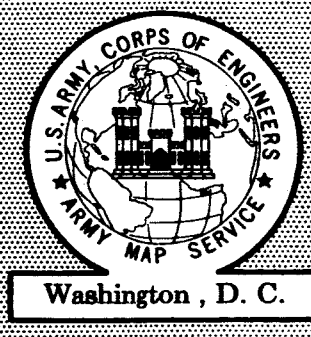
FINAL REPORT

GEMINI CELESTIAL DISPLAY DEVICE STUDY



Washington, D. C.

FINAL REPORT
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ARMY MAP SERVICE 1 March 1965

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SECTION I

GENERAL

23706

1-01. SCOPE The contents of this report pertains to the finalized Army Map Service (AMS) design of a celestial navigation device, as required in NASA Purchase Request No. T-27508-G, dated 26 May 1964, and Amendments thereto, dated 8 October 1964. It contains concise summaries of all engineering computations that were used in the design. The results are tabulated in SPECIFIC DATA. SECTION I, GENERAL, describes the device, and defines its basic design principles. SECTION II, DEVELOPMENT, specifies how the principles are applied to support the planning and fabrication of the device.

author

1-02. DESCRIPTION The AMS Gemini Celestial Display Device is a visual comparator which provides an out-of-the-window star field, observable during a manned orbital mission, to the flight crew of a Gemini spacecraft. By a visual comparison of the actual out-of-the-window view to its similar representation on the device, an astronaut user will determine the location of the orbiting Gemini spacecraft relative to the stars.

a. The device is used on a real time basis during flight to enable the Gemini crew to identify the immediate major stars and constellations as seen through either the right or left spacecraft windows. The device may also be utilized on an elasped time basis to allow the astronauts to select the star field view at a specific future orbital period time increment, i.e. 10 minutes, 15 minutes, etc., from now.

b. Simulated spacecraft attitudes (refer to Fig. 1) are incorporated into the design of the device which permit the astronaut to compensate for orbital changes during flight. The orbital changes are:

(1) 0° YAW, the spacecraft orientation in which the astronauts are looking ahead (foresight) along the orbital path, with the Small End of the spacecraft Forward (SEF).

(2) 180° YAW, the orientation in which the spacecraft is turned (swung) to the right or left, around its Z-axis. In this position the astronauts are looking behind (backsight), opposite to the orbital direction, with the Blunt End of the spacecraft Forward (BEF).

(3) Pitch, tipping the spacecraft up or down, relative to its lateral Y-axis, to any position in an angular range between +10° and -30°.

(4) A variation in the orbital period between 88 and 91 minutes, the time it takes the spacecraft to complete one orbit.

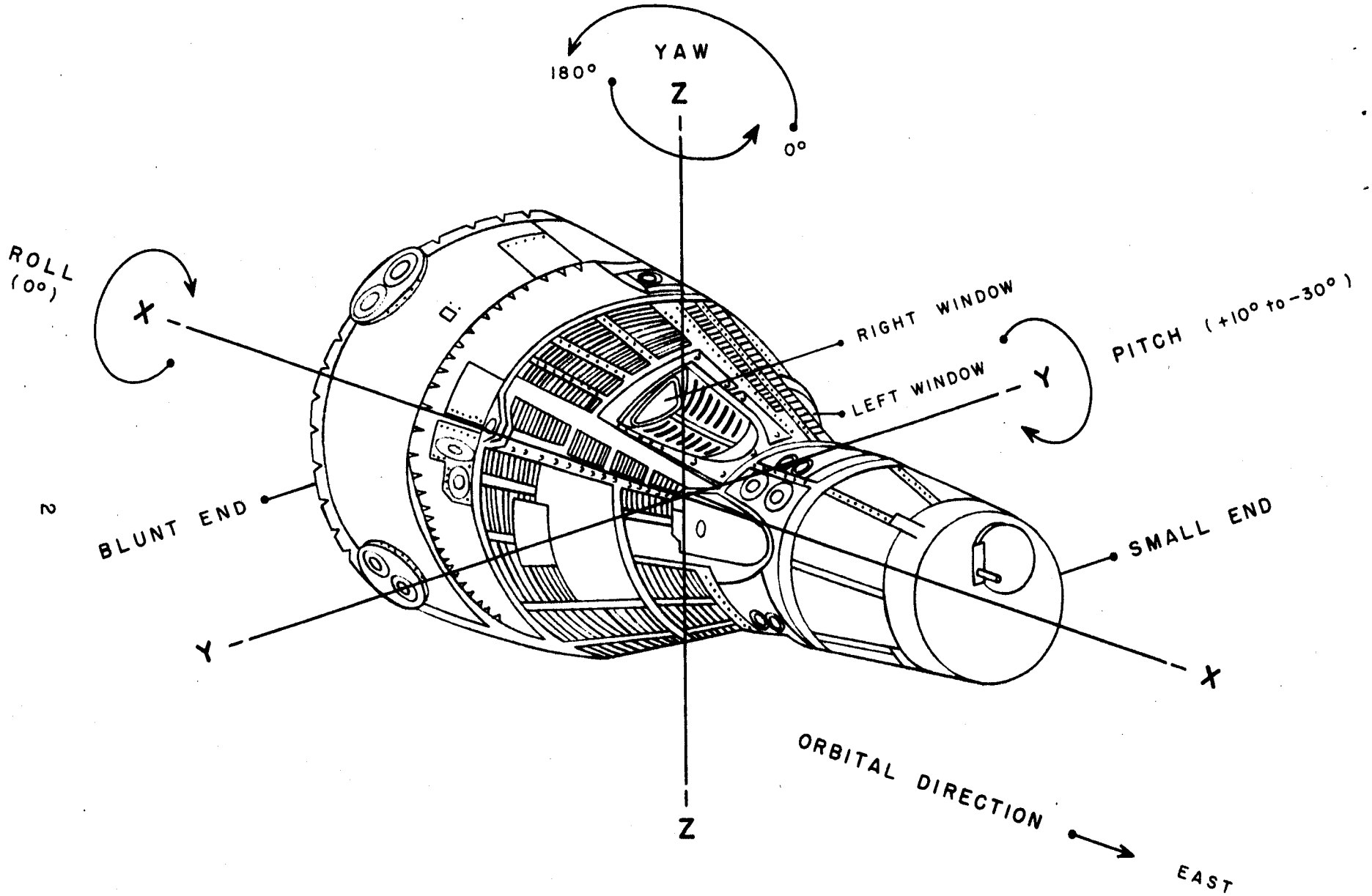


FIGURE 1

GEMINI SPACECRAFT ATTITUDES

c. The device is hand held, and manually operated by an astronaut. Prior to orbiting, the device is stored in a small NASA case. The final AMS recommended Gemini Celestial Display Device consists of two parts: the Star Maps and the Display Board.

(1) Star Maps (refer to Fig. 4 and 5) - There are two maps, one for 0° YAW, and the other for 180° YAW. Each map covers the same portion of the celestial sphere but the sequence of star placement is different. The area of the sphere shown on the maps is the sidereal time period of Right Ascension (RA) from zero hours (0^h) to 24 hours (24^h), between 75° North and 75° South Declination. All stars from +4.0 magnitude (medium brightness) are plotted at a scale of one inch represents forty degrees ($1'' = 40°$), and symbolized in categories relative to four brightness groups: ✱ +1, ● +2, • +3, and · +4 magnitudes. In addition, some stars of +5 magnitude are shown (·) if they form an integral pattern with the brighter ones. The stars of +2 magnitude or greater are named. The Ecliptic, the path of the sun, is shown pertinent to a reference line (plane) representing the Celestial Equator. A Right Ascension scale, calibrated in ten minute increments, appears on each map. The scales are oriented to each map in such a manner that they may be indexed to a specific edge of the device. Each map is extended an additional 24 hours RA of itself which provides duplicate coverage of the celestial sphere applicable to a particular YAW, 0° or 180°. The maps are assembled back-to-back as a single unit. The ends are arranged so that they fold into the interior of the map unit, similar to the bellows of an accordian.

(a) Orbital Perturbation Scales (OP Scale) - The value for orbital perturbations, the gravitational and non-gravitational forces of the Earth, Moon and Sun disturbing the orbital motions of the Gemini Spacecraft in flight, is incorporated in an auxiliary scale supporting the RA scale of each specific YAW star map. The scale has a zero position which is keyed into the RA index map value after the spacecraft is in orbit. The OP scale is graduated in a series of five flights for 300 orbits.

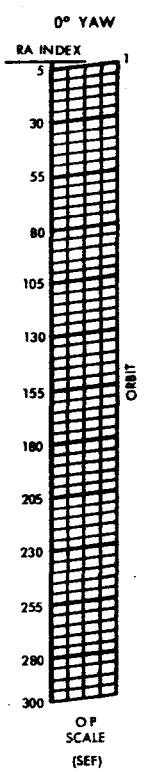


FIGURE 2

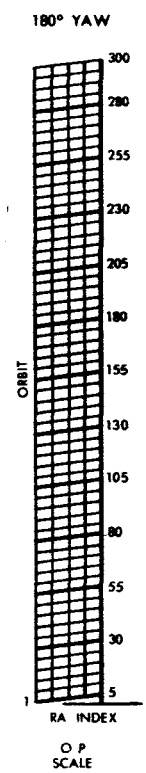


FIGURE 3

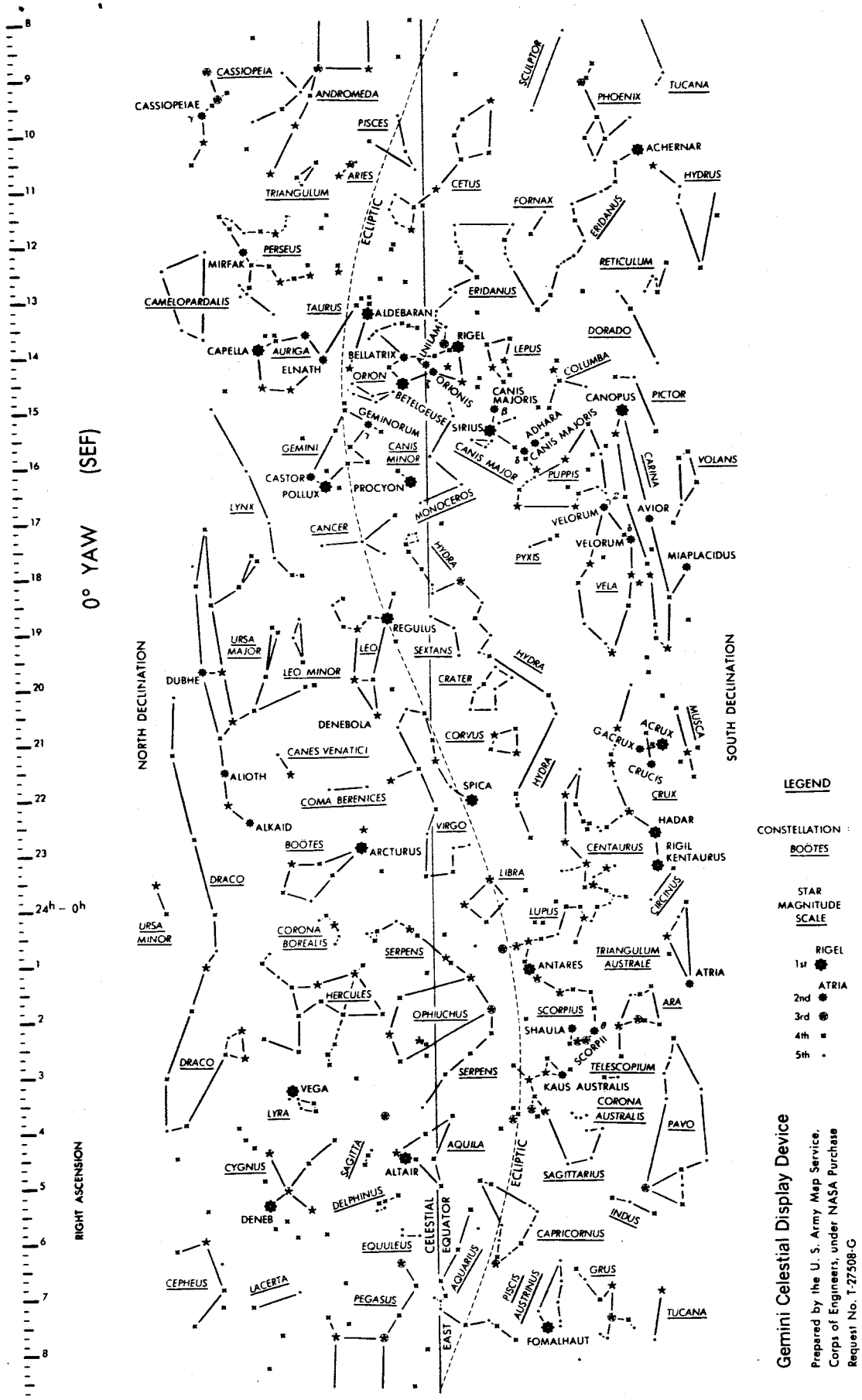


FIGURE 4

0° YAW

(SEF)

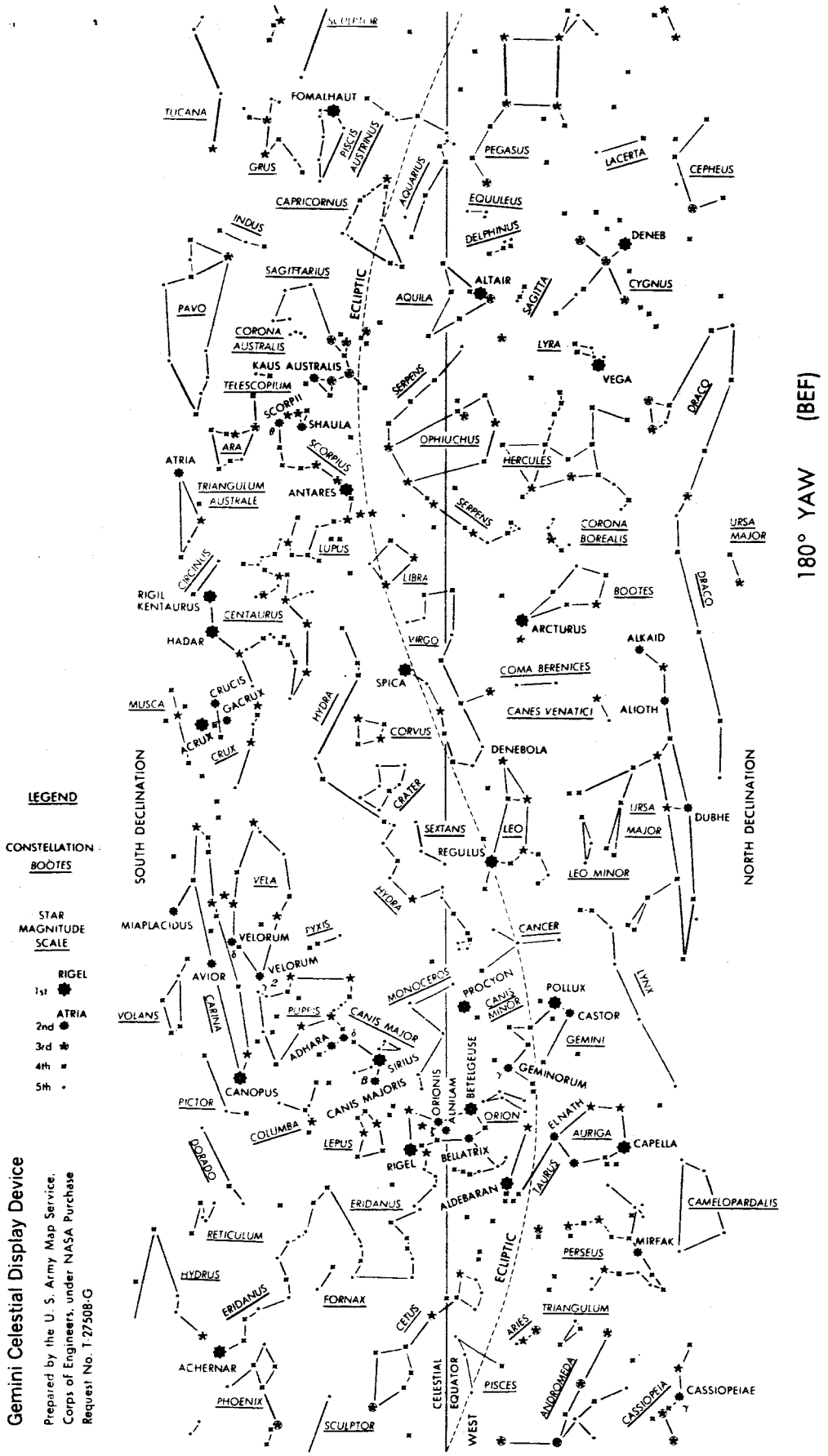


FIGURE 5

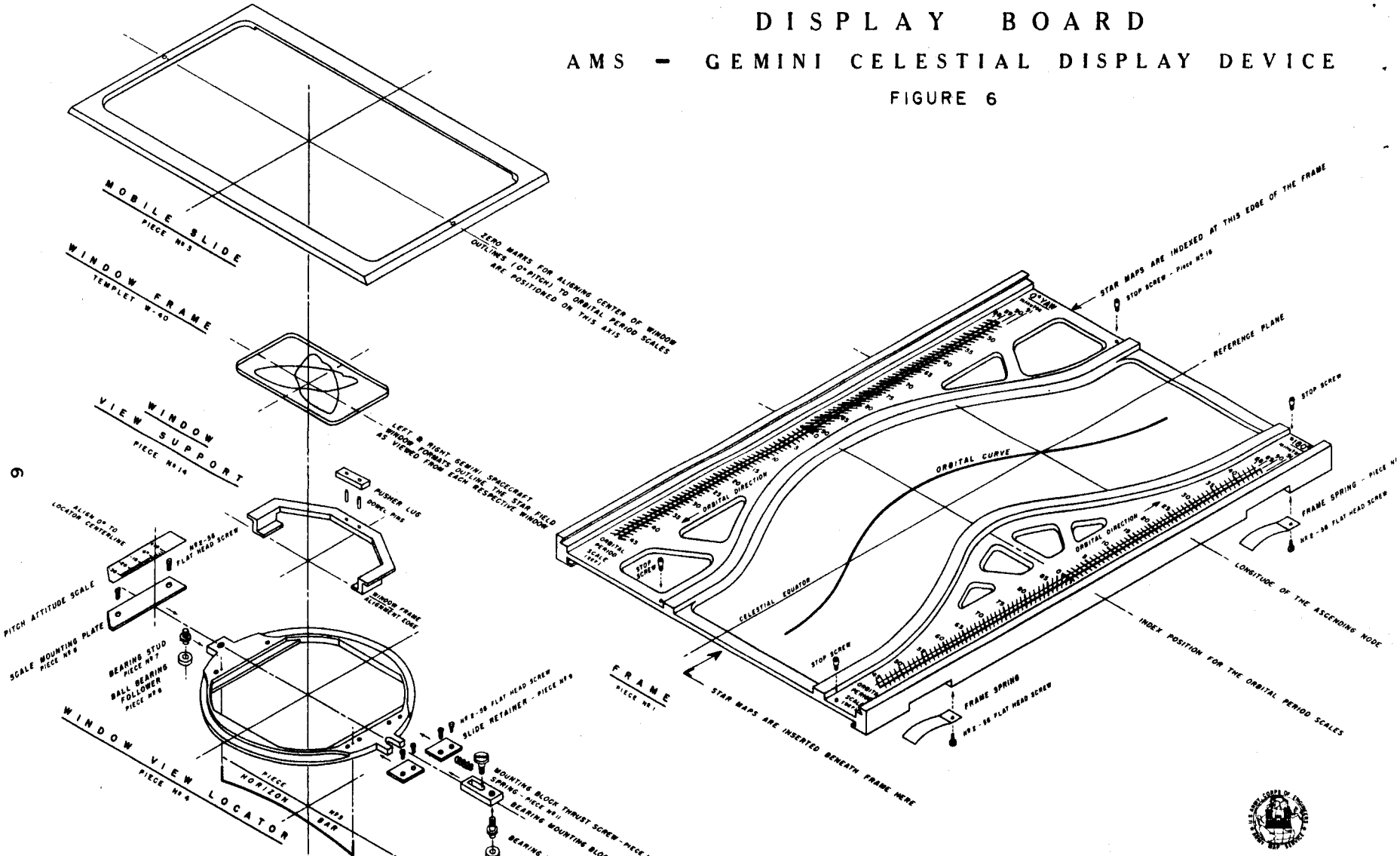
180° YAW

(BEF)

DISPLAY BOARD

AMS – GEMINI CELESTIAL DISPLAY DEVICE

FIGURE 6



Prepared by the U. S. Army Map Service, Corps of Engineers, under NASA Purchase Request No. T-27508-G

(2) Display Board (refer to Fig. 6) - The display board contains the necessary mechanisms to simulate specific orbital parameters, i.e. inclination of the orbital plane, the longitude of the ascending node, the orbital period, and spacecraft attitudes (e.g. pitch and yaw) of the Gemini training flight. The mechanisms are:

(a) Frame - The frame is the primary feature of the device, and the largest part of the display board. It contains all of the specified orbital parameters. The longest centerline of the frame is a longitudinal axis which represents the reference plane, or the celestial equator. The path of the orbit, from 0° to 360° follows a theoretical sine wave, the path of the spacecraft moving around a circle at a uniform speed projected on a plane. The tracks of the orbital plane mechanism are equally positioned north and south from the orbital curve. They serve to align the center of the spacecraft window outlines (at 0° pitch) to the simulated orbit.

1. Orbital Period Scales (exemplified on this page, Fig. 7 and 8) - Two graphic scale representations, one for 0° YAW and the other for 180° YAW, of four orbital time periods for 88, 89, 90, and 91 minutes are affixed to the frame. Each is pre-positioned to a 90° offset of the longitude of the ascending node, the position on the celestial equator where the spacecraft crosses from the Southern Hemisphere to the Northern Hemisphere. The time graduations are calibrated in one minute increments, increasing in value along respective orbital directions inherent in the design of the device.

2. The star maps are inserted as a single unit beneath the frame. The unit is retained to the display board by four springs on the bottom of the piece.

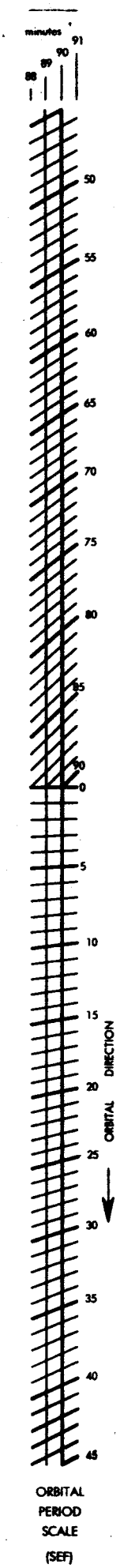


FIGURE 7

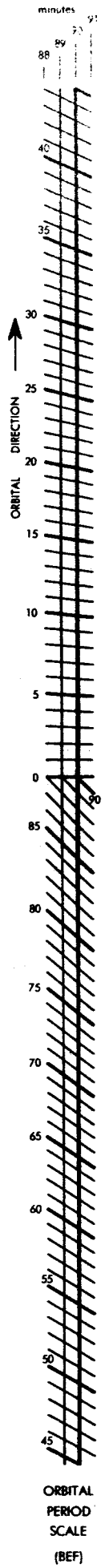


FIGURE 8

(b) Window Frame - The window frame is a piece of transparent plexiglass, deglossed to prevent stray light reflections, containing a cut-out format of the Gemini spacecraft left and right windows. The windows have been outlined relative to a spacecraft 0° pitch, 0° yaw, and 0° roll. The left and right windows are symmetrically positioned in such a manner that their centers coincide on the window frame. When the window frame is properly keyed to all of the orbital parameters and spacecraft attitudes on the device, the respective delineated window scene represents the actual view, within the symbolized limits of the star maps, which the astronaut user shall see at a 90° visual offset from his Zenith.

(c) Window View Support - The window view support holds the window frame. The support is used to simulate the spacecraft pitch between +10° and -30°. The part is fitted to the window view locator (see below), and slides back and forth for indexing to a pitch scale adjacent to one of its support flanges. A pusher lug mounted on the piece is used to move the support to a desired position.

