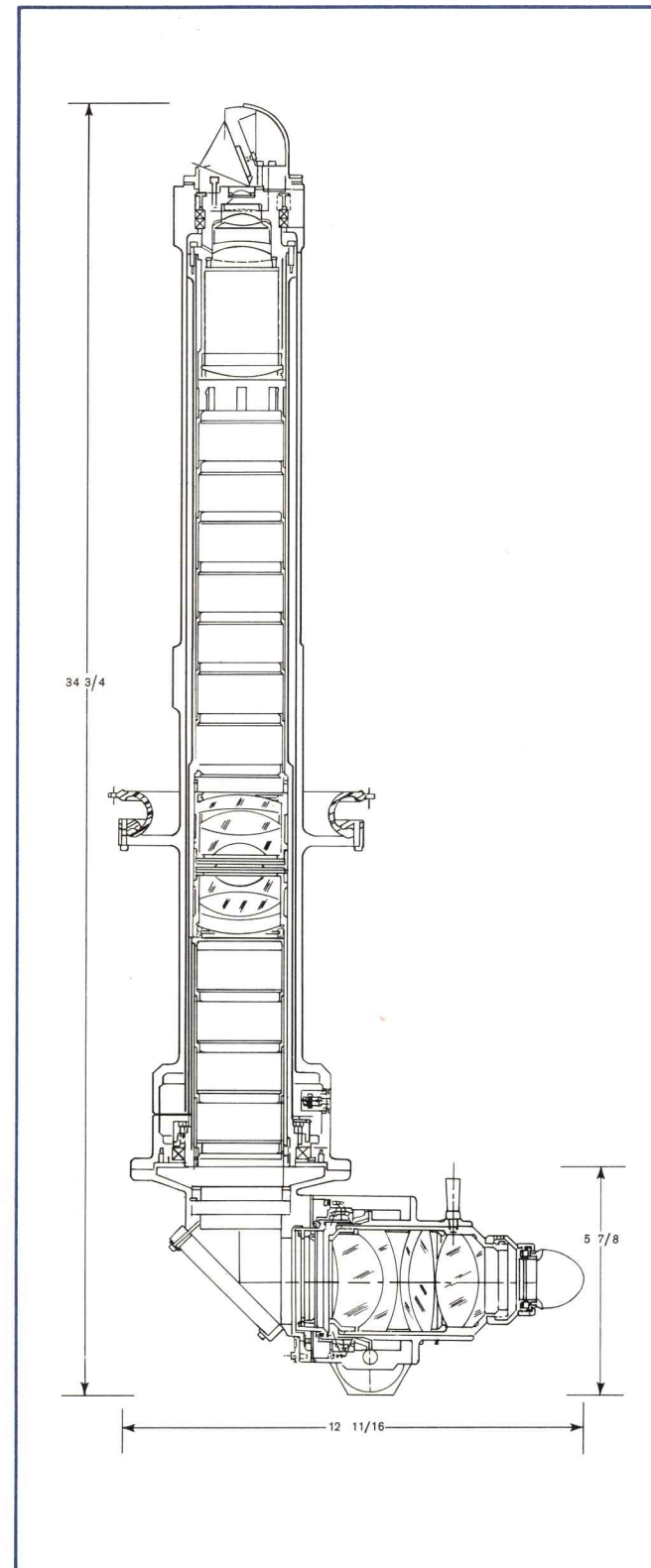


# ALIGNMENT OPTICAL TELESCOPE FOR APOLLO LUNAR MODULE

**Kollsman** **sk**  
INSTRUMENT CORPORATION  
SUBSIDIARY OF STANDARD KOLLSMAN INDUSTRIES INC.



## SPECIFICATIONS

FIELD OF VIEW	60°
MAGNIFICATION	1X
AOT ACCURACY	1 arc min.
ALIGNMENT ACCURACY	30 arc secs.
WEIGHT	22½ lbs.
POWER	11 watts
MECHANICAL INTERFACE	4 point mount to LM Nav. Base
ENVIRONMENTAL	
Temperature	-20°F to +160°F
Shock	10 g
Acceleration	10 g
Vibration (Random)	10 g rms - 20 Hz to 2000 Hz
Leak Rate (at 5 psi)	1 x 10 <sup>-4</sup> std. cc/sec.
DIMENSIONS (Maximum Envelope)	34¾" x 12¼" x 7¾"

