

THIS PUBLICATION IS ISSUED AS THE BASIC
HANDBOOK OF OPERATION AND MAINTENANCE INSTRUCTIONS
FOR THE

MAUNA KEA TELESCOPE

DOMED DRIVE

HAWAII

CUSTOMER: CANADA-FRANCE-HAWAII TELESCOPE CORPORATION

CUST. REF.: SNC 3516/0000/4440/8A & INQUIRY 3516-909

SHP REF.: PROJECT 2963 AND J-5073 @ 5080 F



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TELESCOPE DOME DRIVE

MAINTENANCE MANUAL

N°

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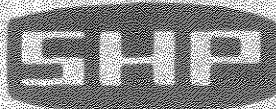
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I DESCRIPTION1.0. GENERAL

The hydraulic system will consist of three (3) drive units positioned around the track which supports the telescope dome and a central hydraulic power unit supplying the necessary flow at the system pressure of 1500 PSI to all drive units. All components are suitable for operation at peaks up to 4000 PSI.

2.0. SPECIFICATIONS

The hydraulic system is conform to the U.I.C. and the C.S.A. requirements.

2.1. Oil: MIL-H-5606B

2.2. Weight of drive unit: 4,550 lbs. each

2.3. Weight of hydraulic power unit (dry): 2,800 lbs.

2.4. Weight of oil in power unit: 2,400 lbs.

2.5. Pump capacity: 20 GPM each

2.6. Electric power requirements:

- a) 80 amps @ 485 Volts, 3 phases, 60 cycles
- b) 1 KW, 110 Volts, 60 cycles to the vent valves and warning switches. For servo valves supply, see Part II, Chap. 3.2.

2.7. Drive output torque at drive wheel: 8,700 ft/lbs. maximum

2.8. Maximum slewing speed of drive wheel: 5.7 RPM

2.9. Operating speed of drive wheel: .24 RPM maximum

2.10. Slewing speed of dome: 45°/min.

2.11. Operating speed of dome: 8 revolutions per 24 hours



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2.12. Backlash: 1° 2.13. Heat dissipation: .5 KW max. at 27° F ambient
and at tracking speed

2.14. Maximum drain line back pressure: 50 PSI

2.15. Peak pressure: 100 PSI above system pressure

3.0. DRIVE UNITS (Ref. DWG # E-6529)3.1. General Description

Each drive unit consists of an hydraulic motor having a displacement of 3.03 cu.in/REV driving a rubber coated wheel of 24" diameter through a right angle 1:140 reduction planetary gear and a bearing housing.

The wheel is fixed on the shaft and driven through a splined bushing. The rubber layer of 1" thickness, 70A Durometer, on the wheel O.D. will allow small axial deflections by shearing.

The drive assembly is mounted on a pivoted frame, the axis of the pivot being perpendicular to that of the track. This system of mounting will allow the track to move up and down by $1\frac{1}{2}$ " without affecting the seating of the drive wheel pressure on the track. Also the moments induced by the traction force are minimized.

An hydraulic cylinder pulling on the bare of the drive assembly exerts enough force on the drive wheel to ensure traction without slip.

3.2. Hydraulic Description (Ref. DWG # E-6664)3.2.1. Of Drive Wheel

The three drive units are connected in parallel. A manifold assembly (4) mounted on the motor includes two electrohydraulic servo valves for the control of the speed and direction of the motor.



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One servo valves (4-1) of .44 GPM rating will control the operational speed while the slewing speed is controlled by both the .44 GPM and 15 GPM rated servo valve (4-2).

A high pressure 10 micron filter (12) is installed upstream from the servo valves. This filter is provided with an electric alarm switch (13) which gives a signal to indicate the necessity of changing the filter element, suitable for direct connection to a visual and/or audio warning system.

A double pilot operated check valve (1-5) isolates the two servo valves.

Dual relief valves (5-1) installed near the drive motor provide the necessary deceleration torque at the drive wheel in case of hydraulic pressure failure.

Two replenishing check valves (4-4) are used to prevent cavitation during deceleration cycles.

One four way solenoid valve (4-3) cuts all flow going to servo-valves.

3.2.2. Of Tensionning Cylinder

The hydraulic cylinder (14) which keeps wheel on the dome track has a bore of 2 1/2". It is used also to lift off the wheel from the track for replacement or others.

The four way valve (6-2) directs oil to the cylinder through a pressure reducing valve (6-4) and allow the wheel to be lifted off.

This hydraulic valve is spring offset to a position providing pressure for tensionning. In case of a power failure, the accumulator (3) on the power unit will provide the



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pressure to maintain the necessary wheel friction. In this case, the wheel drive acts to decelerate the dome to a smooth stop. The control valve solenoid has to be energized to lift the wheel drive off the track.

An orifice (6-5) provides continuous flow required for low temperature and for smooth displacement of the cylinder.

One relief valve (6-3) set @ 650 PSI protects the cylinder rod end side against over pressure while two flow controls (9) permit adjustment of cylinder in both directions.

Two shut-off valves (24) at the inlet of each drive unit serve to isolate one unit for maintenance while the other two remain operational.

4.0. HYDRAULIC POWER UNIT (Ref. DWG # D-6767)

The hydraulic power unit consists of two identical and parallel systems each containing a 20 HP, 480 Volts, 3 phases, 60 cycles, 1800 RPM double-shafted motor directly coupled to a pump on each side.

The motor/pump assembly is mounted on top of a J.I.C. reservoir of 300 gallons capacity. The reservoir is fitted with level (1-F) and temperature switches (1-G) which provide appropriate electric signals for low level and high oil temperature.

The main pump (2) is of the axial piston type pressure compensated and will supply the system flow requirement at 1500 PSI continuous system pressure.

The other pump (6) is a vane type pump which supercharges the inlet of the main pump and provides continuous filtration and cooling circulation through an air-oil cooler (8). This circuit and the fact that the pumps are derated in pressure will considerably increase the service life.



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Two-stage low pressure switch (13) will shut off electric motor if boost pressure is not maintained.

Another pressure switch (24) at the axial piston pump outlet will indicate "PRESSURE AVAILABLE".

A pump mounted manifold (5) contains a relief valve and a vent valve to depressurize the system.

Two solenoid valves mounted on manifold (28) are used to vent pressure compensator of main pumps (2) thus giving full flow from pumps without compensation, even if pressure reaches 1500 PSIG.

Three filters are installed in return lines of system. Two of them (11) are installed on suction line of piston pumps (2) and filter oil coming from booster pumps (6). The third filter or main filter (16) filters oil coming from system as well as oil coming from main pumps during their unloaded cycle.

All filters are protected with one by-pass relief valve and one pressure switch (12) to give a signal when filter element requires replacement.

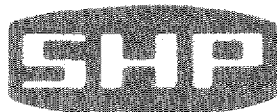
Each motor/pump system has an air/oil cooler which will be mounted on the hydraulic room air ducts remotely located from the power unit. The air supply to the coolers will be at 45 ° F maximum, 2300 CFM per cooler (1).