(d) Window View Locator - The window view locator is a circular mechanism in which the window view support fits and slides. The center of this piece is coincident with the origin (zero position) of the Gemini spacecraft coordinate (X, Y and Z) system. The window view locator rests on top of the frame tracks. On the opposite sides of the locator Y-centerline are little wheels, or followers, which ride along the edge of the north and south tracks. They aid in mechanically positioning the Y-centerline (at its origin) of the mechanism perpendicular to any point of the theoretical orbital curve on the frame. The window view locator also contains a horizon bar which depicts an apparent horizon, as viewed from the Gemini spacecraft window.

(e) Mobile Slide - The mobile slide is a rectangular piece retaining the circular window view locator on the frame. It is primarily utilized to manually move the locator support and window frame along the simulated orbit on the frame. The slide has two zero markers. They are positioned on the centerline of the slide, which passes through the origin of the spacecraft coordinate system (center of the window view locator) at every point of the orbital curve. The mobile slide, plus the north and south orbital tracks, keep the Y-centerline of the window view locator perpendicular to every point on the orbit at its (locator) center. The zero markers are used for referencing the spacecraft windows to their respective orbital star field for a specified time increment, e.g. 10 minutes, on the 0° YAW or 180° YAW orbital period scale.

1-03. OPERATION The operation of the display device is dependent upon the known orbital period, a longitude of the ascending node, the RA value at the position of the specific ascending node, and the attitude of the spacecraft, with regards to pitch and yaw, during the time of orbital flight.

a. The orbital period and the right ascension of a longitude of the ascending node of a specific orbit, computed by the data furnished by NASA tracking stations, are conveyed to the orbiting astronauts by the ground crew. The device is removed from its spacecraft case. The star map unit is extended to its full size. The device user removes the paper backing from each OP Scale (stored with the device), and positions the RA INDEX line by the given right ascension value on its respective YAW Star Map RA Scale. The OP Scales are placed in such a position within the 48^h map range as to afford a convenient utilization of star plots for 33^h RA (24^h plus 9^h) during the entire training flight. The star map for the respective YAW orientation, 0° or 180°, is inserted face up beneath the frame, towards the window view locator. The star map is indexed to 1 (representing the first orbit) on the OP Scale at the top outer edge of the frame (refer to Fig. 6). The 0° YAW and 180° YAW labeling the orbital period scale indicate the top of the frame. The orbit is now "tied-in" to the celestial sphere, in reference to the first orbit. Periodically the star map (s) must be re-indexed due to the effects of orbital perturbations. This may be done by orbit, or re-indexed by any grouping of orbits, up to a maximum of 5 orbits. Any greater re-indexing period will induce a discrepancy in the out-of-the-window view. Re-indexing is performed by moving the map so that the corresponding orbit intersection graduation on the OP Scale is aligned to the edge of the frame.

b. The window view support is placed in the spacecraft pitch attitude position by activating the pusher-lug and aligning the support flange edge with the angular value on the pitch scale.

c. The astronaut user pushes the mobile slide in the orbital direction indicated on the orbital period scale for the YAW orientation the spacecraft is presently in. The movement of the simulated orbital directions in the design of the frame and orbital period scales are opposite to the actual direction in flight. Caution should be exercised by the user in applying the correct YAW star map and orbital period scale with the actual YAW orientation. 0° YAW values are on the left side of the device, and 180° YAW values are on the right. The index marks on either side of the mobile slide are used to position the window frames over the proper star field at specified times on the orbital period scales. If the orbital period is 88 minutes the index mark is moved to coincide with those graduations which terminate on the left of the scale. If the orbital period is 89 minutes, the index mark is moved to coincide with those minute graduations crossing the thin long line. For 90 minutes use the graduations crossing the heavy long line. For 91 minutes use the graduations terminating to the right of the scale. This system works with both scales.

d. For a change in YAW attitude, the respective map is inserted beneath the frame and indexed to the same RA value as the previous one. The corresponding YAW orbital period scale is now used, with its respective orbit value.

e. The star maps, RA scales, OP scales, orbital period scales and pitch scale have been designed to provide for systematic operation at various YAW and Pitch. A repositioning of the window frame is not required.

1-04. RESEARCH - The features formulating the fundamental design of the celestial display device are: the user requirements, the stars, the orbit, and the orbital parameters and attitudes of the Gemini spacecraft during flight.

a. User Requirements - The celestial display device shall display to the Gemini flight crew the out-of-the-window star field observable during flight. The device is intended for use on a real time basis during flight to enable the flight crew to identify the major stars and constellations observable out-of-the-window, or it may be used on an elapsed time basis to allow the astronauts to select the star field that will be in view at a particular time during the flight. The device shall be capable of meeting its design requirements during any of the specified Gemini manned orbital missions, including orbital element changes during flight. The device shall consist of a display board and the necessary star map(s) depicting the star field along the flight path. As a design objective, the dimensional envelope for the device shall have a rectangular configuration of 7" x 11" x 1/2", with a maximum weight not exceeding one pound. It shall fit in a spacecraft storage case 9 1/2" x 11" x 3/4".

(1) A visual comparator meets the user requirements. The comparator, in support of visualizing spatial distributions over various areas of the celestial sphere, should contain a conventionalized picture (star map) at a much reduced scale of the celestial sphere. A format (spacecraft window frame) superimposed over the celestial representation to illustrate the varying views in the progression of orbital flight, and various methods should be incorporated into a retaining frame (display board) to aid in accurately presenting the variation of the field of view.

(2) The visual comparator must act as a navigational medium using celestial bodies primarily for the determination of position.

b. The Stars - The display device is an instrument for determining horizontal direction. The stars are celestial beacons used as a basis for its directional finding system. In looking at the stars, they all appear to fall on a spherical surface. The conventional globe of this theoretical surface is the celestial sphere. It shows the sky as a spherical shell surrounding a spherical earth. The earth is relatively so small, in reference to the infinite celestial sphere, that it may be considered only a point at the center. In similar thought, a spacecraft orbiting the earth may also be considered at the same point at the center, or its orbit can theoretically be projected to the full circumference of the celestial sphere. Astronomical objects lie within and outside the celestial sphere. The apparent position of a star is its place on the celestial sphere. It denotes a star's direction, and nothing else about its location in space. In describing apparent positions of stars on the celestial sphere, there is no concern with their distances, only the definition of their projections on the sphere. The apparent distance between two stars is accordingly their difference in direction expressed in an angular measure. The celestial sphere survives only as a convenient means of representing the star positions. By this convention the stars can be shown on the surface of a globe, or in a projection on a plane map.

(1) The configuration of the device is rectangular for ease in operation, and to meet storage requirements in the Gemini Spacecraft.

(2) Stars are positioned on the celestial sphere through a spherical method of angular coordinates termed the geocentric equatorial coordinate system. This order is an extension of the equatorial system commonly used on the earth. The intersection of the plane of the terrestrial equator, extended, with the celestial sphere is a great circle called the celestial equator. The earth's axis, extended, intersects the celestial sphere at the north and south celestial poles. Small circles parallel to the celestial equator, similar to parallels of latitude on the earth, are called parallels of declination. There are North (+) Declinations relative to the Northern Celestial Hemisphere, and South (-) Declinations relative to the Southern Celestial Hemisphere. Great circles through the celestial poles, similar to meridians on earth, are called celestial meridians if they are considered to remain fixed to terrestrial meridians, and hour circles if they are considered to remain on the rotating celestial sphere. The relationship of the orbit in the design of the device is to the celestial sphere. Thus, the hour circles, measured in the sidereal time of Right Ascension, are used for plotting the longitude of the stars. Right Ascension (RA) is measured eastward from the hour circle of the vernal equinox in hours, minutes, and seconds from zero hours (0^h) through 24 hours (24^h).

(3) There are methods of transforming the angular coordinates of the spherical representation of the celestial sphere to a nonspherical surface (plane) without deforming geometric relationships among the points on the sphere. The creation, or retention, of geometric qualities (properties) of the celestial sphere determine the transformation process. The transformation process is such that there is an arrangement of the magnitude and scale variation of desired properties on a "tailored" projection. Properties to be retained, or employed are: conformity, equivalence, azimuth, and the transformation of significant lines on the celestial sphere to simple lines on the map.

(a) Orthomorphism, the conformal property desired, is the retention of angular relationships at each star in regards to apparent position and apparent direction. It is obtained by arranging the scale of a projection so that at each star the scale is uniform in all directions. The conformal property is a simple cylindrical projection having an equal spacing of right ascension and declination. The cylindrical projection, which shall be used to compile the star map(s), is a cartesian grid with its X and Y coordinates measurable in equal units.

1. SCALE - The user requirements dictate the overall size and weight of the device. Preliminary calculations, based upon a scale of 1" represents 30°, produced sufficient data indicating that a very satisfactory star map could be produced, but to hold the map, a larger and heavier display board would be required. Further calculations and designs, based on a scale of 1" represents 35° provided sufficient information to conclude that for a prototype model the scale of the star map(s) and any relative mechanism should be 1" = 35°. Modifications to the prototype, in form of a final model, set the final scale at 1" = 40°. This means that the celestial sphere for 24 hours RA (or 360°), and 75° North and South Declination (or 150°) shall be compiled into a star map at the representative scale of 1" = 40°. The map format is then:

$$\text{for Declination} = \frac{2 \times 75^\circ}{40^\circ}(1") = \frac{150^\circ}{40^\circ} \times 1" = 3.75"$$

$$\text{for RA} = \frac{360^\circ}{40^\circ} \times 1" = 9.00"$$

or 3.75" x 9.00"

(b) The equivalence property desired is the retention of the relative sizes of areas (referred to as equal area) on a projection. The relative sizes of stars can only be delineated for visual interpretation by arranging their symbolization in a series of brightness groups. In this instance the star magnitude scale is utilized to symbolize the stars. Working with the limited map format, consideration must be given to star symbols, type (star, constellation, and other feature names) the ecliptic, the celestial equator, and the scale of the spacecraft window formats. There will be a potential congestion of information appearing on the map. This information must be limited in scope to present a star map which is easily understood and can be fully utilized by the user.

(c) The property of azmuthality is the retention of azimuths from one point to another. This property is normally contained in a map. In design terms of the device, azmuthality and the ability to transform significant lines on the celestial sphere to simple lines on the map are contained in the display board. The device is a dual-stage unit in which one element is dependent upon the other, to provide the ultimate data. The maps depend upon the display board mechanisms, and the mechanisms depend upon the maps. A divorce of the two is impossible for the proper operation of the device.

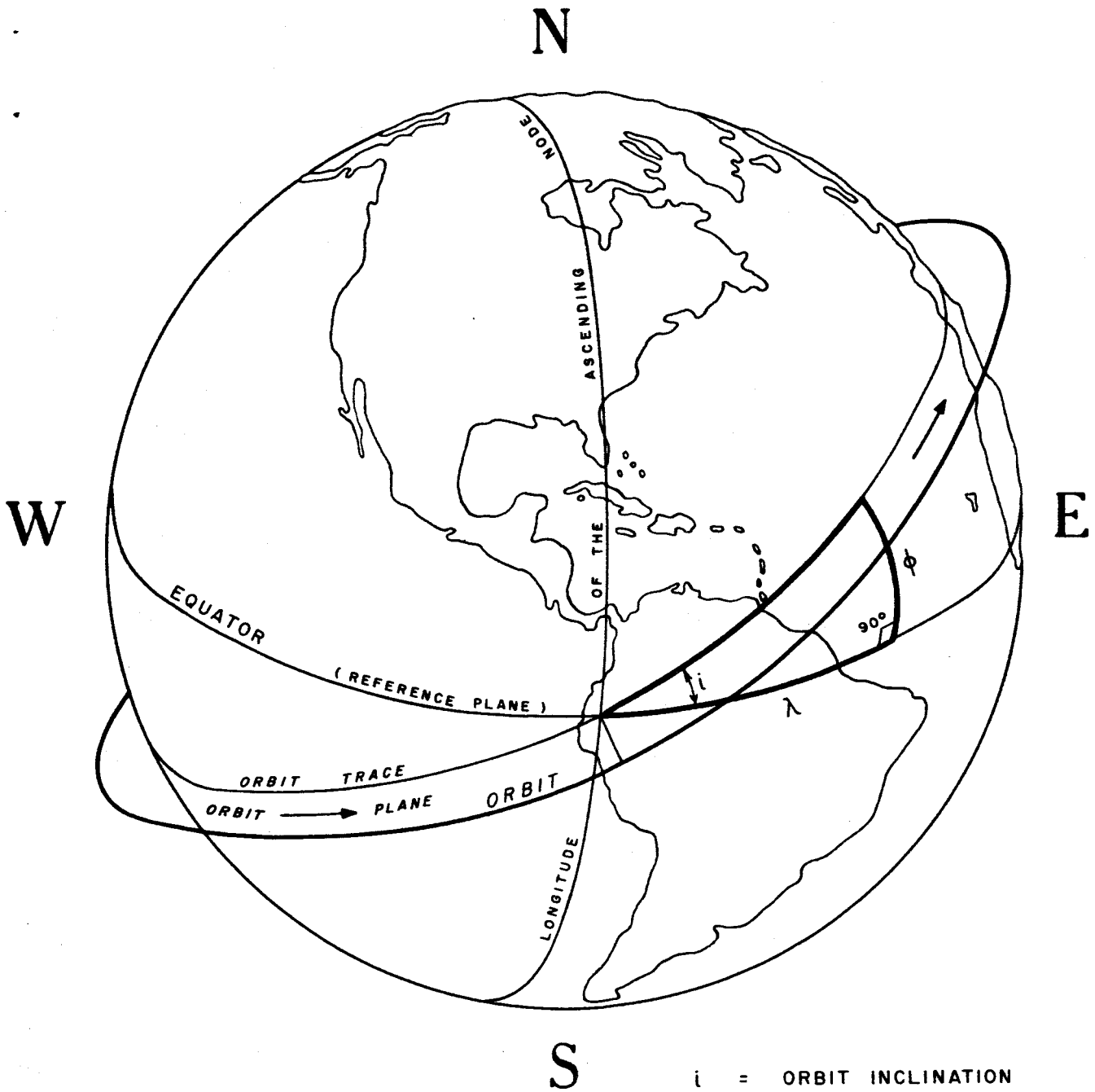
c. ORBIT - The map projection has been established as being a conformal cylindrical one in which the map plane is equal in RA and Declination. The orbit can be assumed to be a great circle around the earth. The spacecraft is considered as a point moving around the circle at a uniform speed. The great circle forms the circumference of the orbit plane. The definition of the orbit plane, where it cuts the spherical shape of the earth, is the orbit trace. In reference to the surface of the earth's sphere (refer to Fig. 9), the orbit trace forms the hypotenuse of a right spherical triangle at the longitude of ascending node. The remaining parts of the triangle are longitude (λ) and latitude (ϕ). The orbit inclination, an orbital parameter, is the angle between the orbit plane and equator (reference plane), and is the angle "i" in the spherical triangle. The equation for the orbit is: $\text{Tan } \phi = \text{Tan } i \ (\text{Sin } \lambda)$. Since there is a similarity in the equatorial coordinate systems of the terrestrial and celestial spheres, the above orbit definition can be projected onto the celestial sphere and applied in its present form. When plotted to the celestial equator and the entire 360° (24^h RA), the orbit trace takes the shape of a sine wave. The orbit trace should be designed into the display board frame as a theoretical orbital curve.

(1) Similarly, the Ecliptic also takes the shape of a sine wave. It shall be shown on the star maps, and is plotted using the equation: $\text{Tan } \phi = \text{Tan } \epsilon \ (\text{Sin } \lambda)$ Where ϵ equals the mean obliquity, the angle between the planes of the celestial equator (reference plane) and the sun's path (ecliptic).

d. ORBITAL PERIOD - One of the orbital parameter elements is the time required for one complete circuit of the orbit. This is termed the orbital period. The latitude of permissible orbital periods is 87.2 minutes to 91.2 minutes. During flight, the astronaut is looking forward 90° on the celestial sphere from the position of the spacecraft. This 90° offset must be reflected in the graduations on the orbital period scale(s) provided. There being two YAW attitudes, two scales must be compiled, one for each YAW. In addition, consideration must be given to the limited space allowed for the scales on the frame. For this reason there must be a practical approach in presenting some form of a scale which contains a logical sequence of orbital periods for easy interpretation. In addition a problem arises in transforming the equally spaced minute increments along the orbital curve, a curved line, onto a straight line paralleling the celestial equator.

e. SPACECRAFT ATTITUDES

The apparent angular direction of stars are expressed in a linear measure in the design of the device. Angular movements of the spacecraft must also be expressed in linear measure. For this reason the pitch attitudes may be scaled in the same calibration as the star map 1" = 40°. Although the window frame will be moving in a horizontal direction to the stars in the device, there will be no discrepancy because of the infinite distance of the stars from the spacecraft windows. The YAW attitudes must be considered in the planning of the star maps, RA scales, OP scales, and orbital period scales. The positions of the longitude of the ascending node on the orbital curve and the index point for the zero minutes of each orbital period scales must be located. The YAW attitudes are not an angular problem, they are situations which must be resolved by the positioning of various features.



i = ORBIT INCLINATION

ϕ = LATITUDE

λ = LONGITUDE

ORBIT DEFINITION: $\tan \phi = \tan i \, (\sin \lambda)$

FIGURE 9

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SECTION II

DEVELOPMENT

2-01. ORBITAL CURVE and TRACKS

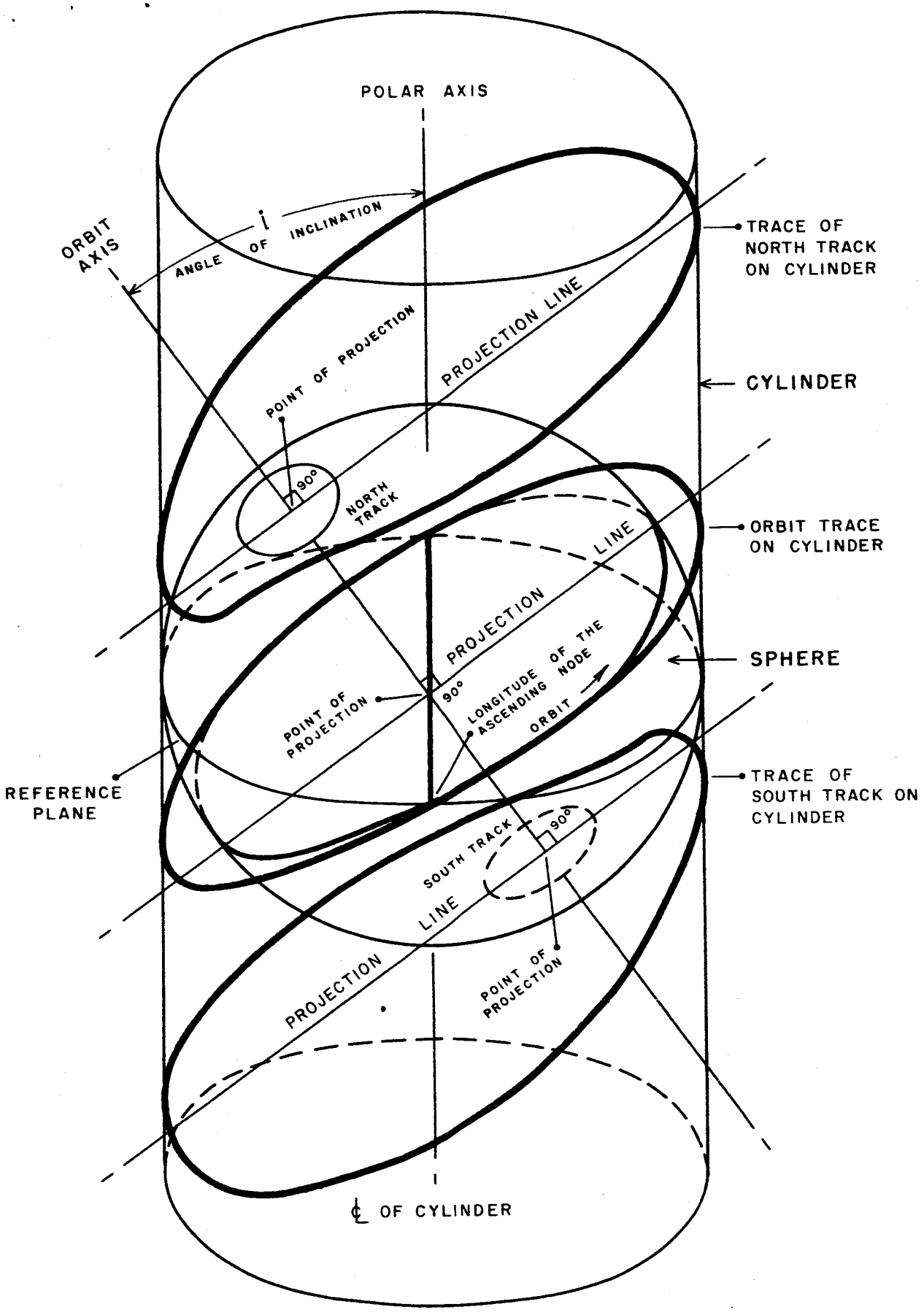
a. Simultaneous lines of intended position (orbital parameters) are standardized in the display board mechanisms. True lines of position cannot be determined until the Gemini spacecraft is in actual flight. The miniature size of the device, as compared to the infinite sky, is of such a nature that the incorporated lines of intended position are sufficiently accurate to provide a reliable fix of position in orbit during flight.

b. The fundamental definition of the orbit in the design of the device is a great circle. The earth and sky are considered as being truly spherical for the purposes of eliminating complexities in the projection of lines of position, and to transform curvilinear distances into rectangular representations, equal in all directions. The above shapes can be considered because they do not induce any significant errors in the practical solution of the problem of spacecraft position.

(1) The projection of the great circle on a plane is conceived through the mediums of a sphere and a cylinder tangent to the sphere, refer to Fig. 10 - Geometry of the Orbit Tracks.

(2) The sphere is representative of the celestial sphere (and the terrestrial globe), with the polar axis parallel to the longitudinal axis of the cylinder. The cylinder is tangent to every point on the reference plane, or celestial equator.

(3) The orbit, a great circle on the sphere, is tangent to the cylinder at two points only, the ascending and decending nodes. The orbit is developed on the surface of the cylinder by projecting lines, originating at the center of the sphere, passing through the points on the great circle, onto the cylinder. The lines are perpendicular to the orbit axis. The orbit axis deviates from the polar axis at an angle equal to the orbital inclination (i), at the center of the sphere. It is of importance to note that the orbit projection lines cut a characteristic elliptical shape on the cylinder. The shape conforms to the intended elliptical orbit of the Gemini flight.



GEOMETRY OF THE ORBIT TRACKS

FIGURE 10

c. The designs of the north and south tracks are based upon a spherical segment formed by the intersection of two parallel planes on the sphere. The perimeters of the tangent planes are small circles, equal to each other, with their centers on the orbit axis (refer to Fig. 10 - Geometry of the Orbit Tracks, page 16). The zone, or spherical surface between them, is composed of their edges (the north and south tracks) equally spaced from the zone center, the orbit. The angular distance between the edges is 152.56°, a value derived from a large scale (1" = 9°) graphic analysis of the combination of track widths (1/4"), the window view locator, and the window frame. At a scale of 1" = 40°, the fixed distance between the tracks is 3.814", i.e. 152.56° times 0.025"/° = 3.814".

(1) The trace of each track on the cylinder is individually obtained by projecting a line perpendicular to the orbit axis, from the center of its respective small circle, passing through the edge of the circle onto the cylinder.

d. 90° Arc Distance Scheme - The projection of the orbit trace on a plane is understood to be a sine wave. The characteristic form of this wave is a symmetrical curve pattern repetitious for each 90° arc distance of the orbit. The entire 360° circular range of the orbital curve is plotted through a systematical placement of four 90° arc distance schemes (refer to Fig. 11 - Plotting Format of the Orbital, page 18). The frame of reference for a 90° arc of the orbital curve is composed of the reference plane, a longitude index (0°), a plot distance of 90° of longitude (2.25"), the angle of orbital inclination (28°30', 30°00', or 32°30'), and a scale (1" = 40°). For convenience, the numerical quantities designating the coordinates of points on the orbital curve are: longitude (λ) and latitude (ϕ), transformed into linear measures of equal scale.

(1) The primary objective in the construction of the orbital curve is to procure the latitude coordinates, to the nearest hundred-thousandth of a degree (0.00001°), for a set of points having longitude values of 5° increments within a 90° orbital arc distance, for a specific orbital inclination (i). The equation $\text{Tan } \phi = \text{Tan } i \ (\text{Sin } \lambda)$ is applied in obtaining the ϕ values, (refer to Fig. 12, Specific Data, 30°00' Orbital Curve Plot Values, page 33).

