompanying pre-charge pressure build-up rate becomes essentially the same as that of the unmodified strut configuration.

STANDARD MLG STRUT



SOFT MLG STRUT



It is interesting to note that the results of the instrumented airline tests proved that rebound characteristics of these aircraft were improved markedly in addition to the substantial decrease in the average of positive g loadings experienced by these aircraft. The Figure 4 graph shows a "before and after" plot of vertical acceleration data obtained from aircraft which made 39 landings with the standard, 81 landings with the soft landing gear. It can be seen that the soft-gear landing accelerations clustered much nearer the datum of the "perfect" landing (a landing in which acceleration remains constant at 1 g), with the mean being about 22% less severe in the case of both the impact and the rebound accelerations that were experienced.

but it is changed so little in other respects that it can be mounted on any P-3 aircraft, using the same size bearings, spacers, retainers, etc.

The brake assembly too is changed in capacity, but critical dimensions are not changed, and although the Goodrich wheel and brake must be used together, it is possible to mount either wheel/brake configuration on either the standard or the soft strut.

This type of approach to a design improvement is most economical in respect to spares utilization and provisioning, but it does introduce some potential for confusion and problems where "hybrid" assemblies are concerned. These and items of associated maintenance information are discussed in the later pages of this article.

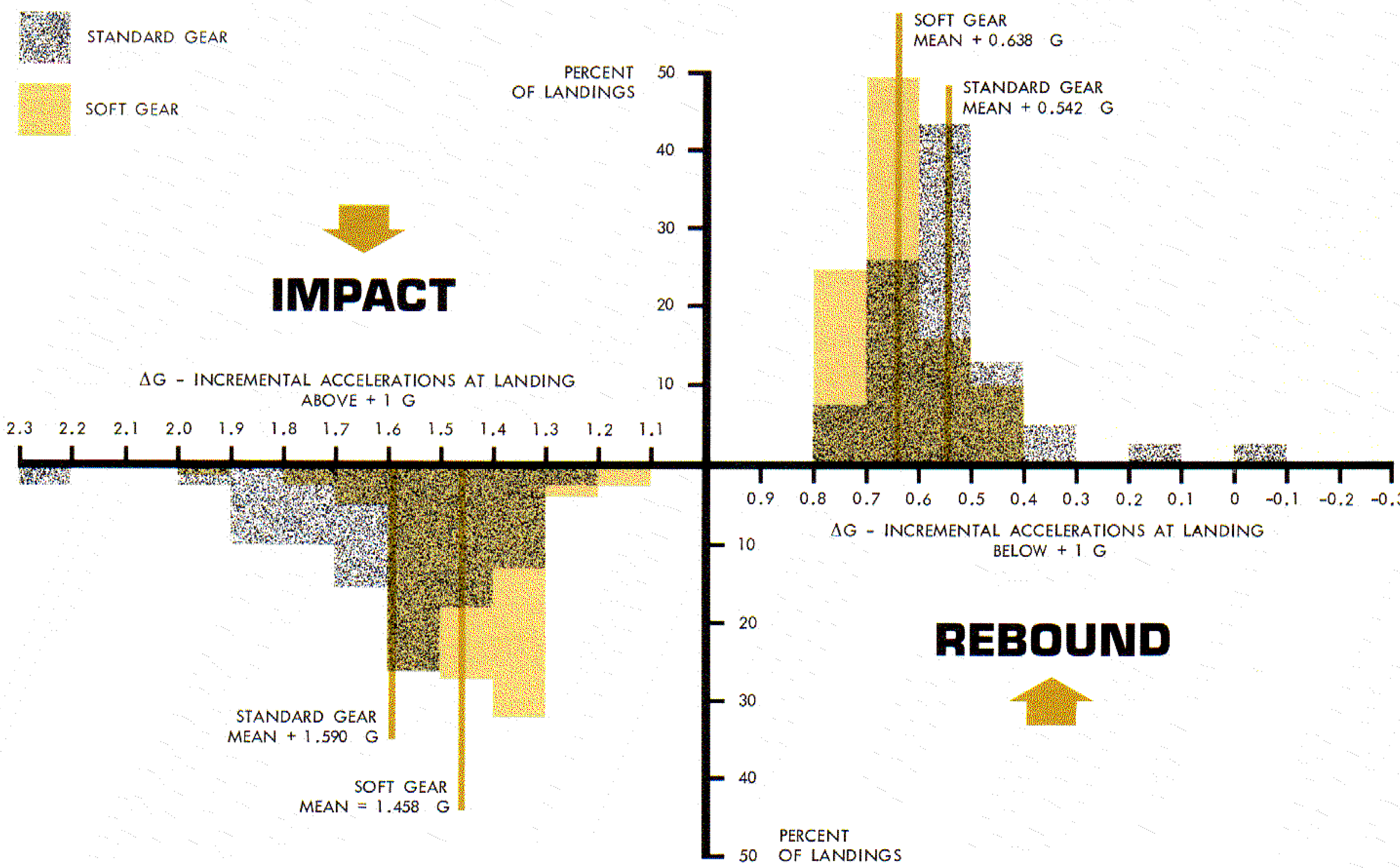


Figure 4 Comparative Impact and Rebound Characteristics of Standard vs Soft MLG on L-188 Electra in Airline Service

MLG WHEEL AND BRAKE ASSEMBLY CHANGES

New and more rugged MLG wheels, tires, and brakes were provided to accommodate the more severe loads of the high gross weight P-3.

The tire size remained the same, but the ply-rating was increased from 26 to 28. Thus it is possible to mount either tire on either the standard (Bendix) or the heavy duty (Goodrich) wheel design.

In similar fashion, the new P-3 wheel is stronger,

NO. 5 TANK FUEL DUMP PROVISIONS

The addition of this facility, which makes it possible to quickly divest the aircraft of up to 18,000 lbs. of weight in an emergency, is the essential factor in establishing the new maximum overload takeoff value. A schematic of this system is shown in Figure 5.

It can be seen that the new design is closely integrated with the original — indeed, the original 3-function manifold (fueling, defueling, and fuel-trans-