One hydraulic control panel (20) gives following indications:

- a) Outlet pressure of supercharging pumps on pressure gauge (20-C)
- b) Outlet pressure of main pumps on pressure gauge (20-A)
- c) Oil temperature in reservoir on temperature gauge (20-D)
- d) Reservoir pressure. This gauge is provided with a pressure reducing-valve to maintain 2.5 PSI in the reservoir. A needle valve (17) permits depressurizing of reservoir.

IMPORTANT

The dome will be normally operated with one motor/pump system thus avoiding high power consumption. The two



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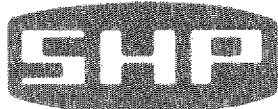
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motor/pump systems will have to be operated to obtain the full slewing speed. However, half the maximum slewing speed can be obtained with one motor/pump. Also, if the oil temperature rises to an unacceptable level with one motor operating, the second motor will be operated, the main pump vented to circulate oil through the second cooler as well.

5.0. ELECTRICAL SYSTEM

The sequence of operation of the entire electrical system can be read on DWG #D-6992

- 5.1. **DRIVE CONTROL PANEL:** Located adjacent to the power unit. (Item 1 of Bill of Material)
Which contains the STOP/START push button for the two pump drives and red "running" lights, and malfunction lights for the drives. It will also contain the starters, manual disconnect switches (circuit breakers) for the two pumps, transformer 480/120 and circuit breaker. A key operated switch will allow deactivating the hydraulic system for maintenance purposes.
- 5.2. **LOCAL CONTROL STATION:** Located at the observatory floor. (Item 3 of Bill of Material)
Which contains a manual spring centered control of the speed and direction of the drive units, a start/stop push button and pilot lights for the two pump drives and a local remote control mode selector switch with the appropriate relays and terminal blocks.
- 5.3. **JUNCTION BOX:** Located adjacent to the power unit (Item 2 of Bill of Material)
With a terminal strip to accommodate the incoming signals from the computer.
- 5.4. **TERMINAL BOXES:** (Items 4 and 5 of Bill of Material)
On each drive unit and on the power unit, a terminal box is installed and is wired to the various switches and valves contained in that unit.



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II PREPARATION FOR USE1.0. HYDRAULIC POWER UNIT1.1. Reservoir

- Check that drain valve (1-C) is closed and valves (18) are open.
- Fill reservoir with 300 gallons of clear hydraulic oil conform to MIL-H-5606B. Great care must be taken during this process to eliminate risk of contamination. Check oil level during filling.
- Connect 100 PSIG air system to pressure reducing valve (20-C) and allow pressure to slowly build up in the reservoir up to 2.5 PSIG. Check pressure on gauge.

1.2. Pumping Unit

Check pump rotation by momentarily starting and stopping electric motor from drive control panel.

If pump rotation is incorrect reverse two motor leads connection inside control panel.

1.3. Accumulator

Since the power unit has been tested at the SHP Enterprises, the precharging of accumulator is not necessary.

If for any reasons precharging is necessary: connect nitrogen bottle to the test connection bloc (3-a) and check pressure on gauge (3-b). Precharge pressure must not exceed 900 PSIG.

2.0. HYDRAULIC DRIVE

Check that mechanical arms (item # 30, Dwg. E-6529) used for transportation have been removed.

Check that valves (24) are opened.



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3.0. ELECTRICAL AND CONTROLS3.1. Main Power

Check that 480 Volts 3 phases 60 cycles has been connected to the drive control panel breaker CB1.

3.2. Computer

The following computer signals will be required for the systems

1. One (1) constant 110 Volts/60 cycles for the supply solenoids on the drive units. To be available whenever Item 4 is available. 10 amps inrush, 2 amps continuous.
2. Two (2) N.O. and one (1) N.C. contacts rated for 110V/60 cy, 3 amp. for the start of pump # 1.
3. Two (2) N.O. and one (1) N.C. contacts rated for 110V/60 cy. 3 amp. for the start of pump # 2.
4. Three (3) variable voltages of up to ± 10 VDC 100 MA to drive (slewing mode) the large capacity servo valves.
5. Three (3) variable voltages of up to ± 5 VDC 100 MA to drive the small capacity servo valve (normal mode).
6. One (1) N.O. contact rated for 110V/60 cy. 3 amp. rating for venting of system pressure.
7. Allowance for spare supplies.

3.3. Interlock

The following interlocks and signals will be required (to be supplied by others).

1. No signals to start the pumps shall be permitted unless the signals on the servo valves are null.



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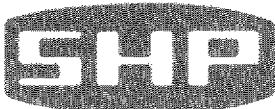
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2. The computer will provide the necessary signal to start the second pump whenever dome speeds - above $22\frac{1}{2}^{\circ}/\text{min.}$ - are required.
3. The computer will stop one of the pumps whenever dome speeds - above $22\frac{1}{2}^{\circ}/\text{min.}$ - are not required.
4. Null signals from the computer will cause the system to stop.
5. The feedback loop is closed through the computer which will up-date the signals to the servo valves accordingly.
6. Any continuous discrepancy between the command and feedback signals such as a "runaway" condition shall be signalled and appropriate action taken by the computer.
7. The control of acceleration and deceleration shall be provided by the computer except for the local manual mode when they shall be controlled manually.



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III OPERATION

1.0. GENERAL

There are two modes of operation: the normal tracking mode and the local or slewing mode.

1.1. In the normal mode, only one pump will be operative and the large capacity servo valve in each drive unit will be inactivated together with its supply solenoid valve.

The drive units will be capable of rotating the dome at speeds of up to one revolution per day.

1.2. In the slewing mode, the drive units will be capable of driving the dome at speeds of up to 45°/min. either manually by the control handle at the local station located at the observatory floor, or through the computer.

2.0. CONTROLS

There are two modes of controls: the remote control mode and the local mode.

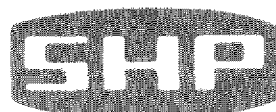
2.1. Remote Controls

2.1.1. Conditions:

- 1) The three drive units must be in slow position.
- 2) No current on the servo-valves: C1 and C4 N.O. contacts of computer are closed.
- 3) Drive control panel key switch KS1 on POWER ON.
- 4) Control station selector switch SS1 on REMOTE.
- 5) Disconnect switches CB1 - CB2 - CB3 - CB4 - on POWER ON.

2.1.2. Start-Stop

- a) Start from drive control panel:
Press START button PB2 or PB6, or both, to start either one or both electric motors.



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- b) Start from computer:
Momentary closing of N.O. contacts C2 or C5, or C2 and C5, to start either one or both electric motors.
- c) Stop from drive control panel:
Push on PB3 and/or PB7 stop button.
- d) Stop from local control station:
Push on PB4 and/or PB8 stop button.
- e) Stop from computer:
Open momentary of NC C3 and C6 contacts.
- f) Automatic stop:
If boost pressure is not maintained at the inlet of main pump pressure switches PS1 and/or PS2 will stop pumping units No. 1 and/or No. 2.