For complete data, contact  
SPACE DIVISION (ELECTRO-OPTICAL)

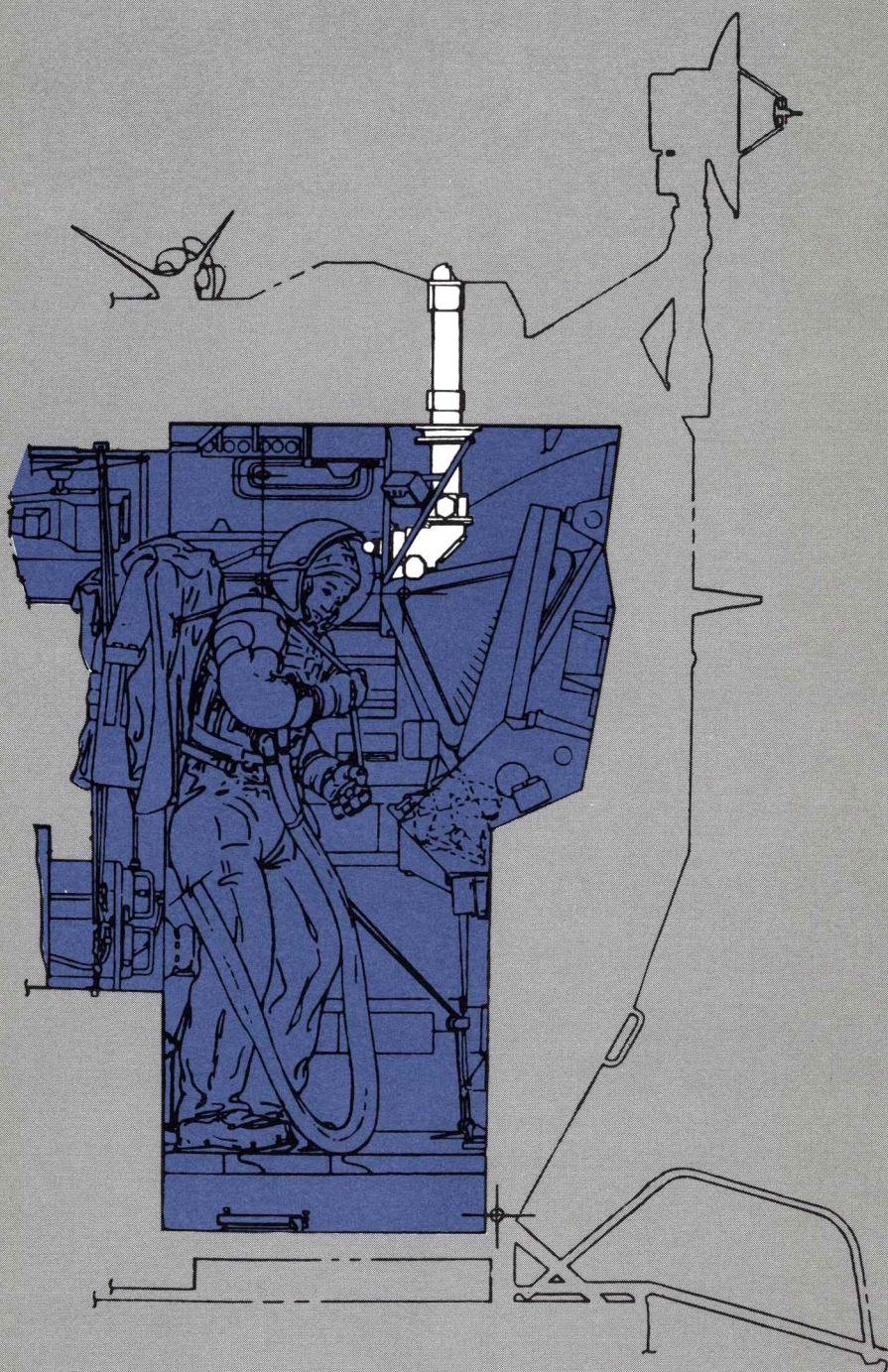
**Kollsman**  
INSTRUMENT CORPORATION  
SYOSSET, NEW YORK 11791