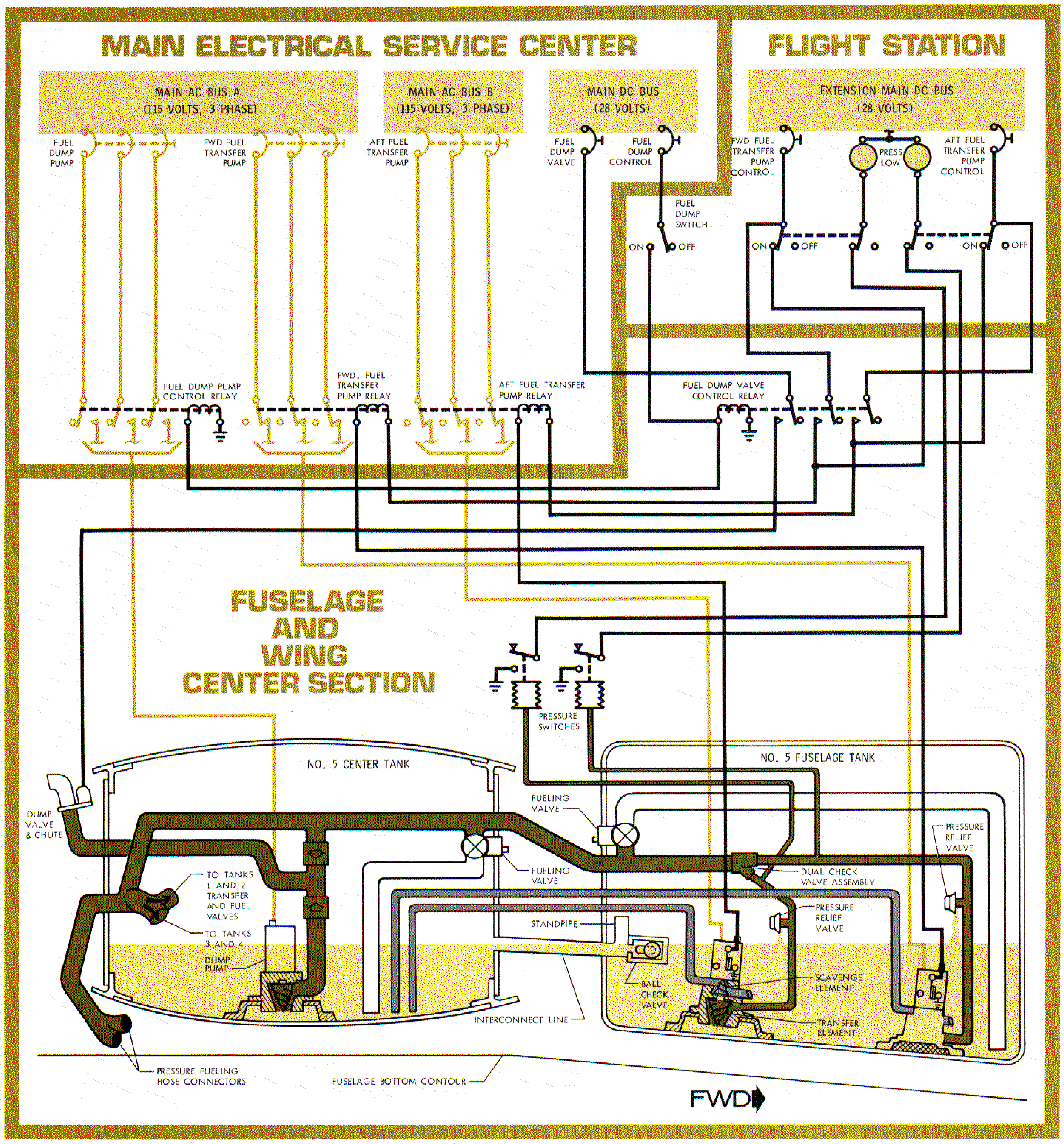
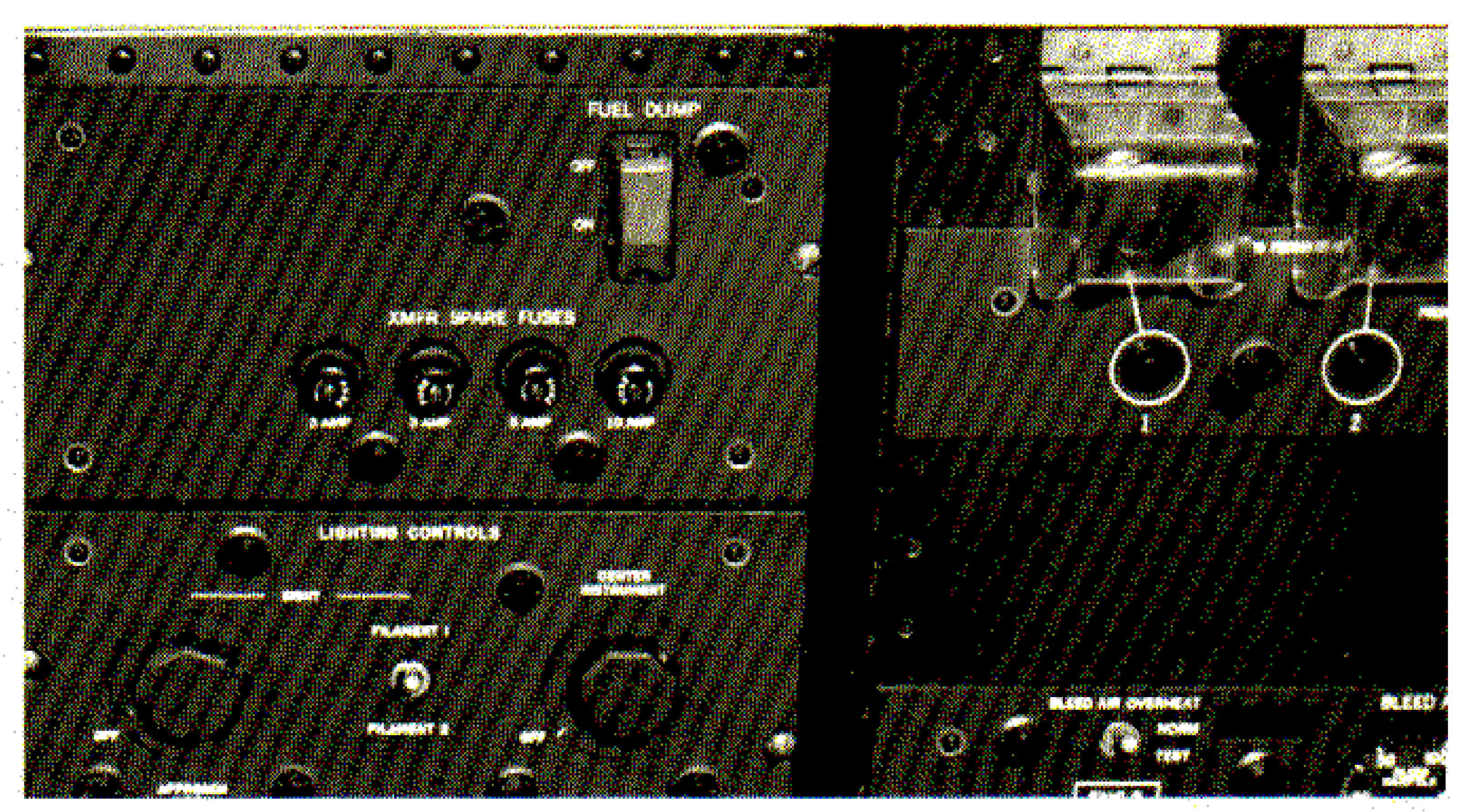


Figure 5 Electrical/Hydraulic Schematic of Fuel Dump System and Related Fuel-Transfer System Components. Schematic condition shown is normal to fuel-transfer operation.

fer) is converted to a 4-function manifold by the addition of one motor-pump, one shutoff valve, two check valves and some plumbing.

The new motor-pump assembly is mounted in the No. 5 Center compartment of the No. 5 Tank, and its discharge is plumbed in parallel with the discharge of the twin fuel transfer motor-pumps in the No. 5 Fuselage compartment.

The single guarded switch shown in Figure 5 controls the system. When the switch is turned "ON" two relays are energized. The contacts of one, the



Fuel Dump Valve Control Relay, energizes the "open" windings of the reversible, 28-V dc dump valve motor, and energizes both Transfer Pump relays*. The contacts of the other Dump Switch-controlled relay direct 3-phase, 115-V ac power from Main AC Bus A to the Fuel Dump Pump.

The entire output of both transfer pumps and the dump pump (approximately 1000 lb. per minute total) is discharged overboard through the short dump chute above the inboard trailing edge of the left wing. Although the Transfer System is pressurized throughout the Dump interval, fuel will not be transferred to the Engine-Feed tanks because the Dump procedure directs that the four Transfer Valves be turned to "OFF" before actuating the Dump Switch.

The Dump System is quite simple and direct, and relatively safe from incapacitation by failure or malfunction of related components. The few components which are essential to normal operation of the Dump System can be seen in Figure 5. For example, the entire Main AC and DC Bus systems must be energized for normal dump system operation. The system will be deprived of: one Transfer Pump if Main AC Bus B is de-energized, one Transfer Pump and the Dump Pump if Main AC Bus A is de-energized. Of course, the system is totally inoperative if all Main Buses are de-energized.

Check valves prevent Dump flow from an operative pump from bypassing back into No. 5 Tank via an inoperative pump, but this type of protection is not, and cannot be, afforded the two No. 5 Tank fueling valves. If either one of these valves is open, normal transfer and dump flow cannot be achieved. The dump pump would operate and evacuate No. 5 Ctr. Tank completely, No. 5 Fus. Tank would be emptied to the level of the interconnect, but little if any output from the two transfer pumps would be dumped.

** These relays should, of course, already be energized, for the fuel transfer system should operate continually while airborne with fuel in No. 5 Tank. The energization via the Dump Valve Control Relay may seem somewhat redundant, but it is necessary to ensure that the full capability of the Dump system will always be realized, even though someone has inadvertently turned the transfer pumps off in an emergency situation.*

MAINTENANCE OF "HEAVYWEIGHT" P-3 COMPONENTS

SOFT MLG STRUT MAINTENANCE Cross section views of both the standard and the soft MLG strut are given in Figure 6. The soft strut is being installed at the factory on BUNO 153442 and subsequent. As a general rule, it can be said that standard struts will be found on earlier aircraft, soft gear on the later, but the struts are interchangeable and either or both types of struts *may* be found on any given aircraft. Soft struts are identified 937958-103* on the Strut Servicing Instruction placard, and since the soft strut requires slightly more pre-charge pressure than the standard strut, it is important always to consult and observe the instruction placard on the strut when servicing *any* strut.

Oil *filling* procedure is identical for all P-3 struts but it should be noted that it is *not* permissible to remove surplus oil through the drain of a soft MLG strut as is sometimes done on the standard configuration. The drain on the soft strut is a poppet type plug located inside the oleo piston (about 16 inches above the bottom at full piston extension), and although it may be used to empty a strut which is to be disassembled, it should never be used otherwise. The oil seal on the soft strut plug will be spoiled if the plug is utilized, and this seal cannot be replaced unless the strut is disassembled. If it is necessary to remove *surplus* oil from a soft strut, it can be done by either collapsing the oleo or a siphon hose can be utilized, inserting the hose through the strut filler port.

To drain the oleo preparatory to disassembly, in order to reach the drain plug poppet a ventilating screen secured by a snap-ring in the internally-wrenching nut at the bottom of the piston must be removed. The new arrangement can be seen in Figure 6.