NOTES

Electric motors will run only 4 seconds if low boost pressure does not reach the required pressure: PS1 (1) and PS2 (1).

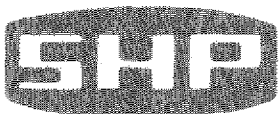
Electric motors will not start at the same time: there will be a 10 second delay between each start-up.

IT IS THEREFORE NECESSARY that to start the two motors from the computer the N.O. contact C2 and C5 be momentary closed with a 10 seconds interval.

2.1.3. Pressure Build-up

Five (5) seconds after start-up of motors: Solenoid "B" is energized (pump # 1 delivering) solenoid "C" is energized (pump # 2 delivering) solenoid "A" and "D" (pilot operated venting valves) are de-energized. Circuit is pressurized.

System working pressure is reached: automatically N.O. contact of pressure switch PS4 (pressure available) closes to give the information to the annunciator panel.



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2.1.4. Circuit Venting

- a) By stopping electric motors: solenoids "B" and "C" are de-energized (pumps are not delivering). Solenoids "A" and "D" will automatically energized 30 seconds after electric motors have stopped and will remain energized for 30 seconds to allow complete venting of accumulator and circuit.
- b) Without stopping the electric motors: N.O. contact C7 of computer automatically closes to feed solenoids "A" and "D"; C7 contact will remain close as long as no pressure is required in system.

NOTE:

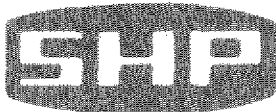
If one unit is stopped, solenoids "B" or "C" (pump venting) will be de-energized to allow unit re-start-up without the electric motor being under load.

2.1.5. Operation

- a) Slow operation: energize SVL1, SVL2 and SVL3 with variable current ± 10 V. supplied by computer.
- b) Fast operation: energize SVF1, SVF2, SVF3 with variable current ± 10 V. supplied by computer and simultaneous energize solenoids "E", "G" and "I" by the closing of contact N.O. C8 of computer.

2.2. Local Controls2.2.1. Conditions

- 1) Drive control panel key switch KSI on POWER ON.
- 2) Selector switch SS1 of local control station on LOCAL.



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- c) Going from REMOTE CONTROL MODE to LOCAL MODE will stop the electric motors (selector switch JS1).

2.2.2. Start-Stop

- a) Start from local control station:
Press PB1 and/or PB5 to start one or both pumping units.
- b) Stop from local control station:
Press PB4 and/or PB8 to stop one or both pumping units.
- c) Stop from drive control panel:
Press PB3 and/or PB7 to stop one or both pumping units.
- d) Automatic stop:
If boost pressure is not maintained pressure switches PS1 and/or PS2 will stop one or both pumping units.

NOTES: See notes at 2.1.2.

2.2.3. Pressure Build-up

See 2.1.3.

2.2.4. Circuit Venting

- a) By stopping the electric motors (identical as for REMOTE CONTROL MODE)
- b) Without stopping the electric motors:
by energizing "A" and "D" solenoids (pilot operated venting valves) with TS4 contact switch. As long as TS4 remains closed, there will be no pressure build-up in system. System will be completely depressurized only after complete venting of accumulator.

NOTE: See note at 2.1.4.



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2.2.5. Operation

By operating remote control lever T4: simultaneous energizing of SVF1, SVF2 and SVF3 servo-valves and "E", "G" and "I" solenoid valves.

The direction and speed of hydraulic motor rotation is also controlled by control lever.

By releasing remote control lever, current is cut on the servo-valves and solenoid valves, and drive units are therefore stopped.

3.0. RISE OF DRIVE UNITS

Selector switch SSI on LOCAL - hydraulic units operating.

Energize solenoid valves "F", "H" and "J" by contact switches TS1, TS2 and TS3.

The drive units will remain raised as long as current is maintained on solenoid valves.



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TROUBLE-SHOOTING CHART FOR HYDRAULIC SYSTEMS

1.0. NOISY PUMP?CauseWhat to do

Air leaking into system

Be sure the oil reservoir is filled to normal level and that oil intake is below surface of oil. Check pump packing, pipe and tubing connections, and all other points where air might leak into system. One good way to check a point on the intake side suspected of leakage is to pour oil over it. If the pump noise stops, you have found the leak.

Air bubbles in intake oil

If oil level is low or return line to reservoir is installed above oil level, air bubbles will form in oil in reservoir. Check oil level and return-line position.

Cavitation (the formation of vacuum in a pump when it does not get enough oil)

Check for clogged or restricted intake line, plugged air vent in reservoir. Check strainers in intake line. Oil viscosity may be too high. Check recommendation.

Loose or worn pump parts

Check manufacturer's maintenance instructions first. Tightening every nut in sight may not be the way to stop leakage. Look for worn gaskets and packings; replace if necessary. There is usually no way to compensate for wear in a part; it is always better to replace it. Oil may be of improper grade or quality. Check recommendations.

Stuck pump vanes, valves, pistons, etc.

Parts may be stuck by metallic chips, bits of lint, etc. If so, disassemble and clean thoroughly. Avoid the use of files, emery cloth, steel hammers, etc., on machined surfaces. Products of oil deterioration such as gums, sludges, varnishes, and lacquers may be cause of sticking. Use solvent to clean parts and dry thoroughly before reassembling. If parts are stuck by corrosion or rust, they will



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TELESCOPE DOME DRIVE

MAINTENANCE MANUAL

N° PART IV

REF. 5073/74/75 F

DATE JAN. 1977

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CauseWhat to do

probably have to be replaced. Be sure oil has sufficient resistance to deterioration and provides adequate protection against rusting and corrosion.

Filter or strainer too dirty. Filter too small

Filter and strainers must be kept clean enough to permit adequate flow. Check filter capacity. Be sure that original filter has not been replaced by one of smaller capacity. Use oil of quality high enough to prevent rapid sludge formation.

Pump running too fast

Determine recommended speed. Check pulley and gear sizes. Make sure that no one has installed replacement motor with other than recommended speed.

Pump out of line with driving motor

Check alignment. Misalignment may be caused by temperature variation.

2.0. LEAKAGE AROUND PUMPCauseWhat to do

Worn packing

Tighten packing gland or replace packing. Trouble may be caused by abrasives in oil. If you suspect this sort of trouble, make a thorough check of points where abrasives may enter system.

Head of oil on suction line

Usually it is better to have no pressure on the suction side of the pump, although it may be necessary. With more than slight head, leakage may result. If head is not required and components can be rearranged, do so. Otherwise, don't worry about the leakage. Just wipe off the pump periodically, and, if feasible, install a drip pan. Don't let oil leak onto floor!