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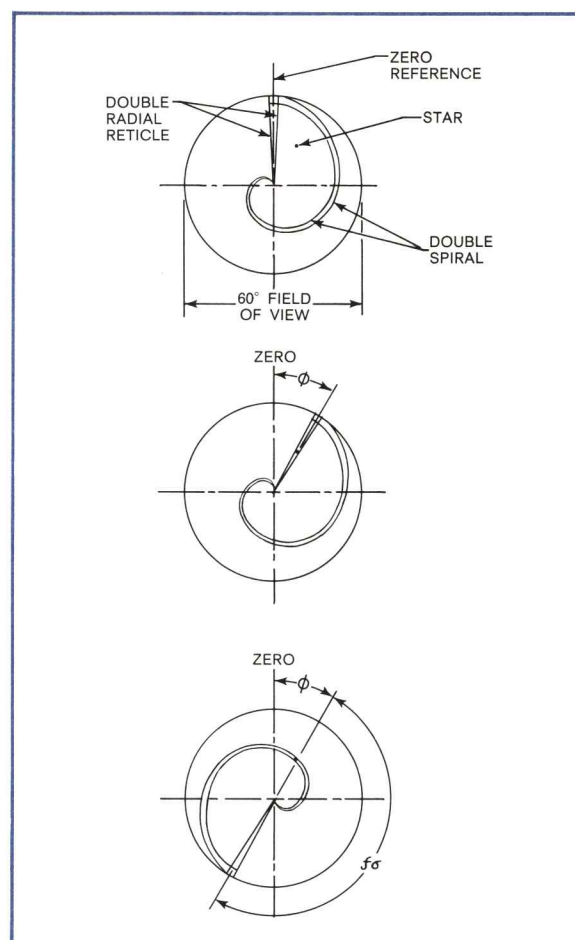






## CELESTIAL NAVIGATION SYSTEMS FOR LUNAR MISSION

The Guidance and Navigation system used by the Lunar Module, the vehicle which will land two NASA Astronauts on the surface of the moon, depends upon Kollsman's Alignment Optical Telescope for its alignment during lunar orbit and prior to the ascent from the lunar surface.