In order to disassemble the soft strut oleo piston from the cylinder, it is necessary to detach the orifice plate support tube (i.e. remove the nut at the top of

** Originally, soft struts were identified 937958-101, but a small modification presently being retrofit (and incorporated on new struts) changes the identification to 937958-103.*

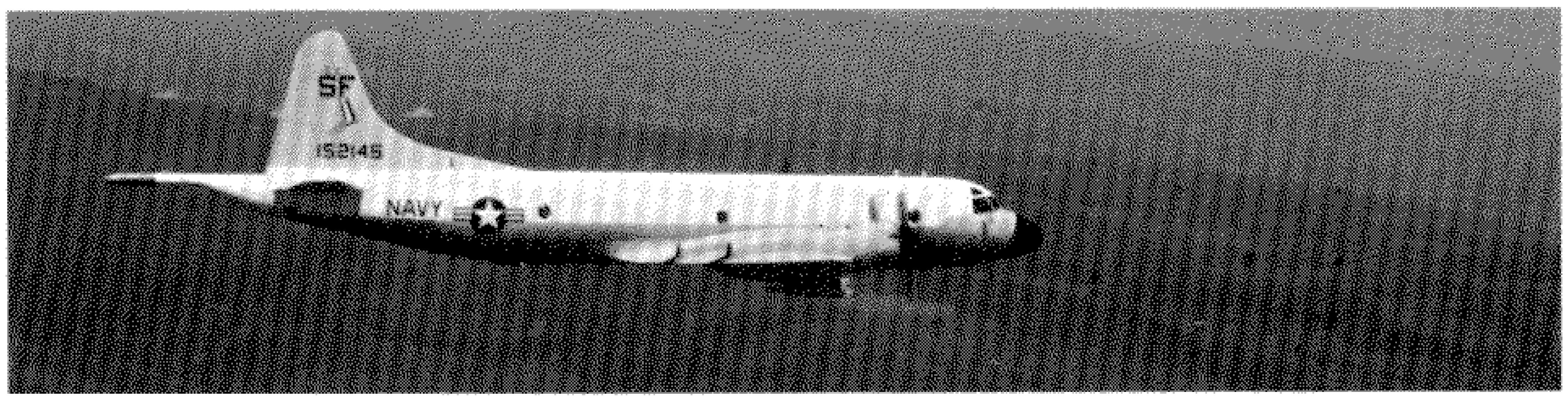
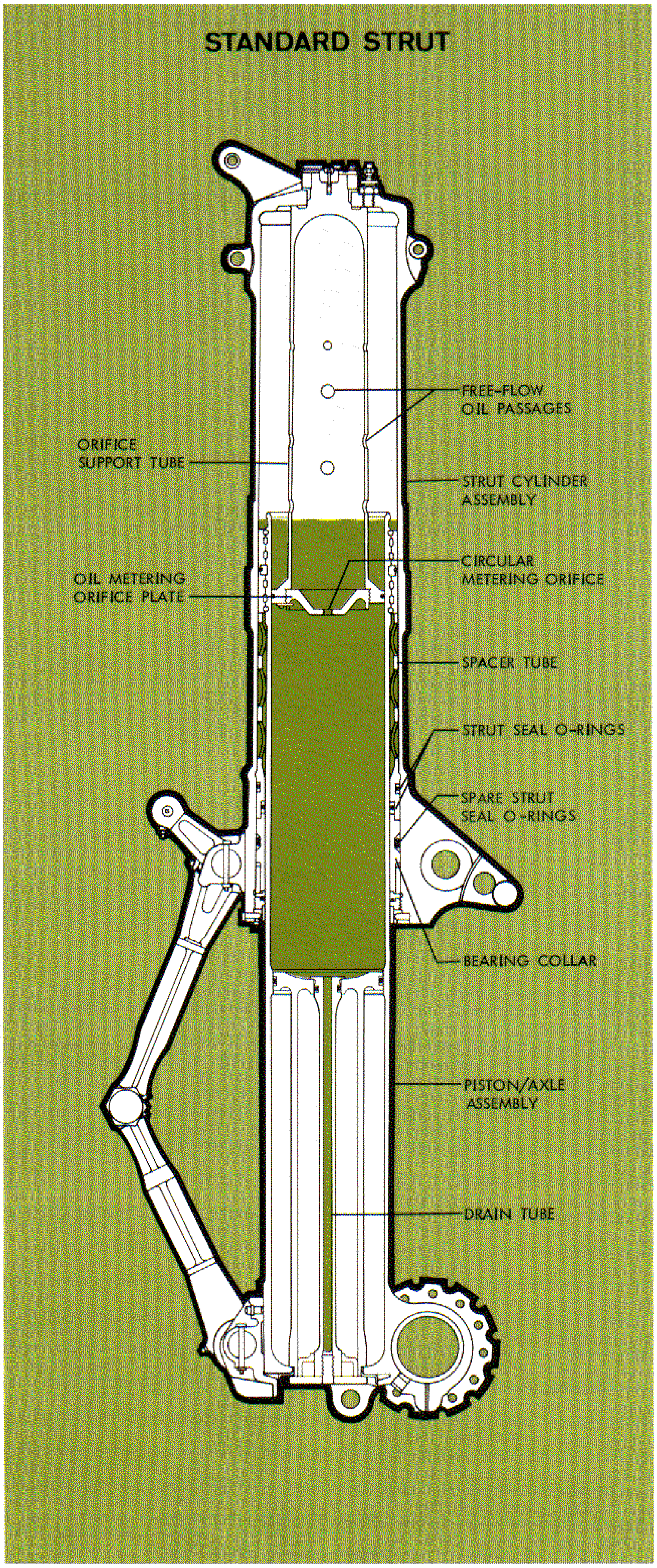
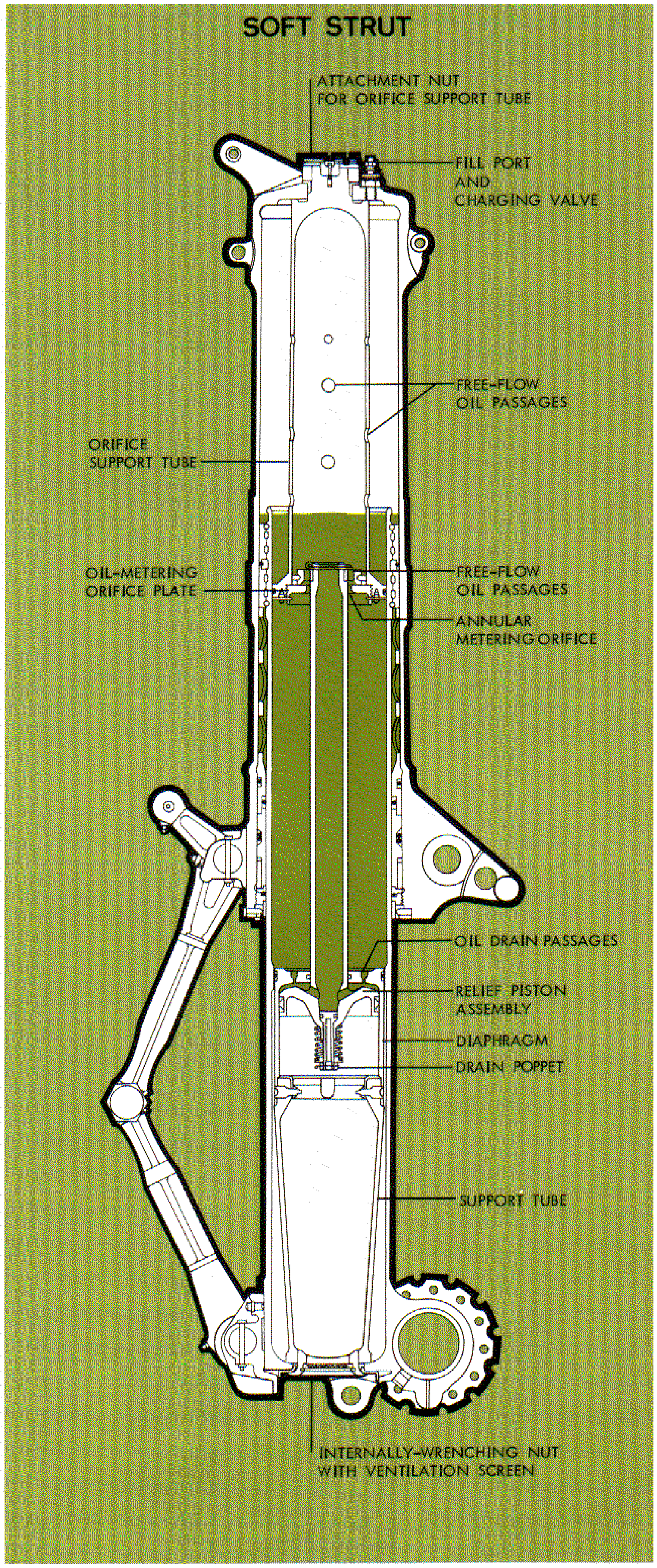


Figure 6
Detail of Standard
and Soft Struts

the strut), for the orifice plate and its supporting mount should remain attached to the piston/axle assembly of the modified strut while the oleo is withdrawn from the strut.