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3.0. OVERHEATINGCauseWhat to do

Oil viscosity too high

Check oil recommendations. If you're not sure of viscosity of oil in system, it may be worth your while to drain the system and install oil of proper viscosity. Unusual temperature conditions may cause oil of proper viscosity for "working temperature" to thicken too much on way to pump. In this case, use of oil with higher viscosity index may cure trouble.

Internal leakage too high

Check for wear and loose packings. Oil viscosity may be too low. Check recommendations. Under unusual working conditions temperature may go high enough to reduce viscosity of recommended oil too much. Proceed with caution if you are tempted to try a higher viscosity oil.

Excessive discharge pressure

If oil viscosity is found to be OK, trouble may be caused by high setting of relief valve. If so, reset.

Oil cooler clogged

On any machine equipped with an oil cooler, it is probable that high temperatures are expected. If temperatures run high normally, they'll go even higher if oil cooler passages are clogged. If you find a clogged cooler, try blowing it out with compressed air. If this won't work, try solvents.

Poorly fitted pump parts

Poorly fitted parts may cause undue friction. Look for signs of excessive friction; be sure all parts are in alignment.

Low oil

If the oil supply is low, less oil will be available to carry away just as much heat. This will cause a rise in oil temperature, especially in machines without oil coolers. Be sure oil's up to level.



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4.0. PUMP NOT PUMPINGCauseWhat to do

Pump shaft
turning in wrong
direction

Shut down immediately. Some types of pumps can turn in either direction without causing damage; others are designed to turn in one direction only. Check belts, pulleys, gears, motor connections. Reversed leads on 3-phase motor are commonest cause of wrong rotation.

Intake clogged

Check line from reservoir to pump.
Be sure filters and strainers are not clogged.

Low oil level

Be sure oil is up to recommended level in reservoir. Intake line must be below level of oil.

Air leak in
intake

If any air at all is going through pump, it will probably be quite noisy. Pour oil over points suspected of leakage; if noise stops you've found the leak.

Pump shaft speed
too low

Some pumps will deliver oil over a wide range of speeds; others must turn at recommended speed to give appreciable flow. Find out first the speed recommended by the manufacturer; then, with a speed counter if possible, check the speed of the pump. If speed is too low, look for trouble in driving motor.

Oil too heavy

If oil is too heavy, some types of pumps cannot pick up prime. You can make a very rough check of viscosity by first getting some oil that is known to have the right viscosity. Then, with both oils at the same temperature, pour a quart of each oil through a small funnel. The heavier oil will take a noticeably longer time to run through. Oil that is too heavy can do great harm to hydraulic systems. Drain and refill with oil of the right viscosity.



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CauseWhat to do

Mechanical trouble (broken shaft, loose coupling, etc.)

Mechanical trouble is often accompanied by a noise that you can locate very easily. If you find it necessary to disassemble, follow the manufacturer's recommendations to the letter.

5.0. LOW PRESSURE IN SYSTEMCauseWhat to do

Relief valve setting too low

If relief valve setting is too low, oil may flow from pump through relief valve and back to the oil reservoir without reaching point of use. To check relief setting, block discharge line beyond relief valve and check line pressure with pressure gauge.

Relief valve stuck open

Look for dirt or sludge in valve. If valve is dirty, disassemble and clean. Stuck valve may be indication that system contains dirty or deteriorated oil. Be sure, therefore, that oil has high enough resistance to deterioration.

Leak in system

Check whole system for leaks. Serious leaks in the open are easy to detect, but leaks often occur in concealed piping. One routine in leak testing is to install pressure gauge in discharge line near pump and then block off circuit progressively. When gauge pressure drops with gauge installed at a given point, leak is between this point and check point just before it.

Broken, worn or stuck pump parts

Install pressure gauge and block system just beyond relief valve. If no appreciable pressure is developed and relief valve is OK look for mechanical trouble in pump. Replace worn and broken parts.



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TELESCOPE DOME DRIVE

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CauseWhat to do

Incorrect control valve setting; oil "short-circuited" to reservoir

If open-center directional control valves are unintentionally set at neutral position, oil will return to reservoir without meeting any appreciable resistance and very little pressure will be developed. Scored control-valve pistons and cylinders can cause this trouble. Replace worn parts.

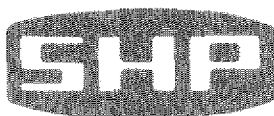
6.0. ERRATIC ACTIONCauseWhat to do

Valves, pistons etc., sticking or binding

First, check suspected part for mechanical deficiencies such as misalignment of a shaft, worn bearings, etc. Then look for signs of dirt, oil sludge varnishes and lacquers caused by oil deterioration. You can make up for mechanical deficiencies by replacing worn parts, but don't forget that these deficiencies are often caused by the use of wrong oil.

Sluggishness when a machine is first started

Sluggishness is often caused by oil that is too thick at starting temperatures. If you can put up with this for a few minutes, oil may thin out enough to give satisfactory operation. But if oil does not thin out or if surrounding temperature remains relatively low, you may have to switch to oil with lower pour point, lighter viscosity, or, perhaps, higher viscosity index. Under severe conditions, immersion heaters are sometimes used.



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V MAINTENANCE1.0. OIL & RESERVOIR

Reservoir must be drained approximately each year. The oil should be analysed every 6 months and must be changed every two year or at more frequent intervals depending contamination.

Oxydation of oil causes it to darken, this can be used as an indication of the need for an oil change.

The reservoir should be carefully inspected and cleaned if a change of oil is found necessary. Check magnetic plug (1h) for metallic particles.

2.0. FILTRATION SYSTEM

All filters are equipped with a differential pressure switch which will give the indication that filter element is contaminated and need to be changed. Refer to Bill of material Part VI for correct part number of filter and element.

3.0. DRIVE UNITS

Pivots of tensionning cylinder and those of the pivoting base have been greased before shipping. Check at regular interval and use good industrial grease if needed. Do the same thing for the pillow block which has two greasing points.

4.0. GAUGES

Check gauges located on control panel, against a laboratory test gauge at frequent intervals.

5.0. FITTINGS

Periodically check fittings for leaks and tighten if necessary.

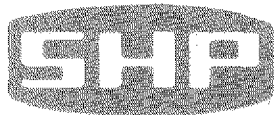
6.0. HYDRAULIC COMPONENTS

For servicing of hydraulic components such as pumps and valves refer to part VI of manual.



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BILL OF MATERIAL

SHP 5074-F

MACHINE TELESCOPE DOME DRIVE - ITEM 1

DATE NOV. 11/75 BY J.V.