EXAMPLE:

Given -

$i = 30°$

$\text{Tan } i = 0.577350$

$\lambda = 10°$

$\text{Sin } \lambda = 0.17365$

$\text{Tan } \phi = 0.577350 \ (0.17365) = 0.100257$

$\phi = 5°43'30"$ or $5.72500°$

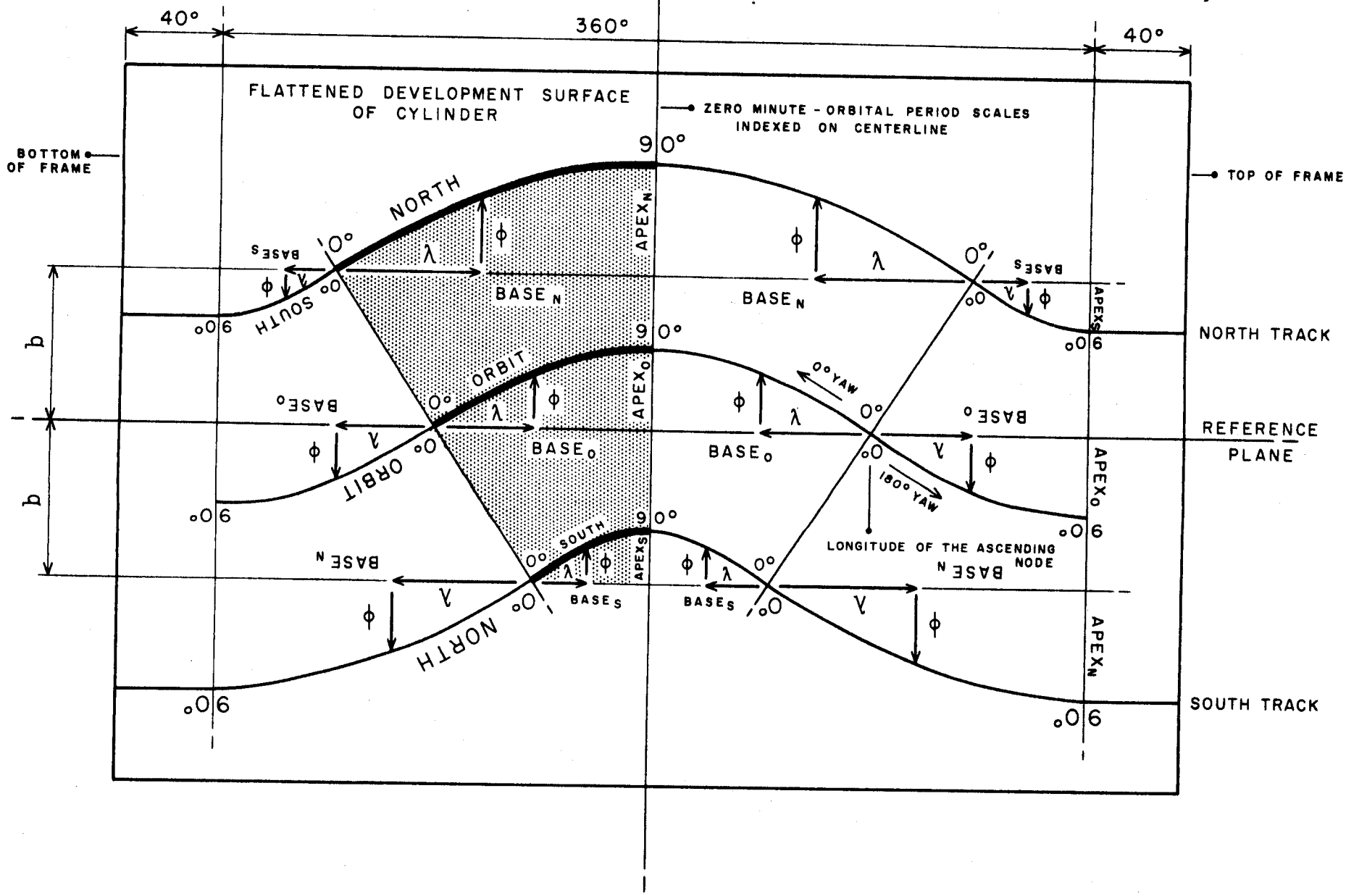


FIGURE II

PLOTTING FORMAT OF THE ORBITAL CURVE TRACKS

(2) The angular distances (λ and corresponding ϕ) of the set of orbital curve points are converted to linear plot values using the scale factor 1° = 0.025" (refer to Fig. 12, page 35):

$$\lambda = 10° = 10\ (0.025) = 0.250"$$

$$\phi = 5.72500° = 5.72500\ (0.025) = 0.143"$$

(3) Orbit Curve Track Scale Factors (refer to Fig. 13 - Specific Data, 30°00' Orbit Curve Track Scale Factors for 90° of Orbit, page 35, and Fig. 14 - Specific Data, North and South Track Plot Values for 90° of a 30°00' Orbit, page 36) -

1. The geometric formation of the orbital curve on a plane contains a base line ($base_o$) and a line perpendicular to the base upon which the curve reaches its apex ($apex_o$). Both are relative to the reference plane. A scale factor for the λ and ϕ coordinates is given as a constant (1° = 0.025").

2. The projection of the orbit zone on a plane, as determined by a cylinder, does not necessarily conform to any standard set of curves. It is a unique situation in which the centerline, the orbital curve, is defined by a sine wave, but the traces of the tangent planes, or north and south tracks, are irregular curves, not readily defined. The spherical unity of the orbital curve and tracks is kept intact by assigning the same λ and ϕ angular coordinates, as determined for the specific orbital curve, to the tracks.

3. The linear definition of the track coordinates are unequal scale-wise in λ and ϕ vector plot values. To effect a transformation of the track angular coordinate distances into linear directions, scale factors proportional to the orbital inclination, $base_o$, $apex_o$, and the distance from the orbital curve to the tracks, are calculated based on 90° arc distance of the small circles.

4. Method of Obtaining Orbital Track Scale Factors:

a. Extend a line perpendicular to the orbital curve at the junction of the orbit, the reference plane ($base_o$) and 0°.

b. Plot points equal to $\frac{152.56°}{2}$ (0.025), or 1.907" on the line, each side of the orbital curve.

c. Through each point construct lines parallel to $base_o$, bisecting the 90° line. Each line represents the base, $base_n$ and $base_s$, of their respective track.

d. The line perpendicular to the orbital curve forms the hypotenuse of two similar right triangles, whose legs are side a and side b, with interior angles of 90°, i, and 90° - i. The sides a and b are obtained respectively by: (when i = 30°)

$$\text{side a} = 1.907 \cos 90° - i = 1.907 \cos 60° = \underline{0.954"}$$

$$\text{side b} = 1.907 \sin 90° - i = 1.907 \sin 60° = \underline{1.652"}$$

It follows:

$$\text{base}_n = \text{base}_o + \text{side a} = 2.250 + 0.954 = \underline{3.204"}$$

$$\text{base}_s = \text{base}_o - \text{side a} = 2.250 - 0.954 = \underline{1.296"}$$

$$\text{apex}_n = 1.907 - (\text{side b} - \text{apex}_o) = 1.907 - (1.652 - 0.750) = \underline{1.005"}$$

$$\text{apex}_s = \text{side b} - (1.907 - \text{apex}_o) = 1.652 - (1.907 - 0.750) = \underline{0.495"}$$

e. The scale factors for the linear transformation are computed using the equations:

$$1° = \frac{\text{base}_n}{90°} = \frac{3.204}{90} = 0.03560"$$

$$1° = \frac{\text{apex}_n}{i} = \frac{1.005}{30} = 0.03350"$$

$$1° = \frac{\text{base}_s}{90°} = \frac{1.296}{90} = 0.01440"$$

$$1° = \frac{\text{apex}_s}{i} = \frac{0.495}{30} = 0.01650"$$

f. After the scale factors are computed, the λ and ϕ angular coordinates are multiplied by their respective track factors to obtain the final plot values.

EXAMPLE:

North Track $\quad \lambda = 10° \quad \phi = 5.72500°$

$$\lambda = 10\ (0.3560) = 0.356"$$

$$\phi = 5.72500\ (0.03350) = 0.192"$$

g. All plot values for the orbital curve and tracks are computed. The respective base lines are drafted according to the dimensions in Fig. 13, page 34, for a 90° arc distance, and systematically positioned in relation to the Plotting Format of the Orbital Curve Tracks, Fig. 11, page 18. The λ and ϕ coordinates are plotted in inches in reference to the zero curve positions indicated on the format.

2-02. Orbital Period Scale - Position is interpreted from the time, distance, and rate of spacecraft motion in the orbital period. The intended orbital period of the Gemini flight lies within a range of 87.2 and 91.2 minutes. The above three elements, being of a uniform nature, are equally measured along the orbital curve. The plotted position of equally proportioned points along the orbital curve are projected onto a straight line, parallel to the reference plane. The increments on a straight line are not uniform, but take on the appearance of an arithmetic progression, and recession.

a. Construction - The intended orbital period of the Gemini flight lies within a range of 87.2 and 91.2 minutes. For practical reasons whole minute orbital period, 88, 89, 90, and 91 minute,representations are combined in one time scale concept. The 90° arc distance symmetry of the orbital curve is utilized in obtaining the plot distances, in one minute units, for the combination scale. By the application of graphical proportioned units two orbital period scales are constructed in such a manner as to automatically provide three additional scales. Refer to Fig. 15, page 22.

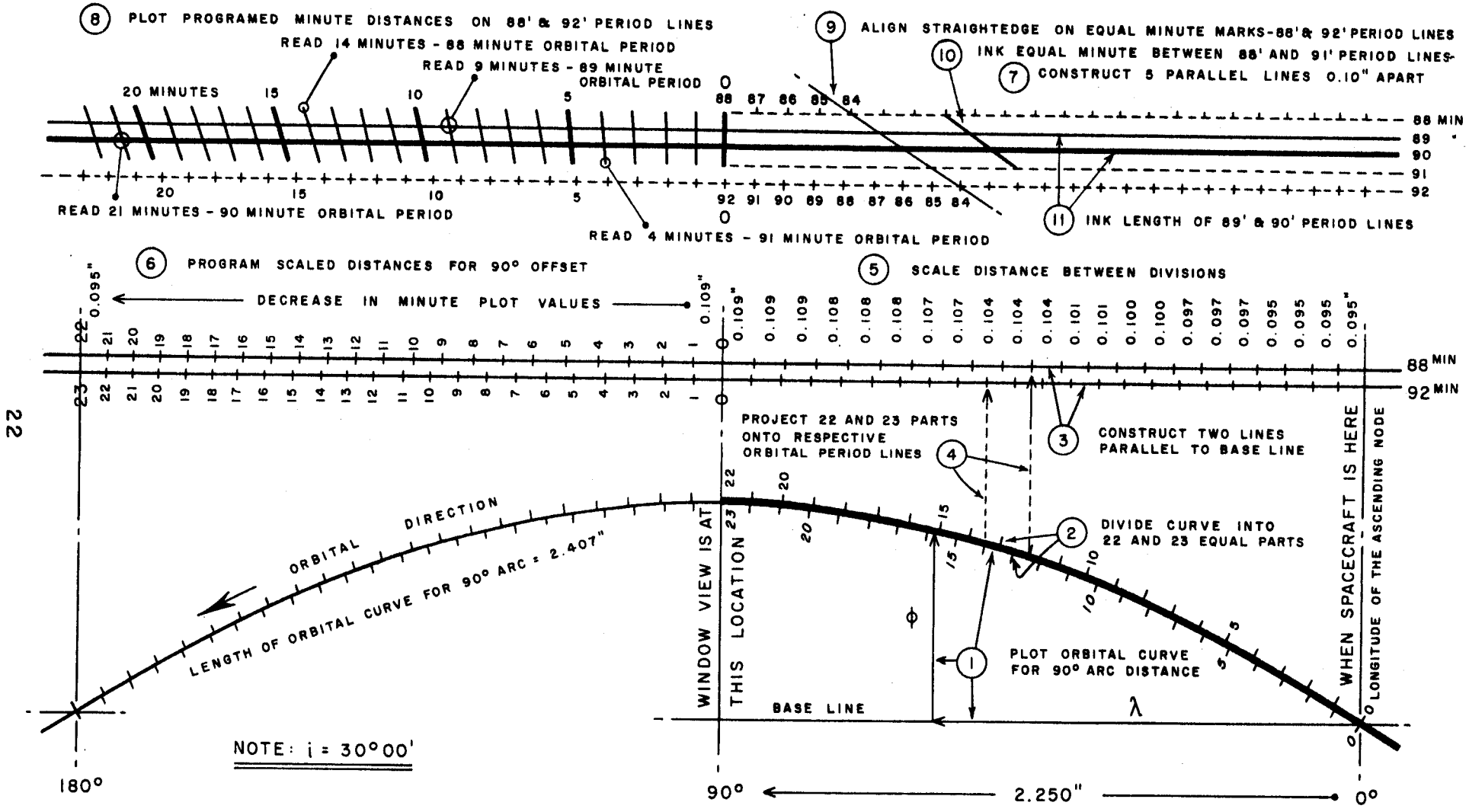
(1) The orbital periods of 88 minutes and 92 minutes, which provide whole minute divisions (22 and 23 minutes respectively) for 90° arc distance, are used as the base for the scale construction.

$$\frac{90°}{360°} \times 88 = 22 \text{ minutes} \qquad \frac{90°}{360°} \times 92 = 23 \text{ minutes}$$

(2) Each specific orbital curve is plotted at a ten time enlargement of the actual scale, at a representation of 1" = 4° (0.250" = 1°) for 90° arc distance, to the plot points previously computed. The plot points are connected with a solid line.

(3) The length of each specific orbital curve is measured, drawn as a straight line, and divided into 22 and 23 equal parts. The line is transposed to its respective orbital curve. Working the line along the configuration of the curve, the 22 and 23 units are marked on the curve, e.g. the length of a 30° orbital curve for 90° is 2.407".

(4) Two lines, parallel to the base line (reference plane) are drawn. Lines perpendicular to the base line are drafted through the plotted minute increments intersecting their respective parallel lines.



CONSTRUCTION OF THE ORBITAL PERIOD SCALE FOR 0° YAW

FIGURE 15

(5) The distances are measured to the nearest hundredth of an inch. The values are adjusted so that the summation of the plot distances equal 90° at 1" = 4°, or 22.50". The distances divided by ten are the actual plot values of the minute units of the 22 part and 23 part divisions of 90° of orbital curve.

(6) A review of the minute distances for the three orbital inclinations of 28°30', 30°00', and 32°30' indicates the plot values for a 30°00' orbital inclination will satisfactorily serve as a mean orbital period scale for all three inclinations.

b. Placement of the Orbital Period Scale Zero Minute Position (refer to Fig. 11, page 18) - The determining factors of the zero minute placement are the location of the longitude of the ascending node, the direction of the orbit, and the North, South, East, and West orientations of the celestial sphere on the map plane in regards to the configuration of the orbital curve inherent in the display board design.

(1) The windows in the spacecraft are in a set position restricting the astronauts to a direct forward view of the heavens. It is impossible to determine the zenith, the position directly overhead, from the cabin. Any view, from either the left or right window, shall be one 90° from zenith along the orbit, i.e. along the configuration of the orbital curve in the device. There is a 90° difference between the view, which determines position, and the physical location of the spacecraft. The design features built-into the device adjust for this discrepency automatically.

(2) The longitude of the ascending node for both YAW attitudes is in the same position on the display board. Their orbital direction increase are opposite to each other at this point. The 90° view offset for 180° YAW is opposite to its designed orbital direction, and equal to the 90° offset placement for 0° YAW. This location is at the center of the longest length of the display board. All units are designed relative to the view, and all movements in the device must be evaluated and calibrated to the view position on the orbital curve. Therefore, the progression of actual minute plot values, relative to the configuration of the curve, for the orbital period scale is inversed, e.g. the plot distance between 22 and 21 minutes (for an 88 minute period) is applied for plotting 0 to 1 minute, and vise versa.

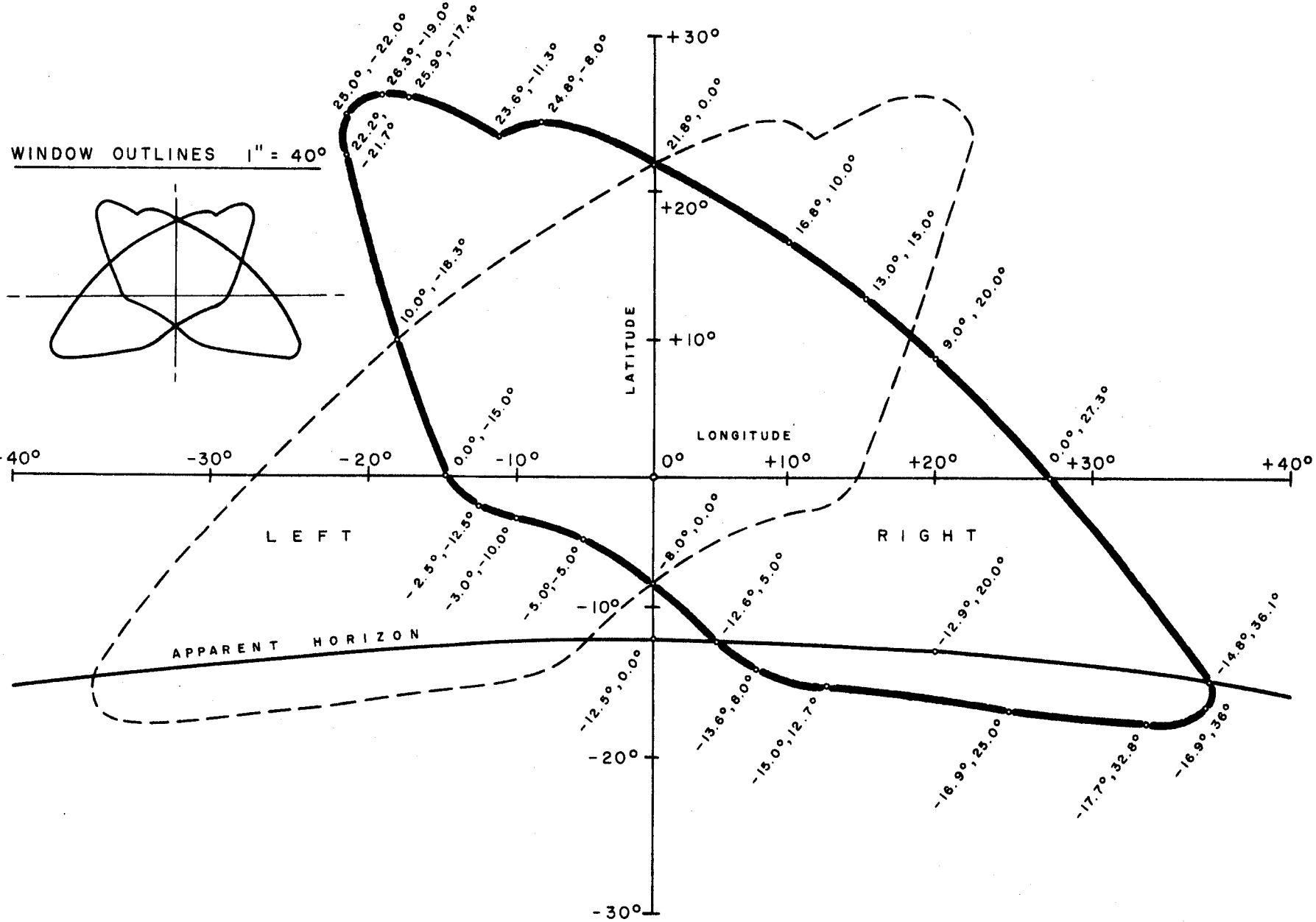
EXAMPLE (for a 30°00' orbit):

Orbital period = 88 minutes Scale 1" = 40°

MINUTE	ACTUAL VALUE	INVERSE VALUE FOR SCALE
0	0.095"	0.109"
1	0.095	0.109
2	0.095	0.109
3	0.095	0.108
4	0.097	0.108
5	0.097	0.108
6	0.097	0.107
7	0.100	0.107
8	0.100	0.104
9	0.101	0.104
10	0.101	0.104
11	0.104	0.101
12	0.104	0.101
13	0.104	0.100
14	0.107	0.100
15	0.107	0.097
16	0.108	0.097
17	0.108	0.097
18	0.108	0.095
19	0.109	0.095
20	0.109	0.095
21	0.109	0.095
22		

(3) Utilizing the above values the minute plot distances for 0° YAW are arranged in a traverse order by an arithmetic progression. Zero minute being in the center of the scale, the zero inch plot location is at 2 x 22 = 44 minutes for an 88 minute orbital period, and 2 x 23 = 46 minutes for a 92 minute period, refer to Fig. 16, page 42.

c. Construction of the Orbital Period Scale (refer to Fig. 15, page 22) Five parallel lines, each representing 88, 89, 90, 91, and 92 minute orbital periods respectively, spaced 0.10" apart, are drawn parallel to each other. A perpendicular line is constructed at the left end. This line is the zero inch plot mark. The minute increments for 88 and 92 minute periods are plotted on their respective lines, the outside ones. Minute increments of equal values, i.e. 0 minutes, 15 minutes, etc., on both period lines are connected with a straight-edge. Equal value lines are inked between the 88 and 91 minute periods. Upon drafting all equal minute lines, ink the length of the 89, and 90 minute period lines, bisecting all of the equal minute ones. The 92 minute orbital period line was utilized for convenience in the construction of the combination scale, and shall not appear on the final copy.



· GEMINI SPACECRAFT WINDOWS ·

FIGURE 17

2-03. PITCH SCALE (refer to Fig. 6, page 6) - The pitch scale is a graduated reference line used in compensating the movement of the window frame to an intended spacecraft pitch attitude, i.e., somewhere within the range of +10° and -30°. All angular directions in the device are transformed, or translated into linear measures and movements. A graduated horizontal offset of the window frame simulates the angular movement of the spacecraft. The pitch scale is plotted to 1" = 40° by use of an Engineer's Scale graduated with 40 units to the inch.

2-04. WINDOW FRAME - The left and right Gemini spacecraft window formats on the window frame outline the star field on the device as viewed by the Astronauts from their respective window. The formats are required to be of the same scale as the orbital tracks and star maps. The window outlines are obtained from Figure 2, Gemini Windows, Out-of-the-Window View, of the Statement of Work-Purchase Request No. T-27508-G, dated 26 May 1964. The window shapes are delineated to a particular scale by the use of angular coordinates assigned to the configuration of the right window. The coordinates are given in Fig. 17, Gemini Spacecraft Windows, page 25. The angular coordinates are converted to 1" = 40°, and plotted on a cartesian grid.

a. Figure 2 from the Statement of Work is placed in a reflecting projector, an optico-mechanical instrument. The right window image is optically superimposed over the plotted coordinates placed on the instrument projection table. The scaled configuration of each window is traced. The tracing is the master templet used to machine the window frame.

b. The windows are symmetrical. The center of their symmetry represents the center of the Spacecraft at 0° pitch, the origin of the vehicle coordinate system. If a cross-hair was substituted at this point, the orbital period scale for 0° YAW rearranged without a 90° offset, and the window frame zeroed at 0° pitch, the ground crew could track the spacecraft in relation to the celestial sphere.

2-05. STAR MAPS - The function of the display board is to indicate direction with respect to the intended elements of the spacecraft. The star maps for 0° and 180° YAW work in conjunction with the display board. They serve to present the sequence of celestial landmarks as they appear through the spacecraft windows at directed intervals, and enable the determination of the vehicle's position. The format of the spacecraft windows, the sequence of the stars approaching the bottom or top of the windows, the position of the orbital to the reference plane, and the simulated yaw attitudes in the display board govern the schematic layout of the celestial sphere in each graphic representation.

a. The entire sky is laid out on the celestial sphere in a manner analogous to the surface of the earth, but instead of longitude and latitude which are terrestrial measurements, there are right ascension (RA) and declination corresponding to them respectively.

(1) Right ascension, measured in hours and minutes, is an angular distance increasing in value from east to west, beginning from the zero, or twenty-fourth hour line (First Point of Aries), and going east completely around the heavens, back to zero again. The orbit and right ascension increase in the same direction, eastward. The circular nature of the orbit and the celestial sphere requires that the sequence of star placement, increasing in RA, enter at the bottom of the spacecraft windows, pass in view, and exit at the top for a 0° Yaw attitude. For a 180° Yaw orientation, the progression of stars begins at the top and passes out at the bottom of the windows. Thus east is oriented to the bottom of the windows at 0° Yaw, and to the top at 180° Yaw.