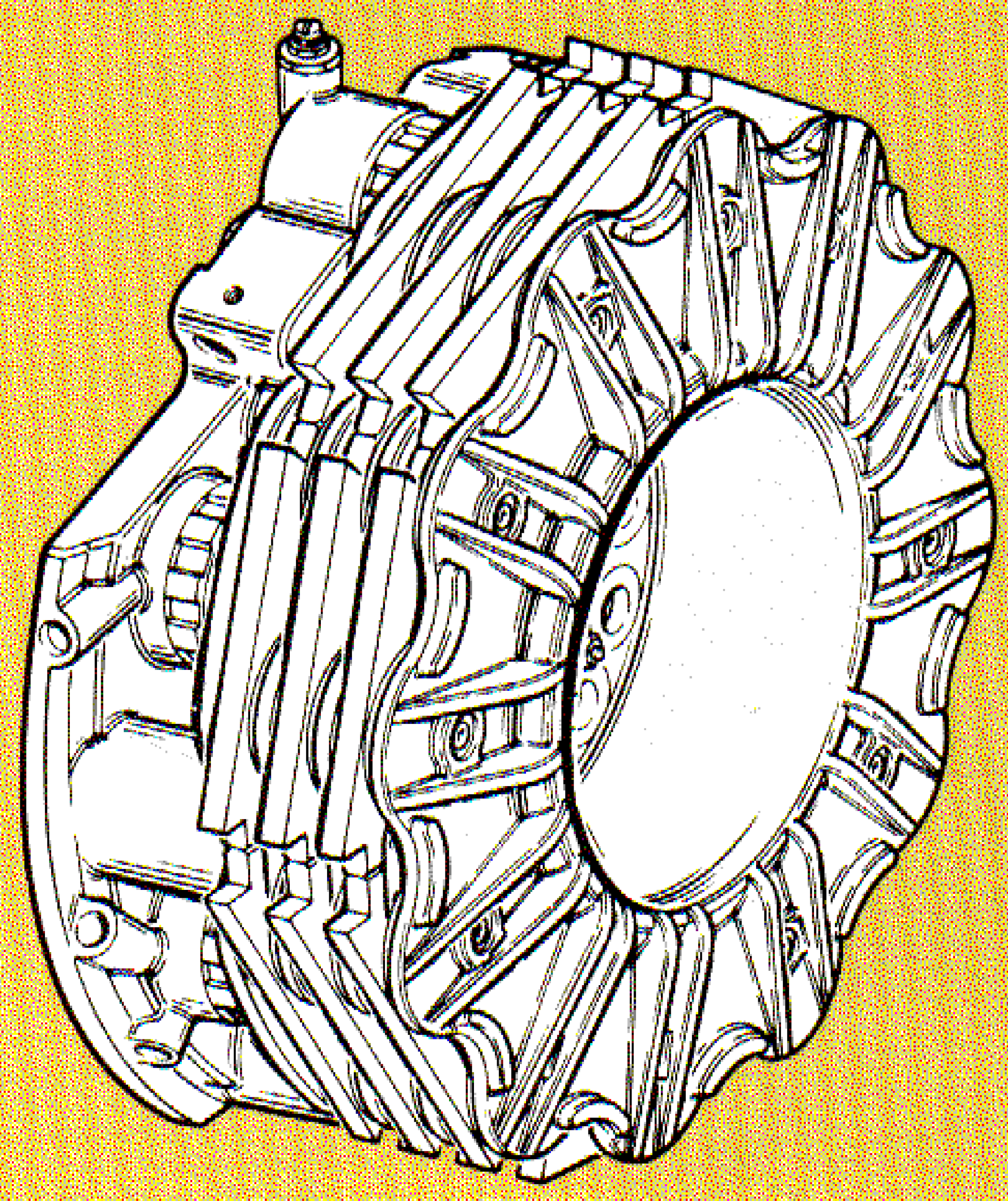
Heavy-Duty MLG Wheels of the same split-type design as the standard wheel are provided on high gross weight aircraft. The designs differ sufficiently to prevent standard halves from being mated with heavy duty halves, and it should be noted that different tie bolts requiring different assembly torque values are employed. Normally, the new 28-ply rating tires only should be mounted on the new Goodrich wheels and, as mentioned, the Goodrich wheels can only be utilized with the new Goodrich brake assembly.

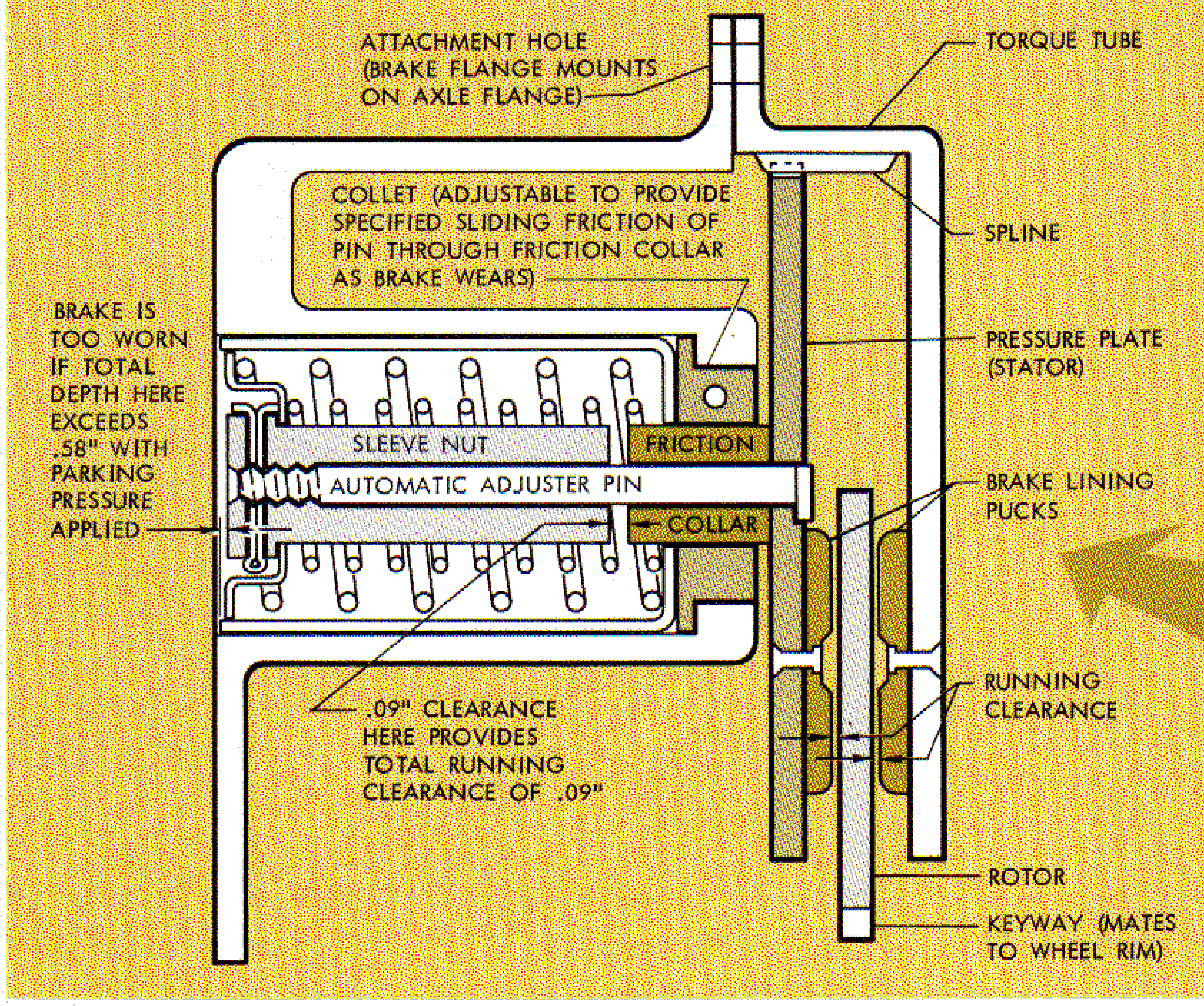




There is some variance in tire inflation pressures between the LGW and the HGW P-3. In all cases, the inflation placard on the MLG doors should reflect whether the aircraft is of the LGW or HGW configuration, and tire pressures should be adjusted accordingly.

[A recent field report of the mis-assembly of a Bendix wheel on a Bendix brake recounted a situation so hazardous as to warrant the attention of everyone concerned with the P-3. In this case, the keys on the wheel were not engaged to the keyways at the corners of the 7-sided rotor "discs," when the wheel was mounted, but were fitted over the flats. If a wheel is installed in this way, it will turn free for a few degrees before the disc-segment's corners jam on the keys. If the aircraft actually operates in this condition, at best the brake will malfunction, at worst the wheel may fracture.]