PAGE 1 OF 5

QTY. 1 TITLE 300 GALS. (2) 20 HP POWER UNIT

DRAWING E-6664

PROJECT 2963-4

ITEM	QTY.	DESCRIPTION	V	MFG.	P.O.	DEL. DATE		
1	1	S214 R 300 JIC Reservoir (A-2903)		SHP	STK			
1a	1	1611 3/4 IPT, 5 PSI Filtered pressure/vacuum relief vent		RITS	996			
1b	1	G 620-5-A1 Oil level indicator	*	LUBE DEVICES	STK			
1c	1	# 532-1 Drain valve		NEO	STK			
1d	2	S 201-D Aluminum door, modified as per D-6794	*	SHP	STK			
1e	1	UC SE 1322 Filler filter	*	UCC	STK			
1f	1	LS - 1800 Low level electric alarm, 115/230 VAC		GEMS	STK			
1g	1	22800 Series 100 - 300°F Temperature switch, 125/250 VAC	*	ECUALL	STK			
1h	1	# 502 Magnetic plug 1 1/4		KEBBY	684			
1i	1	B-5055 Name plate		SHP	STK			
1j	4	#100 Fabcel Neoprene pad, 18" x 4" x 5/16 Thk		FABCEL	625			
1k	4	13/16 I.D. x 2" O.D. x .148 Thk. Type A wide plain washer		CONN'L	STK			
2	2	P3V07-01C-053-3-R01-1A84 Variable volume/pressure compensated piston pump, with maximum displacement handwheel	*	DERISON	STK			
2a	2	A-5112 Splined bushing	*	SHP	661			
2b	2	B-6770 Coupling	*	SHP	1468			
2c	2	FTH-24 SAE flange		SHP	STK			
2d	2	FTH-16 SAE flange		SHP	STK			
2e	2	202-702-16-16 Drain adaptor		ACROBUT	STK			

NOTES: (*) Spare parts recommended

REV. 4 12/23/76

Rev. 2 Jan. 20/76

Rev. 1 Dec. 21/75

Project 2963-4

SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5074-F

PAGE 2 OF

ITEM	QTY.	DESCRIPTION	✓	MFG.	P.O.	DEL. DATE		
3	1	A1077-200						
		Accumulator, 1 gallon	*	GREER	683	15/1/76		
3a	1	AG3-Z		GREER	683	15/1/76		
3b	1	Pressure gauge, 2½" dial, 0-4000, 1/4 NPT connection	*	UCC	STK			
4	2	S236L5-4		SHP	1401			
5	2	3308-009-A1 110/60						
		Block Manifold (B/M Page 5)Ref. S310ME-5065	*	SHP				
5	2	TIC-014-21L03						
		Vane pump	*	DENISON	STK			
6a	2	S270 FD24S		SHP	STK			
6b	2	FSS-24		SHP	STK			
		SAE flange	*	SHP				
6c	2	FTH-16		SHP	STK			
		SAE flange	*	SHP				
7	2	6534-1½						
		90° Flexmaster	*	AEROQUIP	STK			
8	2	OCH-S1						
		HEAT EXCHANGER - Single Pass		YOUNG	STK			
9	2	S236L4-2		SHP	STK			
		Bell housing						
10	2	# 400						
		Flexible coupling	*	MAGNALOY	STK			
10a	2	1/2 Coupling bore as per Dwg. #A-3870, 7/8 Ø 3/16 (TIC)			STK			
10b	2	1/2 Coupling bore as per Dwg. #A-3872, 1 3/8 Ø 5/16 (Bot. TS shaft)			STK			

RE: APR 1 20/76
 Rev. 2 Jan. 20/76
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Project 2963-4

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BILL OF MATERIAL

SHP 5074-F

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ITEM	QTY.	DESCRIPTION	✓	MFG.	P.O.	DEL. DATE		
11	2	RFB-401		GRESEN	STK			
11a	4	FWH-32		SHP	STK			
12	3	DPD1T-H10		BARKSDALE	687	15/1/74		
13	2	D2T A150		BARKSDALE	1019	22/1/74		
14	2	3C15-8-65		FLUID CONTROLS	681			
15	3	3C16-10-15		FLUID CONTROLS	681			
16	1	RFB-401		GRESEN	STK			
16a	2	FWH-32		SHP	STK			
17	1	2N13-R4-S		FLUID CONTROLS	STK			
18	2	Model 1 1/4 CS-790-KT		CLAYTON	689	15/1/74		
		S.W. Petro Hi-pressure ball valve	*					

Note: (*) Spare parts recommended

Rev. 1 Dec. 21/75

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NOMENCLATURE

SHP5074-F

MACHINE

BLOC DE DISTRIBUTION

ITEM 5

DATE MARCH 18-1968 J.V.

PAGE 5 DE

OTE 2

TITRE EXON-00941-110/60

DESSIN

SHP 5074
A-7200

PROJET

QTY	REF	DESCRIPTION	QTY	REMARKS	P.D.	RECEP PREVIA
1	5270ME-5005	BLOC DE DISTRIBUTION	1	SHP	OK	
1	ALUM 6061-T6 1/2" x 1/2" x 3 1/2" LG.		1	IDEAL META		
1	5274C	CLAPET AVEC RETOUR - DESSIN A-5071 (H07C)	1	SHP	OK	
1	52724-318	LIMITON DE PRESSION	1	DEALSON	OK	
1	1/16" - 14 UNC x 2 1/4" LG.	VIS ALLEN	1	COMPL	OK	
1	02207-35-101-0201-110/60	DISTRIBUTION 110/60	1	DEALSON	OK	
1	10/32-UNC x 1 1/4" LG.	VIS ALLEN	1	COMPL	OK	
2	FTH-30	ROD 3/16"	2	SHP	OK	
1	FWH-24	ROD 5/16"	1	SHP	OK	
2	5296 E 9/16"	BRACKET	2	SHP	OK	
2	5296 E 9/16"	BRACKET	2	SHP	OK	



SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5075-F

MACHINE TELESCOPE DOME DRIVE UNIT

DATE JAN. 21/76 BY A.B.

PAGE 1 OF 14

QTY. 3 TITLE DRIVE UNIT ASSEMBLY

DRAWING E-6529

PROJECT 2963-4

ITEM	QTY.	DESCRIPTION	V	MFG.	P.O.	DEL. DATE		
1	1	Transmission and driving wheel - Dwg. D-6777 - B/M pages 3 to 5						
2	1	Base structure Dwg. E-6812 - B/M page 6						
3	1	Pivoting base Dwg. E-6813 - B/M page 7						
4	1	Manifold Dwg. E-6738 - B/M page 8						
5	1	Manifold Dwg. D-6795 - B/M page 9						
6	1	Manifold Dwg. E-6797 - B/M page 10						
7	Lot	Tubing, fittings, hoses, clamps - B/M pages 11 to 13						
9	2	2R13-R4-S Restrictor valve		FLUID CONTROLS	STK			
10	1	Speed reducer, male shaft, Brevini EC 3.090, ratio 1/140 c/w adaptor for FHA0050 motor		BREVINI	717	12/76		
11	1	FHA 0050 Hydraulic motor		HYDROLAND	STK			
12	1	2036-10 PL-R-50 Pressure filter		RUCKER	954	2/78		
13	1	9673-1-H Pressure differential switch		BARKSDALE	955			
14	1	184P Cylinder, 2 1/2 bore - - 6" stroke, cushioned both ends, #6 style rod.		CY-MARK	956	12/78		
15	8	3/4-10NC x 3 1/2 Lg. Hex. head bolt c/w washer & nut			STK			
16	10	1/2-13 NC x 1 3/4 Lg. Hex. head bolt c/w lock washer			1031			

NOTES:



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SHP 5075-F

MACHINE DOME DRIVE UNIT

DATE JAN. 21/76 BY A.B.