(2) Declination is measured in degrees, minutes, and seconds beginning at the celestial equator and going 90° north (+) to the north celestial pole, and 90° south (-) to the south celestial pole. In a 0° Yaw attitude north is oriented to the left spacecraft window. For a 180° Yaw attitude north is oriented to the right spacecraft window.

(3) The spacecraft window outlines are in a fixed relationship in the device. The conforming map orientation plot plans are:

0° Yaw - Orbital direction and the right ascension increase towards the bottom of the frame (refer to Fig. 11), and the north declination is relative to the north track

180° Yaw - Orbital direction and the right ascension increase towards the top of the frame, and north declination is relative to the south track

b. The compilation of the star positions is based on a scale of 1" = 35°. The final copy is a reduction of the compilation to a representation of 1" = 40°. The star coordinates in right ascension and declination are obtained from: Mean Places of Stars, 1964.0, pages 288-298, The American Ephemeris and Nautical Almanac, 1964, printed by the U.S. Printing Office. Refer to SPECIFIC DATA, Star Map Plot Values, page 45.

(1) Right ascension and declination coordinates are translated to the nearest hundredth of an hour and degree respectively. The translations are converted to inch plot values using the following factors:

RA - 1^h sidereal times equals 15°; for a scale of 1" = 35° the RA conversion factor is:

$$\frac{15^\circ}{35^\circ} \times 1'' = 0.42857''/^hRA$$

Declination - 1" = 35° or 0.02857"/°

(2) The star plot values and progression of star placement on the celestial sphere are programmed for a photographic compilation of symbolized stars using the Army Map Service - Type Placement System. The system has X and Y coordinate input units calibrated to 0.001". It has a photo-coordinatograph with capabilities of moving to a commanded X and Y coordinate position, and exposing a symbol, delineated on a negative in its photo-head, onto a sheet of 24" by 32" positive film. The center of the plotted symbols are accurate to within 0.003", a value applicable only to the specific overall size of the star maps. The accuracy of the system will vary on different size formats. The exposed film positive, developed at a later independent period, is a symbolized transparency of the celestial sphere which can be oriented in any planular position required for the specific yaw attitudes. A film positive is produced for each yaw. The placement of type (names, numbers, etc.), the ecliptic, and the celestial equator complete the film positive as a final map. To facilitate coordinate input, and photo-coordinatograph plotting and symbol exposure, the X and Y coordinate axes are assigned the base plotting values of 10.000".

(3) Right ascension coordinates are multiplied by the conversion factor $0.42857"/^{m}RA$. 10.000 inches are added to the products.

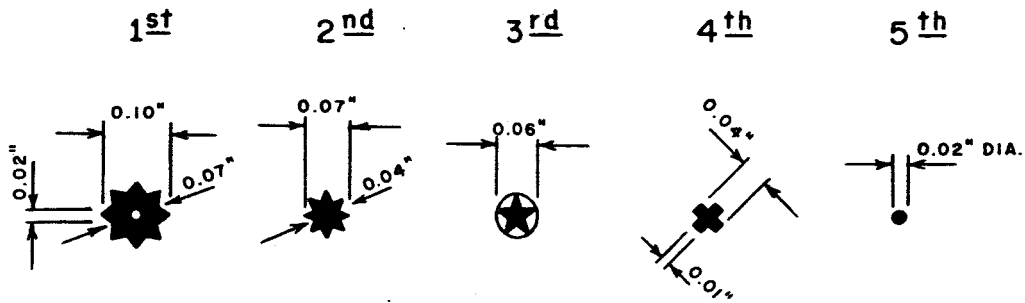
(4) Declination coordinates are multiplied by the conversion factor 0.02857"/°. Minus (-) declination conversions are added to 10.000". Plus (+) declination conversions are subtracted from 10.000".

(5) The conventional manner in which the stars have been symbolized on the maps is by varying the symbol configurations and sizes in accordance with apparent magnitudes. The amount of stars appearing on the maps have been determined by the scale of the maps, the congestion of detail, and the groups of stars forming patterns. The symbolization criterium is based upon two astronomical facts. One, a star is a point of light, and all points of light are the same size, regardless of what the actual size of the star may be. It is the variance in the degrees of brilliance which enable a visual differentiation between the bright ones and the fainter ones. Two, the stars are of an infinite variety, arranged in the heavens in a series of patterns called constellations.

(a) The stars appearing on the maps have been placed into five magnitude groups for map symbolization. The groups placement criterium is as follows: all stars of +1.3 and larger magnitudes are symbolized as a first magnitude (mag) star. The whole magnitude unit of the remaining stars is the dividing value for group assignment; i.e. +1.4 to +2.0 = second mag, +2.1 to 3.0 = third mag, +3.1 to +4.0 = fourth mag, and +4.1 to 4.75 = fifth mag. All stars decreasing to the fourth magnitude appear on the maps. A selection of fifth magnitude stars is made on the basis of an association with a constellation pattern, or as part of an intricate grouping of stars forming an identifiable celestial feature.

1. The names of stars to +2.0 mag were obtained from The American Ephemeris and Nautical Almanacs for 1959 (U.S. Army technical manual - TM-5-236-59) and 1964 (U.S. Naval Observatory publication).

2. The star symbol configurations, as delineated in Fig. 18 below, are extracted from The Air Almanac 1965, Issued by the U.S. Naval Observatory, Washington, D.C. Dimensions are assigned relative to a compilation scale of 1" = 35°. The final star map scale is 1" = 40°.



NOTE: DIMENSIONS ARE FOR A SCALE OF 1" = 35°

STAR MAGNITUDE SYMBOLIZATION

FIGURE 18

(a) Constellation is a name used in astronomy originally to designate groups of stars that were imagined to form configurations, familiar objects, animals, and personages in the sky. Constellations at the present time is the term refering to definite areas of the sky. The actual boundaries of the constellations are not shown on the star maps because it would tend to congest detail and confuse the astronaut user. The constellations have been delineated in reference to the artificial groupings of personages and objects drawn on THE HEAVENS, a sky map, produced December 1957 by the National Geographic Magazine, Vol. CXII, No. 6.

b. Ecliptic (refer to Fig. 19, page 44) - The apparent path of the sun in the celestial sphere is the ecliptic. Its mean obliquity ϵ, or angle of inclination with the celestial equator is 23° 26' 28".28 or 23.44397° (page 50, The American Ephemeris and Nautical Almanac for 1964). The ϕ coordinates for a 90° arc distance on the ecliptic are computed in similar methods used on the orbital curve using the equation: $\tan \phi = \tan \epsilon \sin \lambda$. The conversion of the coordinates is to a scale of 1" = 35°. The ecliptic is plotted in a similar scheme to that of the orbital curve on the respective star maps. The point at which the Sun crosses the equator on its way north is the First Point of Aries. It is also the position for 0^hRA. At this point it is keyed into the plotted maps.

c. The Right Ascension Scale (refer to Fig. 4 and 5, pages 4 & 5) - is graduated in 10 minute units equal to $\frac{10}{60}$ x 0.42857 = 0.071428"/10^{m}_{RA} or 24 (0.42857"/$^{h}_{RA}$) = 10.286".

$(1)_{is}$ The indexing of the right ascension to the longitude of the ascending node$_{A}$ at the top edge of the frame. This is an offset of 90° arc distance, 30° extension for pitch orientations, and 1/4" or 10° frame support at end of tracks, or 130° from the longitude of the ascending node. The equivalent RA value for 130° is 8^{h} 40^{m}, the distance from the longitude of the ascending node to the Star Map Index location on the outside of the frame. The right ascension scale for 0° YAW has a value of 8^{h} 40^{m} at the First Point of Aries. The right ascension scale for 180° YAW has a value of 24^{h} 00^{h} - 8^{h} 40^{m} = 15^{h} 20^{m} at the First Point of Aries.
The scales increase in RA value as directed by the plots of their respective YAW Star Maps. Offsetting the RA Scale automatically positionsthe stars in their correct location to the longitude of the ascending node.

2-06. OP (Orbital Perturbation) Scale - An orbital perturbation is the departure of the Gemini spacecraft from its intended orbital parameters, i.e., orbital period, attitudes, etc. The OP Scale is an auxiliary unit which supplements the RA Scale for a periodic displacement of the star map unit in the display board.

a. The motions of the spacecraft reflect both gravitational and nongravitational perturbations. The centrifugal force arising from the rotation of the earth causes a deformation, or oblateness, of orbit. The principal orbital perturbation arises from the attraction of this equatorial bulge. The effect of the attraction is a gradual recession of the equatorial crossing of the ascending node. Inversely the attraction causes a succession of the right ascension of the ascending node.

b. Each celestial display device feature is designed to fit a reserved position in which all angular relationships are retained, regardless of the linear distance between them, e.g. the spacecraft's fluctuating flight altitude. The length (360°), configuration (sine wave), and scale (1" = 40°) of the orbital curve cannot be altered to accomodate a variance in the linear amplifications and reductions of the spacecraft orbital parameters. Neither can there be a compromise of a scale (1" = 40°) adjustment of the star maps, orbital period scales, the pitch scale, and the format of the spacecraft windows for the orbital perturbations. All built-in device features are required to be maintained compatible with each other. Offsets of linear motions effecting the compatibility of the standard features are considered by a linear displacement, or a re-indexing of a whole device unit. The effects of orbital perturbations are translated into a linear displacement of the star map through a re-indexing of the RA value of longitude of the ascending node.

c. Re-indexing is performed by use of the OP Scale, graduated relative to the Gemini spacecraft perturbed positions in terms of orbits. A specific YAW OP Scale is attached to its respective YAW Star Map RA Scale by the Astronaut user during flight to the RA index value obtained from the ground crew. Once this is attached the user re-indexes the map at the beginning of each new orbit.

d. Method of OP Scale Construction:

(1) Gemini flight information furnished by NASA:

Orbital perturbations relative to a 28.34° orbit = $+1^{m}\ 48^{sec}$ RA/orbit

(2) Assumed flight duration = 300 orbits

(3) Given: Scale - 1" = 40° (0.025" = 1°)

1^{h}RA = 15°

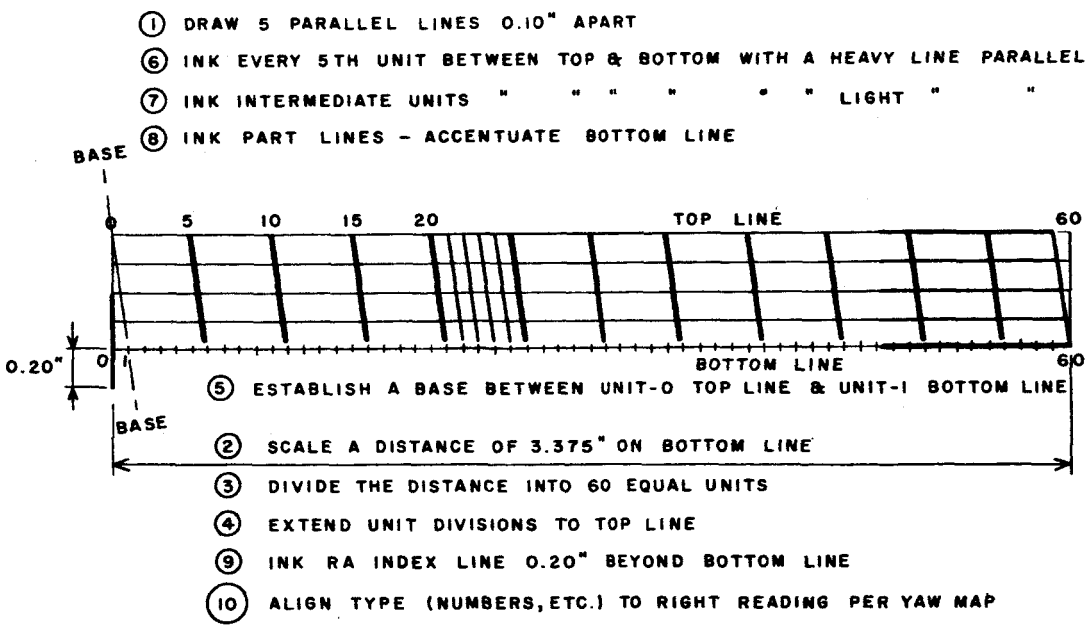
$+1^{h}/48^{sec} = +1.8^{m}$ RA

$$\text{Length of OP Scale} = \frac{\text{number of orbits (OP/orbit) degrees/}^{h}\text{RA (times scale factor)}}{\text{60 minutes/hour}}$$

$$= \frac{300\ (1.8)\ 15\ (.025)}{60} = 3.375"$$

Parameter of scale = 300 orbits = 60 x 5 orbits or 60 units and 5 parts

$$\text{unit value} = \frac{\text{Length of OP Scale}}{\text{No. of units}} = \frac{3.375}{60} = 0.05625"$$



OP SCALE FIGURE 20

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
28°30' ORBITAL CURVE PLOT VALUES

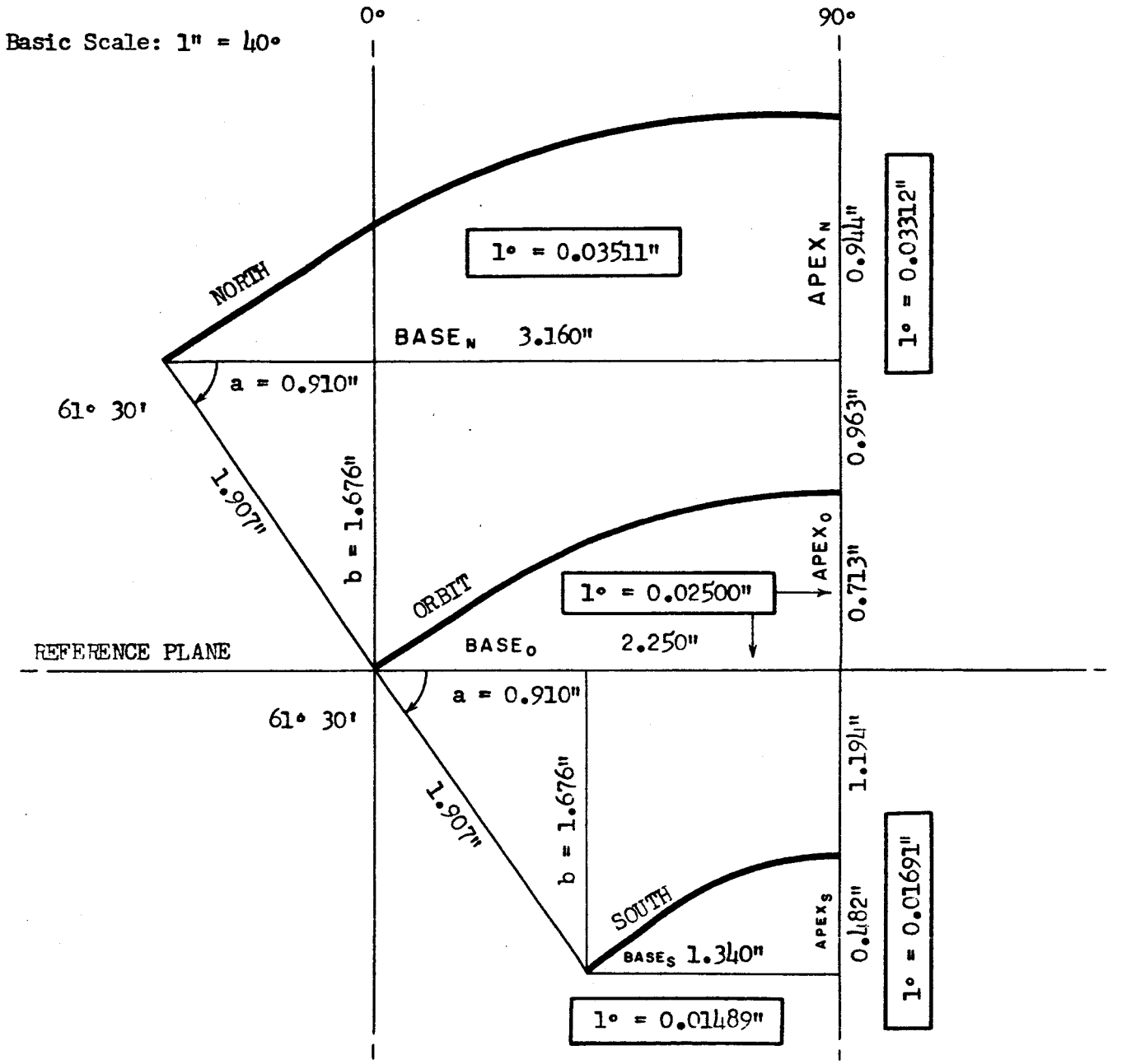
SCALE: 1" = 40°
1° = 0.02500"

Tan ϕ = Tan 28° 30' (Sin λ)
= 0.542956 (Sin λ)

L O N G I T U D E				L A T I T U D E				
λ	PLOT	SIN λ	TAN ϕ	ϕ			DEGREES	PLOT
0°	0.000"	0.00000	0.000000	0°	00'	00"	0.00000°	0.000"
5	0.125	0.08715	0.047319	2	42	30	2.70833	0.068
10	0.250	0.17365	0.094284	5	23	10	5.38611	0.135
15	0.375	0.25882	0.140528	8	00	00	8.00000	0.200
20	0.500	0.34202	0.185702	10	31	10	10.51944	0.263
25	0.625	0.42262	0.229464	12	55	30	12.92500	0.323
30	0.750	0.50000	0.271478	15	11	20	15.18889	0.380
35	0.875	0.57358	0.311429	17	17	50	17.29722	0.432
40	1.000	0.64279	0.349007	19	14	20	19.23889	0.481
45	1.125	0.70711	0.383930	21	00	10	21.00278	0.525
50	1.250	0.76604	0.415926	22	35	00	22.58333	0.565
55	1.375	0.81915	0.444762	23	58	40	23.97778	0.599
60	1.500	0.86603	0.470216	25	11	00	25.18333	0.630
65	1.625	0.90631	0.492086	26	12	00	26.20000	0.655
70	1.750	0.93969	0.510210	27	01	50	27.03056	0.676
75	1.875	0.96592	0.524452	27	40	30	27.67500	0.692
80	2.000	0.98481	0.534708	28	08	00	28.13333	0.703
85	2.125	0.99619	0.540887	28	24	30	28.40833	0.710
90	2.250	1.00000	0.542956	28	30		28.50000	0.713

SPECIFIC DATA

28° 30' ORBIT CURVE TRACK SCALE FACTORS FOR 90° OF ORBIT



a = 1.907 Cos 61° 30' = 1.907 (0.477159) a = 0.910"

b = 1.907 Sin 61° 30' = 1.907 (0.878817) b = 1.676"

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

1" = 40°

NORTH CURVE TRACK PLOT VALUES FOR 90° OF A 28°30' ORBIT

L O N G I T U D E Scale: 1° = 0.03511"		L A T I T U D E Scale: 1° = 0.03312"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.00000°	0.000"
5	0.176	2.70833	0.090
10	0.351	5.38611	0.178
15	0.527	8.00000	0.265
20	0.702	10.51944	0.348
25	0.878	12.92500	0.428
30	1.053	15.18889	0.503
35	1.229	17.29722	0.573
40	1.404	19.23889	0.637
45	1.580	21.00278	0.696
50	1.756	22.58333	0.748
55	1.931	23.97778	0.794
60	2.107	25.18333	0.834
65	2.282	26.20000	0.868
70	2.458	27.03056	0.895
75	2.633	27.67500	0.917
80	2.809	28.13333	0.932
85	2.984	28.40833	0.941
90	3.160	28.50000	0.944

SOUTH CURVE TRACK PLOT VALUES FOR 90° OF A 28°30' ORBIT

L O N G I T U D E Scale: 1° = 0.01489"		L A T I T U D E Scale: 1° = 0.01691"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.00000°	0.000"
10	0.149	5.38611	0.091
20	0.298	10.51944	0.178
30	0.447	15.18889	0.257
40	0.596	19.23889	0.325
50	0.745	22.58333	0.382
60	0.893	25.18333	0.426
70	1.042	27.03056	0.457
80	1.191	28.13333	0.476
90	1.340	28.50000	0.482

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
30°00' ORBITAL CURVE PLOT VALUES

FIGURE 12

SCALE: 1" = 40°
1° = 0.02500"

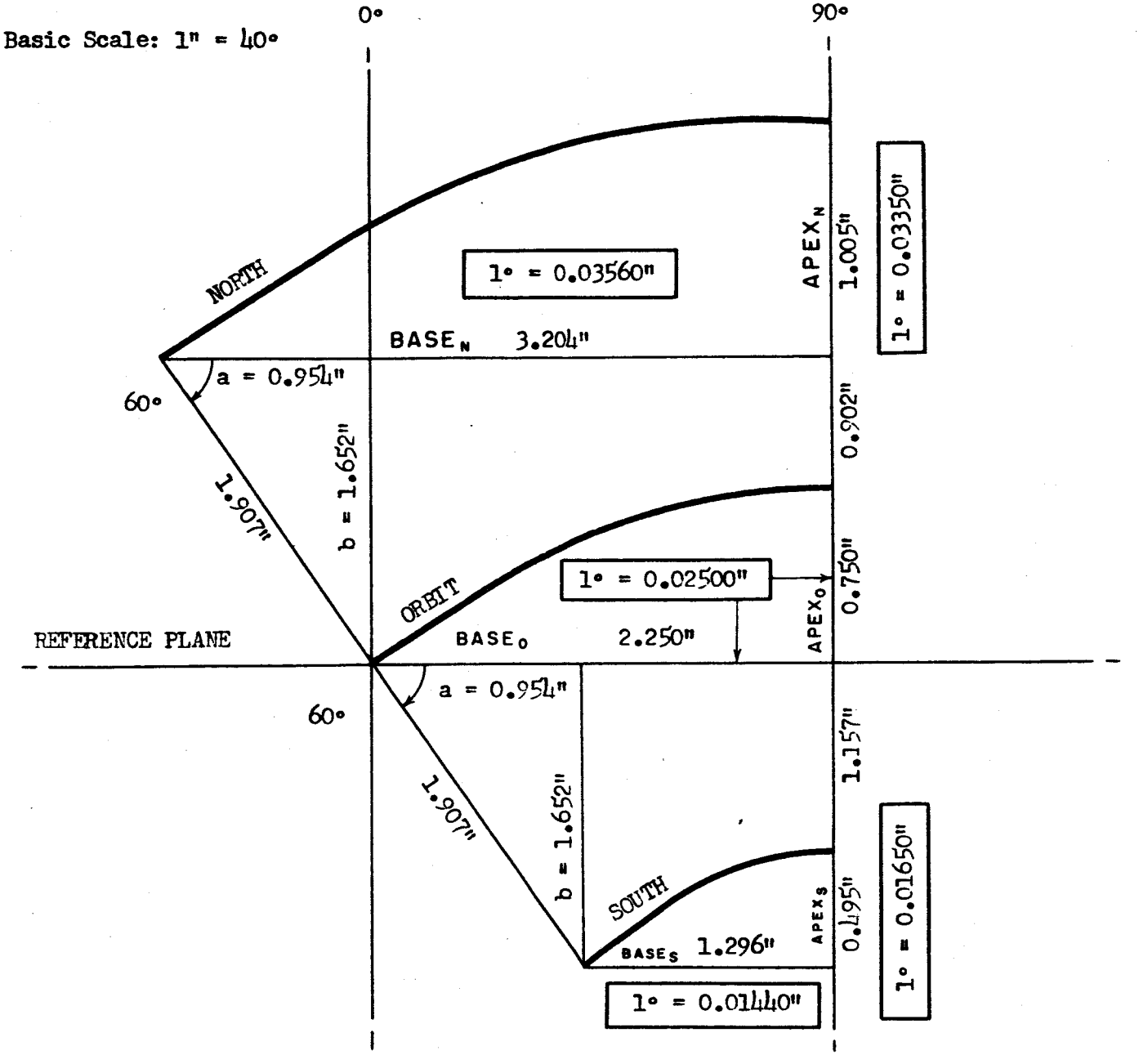
Tan ϕ = Tan 30° 00' (Sin λ)
= 0.577350 (Sin λ)