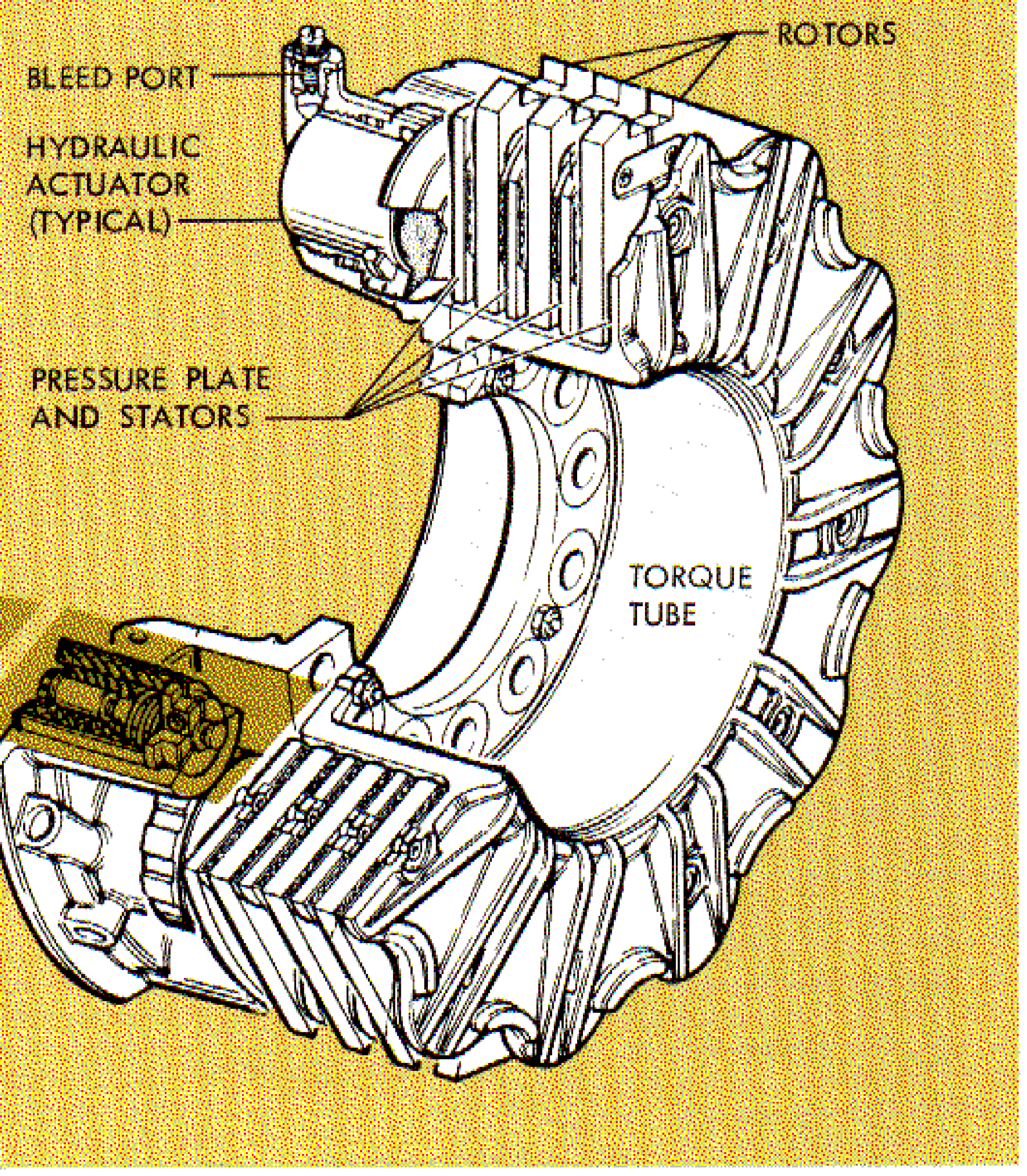
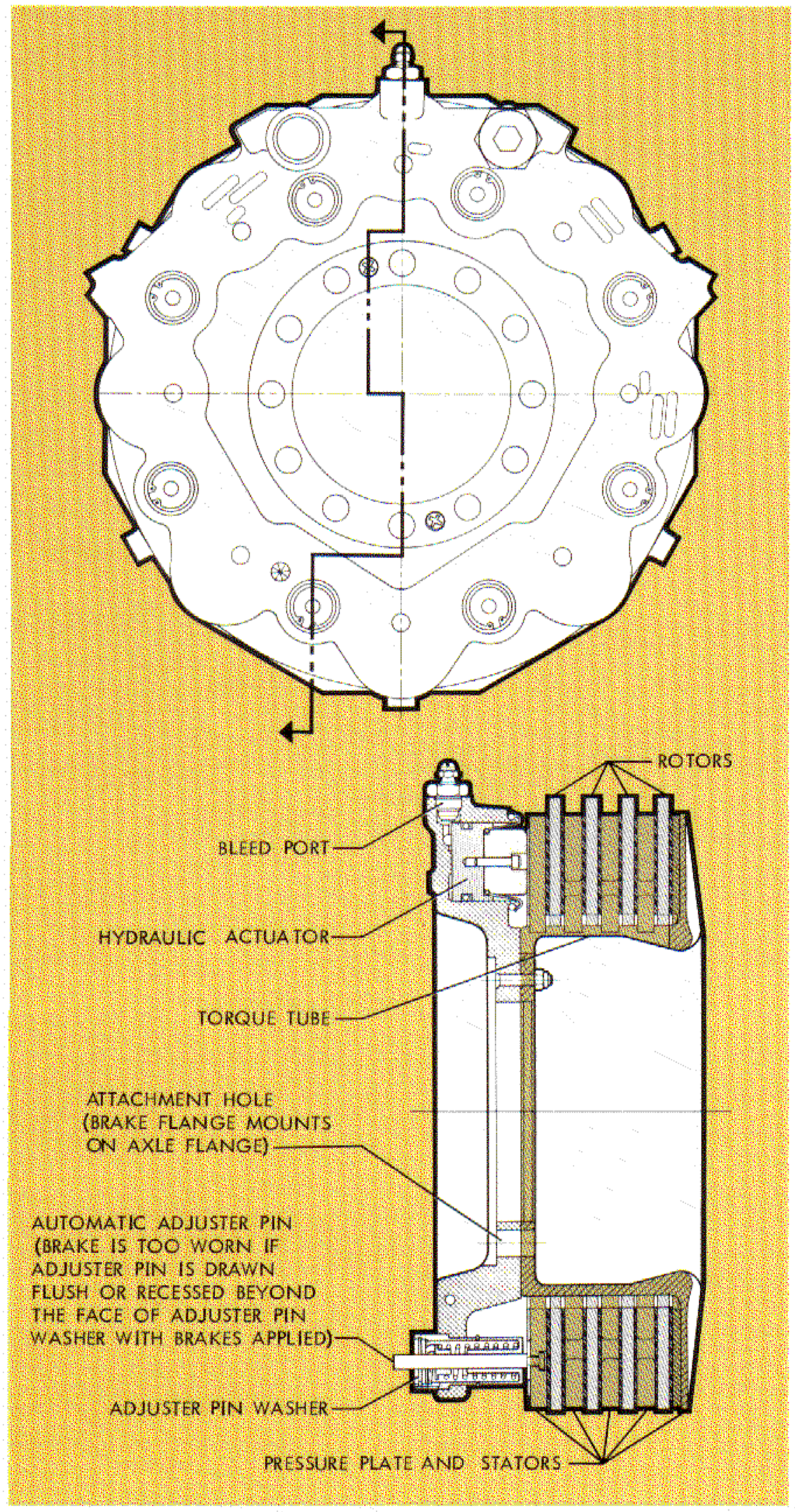


Figure 7 Comparison of Bendix (Standard) and Goodrich (Heavy-Duty) Brake Assemblies

Heavy Duty Brakes, made by Goodrich, incorporate four one-piece rotor discs rather than the three 7-part discs employed by the Bendix assembly, but are not significantly different in respect to operating principles, and bleeding procedures are identical. As with the Bendix brake, a check of lining wear on the Goodrich brake is made at the brake adjuster assemblies while the brake is applied, but there is some variation as to the location and amount of critical dimension. Figure 7 shows both assemblies. With the Bendix brake, the exposed end of the spring holder insert is used as the fixed reference point, measuring the amount of recess (with brakes applied) of the outer face of the sleeve nut; 0.58 in. being maximum allowable. With the Goodrich brake, the outer face of the adjuster pin washer serves as the fixed index point, and brakes should be overhauled if the pin is drawn flush with the washer face when brakes are applied.

Attachment bolts for the Goodrich brake are one-eighth inch longer than those used with the Bendix assembly (NAS 629-20 vs. NAS 629-18). It is permissable to utilize the longer bolt to install the Bendix brake assembly provided extra washers are used to offset the extra shank, but of course the short bolts should *never* be used with the Goodrich assembly. Torque value is the same in all cases, 1000 to 1100 in-lbs.



NOSE LANDING GEAR In adapting the design for higher gross weight operation, no structural changes were made to the NLG. New aluminum NLG wheels, introduced on later aircraft in place of the original magnesium, can be used interchangeably on any aircraft, as can the magnesium wheels. Inflation pressures for both the NLG Strut and the tires are somewhat higher (as shown in Figure 8) for aircraft qualified to operate at high gross weight. Consequently, it is necessary to ensure that the NLG Strut and the NLG Tire inflation placards on every aircraft are the proper ones for the gross weight capabilities of the aircraft. The placards should be consulted in every case before servicing.