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QTY. TITLE TRANSMISSION & WHEEL ASSEMBLY - ITEM I

DRAWING D-6777

PROJECT 2963-4

ITEM	QTY.	DESCRIPTION	V	MFG.	P.O.	DEL. DATE	
*		*THESE ITEM NUMBERS ARE SHOWN ON DRAWING D-6777 ONLY					
		PILLOW BLOCK			781		
1	1	Casting Dwg. E-6775		MAGDOG	846		
		Machining Dwg. D-6810					
2	1	FLAME CUT IN 3/4" PL. 10 1/8 DIA. x 3/4 HRS 1018 Seal holder Dwg. A-6819			C/A 1021		
3	10	3/8-16 x 1 1/4 Lg. Socket head cap screw c/w lock washer			987		
4	1	FLAME CUT IN 5/8 PL. 9" DIA x 1/2 HRS 1018 Retaining ring Dwg. A-6556			C/A 1022		
5	2	1/4 NPT straight Grease cup			STK		
6	1	TDO - Cone 48282 (2), Cup 48220D Tapered roller bearing		TIMKEN	734		
7	1	23028 CW33 Spherical roller		SKE	737		
8	2	2" I.D. - 1"-8NC x 1 1/4 Lg. stud, Eye bolts			993		
9	1	#55075 - 55 Oil seal, Group A, plain round		NATIONAL	952	755	
10	1	1/4 NPT Plug			STK		
		SHAFT					
11	1	Ultimo 4 HTSR 6" DIA X 44 1/8" SHAFT Dwg. D-6549			788		
12	1	FLAME CUT IN 3/4 PL. 6" DIA. x 3/4 HRS 1018 Disc Dwg. A-6820			C/A 1053		

NOTES

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BILL OF MATERIAL

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BILL OF MATERIAL

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MACHINE TELESCOPE DOME DRIVE UNIT

DATE Jan. 21/76

BY A.B.

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QTY. TITLE BASE STRUCTURE - ITEM 2

DRAWING E-6812

PROJECT 2963-4

ITEM	QTY.	DESCRIPTION	V	MFG.	P.O.	DEL. DATE		
*		*THESE ITEM NUMBERS ARE SHOWN ON DRAWING E-6812 ONLY						
1	2	Plate, HRS 1020, 1 1/4" x 10 1/2" x 36" Lg. Dwg. D-6839			935	CA 1023		
2	1	Plate, HRS 1020, 5/8" x 2 FT x 3 FT TO MAKE PARTS a to e — " —			935	1024		
3	1	Plate, HRS 1020, 1" x 2 FT x 3 FT TO MAKE PARTS a to d — " —			935	1025		
4	1	Plate HRS 1020 3/4 x 5 1/2 x 8 1/2			935	1026		
6	1	6 x 4 x 1/4 x 31" ASTM A30 tubing Dwg. D-6839			927	CA 1027		
7	45	feet, 4 x 4 x 3/16 ASTM A30 tubing TO MAKE PARTS a to j — " —			927	1054		
8	2	2 x 2 x 3/16 x 28 1/4 ASTM A30 tubing — " —			927	1055		
9	1	Bracket Dwg. A-5939			927	1056		
10	2	19" Lg. Rail		STAUFF	STK			
11	2	Wire clamp						
12	2	2 x 2 x 1/8 Steel angle, Junction box bracket 12" Lg.			935	CA 1057		
14	1	Name plate Dwg. B-5055			STK			

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MACHINE TELESCOPE DOME DRIVE UNIT

DATE Jan. 21/76 BY A.B.

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QTY. TITLE PIVOTING BASE - ITEM 3

DRAWING E-6B13

PROJECT 2963-4

ITEM	QTY.	DESCRIPTION	V	MFG.	P.O.	DEL. DATE		
*		*THESE ITEM NUMBERS ARE SHOWN ON DRAWING E-6B13 ONLY						
1	1	Plate, HRS 1020, 5/8 x 4 ft. x 6 ft. to make parts a to J			335	C/A 1058		
2	1	plate, HRS 1020 1" x 16 5/8" x 25 3/4"			935	1059		
3	1	Plate, HRS 1020, 1" x 16 5/8" x 32" (Flame cut)			935	1060		
4	1	Plate, HRS 1020, 1" x 16 5/8" x 40" (Flame cut shape)			935	1061		
5	1	Plate, HRS 1020, 3/8" x 8" x 57 1/2" To make A B C			935	1062		
6	2	Bracket Dwg. A-5939				1063		
7	1	Bracket Dwg. A-5938				1064		
8	1	Bar, CRS 1020, 3/8" x 1 1/2" x 15". Bracket				1065		
9	2	1/4" NPT (straight) Grease cup						
10	2	GEZ 208ES. Steel on steel spherical plain bearing		SKF	951	1028		
11	2	SPS 245, 2 1/2" dia. x 7 1/2" Lg., Pivot Dwg. A-6824			900	C/A 1066		
12	4	Bar, HRS 1020, 6" dia. x 1 1/16" Lg. Seal holder Dwg. A-6825			957	C/A 1067		
13	4	Bar, HRS 1020, 3" dia. x 1 1/32" Lg., Spacer Dwg. A-6826			957	C/A 1068		
14	4	#40 "O"ring		PARKER	948			
15	4	#45 "O"ring		PARKER				
17	24	3/8-16NC x 7/8" Lg. Socket head cap screw c/w lock washer			987			

NOTES :

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MACHINE TELESCOPE DOME DRIVE UNIT

DATE JAN. 21/76 BY J.V.