LONGITUDE				LATITUDE				
λ	PLOT	SIN	TAN ϕ	ϕ			DEGREES	PLOT
0°	0.000"	0.00000	0.000000	0°	00'	00"	0.00000°	0.000"
5	0.125	0.08715	0.050316	2	52	50	2.88056	0.072
10	0.250	0.17365	0.100257	5	43	30	5.72500	0.143
15	0.375	0.25882	0.149430	8	29	40	8.49444	0.212
20	0.500	0.34202	0.197465	11	10	15	11.17083	0.279
25	0.625	0.42262	0.244000	13	42	45	13.71250	0.343
30	0.750	0.50000	0.288675	16	06	10	16.10278	0.403
35	0.875	0.57358	0.331156	18	19	20	18.32222	0.458
40	1.000	0.64279	0.371115	20	21	40	20.36111	0.509
45	1.125	0.70711	0.408250	22	12	30	22.20833	0.555
50	1.250	0.76604	0.442273	23	51	30	23.85833	0.596
55	1.375	0.81915	0.472936	25	18	40	25.31111	0.633
60	1.500	0.86603	0.500002	26	34	00	26.56667	0.664
65	1.625	0.90631	0.523258	27	37	15	27.62083	0.691
70	1.750	0.93969	0.542530	28	28	50	28.48056	0.712
75	1.875	0.96592	0.557674	29	08	50	29.14722	0.729
80	2.000	0.98481	0.568580	29	37	20	29.62222	0.741
85	2.125	0.99619	0.575150	29	54	20	29.90556	0.748
90	2.250	1.00000	0.577350	30	00		30.00000	0.750

SPECIFIC DATA

30° 00' ORBIT CURVE TRACK SCALE FACTORS FOR 90° OF ORBIT

FIGURE 13



a = 1.907 Cos 60° = 1.907 (0.500000) a = 0.954"

b = 1.907 Sin 60° = 1.907 (0.866025) b = 1.652"

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

1" = 40°

NORTH CURVE TRACK PLOT VALUES FOR 90° OF A 30°00' ORBIT

L O N G I T U D E Scale: 1° = 0.03560"		L A T I T U D E Scale: 1° = 0.03350"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.00000°	0.000"
5	0.178	2.88056	0.096
10	0.356	5.72500	0.192
15	0.534	8.49444	0.285
20	0.712	11.17083	0.374
25	0.890	13.71250	0.459
30	1.068	16.10278	0.539
35	1.246	18.32222	0.614
40	1.424	20.36111	0.682
45	1.602	22.20833	0.744
50	1.780	23.85833	0.799
55	1.958	25.31111	0.848
60	2.136	26.56667	0.890
65	2.314	27.62083	0.925
70	2.492	28.48056	0.954
75	2.670	29.14722	0.976
80	2.848	29.62222	0.992
85	3.026	29.90556	1.002
90	3.204	30.00000	1.005

SOUTH CURVE TRACK PLOT VALUES FOR 90° OF A 30°00' ORBIT

L O N G I T U D E Scale: 1° = 0.01440"		L A T I T U D E Scale: 1° = 0.01650"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.00000°	0.000"
10	0.144	5.72500	0.094
20	0.288	11.17083	0.184
30	0.432	16.10278	0.266
40	0.576	20.36111	0.336
50	0.720	23.85833	0.394
60	0.864	26.56667	0.438
70	1.008	28.48056	0.470
80	1.152	29.62222	0.489
90	1.296	30.00000	0.495

FIGURE 14

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
32°30' ORBITAL CURVE PLOT VALUES

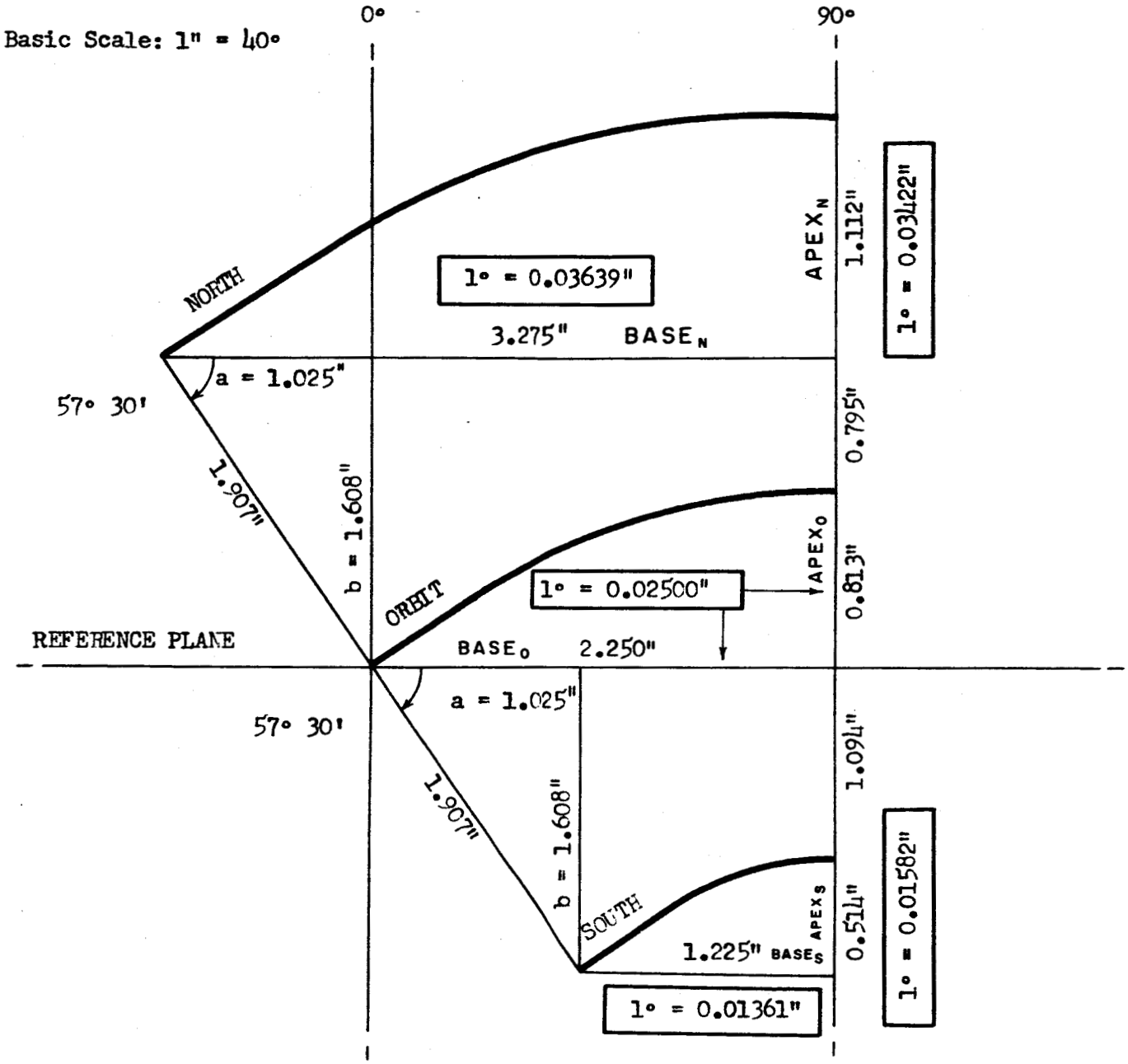
SCALE: 1" = 40°
1° = 0.02500"

Tan ϕ = Tan 32° 30' (Sin λ)
= 0.637070 (Sin λ)

LONGITUDE				LATITUDE				
λ	PLOT	SIN λ	TAN ϕ	ϕ			DEGREES	PLOT
0°	0.000"	0.00000	0.000000	0°	00'	00"	0.00000°	0.000"
5	0.125	0.08715	0.055521	3	10	40	3.17778	0.079
10	0.250	0.17365	0.110627	6	18	45	6.31250	0.158
15	0.375	0.25882	0.164886	9	21	45	9.36250	0.234
20	0.500	0.34202	0.217891	12	17	30	12.29167	0.307
25	0.625	0.42262	0.269239	15	04	10	15.06944	0.377
30	0.750	0.50000	0.318535	17	40	10	17.66944	0.442
35	0.875	0.57358	0.365411	20	04	20	20.07222	0.502
40	1.000	0.64279	0.409502	22	16	10	22.26944	0.557
45	1.125	0.70711	0.450479	24	15	00	24.25000	0.606
50	1.250	0.76604	0.488021	26	00	50	26.01389	0.650
55	1.375	0.81915	0.521856	27	33	30	27.55833	0.689
60	1.500	0.86603	0.551722	28	53	10	28.88611	0.722
65	1.625	0.90631	0.577383	30	00	10	30.00278	0.750
70	1.750	0.93969	0.598648	30	54	20	30.90556	0.773
75	1.875	0.96592	0.615359	31	36	20	31.60556	0.790
80	2.000	0.98481	0.627393	32	06	15	32.10417	0.803
85	2.125	0.99619	0.634643	32	24	00	32.40000	0.810
90	2.250	1.00000	0.637070	32	30	00	32.50000	0.813

SPECIFIC DATA

32° 30' ORBIT CURVE TRACK SCALE FACTORS FOR 90° OF ORBIT



a = 1.907 Cos 57° 30' = 1.907 (0.537300) | a = 1.025"

b = 1.907 Sin 57° 30' = 1.907 (0.843391) | b = 1.608"

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

1" = 40°

NORTH CURVE TRACK PLOT VALUES FOR 90° OF A 32°30' ORBIT

L O N G I T U D E Scale: 1° = 0.03639"		L A T I T U D E Scale: 1° = 0.03422"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.00000°	0.000"
5	0.182	3.17778	0.109
10	0.364	6.31250	0.216
15	0.546	9.36250	0.320
20	0.728	12.29167	0.421
25	0.910	15.06944	0.516
30	1.092	17.66944	0.605
35	1.274	20.07222	0.687
40	1.456	22.26944	0.762
45	1.638	24.25000	0.830
50	1.820	26.01389	0.890
55	2.001	27.55833	0.943
60	2.183	28.88611	0.988
65	2.365	30.00278	1.027
70	2.547	30.90556	1.058
75	2.729	31.60556	1.082
80	2.911	32.10417	1.099
85	3.093	32.40000	1.109
90	3.275	32.50000	1.112

SOUTH CURVE TRACK PLOT VALUES FOR 90° OF A 32°30' ORBIT

L O N G I T U D E Scale: 1° = 0.01361"		L A T I T U D E Scale: 1° = 0.01582"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.00000°	0.000"
10	0.136	6.31250	0.100
20	0.272	12.29167	0.194
30	0.408	17.66944	0.280
40	0.544	22.26944	0.352
50	0.681	26.01389	0.412
60	0.817	28.88611	0.457
70	0.953	30.90556	0.489
80	1.089	32.10417	0.508
90	1.225	32.50000	0.514

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

SCALE: 1" = 40° ORBITAL PERIOD SCALE PLOT VALUES FOR 90° OF ORBIT

ORBIT INCLINATION = 28°30'

Length of Orbital Curve = 2.391"

TIME	ORBITAL PERIOD	
	88 MINUTES	92 MINUTES
MINUTES	INCHES	INCHES
0	0.000"	0.000"
1	0.094	0.091
2	0.096	0.091
3	0.096	0.091
4	0.096	0.093
5	0.098	0.093
6	0.098	0.094
7	0.099	0.094
8	0.099	0.096
9	0.100	0.096
10	0.101	0.097
11	0.102	0.097
12	0.104	0.097
13	0.104	0.099
14	0.106	0.099
15	0.106	0.101
16	0.106	0.101
17	0.107	0.102
18	0.107	0.102
19	0.107	0.102
20	0.108	0.103
21	0.108	0.103
22	0.108	0.104
23		0.104

ORBIT INCLINATION = 32°30'

Length of Orbital Curve = 2.435"

TIME	ORBITAL PERIOD	
	88 MINUTES	92 MINUTES
MINUTES	INCHES	INCHES
0	0.000"	0.000"
1	0.094	0.089
2	0.094	0.089
3	0.094	0.089
4	0.094	0.089
5	0.096	0.092
6	0.096	0.092
7	0.098	0.092
8	0.098	0.094
9	0.100	0.094
10	0.100	0.097
11	0.102	0.097
12	0.102	0.098
13	0.106	0.099
14	0.106	0.100
15	0.106	0.102
16	0.108	0.102
17	0.108	0.104
18	0.109	0.104
19	0.109	0.105
20	0.110	0.105
21	0.110	0.105
22	0.110	0.106
23		0.106

SPECIFIC DATA
88 MINUTE ORBITAL PERIOD PLOT VALUES FOR 360° OF A 30°00' ORBIT
FOR 0° YAW (SEF) OPERATION
FIGURE 16

1" = 40°

MIN	VALUE	PLOT	MIN	VALUE	PLOT	MIN	VALUE	PLOT	MIN	VALUE	PLOT
44	0.000"	0.000"				1	0.109"	4.609"	24	0.095"	6.940"
45	0.109	0.109	67	0.095"	2.345"	2	0.109	4.718	25	0.095	7.035
46	0.109	0.218	68	0.095	2.440	3	0.109	4.827	26	0.095	7.130
47	0.109	0.327	69	0.095	2.535	4	0.108	4.935	27	0.097	7.227
48	0.108	0.435	70	0.095	2.630	5	0.108	5.043	28	0.097	7.324
49	0.108	0.543	71	0.097	2.727	6	0.108	5.151	29	0.097	7.421
50	0.108	0.651	72	0.097	2.824	7	0.107	5.258	30	0.100	7.521
51	0.107	0.758	73	0.097	2.921	8	0.107	5.365	31	0.100	7.621
52	0.107	0.865	74	0.100	3.021	9	0.104	5.469	32	0.101	7.722
53	0.104	0.969	75	0.100	3.121	10	0.104	5.573	33	0.101	7.823
54	0.104	1.073	76	0.101	3.222	11	0.104	5.677	34	0.104	7.927
55	0.104	1.177	77	0.101	3.323	12	0.101	5.778	35	0.104	8.031
56	0.101	1.278	78	0.104	3.427	13	0.101	5.879	36	0.104	8.135
57	0.101	1.379	79	0.104	3.531	14	0.100	5.979	37	0.107	8.242
58	0.100	1.479	80	0.104	3.635	15	0.100	6.079	38	0.107	8.349
59	0.100	1.579	81	0.107	3.742	16	0.097	6.176	39	0.108	8.457
60	0.097	1.676	82	0.107	3.849	17	0.097	6.273	40	0.108	8.565
61	0.097	1.773	83	0.108	3.957	18	0.097	6.370	41	0.108	8.673
62	0.097	1.870	84	0.108	4.065	19	0.095	6.465	42	0.109	8.782
63	0.095	1.965	85	0.108	4.173	20	0.095	6.560	43	0.109	8.891
64	0.095	2.060	86	0.109	4.282	21	0.095	6.655	44	0.109	9.000
65	0.095	2.155	87	0.109	4.391	22	0.095	6.750	45	0.109	9.109
66	0.095	2.250	0	0.109	4.500	23	0.095	6.845	46	0.109	9.218

Length of Orbital Curve for 90° = 2.407"

90° = 22 minutes

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

92 MINUTE ORBITAL PERIOD PLOT VALUES FOR 360° OF A 30°00' ORBIT FOR 0° YAW (SEF) OPERATION

1" = 40°

MIN	VALUE	PLOT
44	-0.104"	-0.208"
45	-0.104	-0.104
46	0.000	0.000
47	0.104	0.104
48	0.104	0.208
49	0.104	0.312
50	0.104	0.416
51	0.104	0.520
52	0.103	0.623
53	0.103	0.726
54	0.102	0.828
55	0.100	0.928
56	0.100	1.028
57	0.099	1.127
58	0.098	1.225
59	0.097	1.322
60	0.096	1.418
61	0.095	1.513
62	0.095	1.608
63	0.093	1.701
64	0.093	1.794
65	0.092	1.886
66	0.092	1.978
67	0.091	2.069
68	0.091"	2.160"
69	0.090	2.250
70	0.090	2.340
71	0.091	2.431
72	0.091	2.522
73	0.092	2.614
74	0.092	2.706
75	0.093	2.799
76	0.093	2.892
77	0.095	2.987
78	0.095	3.082
79	0.096	3.178
80	0.097	3.275
81	0.098	3.373
82	0.099	3.472
83	0.100	3.572
84	0.100	3.672
85	0.102	3.774
86	0.103	3.877
87	0.103	3.980
88	0.104	4.084
89	0.104	4.188
90	0.104	4.292
91	0.104"	4.396"
0	0.104	4.500
1	0.104	4.604
2	0.104	4.708
3	0.104	4.812
4	0.104	4.916
5	0.104	5.020
6	0.103	5.123
7	0.103	5.226
8	0.102	5.328
9	0.100	5.428
10	0.100	5.528
11	0.099	5.627
12	0.098	5.725
13	0.097	5.822
14	0.096	5.918
15	0.095	6.013
16	0.095	6.108
17	0.093	6.201
18	0.093	6.294
19	0.092	6.386
20	0.092	6.478
21	0.091	6.569
22	0.091	6.660
23	0.090"	6.750"
24	0.090	6.840
25	0.091	6.931
26	0.091	7.022
27	0.092	7.114
28	0.092	7.206
29	0.093	7.299
30	0.093	7.392
31	0.095	7.487
32	0.095	7.582
33	0.096	7.678
34	0.097	7.775
35	0.098	7.873
36	0.099	7.972
37	0.100	8.072
38	0.100	8.172
39	0.102	8.274
40	0.103	8.377
41	0.103	8.480
42	0.104	8.584
43	0.104	8.688
44	0.104	8.792
45	0.104	8.896
46	0.104	9.000

Length of Orbital Curve for 90° = 2.407"

90° = 23 minutes

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
PLOT VALUES FOR 90° OF THE ECLIPTIC

FIGURE 19

SCALE: 1" = 35°
1° = 0.02857

$\tan \phi = \tan \epsilon (\sin \lambda)$
$= \tan 23° 26' 38''.28 (\sin \lambda)$
$= 0.43365 (\sin \lambda)$

L O N G I T U D E				L A T I T U D E			
λ	PLOT	SIN	TAN ϕ	ϕ		DEGREES	PLOT
0°	0.000"	0.00000	0.00000	0°	00'	0.000°	0.000"
5	0.143	0.08715	0.03780	2	10	2.167	0.062
10	0.286	0.17365	0.07530	4	18	4.300	0.123
15	0.429	0.25882	0.11224	6	24	6.400	0.183
20	0.571	0.34202	0.14832	8	26	8.433	0.241
25	0.714	0.42262	0.18327	10	23	10.383	0.297
30	0.857	0.50000	0.21683	12	14	12.233	0.349
35	1.000	0.57358	0.24873	13	58	13.967	0.399
40	1.143	0.64279	0.27875	15	35	15.583	0.445
45	1.286	0.70711	0.30664	17	03	17.050	0.487
50	1.429	0.76604	0.33219	18	23	18.383	0.525
55	1.571	0.81915	0.35522	19	33	19.550	0.559
60	1.714	0.86603	0.37555	20	35	20.583	0.588
65	1.857	0.90631	0.39302	21	27	21.450	0.613
70	2.000	0.93969	0.40750	22	10	22.167	0.633
75	2.143	0.96592	0.41888	22	44	22.733	0.649
80	2.286	0.98481	0.42706	23	08	23.133	0.661
85	2.428	0.99619	0.43200	23	22	23.367	0.668
90	2.571	1.00000	0.43365	23	27	23.450	0.670

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
	Conversion Factor: 0.42857"/^{h}RA			Conversion Factor: 0.02857"/°			
STARS FOR FIRST MAGNITUDE SYMBOLIZATION							
ACHERNAR	1^h 36' 22.5"	1.606^h	10.688"	-57° 25' 09"	57.419°		11.640"
ALDERBARAN	4 33 51.1	4.564	11.956	+16 26 18	16.438	-0.470"	9.530
RIGEL	5 12 48.4	5.213	12.234	- 8 14 31	8.241		10.235
CAPELLA	5 14 1.6	5.234	12.243	+45 57 49	45.964	-1.313	8.687
BETELGEUSE	5 53 13.3	5.887	12.523	+ 7 24 07	7.402	-0.211	9.789
CANOPUS	6 23 09.1	6.386	12.736	-52 40 32	52.676		11.505
SIRIUS	6 43 33.7	6.726	12.883	-16 39 55	16.665		10.476
PROCYON	7 37 25.1	7.624	13.267	+ 5 19 07	5.319	-0.152	9.848
POLLUX	7 43 6.9	7.719	13.308	+28 06 53	28.115	-0.803	9.197
REGULUS	10 06 27.4	10.108	14.332	+12 08 38	12.144	-0.347	9.653
ACRUX	12 24 34.8	12.410	15.319	-62 53 59	62.899		11.797
SPICA	13 23 17.6	13.388	15.738	-10 58 26	10.974		10.314
HADAR	14 01 15.9	14.021	16.009	-60 12 01	60.200		11.720
ARCTURUS	14 14 1.1	14.233	16.100	+19 22 08	19.369	-0.553	9.447
RIGIL KENTAURUS	14 37 8.4	14.619	16.265	-60 41 17	60.688		11.733
ANTARES	16 27 11.8	16.453	17.051	-26 21 14	26.354		10.753
VEGA	18 35 43.1	18.595	17.969	+38 44 57	38.749	-1.107	8.893
ALTAIR	19 49 01.6	19.817	18.493	+ 8 46 19	8.772	-0.251	9.749
DENEB	20 40 12.2	20.670	18.859	+45 09 03	45.151	-1.290	8.710
FOMALHAUT	22 55 39.9	22.928	19.826	-29 48 49	29.814		10.852
STARS FOR SECOND MAGNITUDE SYMBOLIZATION							
γ CASSIOPEIAE	0^h 54' 31.2"	0.909^h	10.390"	+60° 31' 20"	60.523°	-1.729"	8.271"
MIRFAK	3 21 44.5	3.362	11.441	+49 44 05	49.734	-1.421	8.579
BELLATRIX	5 23 11.9	5.386	12.308	+ 6 19 07	6.319	-0.181	9.819
ELNATH	5 24 00.9	5.400	12.314	+28 34 44	28.579	-0.817	9.183
ALNILAM	5 34 23.1	5.573	12.388	- 1 13 24	1.224		10.035
ζ ORIONIS	5 38 56.5	5.649	12.421	- 1 57 37	1.960		10.056
β CANIS MAJORIS	6 21 06.8	6.352	12.722	-17 56 13	17.937		10.512
γ GEMINORUM	6 35 38.0	6.594	12.826	+16 25 54	16.432	-0.469	9.531
ADHARA	6 57 12.6	6.953	12.980	-28 55 19	28.922		10.826
δ CANIS MAJORIS	7 06 55.6	7.115	13.049	-26 20 06	26.335		10.752
CASTOR	7 32 18.3	7.538	13.231	+31 58 07	31.969	-0.913	9.087