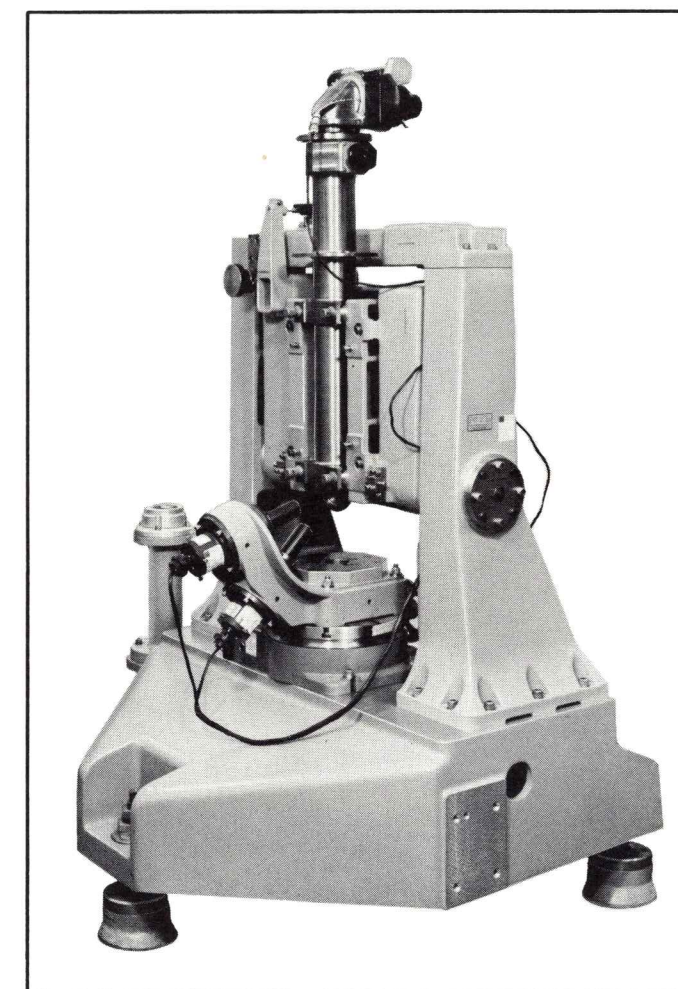
Reticle — Functional Diagram

The Alignment Optical Telescope (AOT) is a unity powered optical system capable of man-aided navigational sightings to selected stars. The AOT is mounted on a common base with the Inertial Measurement Unit (IMU) within the Lunar Module. The AOT is used in conjunction with guidance computer to align this stable inertial reference before and during descent to, and prior to launch from the lunar surface.

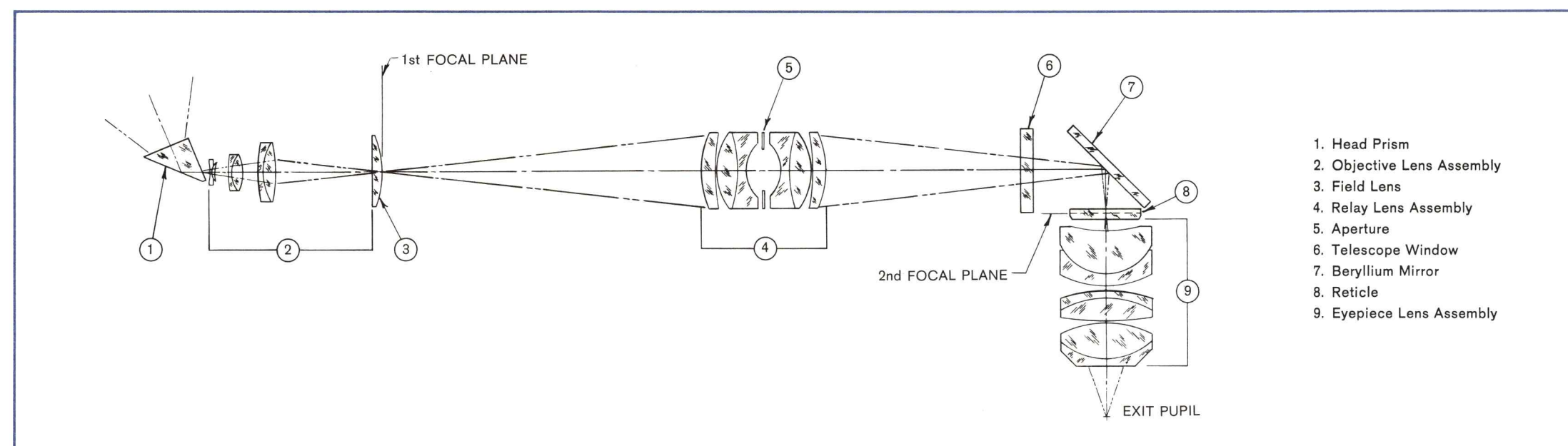
The AOT is a periscopic instrument which provides an instantaneous 60 degree field of view fixed in elevation, by means of an objective prism, at an angle of 45 degrees above the horizontal. A total field coverage of 180 degrees azimuth may be achieved by rotating between three shaft axis detent positions. The image formed by the seven element wide angle AOT objective (including an aspheric field lens) is transferred to reticle plane by means of a six element symmetrical relay system and a beryllium mirror. The design of the reticle allows the instrument to function as a sextant.

The AOT reticle pattern contains a radial cursor and a modified Archimedian spiral. The angular orientation of the reticle is measured by means of a shaft rotation counter to which the reticle mount is geared. Measurement of the shaft angle (i.e., azimuth) to a navigational star is done by superimposing the cursor on the star image. Subsequent rotation until the spiral is superimposed on the target star establishes an angle which is proportional to trunnion angle. The spiral design has included high order correction terms to match the residual distortion of the optical system. In addition, both the cursor and spiral have been constructed of double lines whose separations are designed to compensate for the change in image size through the field.

In order to meet the stringent weight requirements associated with the lunar mission virtually all structural components are machined from beryllium. Since the AOT protrudes from the Lunar Module cabin, its design includes the vacuum seals necessary to contain the cabin atmosphere.



AOT on Test Stand — Rear View



Optical System