INTERCHANGEABILITY — STANDARD AND HEAVY-DUTY COMPONENTS

Insofar as it is possible to do so, aircraft fitted for high gross weight operation should be maintained in that configuration throughout. However, it is recognized that the relative scarcity of heavy-duty spares may under emergency conditions make it unavoidable that a HGW aircraft be "adulterated" with one or more LGW assemblies, and of course when this is done the aircraft is to be maintained and operated as a LGW aircraft until all heavy duty assemblies are restored.

For example, if it becomes necessary to mount a 26-ply tire or to replace Goodrich MLG wheel/brake assemblies with Bendix assemblies* on a high gross weight aircraft, the following operating and maintenance changes are entailed:

1) The aircraft should not be operated at gross takeoff weight in excess of 127,500 lb.
2) NLG strut and tire inflation should be in accord with the LGW placard, as should the MLG tire inflation also. It would be advisable to change the placards concerned to avoid confusion, and to emphasize the single, certain admonition: "Always observe the placards when servicing landing gear."

Note that, as stated previously, the pressure of the MLG strut precharge is dependent solely on whether or not the "soft-gear" modification has been incorporated in the strut. The strut service placard should *always* reflect this, and the strut should be serviced in accordance with the placard regardless of whether the strut is mounted on a LGW or a HGW aircraft.

It is permissible to utilize heavy duty spares on LGW aircraft, but (except for the MLG strut precharge) any such aircraft must continue to be maintained and operated as a LGW aircraft until *every* structural change has been made to the aircraft, and *every* heavy-duty assembly has been incorporated to qualify it for high gross weight operation.**

---

* *It is NOT permissible to intermix Bendix and Goodrich MLG wheel/brake assemblies on any aircraft. If it becomes necessary to substitute at any axle, it is mandatory to substitute at all four axles.*

***At this writing, no decision has been reached regarding the implementation of a complete retrofit program to upgrade standard aircraft to the high-gross-weight configuration.*

MAIN SHOCK STRUT

MENASCO MANUFACTURING COMPANY, BURBANK, CALIFORNIA
MANUFACTURED FOR
LOCKHEED AIRCRAFT CORP., BURBANK, CALIFORNIA

LOCKHEED

SERIAL NO. ______ ORDER NO. ______
SPEC. NO. ______ PART NO. ______

INSTRUCTIONS FOR SERVICING WITH OIL

USE FLUID SPEC MIL-H-5606. WITH WEIGHT ON WHEELS, COMPLETELY DEFLATE STRUT AND REMOVE MS28889-1 AIR VALVE. FILL WITH OIL TO LEVEL OF FILLER HOLE. REPLACE AIR VALVE PER AND 10071.

GLAND NUT IS NOT ADJUSTABLE. REFER TO AIRPLANE T.O. FOR REPAIR

INSTRUCTIONS FOR INFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT MAX 3/4 TURN. INFLATE UNTIL PRESSURE READING AND STRUT EXTENSION AGREE WITH ONE PAIR OF FIGURES ON CHART BELOW. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TO RESEAL.

REPLACEMENT PACKING REQUIREMENT

REFER TO AIRPLANE T.O. OR SHOCK STRUT ASSY DRAWING

INSTRUCTIONS FOR DEFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT ONE TURN MAX. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TORQUE TO RESEAL.

INFLATION CHART

DISTANCE FROM LOWER SURFACE OF CYLINDER TO BOTTOM OF RED LINE ± .13	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25
SHOCK STRUT PRESSURE ± 50 PSI	2265	2155	2055	1955	1870	1795	1720	1655	1595	1535	1480
DISTANCE FROM LOWER SURFACE OF CYLINDER TO BOTTOM OF RED LINE ± .13	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
SHOCK STRUT PRESSURE ± 50 PSI	1430	1385	1340	1300	1260	1225	1190	1160	1125	1100	1070

OPTIONAL METHOD WITH OLEO COMPLETELY EXTENDED (20") AND WHEELS FREE OF GROUND, INFLATE TO 529 PSI ± 10 PSI

WARNING – RELEASE AIR IN STRUT BEFORE DISASSEMBLING

AIRPLANES BUNO 148883 THRU BUNO 153441 EXCEPT A/C INCORPORATING "SOFT" MLG MODIFICATION

INSTRUCTIONS FOR SERVICING WITH OIL

USE FLUID SPEC MIL-H-5606 WITH WEIGHT ON WHEELS, COMPLETELY DEFLATE STRUT AND REMOVE MS28889-1 AIR VALVE. FILL WITH OIL UP TO STANDPIPE. REPLACE AIR VALVE PER AND10071.

REPLACEMENT PACKING REQUIREMENTS

REFER TO AIRPLANE T.O. OR SHOCK STRUT ASSEMBLY DRAWING

GLAND NUT IS NOT ADJUSTABLE. REFER TO AIRPLANE T.O FOR REPAIR.

SHOCK STRUT ASSY NLG

MENASCO MANUFACTURING COMPANY
BURBANK, CALIFORNIA
MANUFACTURED FOR
LOCKHEED AIRCRAFT CORP.
BURBANK, CALIFORNIA

LOCKHEED

SERIAL NO. ______ ORDER NO. ______
SPEC NO. ______ PART NO. ______

INSTRUCTIONS FOR INFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT MAX 3/4 TURN. INFLATE UNTIL PRESSURE READING AND STRUT EXTENSION AGREE WITH ONE PAIR OF FIGURES ON CHART BELOW. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TORQUE TO RESEAL.

OPTIONAL METHOD

WITH OLEO COMPLETELY EXTENDED (14") AND WHEELS FREE OF GROUND, INFLATE TO 240 P S I ± 10 P S I

INSTRUCTIONS FOR DEFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT ONE TURN MAX. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TORQUE TO RESEAL.

INFLATION CHART

DISTANCE FROM LOWER SURFACE OF CYLINDER TO BOTTOM OF RED LINE ± .13	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00
SHOCK STRUT PRESSURE ± 25 PSI	1240	1145	1065	990	930	875	825	780	745	710	675	645	620	595	570	550	530	510	495	475	460

WARNING - RELEASE AIR IN STRUT BEFORE DISASSEMBLING

	TAKEOFF GROSS WEIGHT	PSI MINIMUM	PSI MAXIMUM
MLG	80,000	110	175
	90,000	124	175
	100,000	137	175
	110,000	151	175
	120,000	165	175
	127,500	175	175
NLG	LOW GROSS WEIGHT	155	

Figure 8 Strut and Tire Servicing Instructions for Low-Gross-Weight and High-Gross-Weight Aircraft

It is *not* permissable to substitute spares of the Low Gross Weight configuration on High Gross Weight aircraft if there is *any* practical way to avoid doing so. The NAVPLANTREPO Engineering office at Lockheed has asked that we emphasize this point. They advise that it is preferable to import spares (up to and including entire MLG struts) to practically any location rather than to substitute a low-gross-weight component temporarily on a high-gross-weight aircraft in order to ferry that aircraft to the preferred component. Continued operation with LGW components on a HGW aircraft is forbidden.

MAIN SHOCK STRUT

MENASCO MANUFACTURING COMPANY, BURBANK, CALIFORNIA
MANUFACTURED FOR
LOCKHEED AIRCRAFT CORP., BURBANK, CALIFORNIA

LOCKHEED

SERIAL NO. ______ ORDER NO.
SPEC. NO. ______ PART NO. 937958-103

INSTRUCTIONS FOR SERVICING WITH OIL

USE FLUID SPEC MIL-H-5606. WITH WEIGHT ON WHEELS, COMPLETELY DEFLATE STRUT AND REMOVE MS28889-1 AIR VALVE. FILL WITH OIL TO LEVEL OF FILLER HOLE. REPLACE AIR VALVE PER AND 10071.

GLAND NUT IS NOT ADJUSTABLE. REFER TO AIRPLANE T.O. FOR REPAIR

INSTRUCTIONS FOR INFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT MAX 3/4 TURN. INFLATE UNTIL PRESSURE READING AND STRUT EXTENSION AGREE WITH ONE PAIR OF FIGURES ON CHART BELOW. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TO RESEAL.

REPLACEMENT PACKING REQUIREMENT

REFER TO AIRPLANE T.O. OR SHOCK STRUT ASSY DRAWING

INSTRUCTIONS FOR DEFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT ONE TURN MAX. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TORQUE TO RESEAL.

INFLATION CHART

DISTANCE FROM LOWER SURFACE OF CYLINDER TO BOTTOM OF RED LINE ± .13	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25
SHOCK STRUT PRESSURE ± 50 PSI	2480	2340	2240	2115	2040	1940	1875	1800	1740	1680	1620
DISTANCE FROM LOWER SURFACE OF CYLINDER TO BOTTOM OF RED LINE ± .13	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	16.5
SHOCK STRUT PRESSURE ± 50 PSI	1560	1500	1460	1410	1360	1320	1280	1240	1210	1180	570

OPTIONAL METHOD WITH OLEO COMPLETELY EXTENDED (20") AND WHEELS FREE OF GROUND, INFLATE TO 435 PSI ± 10 PSI

WARNING – RELEASE AIR IN STRUT BEFORE DISASSEMBLING

AIRPLANES BUNO 153442 AND SUBSEQUENT AND OTHERS INCORPORATING "SOFT" MLG MODIFICATION

INSTRUCTIONS FOR SERVICING WITH OIL

USE FLUID SPEC MIL-H-5606 WITH WEIGHT ON WHEELS, COMPLETELY DEFLATE STRUT AND REMOVE MS28889-1 AIR VALVE. FILL WITH OIL UP TO STANDPIPE. REPLACE AIR VALVE PER AND10071.