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

STAR	RIGHT ASCENSION			HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
STARS FOR SECOND MAGNITUDE SYMBOLIZATION - Continued											
γ^2 VELORUM	8h	08'	25.4"	8.140h	13.489"	-47°	13'	47"	47.230°		11.349"
AVIOR	8	21	46.6	8.363	13.584	-59	23	36	59.393		11.697
δ VELORUM	8	43	42.6	8.729	13.741	-54	34	33	54.576		11.559
MIAPLACIDUS	9	12	48.8	9.214	13.949	-69	34	08	69.569		11.988
DUBHE	11	01	31.3	11.026	14.725	+61	56	44	61.945	-1.770"	8.230
GACRUX	12	29	09.4	12.485	15.351	-56	54	43	56.912		11.626
CRUCIS	12	45	36.2	12.760	15.469	-59	29	32	59.492		11.700
ALIOTH	12	52	27.0	12.875	15.518	+56	09	17	56.155	-1.604	8.396
ALKAID	13	46	07.4	13.769	15.901	+49	29	32	49.492	-1.414	8.586
ATRIA	16	44	50.1	16.747	17.177	-68	57	52	68.964		11.970
SHAULA	17	31	9.7	17.520	17.509	-37	04	46	37.080		11.059
θ SCORPII	17	34	43.7	17.579	17.534	-42	58	37	42.977		11.228
KAUS AUSTRALIS	18	21	46.9	18.363	17.870	-34	24	13	34.404		10.983
STARS FOR THIRD MAGNITUDE SYMBOLIZATION											
α ANDROMEDAE	0h	06'	31.3"	0.109h	10.047"	+28°	53'	30"	28.891°	-0.825"	9.175"
β CASSIOPEIAE	0	07	14.7	0.121	10.052	+58	57	05	58.951	-1.684	8.316
α PHOENICIS	0	24	30.5	0.409	10.175	-42	30	05	42.501		11.214
β CETI	0	41	46.9	0.696	10.298	-18	11	02	18.184		10.520
β ANDROMEDAE	1	07	42.5	1.129	10.484	+35	25	49	35.431	-1.012	8.988
γ ANDROMEDAE	2	01	40.8	2.028	10.869	+42	09	28	42.158	-1.204	8.796
α ARIETIS	2	05	08.3	2.085	10.894	+23	17	35	23.293	-0.665	9.335
δ ORIONIS	5	30	10.0	5.503	12.358	- 0	19	28	0.325		10.009
κ ORIONIS	5	46	02.9	5.768	12.472	- 9	40	52	9.681		10.277
β AURIGAE	5	56	53.2	5.948	12.549	+44	56	45	44.946	-1.284	8.716
η CANIS MAJORIS	7	22	40.2	7.378	13.162	-29	13	55	29.232		10.835
ζ PUPPIS	8	02	19.1	8.038	13.445	-39	54	03	39.901		11.140
λ VELORUM	9	06	40.2	9.111	13.905	-43	17	12	43.286		11.237
ι CARINAE	9	16	07.6	9.269	13.972	-59	07	26	59.124		11.689
α HYDRAE	9	25	49.1	9.431	14.042	- 8	30	06	8.502		10.243
β URSAE MAJORIS	10	59	40.9	10.994	14.712	+56	34	33	56.576	-1.616	8.384
DENEBOLA	11	47	13.5	11.787	15.052	+14	46	24	14.774	-0.422	9.578
ζ URSAE MAJORIS	13	22	28.8	13.375	15.732	+55	06	46	55.113	-1.575	8.425
θ CENTAURI	14	04	33.4	14.076	16.033	-36	11	37	36.193		11.034
β URSAE MINORIS	14	50	47.4	14.846	16.363	+74	18	09	74.302	-2.123	7.877

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

SPECIFIC DATA

STAR	RIGHT ASCENSION			HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
STARS FOR THIRD MAGNITUDE SYMBOLIZATION - Continued											
α CORONAE BOR	15h	33'	09.7"	15.553h	16.666"	+26°	50'	05"	26.834°	-0.767"	9.233"
α OPHIUCHI	17	33	15.7	17.554	17.523	+12	35	05	12.584	-0.360	9.640
γ DRACONIS	17	55	46.1	17.930	17.684	+51	29	33	51.492	-1.471	8.529
σ SAGITTARII	18	53	02.0	18.884	18.093	-26	20	36	26.343		10.753
γ CYGNI	20	20	56.1	20.349	18.721	+40	08	26	40.140	-1.147	8.853
α PAVONIS	20	22	48.6	20.381	18.735	-56	51	08	56.852		11.624
α GRUIS	22	05	58.3	22.099	19.471	-47	08	11	47.136		11.347
β GRUIS	22	40	31.5	22.676	19.718	-47	04	25	47.074		11.345
α CASSIOPEIAE	0	38	27.1	0.641	10.275	+56	20	25	56.340	-1.610	8.390
γ URSAE MAJORIS	11	51	56.7	11.866	15.085	+53	53	41	53.894	-1.540	8.460
γ CENTAURI	12	39	31.3	12.659	15.425	-48	45	44	48.762		11.393
δ SCORPII	15	58	12.0	15.970	16.844	-22	31	15	22.521		10.643
ε SCORPII	16	47	49.6	16.797	17.199	-34	13	47	34.230		10.978
9 PEGASI	21	42	25.0	21.707	19.303	+ 9	42	33	9.709	-0.277	9.723
γ PEGASI	0	11	22.7	0.189	10.081	+14	59	01	14.983	-0.428	9.572
κ SCORPII	17	39	59.6	17.667	17.572	-39	00	48	39.013		11.115
δ CASSIOPEIAE	1	23	26.6	1.391	10.596	+60	02	56	60.049	1.716	8.284
β ARIETIS	1	52	38.8	1.878	10.805	+20	37	58	20.633	0.589	9.411
α CETI	3	00	23.7	3.007	11.289	+ 3	56	59	3.949	0.113	9.887
η TAURI	3	45	20.4	3.756	11.610	+23	59	43	23.995	-0.686	9.314
ζ PERSEI	3	51	51.8	3.864	11.656	+31	46	42	31.779	-0.908	9.092
ε PERSEI	3	55	25.9	3.924	11.682	+39	54	28	39.908	-1.140	8.860
ι AURIGAE	4	54	38.8	4.911	12.105	+33	06	39	33.111	-0.946	9.054
β ERIDANI	5	06	04.7	5.101	12.186	- 5	07	54	5.132		10.147
β LEPORIS	5	26	42.1	5.445	12.334	-20	47	13	20.787		10.594
α LEPORIS	5	31	08.5	5.519	12.365	-17	50	48	17.846		10.510
ι ORIONIS	5	33	40.3	5.561	12.383	- 5	55	56	5.933		10.170
ζ TAURI	5	35	29.5	5.591	12.396	+21	07	20	21.123	-0.603	9.397

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FOR STAR MAGNITUDES OF 3.8 AND GREATER (cont)

STARS FOR THIRD MAGNITUDE - Continued

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
α COLUMBAE	5h 38' 20.7"	5.639h	12.417"	-34° 05' 32"	34.092°		10.974"
θ AURGAE	5 57 15.9	5.954	12.552	+37 12 43	37.212	-1.063"	8.937
τ PUPPIS	6 49 02.5	6.818	12.922	-50 34 16	50.571		11.445
π PUPPIS	7 15 52.3	7.264	13.113	-37 01 55	37.032		11.058
ρ PUPPIS	8 06 00.6	8.100	13.471	-24 11 58	24.199		10.691
κ VELORUM	9 20 59.9	9.350	14.007	-54 51 23	54.856		11.567
γ' LEONIS	10 17 59.4	10.299	14.414	+20 01 28	20.025	-0.572	9.428
μ VELORUM	10 45 13.0	10.754	14.609	-49 13 46	49.230		11.407
δ LEONIS	11 12 11.8	11.203	14.801	+20 43 16	20.721	-0.592	9.408
γ CORVI	12 13 57.1	12.233	15.243	-17 20 32	17.342		10.495
β CORVI	12 32 29.5	12.541	15.375	-23 11 52	23.197		10.663
α MUSCAE	12 35 01.0	12.583	15.393	-68 56 15	68.937		11.970
γ VIRGINIS	12 39 50.0	12.664	15.427	- 1 15 08	1.252		10.036
α² CANUM VENAT	12 54 20.8	12.906	15.531	+38 30 44	38.512	-1.100	8.900
ε VIRGINIS	13 00 23.0	13.006	15.574	+11 09 08	11.152	-0.319	9.681
ι CENTAURI	13 18 34.0	13.309	15.704	-36 31 23	36.523		11.043
ε CENTAURI	13 37 35.6	13.627	15.840	-53 17 03	53.284		11.522
η BOOTIS	13 52 58.2	13.883	15.950	+18 34 39	18.578	-0.531	9.469
γ BOOTIS	14 30 37.7	14.511	16.219	+38 27 54	38.465	-1.099	8.901
η CENTAURI	14 33 12.7	14.554	16.237	-42 00 03	42.001		11.200
α LUPI	14 39 31.5	14.659	16.282	-47 14 06	47.235		11.350
ε BOOTIS	14 43 24.8	14.724	16.310	+27 13 30	27.225	-0.778	9.222
α² LIBRAE	14 48 52.9	14.815	16.349	-15 53 36	15.893		10.454
β LUPI	14 56 09.8	14.936	16.401	-42 59 25	42.990		11.228
β LIBRAE	15 15 04.0	15.251	16.536	- 9 15 05	9.251		10.264
γ LUPI	15 32 44.0	15.542	16.661	-41 02 50	41.047		11.173
α SERPENTIS	15 42 29.5	15.708	16.732	+ 6 32 15	6.537	-0.187	9.813
π SCORPII	15 56 40.1	15.944	16.833	-26 00 43	26.012		10.743
β' SCORPII	16 03 20.4	16.056	16.881	-19 42 30	19.708		10.563
η DRACONIS	16 23 29.9	16.391	17.025	+61 35 43	61.595	-1.760	8.240
β HERCULIS	16 28 40.2	16.478	17.062	+21 34 00	21.567	-0.616	9.384
τ SCORPII	16 33 38.2	16.561	17.098	-28 08 35	28.143		10.804
ζ OPHIUCHI	16 35 10.4	16.586	17.108	-10 29 45	10.496		10.300
ζ HERCULIS	16 39 55.7	16.666	17.143	+31 40 01	31.667	-0.905	9.095
η OPHIUCHI	17 08 18.6	17.138	17.348	-15 40 55	15.682		10.448
β ARAE	17 22 18.1	17.372	17.445	-55 29 54	55.498		11.586
ν SCORPII	17 28 18.8	17.472	17.488	-37 16 09	37.269		11.065
α ARAE	17 29 03.3	17.484	17.493	-49 50 59	49.849		11.424
β DRACONIS	17 29 37.0	17.493	17.497	+52 19 38	52.328	-1.495	8.505

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

STAR	RIGHT ASCENSION			HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
STARS FOR THIRD MAGNITUDE SYMBOLIZATION - Continued											
β OPHIUCHI	17h	41'	41.5"	17.695h	17.584"	+ 4°	34'	51"	4.581°	-0.131"	9.869"
δ SAGITTARII	18	18	41.3	18.311	17.848	-29	50	43	29.845		10.853
λ SAGITTARII	18	25	44.9	18.430	17.899	-25	26	36	25.443		10.727
ζ SAGITTARII	19	00	19.3	19.005	18.145	-29	56	01	29.933		10.855
δ CYGNI	19	43	50.9	19.731	18.456	+45	02	31	45.042	-1.287	8.713
γ AQUILAE	19	44	32.8	19.742	18.461	+10	31	27	10.525	-0.301	9.699
ε CYGNI	20	44	45.2	20.746	18.891	+33	50	04	33.834	-0.967	9.033
α CEPHEI	21	17	43.2	21.295	19.126	+62	25	27	62.425	-1.783	8.217
δ CAPRICORNI	21	45	03.3	21.751	19.322	-16	17	30	16.292		10.465
α TUCANAE	22	16	03.0	22.268	19.543	-60	26	23	60.439		11.727
β PEGASI	23	02	01.5	23.034	19.872	+27	53	14	27.887	-0.797	9.203
α PEGASI	23	02	57.9	23.049	19.878	+15	00	40	15.011	-0.429	9.571
α HYDRI	1	57	38.1	1.961	10.840	-61	44	40	61.744		11.764
ο CETI	2	17	31.5	2.292	10.982	- 3	08	25	3.140		10.090
β PERSEI	3	05	49.1	3.097	11.327	+40	49	06	40.819	-1.166	8.834
N VELORUM	9	30	07.6	9.502	14.072	-56	52	30	56.875		11.625
θ CARINAE	10	41	40.1	10.694	14.583	-64	12	20	64.206		11.834
δ CENTAURI	12	06	29.0	12.108	15.189	-50	31	19	50.522		11.443
β TRIANGULI AUST	15	51	57.1	15.866	16.800	-63	19	18	63.322		11.809
ζ AQUILAE	19	03	45.3	19.063	18.170	+13	48	31	13.809	-0.395	9.605
π SAGITTARII	19	07	37.4	19.127	18.197	-21	04	57	21.083		10.602
δ OPHIUCHI	16	12	27.4	16.208	16.946	- 3	36	11	3.603		10.103
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION											
δ ANDROMEDAE	0h	37'	23.8"	0.624h	10.267"	+30°	39'	51"	30.664°	-0.876"	9.124"
β PHOENICIS	1	04	28.8	1.075	10.461	-46	54	40	46.911		11.340
γ PHOENICIS	1	26	48.2	1.446	10.620	-43	30	08	43.502		11.243

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

FOR STAR MAGNITUDES OF 3.8 AND GREATER (cont)

STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
ϵ CASSIOPEIAE	1^h 51' 47.0"	1.863^h	10.798"	+63° 29' 38"	63.494°	-1.814"	8.186"
β TRIANGULI	2 07 23.6	2.124	10.910	+34 49 04	34.818	-0.994	9.006
θ ERIDANI	2 56 53.7	2.948	11.263	-40 26 53	40.448		11.156
γ PERSEI	3 02 10.5	3.036	11.301	+53 22 01	53.367	-1.525	8.475
δ PERSEI	3 40 21.1	3.673	11.574	+47 40 27	47.675	-1.362	8.638
γ HYDRI	3 47 46.6	3.796	11.627	-74 20 59	74.349		12.124
γ ERIDANI	3 56 20.9	3.939	11.688	-13 36 35	13.610		10.389
α RETICULI	4 13 57.4	4.233	11.814	-62 33 49	62.564		11.787
α DORADUS	4 33 13.0	4.554	11.952	-55 07 08	55.119		11.575
π^3 ORIONIS	4 47 53.0	4.798	12.056	+ 6 54 00	6.900	-0.197	9.803
η AURIGAE	5 03 59.2	5.066	12.171	+41 11 16	41.187	-1.177	8.823
ϵ LEPORIS	5 03 56.2	5.066	12.171	-22 25 06	22.419		10.641
μ LEPORIS	5 11 18.8	5.188	12.223	-16 14 49	16.247		10.464
η ORIONIS	5 22 40.0	5.378	12.305	- 2 25 43	2.429		10.069
β COLUMBAE	5 49 41.4	5.828	12.498	-35 46 51	35.781		11.022
ζ CANIS MAJORIS	6 18 55.8	6.316	12.707	-30 02 47	30.046		10.858
μ GEMINORUM	6 20 47.0	6.346	12.720	+22 32 01	22.533	-0.644	9.356
ν PUPPIS	6 36 39.5	6.611	12.833	-43 09 49	43.164		11.233
ϵ GEMINORUM	6 41 43.1	6.695	12.869	+25 10 06	25.169	-0.719	9.281
ξ GEMINORUM	6 43 16.1	6.721	12.880	+12 56 09	12.935	-0.370	9.630
o^2 CANIS MAJORIS	7 01 31.3	7.026	13.011	-23 46 47	23.780		10.679
β CANIS MINORIS	7 25 11.9	7.420	13.180	+ 8 21 48	8.363	-0.239	9.761
σ PUPPIS	7 28 05.3	7.468	13.201	-43 13 40	43.228		11.235
ξ PUPPIS	7 47 46.8	7.796	13.341	-24 46 06	24.769		10.708
o URSAE MAJORIS	8 27 17.4	8.455	13.624	+60 50 25	60.840	-1.738	8.262
ϵ HYDRAE	8 44 52.3	8.747	13.749	+ 6 33 07	6.552	-0.187	9.813
ζ HYDRAE	8 53 29.5	8.891	13.810	+ 6 05 01	6.083	-0.174	9.826
ι URSAE MAJORIS	8 56 45.1	8.946	13.834	+48 11 03	48.184	-1.377	8.623
α LYNCIS	9 18 52.0	9.314	13.992	+34 32 45	34.546	-0.987	9.013
θ URSAE MAJORIS	9 30 27.6	9.508	14.075	+51 50 33	51.842	-1.481	8.519
ϵ LEONIS	9 43 48.7	9.731	14.170	+23 56 27	23.941	-0.684	9.316
υ CARINAE	9 46 12.2	9.770	14.187	-64 54 16	64.904		11.854
187 G. CARINAE	10 15 52.7	10.264	14.399	-61 09 07	61.152		11.747
μ URSAE MAJORIS	10 20 11.5	10.336	14.430	+41 40 52	41.681	-1.191	8.809
ν HYDRAE	10 47 50.8	10.797	14.627	-16 00 17	16.005		10.457
ψ URSAE MAJORIS	11 07 38.8	11.128	14.769	+44 41 39	44.694	-1.277	8.723
θ LEONIS	11 12 21.1	11.206	14.803	+15 37 36	15.627	-0.446	9.554

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FOR STAR MAGNITUDES OF 3.8 AND GREATER (cont)

STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
λ CENTAURI	11h 34' 06.7"	11.569h	14.958"	-62° 49' 14"	62.821°		11.795"
ε CORVI	12 08 16.2	12.137	15.202	-22 25 11	22.420		10.641
δ CRUCIS	12 13 13.3	12.221	15.238	-58 32 56	58.549		11.673
δ URSAE MAJORIS	12 13 39.1	12.228	15.241	+57 13 57	57.233	-1.635"	8.365
δ CORVI	12 27 59.9	12.467	15.343	-16 18 55	16.315		10.466
β MUSCAE X	12 44 03.2	12.734	15.457	-67 54 41	67.911		11.940
γ HYDRAE	13 16 57.6	13.283	15.693	-22 58 56	22.983		10.657
ζ VIRGINIS	13 32 51.4	13.547	15.806	- 0 24 45	0.413		10.012
ν CENTAURI	13 47 20.2	13.789	15.910	-41 30 33	41.509		11.186
μ CENTAURI	13 47 26.3	13.790	15.910	-42 17 42	42.295		11.208
ζ CENTAURI	13 53 17.0	13.888	15.952	-47 06 43	47.112		11.346
π HYDRAE	14 04 18.9	14.072	16.031	-26 30 36	26.510		10.757
α CIRCINI	14 39 34.4	14.659	16.282	-64 49 12	64.820		11.852
κ CENTAURI	14 56 48.6	14.947	16.406	-41 57 40	41.961		11.199
σ LIBRAE	15 01 57.4	15.033	16.443	-25 08 30	25.141		10.718
ζ LUPI	15 09 41.2	15.161	16.498	-51 57 49	51.964		11.485
ν TRIANGULI AUST	15 15 31.2	15.259	16.540	-68 32 54	68.548		11.958
δ LUPI	15 19 00.1	15.317	16.564	-40 31 07	40.519		11.158
γ URSAE MINORIS	15 20 46.2	15.346	16.577	+71 57 43	71.962	-2.056	7.944
ι DRACONIS	15 24 07.5	15.402	16.601	+59 05 29	59.091	-1.688	8.312
ε OPHIUCHI	16 16 24.8	16.274	16.975	- 4 36 22	4.606		10.132
σ SCORPII	16 18 59.7	16.317	16.993	-25 30 29	25.508		10.729
μ' SCORPII	16 49 25.6	16.824	17.210	-37 59 15	37.987		11.085
ζ ARAE	16 55 38.0	16.928	17.255	-55 56 08	55.935		11.598
κ OPHIUCHI	16 55 57.7	16.933	17.257	+ 9 25 46	9.430	-0.269	9.731
ζ DRACONIS	17 08 40.7	17.144	17.347	+65 45 32	65.759	-1.879	8.121
η SCORPII	17 09 34.2	17.159	17.354	-43 11 37	43.193		11.234
α HERCULIS	17 13 00.3	17.217	17.379	+14 25 48	14.430	-0.412	9.588
δ HERCULIS	17 13 33.1	17.226	17.383	+24 52 49	24.881	-0.711	9.289
π HERCULIS	17 13 47.5	17.230	17.384	+36 50 55	36.848	-1.053	8.947
θ OPHIUCHI	17 19 47.8	17.330	17.427	-24 57 55	24.965		10.713
γ ARAE	17 22 21.5	17.373	17.446	-56 20 46	56.346		11.610
ι' SCORPII	17 45 03.9	17.751	17.608	-40 06 54	40.115		11.146
μ HERCULIS	17 45 02.9	17.751	17.608	+27 44 26	27.740	-0.793	9.207
G SCORPII	17 47 24.4	17.790	17.624	-37 02 01	37.033		11.058
ν OPHIUCHI	17 57 02.6	17.951	17.693	- 9 46 15	9.771		10.279
γ SAGITTARII	18 03 29.6	18.058	17.739	-30 25 35	30.427		10.869

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FOR STAR MAGNITUDES OF 3.8 AND GREATER (cont)

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued							
η SAGITTARII	18h 15' 11.4"	18.253h	17.823"	-36° 36' 28"	36.608°		11.046"
η SERPENTIS	18 19 26.7	18.325	17.854	- 2 54 35	2.910		10.083
ϕ SAGITTARII	18 43 24.4	18.724	18.025	-27 01 46	27.030		10.772
γ LYRAE	18 57 35.7	18.960	18.126	+32 38 20	32.639	-0.932	9.068
λ AQUILAE	19 04 20.2	19.073	18.174	- 4 56 17	4.938		10.141
τ SAGITTARII	19 04 41.6	19.079	18.177	-27 43 29	27.725		10.792
δ DRACONIS	19 12 33.0	19.209	18.232	+67 35 53	67.598	-1.931	8.069
δ AQUILAE	19 23 40.9	19.394	18.312	+ 3 02 30	3.041	-0.087	9.913
β' CYGNI	19 29 16.1	19.487	18.352	+27 52 58	27.883	-0.797	9.203
θ AQUILAE	20 09 26.8	20.158	18.639	- 0 55 46	0.930		10.027
β CAPRICORNI	20 18 59.4	20.317	18.707	-14 53 47	14.896		10.426
α INDI	20 35 02.5	20.584	18.822	-47 25 07	47.419		11.355
ζ CYGNI	21 11 24.1	21.190	19.081	+30 04 42	30.079	-0.859	9.141
β CEPHEI	21 28 12.1	21.470	19.201	+70 24 09	70.402	-2.011	7.989
β AQUARI	21 29 39.8	21.494	19.212	- 5 43 50	5.731		10.164
γ GRUIS	21 51 45.3	21.863	19.370	-37 32 06	37.535		11.072
λ AQUARI	22 03 56.1	22.066	19.457	- 0 29 44	0.495		10.014
η PEGASI	22 41 18.7	22.688	19.723	+30 01 57	30.033	-0.858	9.142
δ AQUARII	22 52 44.4	22.879	19.805	-16 00 46	16.013		10.457
α PICTORIS	6 47 49.3	6.797	12.913	-61 54 09	61.902		11.769
δ GEMINORUM	7 17 58.5	7.299	13.128	+22 03 01	22.050	-0.630	9.370
λ URSAE MAJORIS	10 14 56.0	10.249	14.392	+43 05 41	43.094	-1.231	8.769
δ BOOTIS	15 14 03.0	15.234	16.529	-33 26 53	33.448		10.956
ι CETI	0 17 35.6	0.293	10.126	- 9 01 24	9.024		10.258
ζ CASSIOPEIAE	0 34 57.2	0.583	10.250	+53 41 57	53.699	-1.534"	8.466
η CASSIOPEIAE	0 46 54.3	0.782	10.335	+57 37 31	57.626	-1.646	8.354
η CETI	1 06 46.7	1.113	10.477	-10 22 21	10.373		10.296
θ CETI	1 22 13.3	1.371	10.588	- 8 22 07	8.369		10.239

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FOR STAR MAGNITUDES OF 3.8 AND GREATER (cont)

STARS FOR FOURTH MAGNITUDE SYNTHESIZATION - Continued

STAR	RIGHT ASCENSION HOURS			PLOT	DECLINATION DEGREES			INCHES	PLOT
η PISCUM	1^h	29'	33.2"	1.492^h	10.639"	+15°	09'	39"	15.161°	-0.433"	9.567"
51 ANDROMEDAE	1	35	46.3	1.596	10.684	+48	26	48	48.446	-1.384	8.616
τ CETI	1	42	23.7	1.706	10.731	-16	07	35	16.127		10.461
α TRIANGULI	1	51	01.4	1.850	10.793	+29	24	15	29.404	-0.840	9.160
χ ERIDANI	1	54	33.5	1.909	10.818	-51	47	15	51.787		11.480
ϕ ERIDANI	2	15	13.4	2.254	10.966	-51	40	42	51.679		11.476
γ CETI	2	41	26.0	2.690	11.153	+ 3	05	06	3.085	-0.088	9.912
41 ARIETIS	2	47	51.5	2.797	11.199	+27	06	48	27.113	-0.775	9.225
ρ PERSEI	3	02	51.7	3.047	11.306	+38	42	08	28.702	-0.820	9.180
o TAURI	3	22	52.4	3.381	11.449	+ 8	54	12	8.903	-0.254	9.746
ξ TAURI	3	25	12.9	3.421	11.466	+ 9	36	31	9.609	-0.275	9.725
ϵ ERIDANI	3	31	14.0	3.521	11.509	- 9	34	44	9.579		10.274
δ ERIDANI	3	41	31.3	3.692	11.582	- 9	53	03	9.884		10.282
17 TAURI	3	42	44.0	3.712	11.591	+24	00	06	24.002	-0.686	9.314
β RETICULI	3	43	44.5	3.729	11.598	-64	55	12	64.920		11.855
27 TAURI	3	47	01.0	3.783	11.621	+23	56	41	23.944	-0.684	9.316
α HOROLGII	4	12	48.4	4.213	11.806	-42	22	56	42.383		11.211
41 ERIDANI	4	16	31.9	4.276	11.833	-33	53	07	33.885		10.968
ϵ TAURI	4	26	30.7	4.442	11.904	+19	06	08	19.102	-0.546	9.454
θ^2 TAURI	4	26	36.2	4.443	11.904	+15	47	33	15.792	-0.451	9.549
π^4 ORIONIS	4	49	17.2	4.822	12.067	+ 5	32	42	5.545	-0.158	9.842
ϵ AURIGAE	4	59	22.9	4.989	12.138	+43	46	19	43.772	-1.251	8.749
τ ORONIS	5	15	51.4	5.264	12.256	- 6	52	55	6.882		10.197
λ ORONIS	5	33	09.2	5.552	12.379	+ 9	54	41	9.911	-0.283	9.717
σ ORONIS	5	36	56.3	5.616	12.407	- 2	37	10	2.620		10.075
γ LEPORIS	5	42	57.7	5.716	12.450	-22	27	32	22.459		10.642
ζ LEPORIS	5	45	19.4	5.755	12.466	-14	50	03	14.834		10.424
η LEPORIS	5	54	45.9	5.913	12.534	-14	10	23	14.173		10.405
η GEMINORUM	6	12	42.2	6.212	12.662	+22	31	08	22.519	-0.643	9.357
κ CANIS MAJORIS	6	18	29.7	6.808	12.918	-32	27	57	32.466		10.928
θ GEMINORUM	6	50	25.1	6.840	12.931	+34	00	23	34.006	-0.972	9.028
σ CANIS MAJORIS	7	00	17.1	7.005	13.002	-27	52	56	27.883		10.797
l^2 PUPPIS	7	12	26.3	7.207	13.089	-44	34	49	44.581		11.274
ω CANIS MAJORIS	7	13	21.0	7.223	13.096	-26	42	33	26.709		10.763
λ GEMINORUM	7	16	01.5	7.267	13.114	+16	36	24	16.607	-0.474	9.526
κ GEMINORUM	7	42	16.6	7.704	13.302	+24	29	09	24.485	-0.700	9.300
c PUPPIS	7	43	58.3	7.733	13.314	-37	52	49	37.881		11.082

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FOR STAR MAGNITUDES OF 3.8 AND GREATER (cont.)