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QTY.	TITLE	MANIFOLD ASSEMBLY - ITEM 5
1	MANIFOLD ASSEMBLY	ITEM 5

DRAWING D-6798

PROJECT 2963-4

NOTES

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MACHINE TELESCOPE DOME DRIVE UNIT

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QTY.	TITLE	MANIFOLD ASSEMBLY - ITEM 6
1	MANIFOLD ASSEMBLY	1

DRAWING E-6797

PROJECT 2963-4

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MACHINE TELESCOPE DOME DRIVE UNIT

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QTY. 1 Lot TITLE TUBING, FITTINGS, HOSES & CLAMPS - ITEM 7 DRAWING

PROJECT 2963-4

ITEM	QTY.	DESCRIPTION	✓	MFG.	P.O.	DEL. DATE		
		PRESSURE AND RETURN LINES FROM BALL VALVES TO MANIFOLDS & FILTER						
1	2	2021-12-12 Adapter, NPT - JIC		AEROQUIP	STK			
2	12	202702-12-12 Adapter, SAE - JIC		AEROQUIP	STK (2) 1053			
3	20	feet, 3/4" O.D. Hydraulic tube, .095 U.T. SAE 1010			STK			
4	2	2028-12-12S Tee, NPT - JIC		AEROQUIP	STK			
	2	AC55-12-4 Reducer, JIC		FLODAR	STK			
5a	2	1290-12 Nut		AEROQUIP	STK			
6	2	2651-4, 13" Lg. Hose assembly each one complete with		AEROQUIP	STK			
6a	2	4411-4 Swivel JIC		AEROQUIP	STK (4) 1053			
7	2	2021-4-4 Adapter NPT-JIC		AEROQUIP	STK			
8	2	1509-12, 48" Lg. Hose assembly, each one complete with		AEROQUIP	STK			
8a	2	4721-12 Swivel JIC		AEROQUIP	STK			
		PRESSURE & RETURN LINES FROM MANIFOLDS TO CYLINDERS						
9	6	202702-12-12S Adapter SAE - JIC		AEROQUIP	STK			
10	6	2024- 8-12S 90° Adapter NPT - JIC		AEROQUIP	STK 1053 950			
10a	6	2083-8-8S Adapter NPT-NPT		AEROQUIP	STK 1053			

NOTES :

FORM 012

SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5075-F

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QTY.	DESCRIPTION	✓	MFG	P.O.	DEL. DATE		
2	1509-12, 48" Lg.		AEROQUIP	STK			
2	4721-12		AEROQUIP	STK			
1	2083-12-12		AEROQUIP	STK			
4	2021-6-4		AEROQUIP	STK			
4	2028-6-6		AEROQUIP	STK			
8	AC55-6-4		FLODAR	105A-380			
8	1290-6		AEROQUIP	STK			
8	2651-4, 24" Lg.		AEROQUIP	STK			
2	4411-4						
DRAIN LINES							
2	2027-8-8		AEROQUIP	STK			
2	1290-8		AEROQUIP	STK			
2	900605-8		AEROQUIP	STK			
20	feet, 1/2" O.D.			STK			
2	2651-8, 36" Lg.		AEROQUIP	STK			
2	4411-8		AEROQUIP	STK			
1	2021-4-8		AEROQUIP	STK			

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SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5075F

MACHINE TELESCOPE DOME DRIVE UNIT

DATE MARCH 16 76 BY AR

PAGE 14 OF 14

QTY. 3 TITLE TACHOMETER DRIVE

DRAWING C-6551

PROJECT

ITEM	QTY	DESCRIPTION	V	MFG.	P.O.	DEL DATE
1	1	C-6394 COLLECTOR HOUSING MODIFICATIONS		SHP	CA 1012	
2	1	A-6395 MOTOR CRANK SHAFT CENTER ALTERATION		SHP	CA 1104	
3	1	B-6396 ADAPTOR		SHP	CA 1110	
4	1	A-6337 SHAFT		SHP	810	
5	1	ARP 015 "O"RING BUNA N		COMM'L	731	
6	1	ARP 916 "O"RING BUNA N		COMM'L	STK	
7	3	8-32UNC x 1/2 LG SDC. HD. CAP SCREW C/W LOCK WASHER		COMM'L	STK	
8	1	# AA-307-10 SLEEVE BEARING		OILITE	CA 1102	
9	2	# TT-504 THRUST BEARING		OILITE	CA 1103	
10	1	# A-1203 1/4" SHAFT COLLAR		DODGE	1416	
11	1	1/8" x 1/2 LG ROLL PIN		COMM'L	STK	

BILL OF MATERIAL

5079-F

PAGE 2 OF 2

DRAWING C-6596-2

PROJECT 2967-41

NOTES :

BILL OF MATERIAL

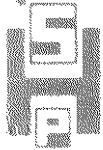
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PAGE 1 OF 2

DRAWING C-6595-2

PROJECT 2063-1

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 REV. 2 JAN 21/76


SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5076-F

MACHINE TELESCOPE DOME DRIVE (ITEM 3) (REV'D 21 DEC '75) DATE OCT. 23/75 BY

PAGE 1 OF 3

QTY. 1 TITLE POWER DISTRIBUTION & DRIVE CONTROL PANELS DRAWING C-FE95-2

PROJECT 2463-1

ITEM	QTY.	DESCRIPTION	V	MFG.	P.O.	DEL. DATE		
1	1	1418 PE ENCLOSURE 42 x 36 x 8		HAMMOND	1060	30-3		
1A	1	TEC 36100 CIRCUIT BREAKER 100 AMP, 600 V, 3 POLES		G.E.	1071	30-3		
1B	2	TEC 36050 CIRCUIT BREAKER 50 AMP, 480 V, 3 POLES		G.E.	1071	30-3		
1C	1	TEC 36015 CIRCUIT BREAKER 15 AMP, 480 V, 2 POLES		G.E.	1071	30-3		
1D	2	PH1-PH100 STARTER 20 HP 460/480V 3 PHASES 215 V, 60 CY COIL		TELETEC.	1059	26-3		
1E	1	PH7P 460/100 V, 1000 VA TRANSFORMER		HAMMOND	1417	26-3		
1F	2	XP2 MA31 PE START GREEN		TELETEC.	1059	26-3		
1G	2	XP2 PL41 PE STOP RED		TELETEC.	1059	26-3		
1H	6	XB2 MV104 PILOT LIGHT RED		TELETEC.	1059	26-3		
1J	9	CA2 AH 20 RELAY 2 COILS 12 VDC 60 CY 20A		TELETEC.	1059	26-3		
1K	9	CA2 AS22 TIMED ATTACHMENT .02 TO 1 SECOND		TELETEC.	1059	26-3		
1L	1	XL2 NG12 KEY SELECTOR SWITCH		TELETEC.	1059	26-3		
1M	20	PAQ2 CA1 TERMINAL BLOCK		GE	1060	30-3		
1N	1	SET OF PLASTIC NAME PLATE 4-PEE DAT		SHP	1			
1O	1	TEF-OM2 MECHANISM		GE	1071	30-3		
1P	1	TH1 HANDLE		GE	1071	30-3		
1R	1	CA2 AD4 ATTACHMENT 4 COILS		TELETEC.	1059	26-3		
1S	1	CA2-AN-1 RELAY 1 COIL 12 VDC 60 CY 20A		TELETEC.	1059	26-3		



BILL OF MATERIAL

SHP 5076-F

MACHINE

TELESCOPE DOME DRIVE (REV'D 21 DEC '75) DATE OCT. 23/75 BY

PAGE 2 OF 3





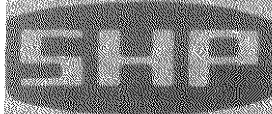


REMOTE STATION JUNCTION BOX

DRAWING C-696-2

PROJECT 2903-4

Votre



SHD ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5076-F

MACHINE TELESCOPE DOME DRIVE

DATE OCT, 23/75 BY

PAGE 3 OF 3

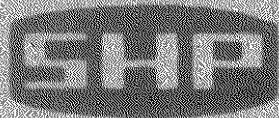
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TITLE

CONTROL STATION (REV'D 21 DEC 75) DRAWING C-6596-2

PROJECT 2963-1

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SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5077-F

MACHINE TELESCOPE DOME DRIVE

DATE JAN. 12/76 BY J. V.