REPLACEMENT PACKING REQUIREMENTS

REFER TO AIRPLANE T.O. OR SHOCK STRUT ASSEMBLY DRAWING

GLAND NUT IS NOT ADJUSTABLE. REFER TO AIRPLANE T.O. FOR REPAIR.

SHOCK STRUT ASSY NLG

MENASCO MANUFACTURING COMPANY
BURBANK, CALIFORNIA
MANUFACTURED FOR
LOCKHEED AIRCRAFT CORP.
BURBANK, CALIFORNIA

LOCKHEED

SERIAL NO. ORDER NO.
SPEC NO. PART NO.

INSTRUCTIONS FOR INFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT MAX 3/4 TURN. INFLATE UNTIL PRESSURE READING AND STRUT EXTENSION AGREE WITH ONE PAIR OF FIGURES ON CHART BELOW. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TORQUE TO RESEAL.

OPTIONAL METHOD

WITH OLEO COMPLETELY EXTENDED (14") AND WHEELS FREE OF GROUND, INFLATE TO 265 P S I ± 10 P S I

INSTRUCTIONS FOR DEFLATION

LOOSEN AIR VALVE TOP 3/4 HEX NUT ONE TURN MAX. TIGHTEN 3/4 HEX NUT TO 50-70 INCH POUNDS TORQUE TO RESEAL.

INFLATION CHART

DISTANCE FROM LOWER SURFACE OF CYLINDER TO BOTTOM OF RED LINE ± .13	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00
SHOCK STRUT PRESSURE ± 25 P S I	1360	1260	1165	1100	1020	960	920	860	820	780	740	710	680	660	640	610	580	560	545	520	510

WARNING - RELEASE AIR IN STRUT BEFORE DISASSEMBLING

OPERATIONAL CHANGES

Pilots will note very little change in operating techniques between the HGW and the LGW aircraft. As is always the case, when a landing is to be made at a higher gross weight, a proportionately higher approach speed is required, and in the roll-out and all taxi maneuvers with the high gross weight aircraft it will be necessary to apply the more efficient Goodrich brakes somewhat more gingerly (than is usually done with the Bendix brakes) to avoid locking the wheels. The locking tendency is

	TAKEOFF GROSS WEIGHT	PSI MINIMUM	PSI MAXIMUM
MLG	85,000	122	190
	90,000	130	190
	100,000	148	190
	110,000	156	190
	120,000	165	190
	133,500	190	190
	*142,000	205	205
NLG	133,500	165	
	*142,000	172	

HIGH GROSS WEIGHT AIRCRAFT
* MAXIMUM OVERLOAD TAKEOFF CONDITION

naturally more pronounced at lighter operating weight than at heavy.

As before, an Abnormal Landing Inspection is required after each reported *hard* landing regardless of weight, but the criteria for Overweight Landing Inspection are changed. Whereas LGW aircraft landings in excess of 91,320 lb. are to be reported on the "Yellow Sheet," only landings in excess of 103,880 lb. are reportable with the high gross weight aircraft. Ten such landings on either configuration (LGW or HGW) necessitate that an Overweight Landing Inspection (as defined in NAVAIR 01-75PAA-3-1) be made. The Overweight Landing Inspection is to carried out immediately following a landing in excess of 105,000 lb. with the LGW aircraft; 114,000 lb. with the HGW aircraft.

There is also a change in criteria for the Zero Fuel Weight computation used in mission loading. Computed weight of the aircraft without fuel or wing pylon stores may be no more than 71,584 lb. on LGW aircraft, 77,200 lb. on HGW aircraft. The weight of wing pylon stores need not be considered in computing the Zero Fuel Weight of any aircraft, except that on aircraft incorporating 10 wing stores stations, the permissible zero fuel weight must be reduced by the amount of weight in excess of 616 lb. carried on any pylon between the inboard engines.

The fuel dump system is used only to minimize landing weight, usually, but not necessarily, in an emergency situation, and always at the Pilot's discretion. For example, if removing the weight of fuel remaining in Tank 5 will reduce total gross weight to less than 114,000 lb., the mandatory Overload Landing Inspection can be avoided, and of course the lighter the aircraft, the slower the approach speed and the shorter the roll-out.

Fuel weight expended from the engine-feed tanks is equally beneficial in this respect, and the fuel dump facility can be utilized to maximize this. In a situation that warrants maximum lightening of the aircraft preparatory, for example, to a short-field landing, if the operator elects to dump fuel as soon as his remaining reserves allow, he will thereby enable engine operation to remove maximum fuel from the engine feed tanks during the remainder of the flight.

Conversely, if fuel transfer is continued unnecessarily for a considerable period enroute to landing, considerably less fuel will be "dumpable" because the bulk of the original Tank 5 supply will be retained in the engine feed tanks. In short, the operator has penalized the system effectively. His only options then are to land with nearly full engine-feed tanks or to fly until their level is reduced acceptably.