STAR	RIGHT ASCENSION HOURS			PLOT		DECLINATION DEGREES				INCHES	PLOT
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued											
α PUPPIS	7h	50'	58.7"	7.849h	13.364"	-40°	28'	56"	40.483°		11.157"
x CARINAE	7	55	51.8	7.931	13.399	-52	53	06	52.885		11.511
β CANCRI	8	14	33.8	8.242	13.532	+ 9	17	52	9.297	-0.266"	9.734
β VOLANTIS	8	25	21.1	8.423	13.610	-66	00	59	66.016		11.886
o VELORUM	8	39	15.7	8.654	13.709	-52	47	37	52.793		11.508
α PYXIDIS	8	42	08.7	8.702	13.729	-33	03	20	33.056		10.944
κ URSAE MAJORIS	9	01	10.6	9.020	13.866	+47	18	01	47.300	-1.351	8.649
c VELORUM	9	02	54.7	9.048	13.878	-46	57	14	46.954		11.341
α CARINAE	9	10	01.1	9.167	13.929	-58	49	09	58.819		11.680
θ HYDRAE	9	12	29.5	9.208	13.946	+ 2	28	01	2.467	-0.070	9.930
38 LYNCIS	9	16	36.6	9.277	13.976	+36	57	22	36.956	-1.056	8.944
23 URSAE MAJORIS	9	28	42.7	9.479	14.062	+63	13	14	63.221	-1.806	8.194
ψ VELORUM	9	29	16.8	9.488	14.066	-40	18	30	40.308		11.152
o LEONIS	9	39	13.8	9.654	14.137	+10	03	25	10.057	-0.287	9.713
ϕ VELORUM	9	55	35.8	9.927	14.254	-54	23	45	54.396		11.545
η LEONIS	10	05	22.3	10.089	14.324	+16	56	20	16.939	-0.484	9.516
λ HYDRAE	10	08	49.9	10.147	14.349	-12	10	32	12.176		10.348
ω CARINAE	10	12	53.1	10.215	14.378	-69	51	32	69.859		11.996
ζ LEONIS	10	14	41.5	10.244	14.390	+23	35	50	23.597	-0.674	9.326
P CARINAE	10	30	44.4	10.512	14.505	-61	29	59	61.499		11.757
ρ LEONIS	10	30	55.0	10.515	14.506	+ 9	29	33	9.492	-0.271	9.729
ν URSAE MAJORIS	11	16	32.3	11.276	14.833	+33	17	27	33.291	-0.951	9.049
δ CRATERIS	11	17	32.3	11.292	14.839	-14	35	01	14.583		10.417
ζ HYDRAE	11	31	13.6	11.521	14.938	-31	39	30	31.658		10.904
λ MUSCAE	11	43	53.8	11.732	15.028	-66	31	45	66.530		11.901
x URSAE MAJORIS	11	44	09.3	11.735	15.029	+47	58	44	47.979	-1.371	8.629
β VIRGINIS	11	48	49.2	11.814	15.063	+ 1	58	03	1.968	-0.056	9.944
e CRUCIS	12	19	24.2	12.324	15.282	-60	12	09	60.202		11.720
δ VIRGINIS	12	53	47.3	12.896	15.527	+ 3	35	34	3.592	-0.103	9.897
δ MUSCAE	12	59	46.0	12.996	15.570	-71	21	19	71.355		12.039
R HYDRAE	13	27	44.4	13.462	15.769	-23	05	45	23.096		10.660
α DRACONIS	14	03	24.8	14.057	16.024	+64	32	51	64.547	-1.844	8.156
ρ BOOTIS	14	30	16.7	14.504	16.216	+30	31	43	30.529	-0.872	9.128
109 VIRGINIS	14	44	25.6	14.740	16.317	+ 2	02	36	2.043	-0.058	9.942
β BOOTIS	15	00	35.3	15.010	16.433	+40	31	54	40.532	-1.158	8.842
ϕ LUPI	15	19	30.9	15.325	16.568	-36	07	56	36.133		11.032
e LUPI	15	20	13.6	15.337	16.573	-44	33	41	44.561		11.273

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FOR STAR MAGNITUDES OF 3.8 AND GREATER (cont)

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued							
β CORONAE BOR	15^h 26' 20.6"	15.439^h	16.617"	+29° 13' 43"	29.229°	-0.835"	9.165"
υ LIBRAE	15 34 50.0	15.581	16.678	-28 01 02	28.018		10.800
τ LIBRAE	15 36 26.4	15.607	16.689	-29 39 39	29.661		10.847
β SERPENTIS	15 44 31.5	15.742	16.747	+15 31 59	15.533	-0.444	9.556
μ SERPENTIS	15 47 44.3	15.795	16.769	- 3 19 17	3.322		10.095
ϵ SERPENTIS	15 49 01.1	15.817	16.779	+ 4 35 05	4.584	-0.131	9.869
η LUPI	15 57 43.7	15.962	16.841	-38 17 44	38.295		11.094
γ HERCULIS	16 20 19.8	16.339	17.002	+19 14 11	19.236	-0.550	9.450
λ OPHIUCHI	16 29 05.8	16.485	17.065	+ 2 03 41	2.061	-0.059	9.941
η HERCULIS	16 41 39.6	16.694	17.155	+38 59 23	38.989	-1.114	8.886
η ARAE	16 46 40.0	16.778	17.191	-58 58 46	58.980		11.685
μ^2 SCORPII	16 49 53.5	16.832	17.214	-37 57 29	37.958		11.084
ζ SCORPII	16 52 02.7	16.868	17.229	-42 18 06	42.302		11.209
δ ARAE	17 27 50.6	17.464	17.485	-60 39 22	60.656		11.733
ξ SERPENTIS	17 35 31.4	17.592	17.539	-15 22 40	15.378		10.439
ι HERCULIS	17 38 26.8	17.640	17.560	+46 01 28	46.025	-1.315	8.685
η PAVONIS	17 42 11.7	17.703	17.587	-64 42 34	64.709		11.849
γ OPHIUCHI	17 46 05.1	17.768	17.615	+ 2 43 10	2.720	-0.078	9.922
ξ HERCULIS	17 56 21.9	17.939	17.688	+29 15 02	29.251	-0.836	9.164
τ^2 OPHIUCHI	18 05 38.5	18.094	17.755	+ 9 33 26	9.557	-0.273	9.727
o HERCULIS	18 06 08.2	18.102	17.758	+28 45 23	28.756	-0.822	9.178
x DRACONIS	18 21 42.4	18.362	17.869	+72 43 03	72.718	-2.078	7.922
α TELESCOPII	18 24 18.2	18.405	17.888	-45 59 25	45.990		11.314
β'LYRAE	18 48 45.0	18.813	18.063	+33 19 11	33.320	-0.952	9.048
ξ^2 SAGITTARI	18 55 34.9	18.927	18.112	-21 09 21	21.156		10.604
δ SAGITTAE	19 45 46.9	19.763	18.470	+18 26 39	18.444	-0.527	9.473
η AQUILAE	19 50 38.3	19.844	18.505	+ 0 54 43	0.912	-0.026	9.974
γ SAGITTAE	19 57 09.3	19.952	18.551	+19 23 36	19.393	-0.554	9.446
δ PAVONIS	20 05 12.6	20.086	18.608	-66 16 34	66.276		11.894
α^2 CAPRICORNI	20 16 03.5	20.268	18.686	-12 39 28	12.658		10.362
β DELPHINI	20 35 51.6	20.597	18.827	+14 28 08	14.469	-0.413	9.587
β PAVONIS	20 41 44.1	20.695	18.869	-66 20 04	66.334		11.895
η CEPHEI	20 44 33.6	20.742	18.889	+61 41 55	61.698	-1.763	8.237
ϵ AQUARI	20 45 43.6	20.762	18.898	- 9 37 44	9.629		10.275
β INDI	20 52 00.6	20.869	18.944	-58 35 30	58.591		11.674
τ CYGNI	21 13 21.1	21.223	19.096	+37 53 28	37.891	-1.083	8.917
γ CAPRICORNI	21 38 05.9	21.634	19.272	-16 49 33	16.826		10.481

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued							
θ PEGASI	22^h 08' 23.0"	22.139^h	19.488"	+ 6° 01' 12"	6.020°	-0.172"	9.828"
ζ CEPHEI	22 09 36.1	22.160	19.497	+58 01 24	58.024	-1.658	8.342
δ CEPHEI	22 27 49.8	22.464	19.627	+58 13 50	58.231	-1.664	8.336
α LACERTAE	22 29 48.2	22.496	19.641	+50 05 49	50.097	-1.431	8.569
ζ PEGASI	22 39 39.9	22.661	19.712	+10 38 35	10.643	-0.304	9.696
ϵ GRUIS	22 46 23.3	22.773	19.760	-51 30 24	51.507		11.472
μ PEGASI	22 48 15.7	22.804	19.773	+24 24 40	24.411	-0.697	9.303
ι CEPHEI	22 48 23.5	22.807	19.774	+66 00 39	66.011	-1.886	8.114
λ AQUARI	22 50 44.2	22.845	19.791	- 7 46 18	7.772		10.222
o ANDROMEDAE	23 00 15.6	23.004	19.859	+42 07 56	42.133	-1.204	8.796
o^2 AQUARI	23 07 31.7	23.126	19.911	-21 22 05	21.368		10.610
γ PISCIUM	23 15 17.9	23.255	19.966	+ 3 05 07	3.085	-0.088	9.912

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued							
ϵ Phe	0^h 07' 35.3"	0.127h	10.054"	-45° 56' 46"	45.946°		11.313"
κ Phe	0 24 26.2	0.407	10.174	-43 52 46	43.880		11.254
μ And	0 54 44.8	0.913	10.391	+38 18 16	38.304	-1.094"	8.906
δ Phe	1 29 45.2	1.496	10.641	-49 15 34	49.259		11.407
ζ Cet	1 49 40.9	1.828	10.783	-10 30 44	10.512		10.300
δ Cet	2 37 38.1	2.628	11.126	+ 0 10 27	0.175	-0.005	9.995
η Per	2 48 03.3	2.801	11.200	+55 44 51	55.747	-1.593	8.407
η Eri	2 54 40.0	2.911	11.248	- 9 02 25	9.040		12.258
κ Per	3 07 03.5	3.118	11.336	+44 43 21	44.723	-1.278	8.722
α For	3 10 32.4	3.176	11.361	-29 07 41	29.128		10.832
16 Eri	3 17 54.9	3.298	11.413	-21 53 16	21.887		10.625
o Per	3 42 03.3	3.701	11.586	+32 10 32	32.176	-0.919	9.081
ν Per	3 42 44.4	3.712	11.591	+42 27 59	42.466	-1.213	8.787
17 Tau	3 43 40.8	3.728	11.598	+24 15 24	24.257	-0.693	9.307
ξ Per	3 56 37.4	3.943	11.690	+35 41 21	35.689	-1.020	8.980
λ Tau	3 58 41.0	3.978	11.705	+12 23 24	12.390	-0.354	9.646
ν Tau	4 01 14.3	4.021	11.723	+ 5 53 27	5.891	-0.168	9.832
48 Per	4 06 02.4	4.101	11.758	+47 37 06	47.619	-1.360	8.640
γ Tau	4 17 44.5	4.296	11.841	+15 32 32	15.542	-0.444	9.556
o Tau	4 20 51.3	4.347	11.863	+17 27 34	17.459	-0.499	9.501
θ Tau	4 26 30.9	4.442	11.904	+15 53 01	15.883	-0.454	9.546
υ Eri	4 34 09.0	4.569	11.958	-30 38 06	30.635		10.875
53 Eri	4 36 31.8	4.609	11.975	-14 22 23	14.373		10.411
π^{22} Ori	4 52 22.5	4.873	12.088	+ 2 22 59	2.383	-0.068	9.932
ζ Aur	4 59 57.5	4.999	12.142	+41 01 31	41.026	-1.172	8.828
ϵ Col	5 29 56.0	5.498	12.356	-35 29 46	35.496		11.014
β Pic	5 46 25.8	5.784	12.479	-51 04 44	51.079		11.459
δ Lep	5 49 46.4	5.830	12.499	-20 52 51	20.881		10.597
δ Aur	5 56 33.7	5.942	12.547	+54 17 03	54.284	-1.551	8.449
δ Col	6 20 47.8	6.346	12.720	-33 25 02	33.418		10.955
ζ Gem	7 01 58.5	7.033	13.014	+20 37 29	20.625	-0.589	9.411
γ^2 Vol	7 09 03.6	7.151	13.065	-70 26 27	70.441		12.012
δ Vol	7 16 51.2	7.281	13.120	-67 53 29	67.891		11.940
ι Gem	7 23 29.6	7.391	13.168	+27 52 16	27.871	-0.796	9.204
ζ Vol	7 42 16.6	7.705	13.302	-72 31 12	72.520		12.072
Br. 1197	8 23 51.7	8.397	13.599	- 3 47 16	3.787		10.108
β Pyx	8 38 41.6	8.645	13.705	-35 10 47	35.180		11.005

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued							
c Car	8h 54' 14.0"	8.904h	13.816"	-60° 30' 23"	60.506°		11.729"
υ U Ma	9 48 26.7	9.808	14.203	+59 12 33	59.209	-1.692"	8.308
46 L Mi	10 51 18.2	0.855	14.652	+34 24 34	34.409	-0.983	9.017
u Car	10 52 01.5	0.868	14.658	-58 39 43	58.662		11.676
260 G. Car	11 07 02.7	1.118	14.765	-58 46 48	58.780		11.679
ξ U Ma	11 16 16.0	1.271	14.830	+31 43 55	31.732	-0.907	9.093
ι Leo	11 22 02.9	1.368	14.872	+10 43 40	10.728	-0.306	9.694
η Vir	12 18 03.8	2.301	15.272	- 0 28 01	0.467		10.013
γ Mus	12 30 17.6	2.505	15.359	-71 56 04	71.934		12.055
κ Dra	12 31 57.4	2.533	15.371	+69 59 11	69.986	-2.000	8.000
τ Cen	12 35 43.4	2.595	15.398	-48 20 36	48.343		11.381
80 U Ma	13 23 47.2	3.396	15.741	+55 10 30	55.175	-1.576	8.424
d Cen	13 28 56.9	3.483	15.778	-39 13 20	39.223		11.121
φ Cen	13 56 04.4	3.934	15.972	-41 55 33	41.926		11.198
ζ Boo	14 39 25.7	4.657	16.282	+13 52 54	13.882	-0.397	9.603
μ Vir	14 41 09.6	4.686	16.294	- 5 30 10	5.503		10.157
π Lup	15 02 39.4	5.044	16.447	-46 54 42	46.912		11.340
γ Lib	15 33 30.5	5.559	16.668	-14 40 15	14.671		10.419
γ Cr B	15 41 13.8	5.687	16.723	+26 24 31	26.409	-0.755	9.245
ρ Sco	15 54 39.4	5.911	16.819	-29 06 38	29.111		10.832
γ Ser	15 54 47.3	5.913	16.820	+15 46 40	15.778	-0.451	9.549
o Tr A	16 12 08.7	6.202	16.944	-63 35 46	63.596		11.817
τ Her	16 18 39.4	6.311	16.990	+46 23 53	46.398	-1.326	8.674
γ Aps	16 27 52.0	6.464	17.056	-78 49 12	78.820		12.252
ε Her	16 58 54.6	6.982	17.278	+30 58 42	30.979	-0.885	9.115
ξ Dra	17 52 54.3	7.882	17.664	+56 52 40	56.878	-1.625	8.375
θ Her	17 55 01.0	7.917	17.679	+37 15 15	37.254	-1.064	8.936
67 Oph	17 58 50.4	7.981	17.706	+ 2 55 54	2.932	-0.084	9.916
θ Ara	18 03 49.6	8.064	17.742	-50 05 46	50.096		11.431
μ Sgr	18 11 36.5	8.193	17.797	-21 04 12	21.070		10.602
109 Her	18 22 09.7	8.370	17.873	+21 45 07	21.752	-0.621	9.379
o Sgr	19 02 31.6	9.042	18.161	-21 47 46	21.796		10.623
κ Cyg	19 16 16.2	9.271	18.259	+53 18 05	53.301	-1.523	8.477
υ Sgr	19 19 35.1	9.327	18.283	-17 55 00	17.917		10.512
ι Cyg	19 28 47.9	9.480	18.349	+51 39 08	51.652	-1.476	8.524
ε Dra	19 48 18.2	9.805	18.488	+70 10 35	70.177	-2.005	7.995
β Aql	19 53 32.6	9.892	18.525	+ 6 18 56	6.315	-0.180	9.820

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

STAR	RIGHT ASCENSION	HOURS	PLOT	DECLINATION	DEGREES	INCHES	PLOT
STARS FOR FOURTH MAGNITUDE SYMBOLIZATION - Continued							
η Cyg	19^h 54' 57.2"	9.916^h	18.535"	+34° 59' 12"	34.986°	-1.000"	9.000"
o^2 Cyg	20 12 29.8	0.208	18.661	+46 37 53	46.632	-1.332	8.668
ϵ Del	20 31 29.5	0.525	18.796	+11 10 47	11.180	-0.319	9.681
α Del	20 37 57.9	0.633	18.843	+15 47 02	15.784	-0.451	9.549
ν Cyg	20 55 49.7	0.931	18.970	+41 01 40	41.028	-1.172	8.828
ξ Cyg	21 03 37.1	1.060	19.026	+43 47 00	43.783	-1.251	8.749
ζ Cap	21 24 36.8	1.410	19.176	-22 34 06	22.569		10.645
ι Peg	22 05 19.9	2.089	19.467	+25 10 07	25.169	-0.719	9.281
γ Aqr	22 19 47.8	2.330	19.570	- 1 34 10	1.570		10.045
δ' Gru	22 27 07.4	2.452	19.622	-43 40 49	43.681		11.248
λ And	23 35 47.7	3.596	0.113	+46 15 47	46.263	-1.322	8.678
ω Psc	23 57 27.6	3.958	0.268	+ 6 39 50	6.664	-0.190	9.810
FIFTH MAGNITUDE STARS							
Psc	0^h 00' 06.8"	0.002^h	10.001"	- 6° 12' 51"	6.214°		10.178"
Cet	0 01 53.8	0.032	10.014	-17 32 11	17.536		10.501
Pse	0 03 29.5	0.058	10.025	- 5 54 32	5.909		10.169
Cet	0 12 48.7	0.214	10.092	-19 07 56	19.132		10.547
And	0 15 12.2	0.253	10.108	+38 28 55	38.482	-1.099"	8.901
And	0 16 26.4	0.274	10.117	+36 35 09	36.585	-1.045	8.955
Tuc	0 18 12.4	0.303	10.130	-65 05 11	65.086		11.860
Tuc	0 29 54.9	0.498	10.213	-63 09 50	63.164		11.805
Cas	0 30 56.2	0.515	10.221	+62 44 00	62.733	-1.792	8.208
And	0 34 57.1	0.583	10.250	+33 31 17	33.522	-0.958	9.042
And	0 36 38.8	0.611	10.262	+29 07 00	29.117	-0.832	9.168
Phe	0 39 37.6	0.661	10.283	-46 16 57	46.283		11.322
Phe	0 41 44.5	0.696	10.298	-57 39 37	57.660		11.647
Cas	0 42 42.5	0.712	10.305	+48 05 16	48.087	-1.374	8.627
And	0 45 25.5	0.757	10.324	+24 04 18	24.072	-0.688	9.312
Psc	0 46 48.7	0.781	10.335	+ 7 23 22	7.389	-0.211	9.789
And	0 47 49.2	0.797	10.342	+40 52 59	40.883	-1.168	8.832
And	0 55 16.3	0.922	10.395	+23 13 25	23.224	-0.664	9.336

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION		DEGREES	INCHES	PLOT
Scl	0h	56'	52.3"	0.947h	-29°	33'	06"	29.552°		10.844"
Psc	1	01	04.3	1.018	+ 7	41	48	7.696	-0.220"	9.780
H. Cep	1	03	27.5	1.058	+86	03	55	86.065	-2.459	7.541
Phe	1	06	52.5	1.115	-55	26	17	55.438		11.581
Eri	3	41	29.9	3.691	-37	25	35	37.427		11.069
And	1	07	24.1	1.124	+47	03	01	47.050	-1.344	8.656
Cas	1	08	53.8	1.148	+54	57	32	54.959	-1.570	8.430
Psc	1	09	40.3	1.161	+29	53	56	29.898	-0.854	9.146
Psc	1	11	47.3	1.196	+24	23	36	24.393	-0.697	9.303
Psc	1	17	28.9	1.291	+27	04	31	27.076	-0.774	9.226
And	1	34	40.5	1.578	+41	13	34	41.226	-1.178	8.822
Psc	1	39	33.3	1.659	+ 5	18	22	5.306	-0.152	9.848
Per	1	41	23.5	1.690	+50	30	29	50.508	-1.443	8.557
Psc	1	43	29.3	1.725	+ 8	58	32	8.978	-0.257	9.743
Ari	1	51	33.0	1.859	+19	07	05	19.118	-0.546	9.454
Phe	1	52	12.2	1.870	-46	28	43	46.479		11.328
Hyi	1	54	01.2	1.900	-67	49	26	67.824		11.938
-47°597	1	55	44.4	1.929	-47	33	38	47.561		11.359
Cet	1	58	18.5	1.972	-21	15	06	21.252		10.607
Cas	1	58	57.8	1.983	+70	44	01	70.733	-2.021	7.979
Cas	2	00	19.2	2.005	+72	14	54	72.248	-2.064	7.936
Psc	2	00	10.9	2.003	+ 2	35	26	2.590	-0.074	9.926
For	2	02	52.6	2.048	-29	28	08	29.469		10.842
Cet	2	11	05.3	2.184	+ 8	40	44	8.679	-0.248	9.752
Tri	2	15	10.0	2.253	+33	40	54	33.682	-0.962	9.038
Hyi	2	21	06.1	2.352	-68	49	23	68.823		11.966
Cas	2	26	04.3	2.434	+67	14	31	67.242	-1.921	8.079
Eri	2	25	39.9	2.428	-47	51	53	47.865		11.368
Cet	2	26	14.5	2.437	+ 8	17	59	8.299	-0.237	9.763
Eri	2	38	25.6	2.640	-43	02	44	43.045		11.230
Eri	2	39	14.8	2.654	-40	00	32	40.009		11.143
Hyi	2	39	01.7	2.651	-68	25	15	68.421		11.955
Ari	2	41	20.0	2.688	+27	33	18	27.555	-0.787	9.213
Per	2	41	43.7	2.695	+49	04	39	49.078	-1.402	8.598
Cet	2	42	24.5	2.707	-14	00	37	14.010		10.400
Cet	2	42	59.5	2.717	+ 9	57	47	9.963	-0.285	9.715