PAGE 1 OF 4

QTY. 1 Lot TITLE INSTALLATION MATERIAL (Rev. Mar. 23/76) DRAWING C-6789
F-6790

PROJECT 2963-4

ITEM	QTY.	DESCRIPTION	✓	MFG.	P.O.	DEL DATE		
		MAIN PRESSURE AND RETURN LINES FROM POWER UNIT TO CIRCULAR RUNS						
1	2	W61-20-20 SAE flat flange		ANCHOR	STK			
1a	2	F55-20 SAE split flange		SHP	STK			
2	2	2786-20, 5 Ft. Lg. Hose assembly, each one c/w		AEROQUIP	STK			
2a	1	FC9106-20 90° hose fitting, split flange type		AEROQUIP	STK			
2b	1	FC9100-20 J.I.C. Swivel		AEROQUIP	STK			
3	60	feet 1 1/4" O.D. Hydraulic tube, .095 W.T., SAE 1010			STK			
4	6	2027-20-20 J.I.C. - J.I.C. adaptor		AEROQUIP	STK			
4a	12	1290-20 Nut		AEROQUIP	STK			
4b	12	900605-20 Sleeve		AEROQUIP	STK			
5	2	2033-20-20 J.I.C. Tee		AEROQUIP	STK			
5a	4	2215-20-16 Reducer J.I.C.		AEROQUIP	STK			
		MOTORS AND MANIFOLDS DRAIN LINES FROM POWER UNIT TO CIRCULAR RUNS						
6	2	1509-16, 5 ft. Lg. Hose assembly, each one c/w		AEROQUIP	STK			
6a	2	4721-16-16 J.I.C. Swivel		AEROQUIP	STK			
7	60	feet 1" O.D. Hydraulic tube, .095 W.T., SAE 1010			STK			
8	6	2027-16-16 J.I.C. - J.I.C. adaptor		AEROQUIP	STK			
8a	12	1290-16 Nut		AEROQUIP	STK			

NOTES:

SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 5077-F

PAGE 2 OF 4

ITEM	QTY.	DESCRIPTION		✓	MFG.	P.O.	DEL. DATE		
8b	12	900605-16-16	Sleeve		AEROQUIP	STK			
9	2	2033-16-16S	J.I.C. Tee		AEROQUIP	STK			
		PRESSURE, RETURN AND DRAIN LINES (CIRCULAR RUNS)							
10	860	feet 1" O.D.	Hydraulic tube, .095 W.T., SAE 1010		AEROQUIP	STK			
11	60	2027-16-16	J.I.C. - J.I.C. adaptor		AEROQUIP	STK			
11a	120	1290-16	Nut		AEROQUIP	STK			
11b	120	900605-16	Sleeve		AEROQUIP	STK			
12	12	2033-16-16S	J.I.C. Tee		AEROQUIP	STK			
		PRESSURE AND RETURN LINES FROM DRIVE UNITS TO CIRCULAR RUNS							
13	120	feet 3/4" O.D.	Hydraulic tube, .065 W.T., SAE 1010			STK			
14	120	feet 1/2" O.D.	Hydraulic tube, .049 W.T., SAE 1010			STK			
15	6	1509-12, 5 ft. Lg.	Hose assembly, each one c/w		AEROQUIP	STK			
15a	2	4721-12-12	J.I.C. Swivel		AEROQUIP	STK			
16	6	1503-8, 5 ft. Lg.	Hose assembly, each one c/w		AEROQUIP	STK			
16a	2	4411-8	J.I.C. Swivel		AEROQUIP	STK			
17	6	2215-16-8	J.I.C. Reducer		AEROQUIP	STK			
18	18	2027-8-8	J.I.C. - J.I.C. adaptor		AEROQUIP	STK			
18a	36	1290-8	NUT		AEROQUIP	STK			

NOTES:

ITEM	QTY.	DESCRIPTION		✓	MFG.	P.O.	DEL. DATE		
18b	36	900605-8	Sleeve		AEROQUIP	STK			
19	6	2021-12-12	NPT - J.I.C. adaptor		AEROQUIP	STK			
20	18	2027-12	J.I.C. - J.I.C. adaptor		AEROQUIP	STK			
21	36	900605-12	Sleeve		AEROQUIP	STK			
22	36	1290-12	Nut		AEROQUIP	STK			
23	24	SM 2127 PP-AS	Clamp tube, 1/2" O.D.		STAUFF	STK			
24	120	SM 3254 PP-AS	Clamp tube, 1" O.D.		STAUFF	STK			
25	6	SM 5318 PP-AS	Clamp tube, 1 1/4" O.D.		STAUFF	STK			
26	60	feet TS 095	Rail		STAUFF	STK			
27	18	SM 3190 PP-AS	Clamp tube, 3/4" O.D.		STAUFF	STK			
28	6	AC 55-16-12	Tube reducer		FLODAR	STK			
29	6	1290-16	Nut		AEROQUIP	STK			



SHP ENTERPRISES LTD.

BILL OF MATERIAL

SHP 50721

MACHINE TELESCOPE DOME DRIVE

DATE APRIL 26 70 BY J.V.

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PROJECT 2963-4

QTY.

TITLE LINES BETWEEN PUMP & HEAT EXCHANGERS DRAWING

ITEM	QTY.	DESCRIPTION	V	MFG.	P.O.	DEL. DATE		
30	60	FT 1 1/4 O.D. HYDRAULIC TUBE .035 WALL THICK			STK			
31	18	2027-20-20 NPT - JIG ADAPTERS		ASBODUP	1223			
32	20	300505-20 SLEEVES		-	STK			
33	20	1220-20 NUT		-	1223			
34	4	2031-20 4 FT Lg HOSE ASSEMBLY / EACH C/M		-	STK			
35	2	201-20		-	STK			
36	4	202-20-20 NPT - JIG ADAPTERS		-	1223			
37	12	305313 PP AS CLAMP TUBE 1 1/4 O.D		STAFF	STK			
38	6	507 IS 015 RAIL		STAFF	STK			
39	2	SUPPORT END OCH 31 AS PER DWG A-0107		SHP	CA 1190			

NOTES