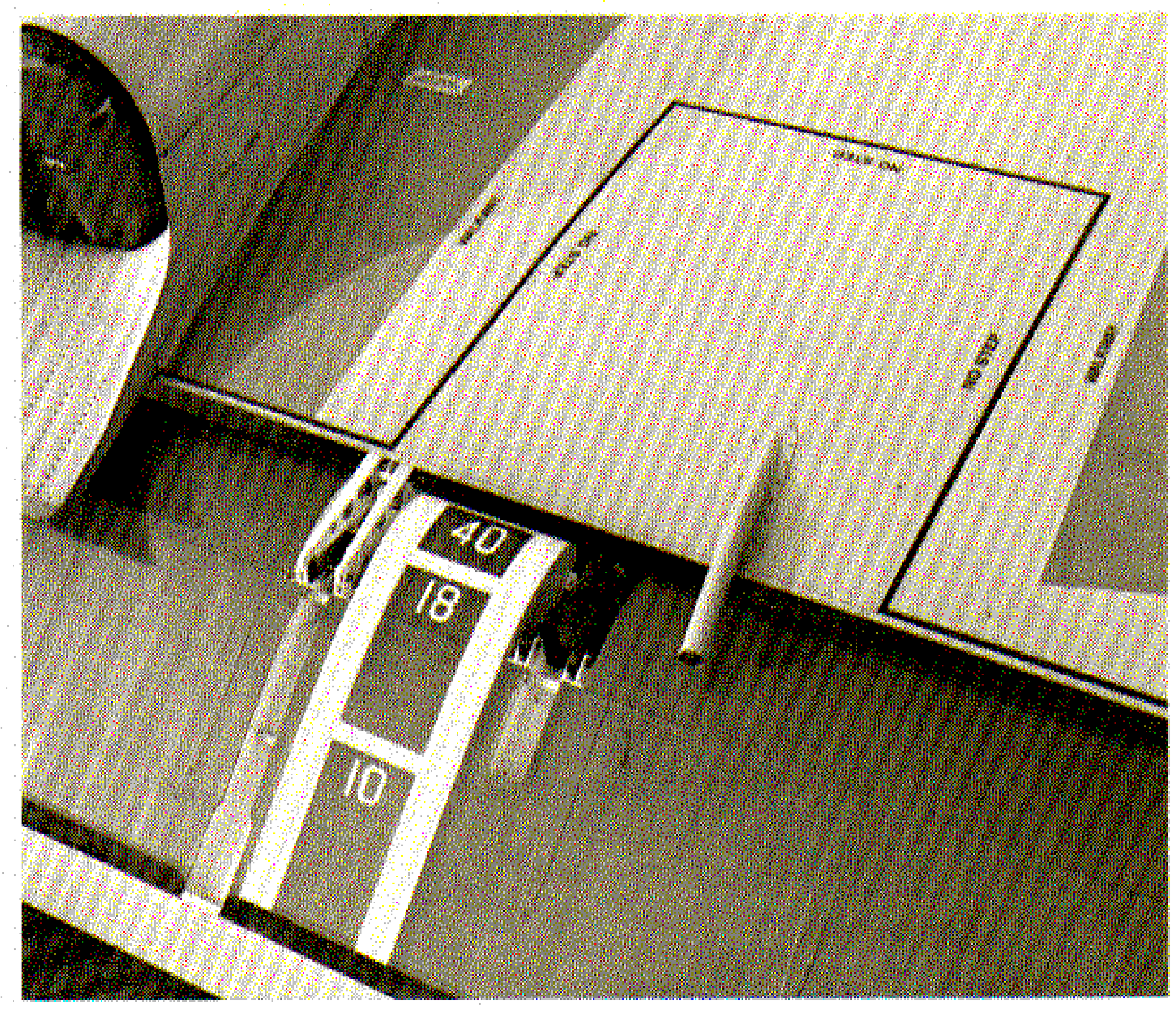
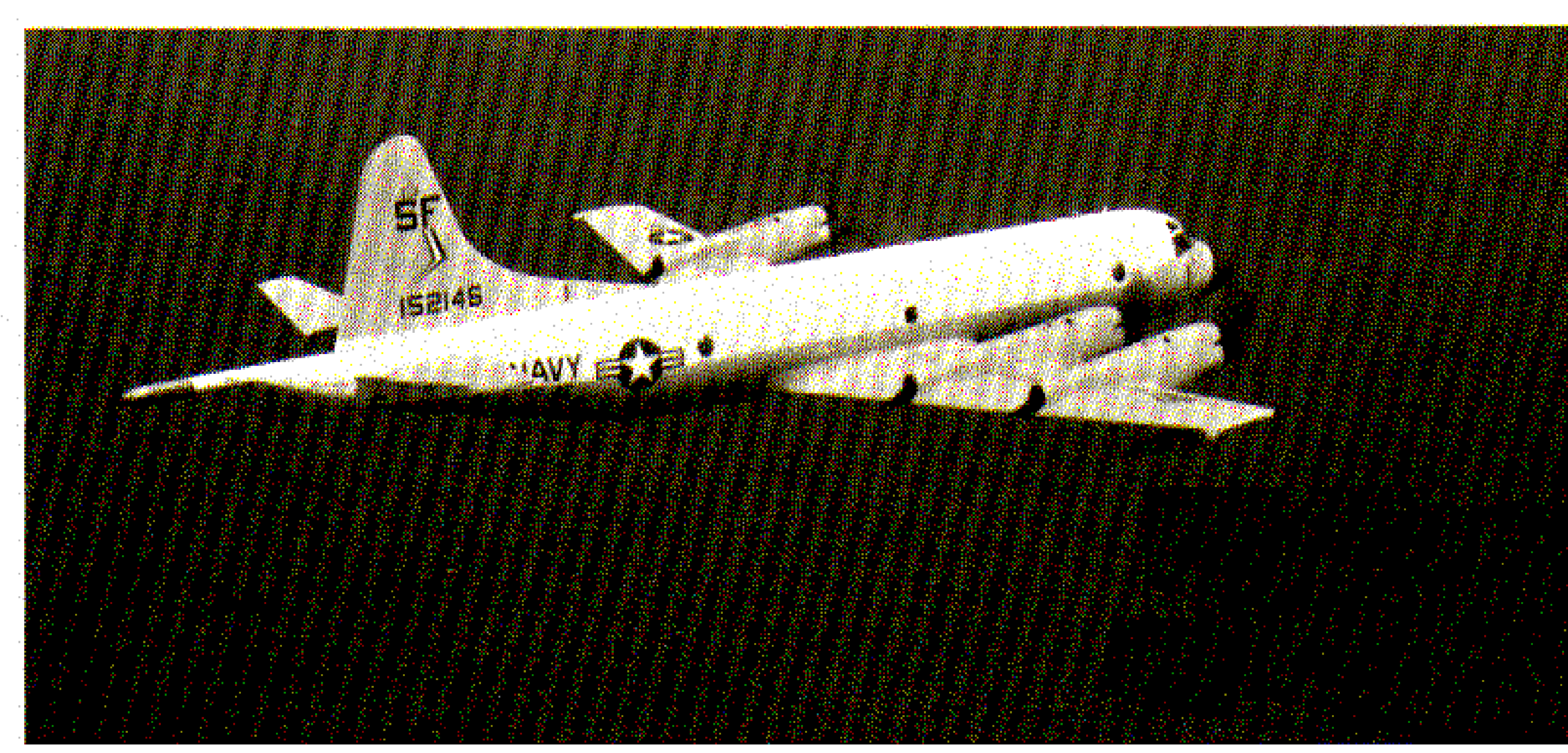


Figure 9 Dump Chute Installation

Flaps should be up during fuel dumping, or extended no more than absolutely necessary. Dumping fuel with flaps in landing position is prohibited. Fuel mists from the dump chute (above the left flap) tend to wash into the flapwell if the flaps are not up, and the tendency worsens the farther the flaps are extended.

Also, airspeed should be maintained between 140 and 220 kts. Tests conducted at Lockheed established the 140-kt. minimum as advisable. Flight tests with the P-3 indicated that within the 140-to-220-kt. range the operation would be satisfactory from the fuel-impingement standpoint. In addition, wind tunnel tests conducted in connection with a general research project indicated that if a fuel plume should be ignited in some manner, the flame will not propagate faster than 140 kts. and probably would wash aft in the slipstream if aircraft speed is in excess of 140 kts. ▲ ▲



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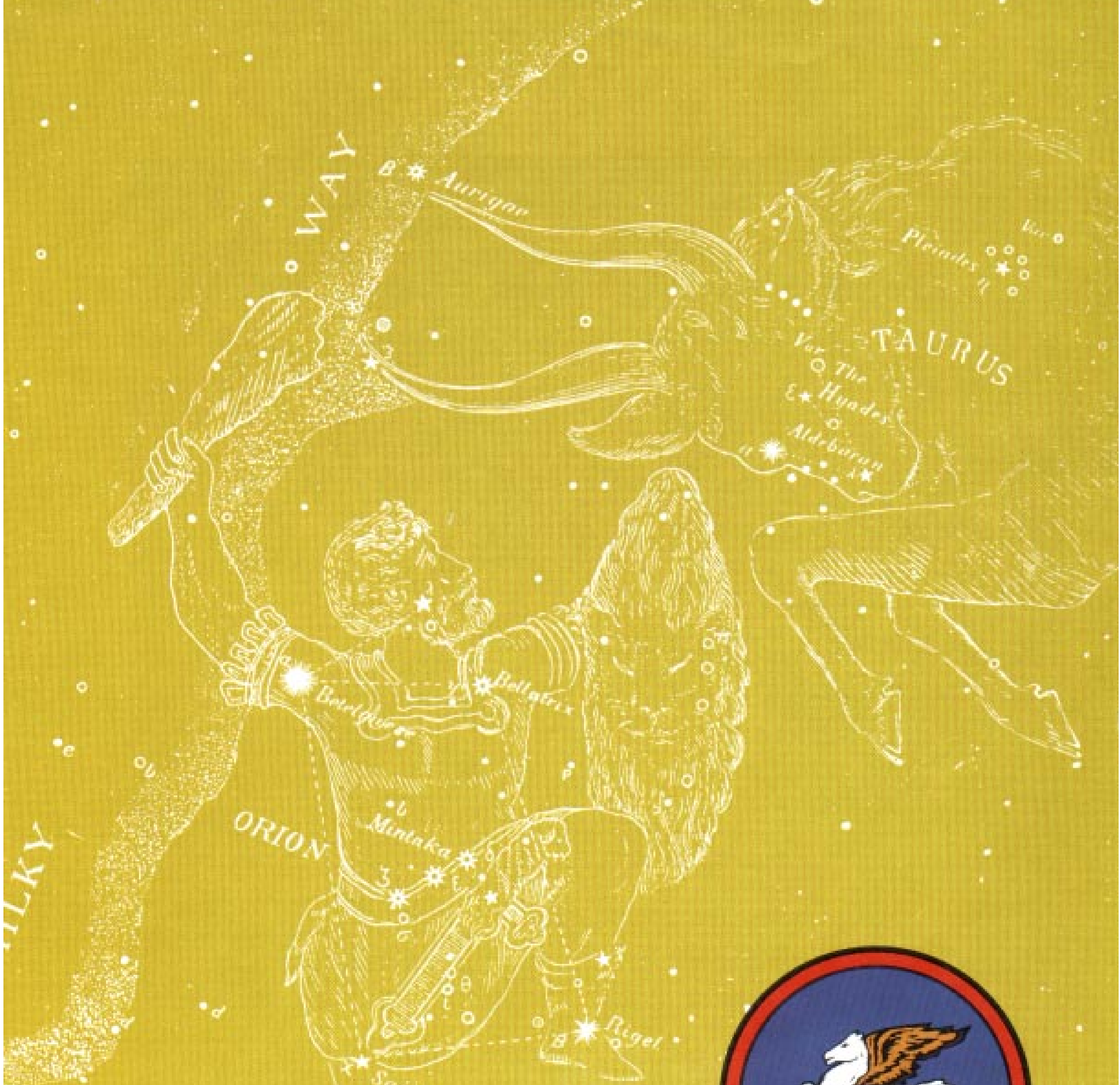
NAS Barbers Point Honolulu, Hawaii	J. M. Nugent, Resident Rep.	Lockheed-California Co., P.O. Box 268 FPO San Francisco, Calif. 96611	(808) 683-444, 436-5216, or 436-6126 Honolulu, Hawaii
Burbank, California	C. F. Wernle, Supervisor P-3 Project, Customer Service	Lockheed-California Company P.O. Box 551, Burbank, California 91503	(213) 847-4680 Burbank, Calif.



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