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION			HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
Eri	2^h	43'	25.3"	2.724^h	11.167"	-18°	43'	26"	18.724°		10.535"
Ari	2	45	45.5	2.763	11.184	+29	05	56	29.098	-0.831"	9.169
For	2	47	35.0	2.793	11.197	-32	33	23	32.556		10.930
Per	2	48	18.2	2.805	11.202	+38	10	18	38.172	-1.091	8.909
Per	2	49	17.4	2.822	11.209	+34	54	46	34.913	-0.997	9.003
Per	2	51	41.5	2.862	11.227	+52	37	00	52.617	-1.503	8.497
Hyi	2	50	41.0	2.844	11.219	-75	12	51	75.214		12.149
Per	2	56	27.1	2.941	11.260	+39	31	12	39.520	-1.129	8.871
Ari	2	57	08.9	2.952	11.265	+21	11	51	21.197	-0.606	9.394
Cet	2	57	46.9	2.963	11.270	+ 8	45	54	8.765	-0.250	9.750
Eri	3	00	48.2	3.013	11.291	-23	45	53	23.765		10.679
Per	3	06	27.4	3.108	11.332	+49	28	39	49.478	-1.414	8.586
Ari	3	09	34.0	3.159	11.354	+19	35	30	19.591	-0.560	9.440
+28°516	3	18	09.4	3.302	11.415	+28	55	09	28.919	-0.826	9.174
82 G. Eri	3	18	29.5	3.308	11.418	-43	12	24	43.207		11.234
H. Cam	3	26	08.2	3.435	11.472	+59	49	00	59.817	-1.709	8.291
Per	3	26	47.0	3.446	11.477	+49	23	09	49.385	-1.411	8.589
Per	3	28	01.6	3.468	11.486	+47	52	21	47.873	-1.368	8.632
Tau	3	28	52.9	3.482	11.492	+12	48	52	12.814	-0.366	9.634
Eri	3	32	11.8	3.536	11.515	-21	45	09	21.752		10.621
Per	3	33	55.3	3.565	11.528	+48	04	28	48.075	-1.374	8.626
Tau	3	35	02.0	3.584	11.536	+ 0	17	19	0.288	-0.008	9.992
Eri	3	35	48.1	3.596	11.541	-40	23	31	40.392		11.154
Tau	3	44	11.1	3.736	11.601	+23	50	15	23.837	-0.681	9.319
Eri	3	44	26.3	3.740	11.603	-12	12	48	12.213		10.349
Eri	3	45	17.9	3.755	11.609	-23	21	18	23.355		10.667
+65°369	3	46	12.2	3.770	11.616	+65	25	01	65.417	-1.869	8.131
Cam	3	46	31.5	3.776	11.618	+71	13	26	71.224	-2.035	7.965
Eri	3	48	06.3	3.802	11.629	-36	18	30	36.308		11.037
Eri	3	58	23.3	3.973	11.703	-24	07	03	24.118		10.689
Ret	3	58	10.3	3.970	11.701	-61	30	05	61.501		11.757
Ret	4	00	22.3	4.006	11.717	-62	15	34	62.259		11.779
Tau	4	02	33.8	4.042	11.732	+21	59	06	21.985	-0.628	9.372
Per	4	03	53.6	4.065	11.742	+50	15	20	50.256	-1.436	8.564
Eri	4	10	06.4	4.169	11.787	- 6	55	49	6.931		10.198
Per	4	12	14.8	4.204	11.802	+48	19	11	48.320	-1.381	8.619
Tau	3	43	03.6	3.718	11.593	+24	21	20	24.356	-0.696	9.304

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION		DEGREES	INCHES	PLOT
	4h	13' 34.6"	4.227h	11.812"	+ 8°	48' 13"	8.804°	-0.252"	9.748"
Tau	4	13 36.8	4.227	11.812	- 7	42 28	7.708		10.220
Eri	4	15 31.7	4.259	11.825	+50	12 32	50.209	-1.434	8.566
Per	4	15 04.9	4.251	11.822	-51	34 36	51.577		11.474
Dor	4	15 51.5	4.264	11.827	-59	23 17	59.388		11.697
Ret	4	22 41.0	4.378	11.876	-34	05 58	34.099		10.974
Eri	5	58 15.2	5.971	12.559	- 3	04 27	3.075		10.088
-3°1256	4	23 13.2	4.387	11.880	+22	12 47	22.213	-0.635	9.365
Tau	4	23 24.2	4.390	11.881	+17	50 50	17.847	-0.510	9.490
Tau	4	24 09.0	4.402	11.887	+22	44 00	22.733	-0.649	9.351
Tau	4	24 17.5	4.405	11.888	+15	32 17	15.538	-0.444	9.556
Tau	4	31 48.1	4.530	11.941	+14	46 13	14.771	-0.422	9.578
Eri	4	32 05.6	4.535	11.944	-29	50 18	29.838		10.852
Tau	4	33 40.4	4.561	11.955	+10	05 18	10.088	-0.288	9.712
Per	4	34 11.4	4.570	11.959	+41	11 33	41.192	-1.177	8.823
Eri	4	34 31.1	4.576	11.961	- 3	25 29	3.425		10.098
Tau	4	36 08.6	4.602	11.972	+12	26 24	12.440	-0.355	9.645
Eri	4	38 51.9	4.647	11.992	-19	44 22	19.739		10.564
Cae	4	39 24.0	4.657	11.996	-41	55 54	41.932		11.198
Tau	4	40 04.9	4.668	12.001	+22	53 22	22.889	-0.654	9.346
Eri	4	43 42.0	4.729	12.027	- 3	19 09	3.319		10.095
Ori	4	48 38.9	4.811	12.062	+ 8	50 24	8.840	-0.253	9.747
Cam	4	50 27.5	4.841	12.075	+66	17 03	66.284	-1.894	8.106
Eri	4	51 07.4	4.852	12.079	- 5	30 42	5.512		10.157
Ori	4	52 54.7	4.882	12.092	+10	05 42	10.095	-0.288	9.712
Cam	4	54 23.6	4.907	12.103	+53	41 48	53.696	-1.534	8.466
Ori	4	54 20.7	4.906	12.103	+13	27 33	13.459	-0.385	9.615
Ori	4	56 40.8	4.944	12.119	+ 1	39 37	1.660	-0.047	9.953
Cam	5	00 12.4	5.003	12.144	+60	23 31	60.392	-1.725	8.275
Tau	5	00 56.5	5.016	12.150	+21	32 25	21.540	-0.615	9.385
Ori	5	02 30.6	5.042	12.161	+15	21 20	15.356	-0.439	9.561
Cae	5	03 06.6	5.052	12.165	-35	31 53	35.532		11.015
Eri	5	07 25.3	5.124	12.196	- 8	47 56	8.798		10.251
Lep	5	10 37.0	5.177	12.219	-11	54 40	11.911		10.340
Ori	5	11 24.4	5.190	12.224	+ 2	49 11	2.820	-0.081	9.919
Lep	5	11 34.1	5.192	12.225	-12	58 58	12.983		10.371

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
	5h	17'	5.298h	12.271"	-13°	12'	46"	13.213°		10.377"
Lep	5	18	5.315	12.278	-21	16	29	21.275		10.608
-21°1135	5	19	5.332	12.285	- 0	25	00	0.417		10.012
Ori	5	22	5.371	12.302	- 7	50	23	7.839	-0.052"	10.224
Ori	5	22	5.382	12.307	+ 1	48	54	1.815	-0.088	9.948
Ori	5	24	5.416	12.321	+ 3	03	57	3.066	-0.169	9.912
Ori	5	28	5.481	12.349	+ 5	55	20	5.923	-0.531	9.831
Tau	5	30	5.502	12.358	+18	34	09	18.569		9.469
Ori	5	30	5.503	12.358	- 7	19	36	7.327	-0.270	10.209
Ori	5	32	5.547	12.377	+ 9	28	00	9.467		9.730
-6°1234	5	33	5.555	12.381	- 6	01	28	6.025		10.172
Ori	5	33	5.560	12.383	- 4	51	38	4.861		10.139
Dor	5	33	5.555	12.381	-62	30	48	62.513		11.786
Ori	5	34	5.582	12.392	+ 9	16	22	9.273	-0.265	9.735
Ori	5	37	5.622	12.409	+ 4	06	09	4.102	-0.117	9.883
Dor	5	44	5.745	12.462	-65	44	56	65.748		11.678
Aur	5	46	5.778	12.476	+39	10	15	39.171	-1.119	8.881
Aur	5	48	5.817	12.493	+39	08	24	39.140	-1.118	8.882
Pic	5	49	5.820	12.494	-56	10	30	56.175		11.605
Tau	5	51	5.851	12.508	+27	36	20	27.606	-0.789	9.211
Ori	5	52	5.871	12.516	+20	16	16	20.271	-0.579	9.421
-63°198	5	53	5.897	12.527	-63	06	02	63.101		11.803
Col	5	56	5.937	12.544	-35	17	10	35.286		11.008
Aur	5	57	5.954	12.552	+15	56	08	15.935	-1.312	8.688
Col	5	58	5.968	12.558	-42	48	59	42.816		11.223
Ori	6	00	6.007	12.574	+ 9	38	56	9.648	-0.276	9.724
Ori	6	01	6.030	12.584	+20	08	27	20.111	-0.575	9.425
Gem	6	01	6.032	12.585	+23	16	01	23.267	-0.665	9.335
Lep	6	04	6.076	12.604	-14	55	50	14.931		10.427
Ori	6	05	6.092	12.611	+14	46	27	14.775	-0.422	9.578
Ori	6	09	6.165	12.642	+14	13	06	14.219	-0.406	9.594
Aur	6	13	6.218	12.665	+29	30	47	29.513	-0.843	9.157
Mon	6	13	6.219	12.665	- 6	15	44	6.262		10.179
	6	14	6.248	12.678	+69	20	08	69.335	-1.981	8.019
H. Cam	6	15	6.254	12.680	-35	07	39	35.128		11.004
Col	6	16	6.275	12.689	+59	01	35	59.027	-1.686	8.314
Lyn	6	21	6.364	12.727	+ 4	36	45	4.613	-0.132	9.868
Mon										

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION		DEGREES	INCHES	PLOT
	6h	26' 49.5"	6.447h	12.763"	+20°	14' 12"	20.236°	-0.578"	9.422"
Gem	6	26 50.0	6.447	12.763	-32	33 23	32.556		10.930
C Ma	6	27 04.2	6.451	12.765	- 7	00 31	7.009		10.200
Mon	6	30 21.3	6.506	12.788	-23	23 29	23.391	-0.210	10.668
C Ma	6	30 57.4	6.516	12.793	+ 7	21 39	7.361		9.790
Mon	6	33 32.8	6.559	12.811	-22	56 07	22.935		10.655
C Ma	6	34 10.9	6.570	12.816	-52	56 44	52.945		11.513
Car	6	35 06.8	6.585	12.822	-19	13 27	19.225		10.549
C Ma	6	36 18.4	6.605	12.831	-18	12 18	18.205		10.520
C Ma	6	38 59.7	6.650	12.850	+ 9	55 50	9.931	-0.284	9.716
Mon	6	41 57.5	6.699	12.871	+13	15 57	13.266	-0.379	9.621
Gem	6	45 59.0	6.766	12.900	+ 2	27 11	2.453	-0.070	9.930
Mon	6	49 04.4	6.818	12.922	-53	34 46	53.580		11.531
Car	6	51 59.5	6.867	12.943	-20	10 43	20.179		10.577
C Ma	6	52 36.8	6.877	12.947	+13	13 30	13.225	-0.378	9.622
Gem	6	52 31.0	6.876	12.947	-11	59 32	11.992		10.343
C Ma	6	52 38.2	6.878	12.948	-24	08 16	24.137		10.690
C Ma	6	54 50.8	6.914	12.963	+77	01 38	77.028	-2.201	7.799
H. Cam	6	54 09.9	6.903	12.958	+58	28 20	58.473	-1.671	8.329
Lyn	6	54 03.7	6.901	12.958	-20	05 22	20.089		10.574
C Ma	6	54 31.9	6.909	12.961	-17	00 22	17.006		10.486
C Ma	7	02 07.8	7.035	13.015	-15	34 44	15.579		10.445
Gem	7	08 51.0	7.147	13.063	+30	18 21	30.306	-0.866	9.134
Mon	7	10 01.5	7.168	13.072	- 0	25 54	0.432		10.012
Pup	7	11 32.0	7.192	13.082	-46	41 54	46.698		11.334
C Ma	7	12 47.1	7.213	13.091	-26	17 21	26.289		10.751
Pup	7	17 01.6	7.284	13.122	-36	40 03	36.668		11.048
C Ma	7	17 12.9	7.287	13.123	-24	53 15	24.887		10.711
Lyn	7	24 00.2	7.400	13.171	+49	17 06	49.285	-1.408	8.592
C M1	7	26 12.2	7.436	13.187	+ 9	00 00	9.000	-0.257	9.743
Gem	7	26 47.9	7.446	13.191	+31	51 28	31.858	-0.910	9.090
G. Pup	7	32 30.7	7.512	13.232	-22	13 02	22.218		10.635
Gem	7	33 42.4	7.562	13.241	+26	58 38	26.978		10.771
Pup	7	33 56.1	7.565	13.242	-28	17 20	28.289		10.808
Pup	7	36 02.1	7.601	13.258	-34	53 12	34.886		10.997
Pup	7	36 48.1	7.613	13.263	-25	16 55	25.282		10.722
Pup	7	37 20.8	7.623	13.267	-26	43 08	26.719		10.763

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
	7h	39'	31.6"	7.659h	13.282"	- 9°	27'	58"	9.466°		10.270
Mon	7	41	03.9	7.684	13.293	+28	58	20	28.973	-0.828"	9.172
Gem	7	42	21.7	7.706	13.303	-28	52	04	28.868		10.825
Pup	7	46	35.3	7.777	13.333	-25	50	48	25.846		10.738
Pup	7	47	15.9	7.787	13.337	-46	59	10	46.986		11.342
Pup	7	58	15.2	7.971	13.416	-18	17	58	18.299		10.523
G. Pup	8	00	23.6	8.007	13.432	+ 2	26	05	2.434	-0.070	9.930
+2°1854	8	06	47.1	8.113	13.477	- 2	52	40	2.878		10.082
Mon	8	07	25.2	8.124	13.482	-19	08	19	19.138		10.547
Pup	8	07	49.3	8.131	13.485	-68	30	41	68.511		11.957
Vol	8	09	34.9	8.160	13.497	-12	49	09	12.819		10.366
Pup	8	10	04.3	8.168	13.501	-39	30	38	39.511		11.129
Pup	8	12	46.1	8.213	13.520	-40	14	13	40.237		11.150
Pup	8	17	12.4	8.286	13.551	-36	32	49	36.547		11.044
Lyn	8	20	22.7	8.339	13.574	+43	18	18	43.305	-1.237	8.763
Cha	8	19	29.2	8.325	13.568	-76	48	23	76.806		12.194
Cha	8	21	45.4	8.363	13.584	-77	22	09	77.369		12.210
Hya	8	35	45.1	8.596	13.684	+ 5	49	49	5.831	-0.167	9.833
Vel	8	36	22.6	8.606	13.688	-42	51	45	42.863		11.225
Hya	8	36	52.6	8.615	13.692	+ 3	28	08	3.469	-0.099	9.901
G. Vel	8	39	25.8	8.657	13.710	-46	31	12	46.520		11.329
Car	8	39	49.4	8.664	13.713	-59	37	56	59.632		11.704
Cnc	8	41	12.3	8.686	13.723	+21	35	57	21.599	-0.617	9.383
Hya	8	41	20.6	8.689	13.724	+ 3	31	44	3.529	-0.101	9.899
Mon	8	41	54.3	8.698	13.728	- 7	06	11	7.103		10.203
Cnc	8	42	38.5	8.711	13.733	+18	17	16	18.287	-0.522	9.478
Vel	8	43	06.7	8.719	13.737	-42	31	05	42.518		11.215
Cnc	8	44	31.4	8.742	13.747	+28	53	34	28.892	-0.825	9.175
Hya	8	44	40.4	8.744	13.747	-13	24	54	13.415		10.383
Vel	8	44	48.4	8.746	13.748	-45	54	33	45.909		11.312
Car	8	45	46.3	8.763	13.756	-56	38	13	56.637		11.618
Hya	8	46	31.6	8.776	13.761	+ 5	58	18	5.972	-0.171	9.829
Pyx	8	49	00.2	8.817	13.779	-27	34	32	27.576		10.788
Cnc	8	56	31.2	8.942	13.832	+11	59	53	11.998	-0.343	9.657
U Ma	8	58	18.6	8.972	13.845	+41	55	35	41.927	-1.198	8.802
G. Vel	8	58	44.7	8.980	13.849	-41	06	46	41.113		11.175
Vol	9	01	53.0	9.032	13.871	-66	15	08	66.252		11.893

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION		DEGREES	INCHES	PLOT
	9h	04'	14.7"	9.071h	+38°	35'	38.597°	-1.103"	8.897"
24 Sextantis	9	05	04.2	9.084	-72	27	72.458		12.070
Car	9	06	20.5	9.106	+51	45	51.751	-1.479	8.521
U Ma	9	07	58.3	9.133	+63	39	63.662	-1.819	8.181
U Ma	9	10	27.7	9.175	-62	10	62.169		11.776
Car	9	14	18.6	9.238	-37	15	37.263		11.065
Vel	9	15	11.2	9.253	-57	23	57.390		11.640
Car	9	22	33.7	9.376	+26	20	26.338	-0.752	9.248
Leo	9	27	45.5	9.463	-35	47	35.793		11.023
Ant	9	29	40.2	9.494	+23	07	23.128	-0.661	9.339
Leo	9	30	08.8	9.502	- 1	01	1.026		10.029
Hya	9	31	19.9	9.523	+69	59	69.990	-2.000	8.000
U Ma	9	32	06.2	9.535	+81	29	81.487	-2.328	7.672
H. Dra	9	31	20.4	9.523	-62	37	62.630		11.789
Car	9	32	01.4	9.533	+36	33	36.558	-1.044	8.956
L Mi	9	32	22.1	9.539	+52	12	52.213	-1.492	8.508
U Ma	9	33	24.0	9.557	-59	04	59.069		11.688
Car	9	35	32.2	9.592	-49	11	49.193		11.405
Vel	9	38	01.1	9.633	- 0	58	0.979		10.028
Hya	9	38	21.1	9.639	-61	09	61.165		11.747
Car	9	39	38.3	9.661	-23	25	23.428		10.669
Hya	9	44	15.4	9.737	-62	20	62.341		11.781
Car	9	49	40.1	9.828	+54	14	54.233	-1.549	8.451
U Ma	9	49	44.7	9.830	-14	40	14.677		10.419
Hya	9	50	17.1	9.838	-46	22	46.379		11.325
Vel	9	50	43.2	9.845	+26	10	26.178	-0.748	9.252
Leo	9	48	08.4	7.802	-46	16	46.282		11.322
Pup	7	51	22.1	7.856	-38	46	38.769		11.108
Pup	7	52	14.7	7.871	-48	00	48.008		11.371
Pup	7	55	18.6	7.922	-22	46	22.783		10.651
Pup	7	57	12.2	7.953	-49	08	49.146		11.404
Pup	10	03	22.2	10.056	-12	53	12.889		10.368
Hya	10	05	18.7	10.088	+35	25	35.421	-1.012	8.988
L Mi	10	05	59.7	10.100	+10	10	10.175	-0.291	9.709
Leo	10	06	05.7	10.102	- 0	11	0.195		10.006
Sex	10	13	13.3	10.221	-41	56	41.943		11.198
Vel	10	18	15.4	10.304	-54	50	54.848		11.567
-54°3471									

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION		DEGREES	INCHES	PLOT
	10h	19'	10.328h	14.426"	-55°	51'	55.861°		11.596"
Vel	10	23	10.394	14.455	-73	50	73.848		12.110
Car	10	24	10.406	14.460	-16	39	16.652		10.476
Hya	10	25	10.425	14.468	-30	53	30.884		10.882
Ant	10	25	10.430	14.470	+36	53	36.892	-1.054"	8.946
L Mi	10	26	10.442	14.475	-58	33	58.555		11.673
Car	10	34	10.570	14.530	-57	22	57.371		11.639
Car	10	35	10.584	14.536	-78	25	78.421		12.240
Cha	10	35	10.596	14.541	-48	02	48.038		11.372
Vel	10	37	10.623	14.553	-58	59	58.995		11.685
Car	10	37	10.631	14.556	-55	24	55.415		11.583
Vel	10	42	10.703	14.587	-60	22	60.378		11.725
Car	10	45	10.758	14.611	-80	21	80.350		12.296
Cha	10	53	10.894	14.669	+24	56	24.942	-0.713	9.287
Leo	10	55	10.918	14.679	-36	56	36.944		11.055
Ant	10	58	10.967	14.700	-18	06	18.107		10.517
Crt	10	58	10.975	14.704	-42	01	42.033		11.201
δ. Vel	11	00	11.007	14.717	+20	22	20.373	-0.582	9.418
Leo	11	03	11.053	14.737	+ 7	31	7.531	-0.215	9.785
Leo	11	09	11.165	14.785	-22	37	22.629		10.647
Crt	11	11	11.184	14.793	-60	07	60.122		11.718
Car	11	14	11.247	14.820	- 3	27	3.454		10.099
Leo	11	19	11.322	14.852	+ 6	13	6.227	-0.178	9.822
Leo	11	19	11.323	14.853	-54	17	54.293		11.551
Cen	11	23	11.384	14.879	-17	29	17.486		10.500
Crt	11	29	11.488	14.923	+69	31	69.530	-1.986	8.014
Dra	11	35	11.585	14.965	- 0	37	0.625		10.018
Leo	11	44	11.733	15.028	+ 6	43	6.731	-0.192	9.808
Vir	11	44	11.746	15.034	-60	58	60.979		11.742
δ. Cen	11	46	11.769	15.044	+20	25	20.419	-0.583	9.417
Leo	11	46	11.775	15.046	-66	36	66.615		11.903
Mus	11	47	11.798	15.056	-63	35	63.588		11.817
Cen	11	49	11.823	15.067	-44	58	44.973		11.285
Cen	11	51	11.851	15.079	-33	42	33.708		10.963
Hya	11	59	11.984	15.136	+ 6	48	6.815	-0.195	9.805
Vir	12	01	12.020	15.151	-63	06	63.113		11.803
Cru	12	03	12.056	15.167	+ 8	55	8.933	-0.255	9.745
Vir									

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

SPECIFIC DATA

FIFTH MAGNITUDE STARS

	RIGHT ASCENSION			HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
Cru	12h	04'	59.4"	12.084h	15.179"	-64°	24'	47"	64.413°		11.840"
Crv	12	06	33.1	12.109	15.190	-24	31	42	24.529		10.701
Cen	12	09	45.6	12.163	15.213	-52	10	06	52.169		11.490
Mus	12	15	36.5	12.260	15.254	-67	45	38	67.761		11.936
Cha	12	16	11.8	12.270	15.259	-79	06	45	79.113		12.260
Cru	12	16	28.3	12.275	15.261	-63	48	12	63.803		11.823
Com	12	25	08.7	12.419	15.322	+28	28	06	28.469	-0.813"	9.187
Cen	12	26	05.0	12.434	15.329	-50	01	54	50.032		11.429
Crv	12	30	12.7	12.504	15.359	-15	59	49	15.997		10.457
C Vn	12	32	02.2	12.534	15.372	+41	33	10	41.553	-1.187	8.813
Cen	12	40	35.2	12.677	15.433	-48	36	57	48.616		11.389
Cru	12	43	30.0	12.725	15.454	-60	47	02	60.784		11.737
Cen	12	51	04.0	12.851	15.508	-48	44	52	48.747		11.393
Cen	12	51	26.1	12.857	15.510	-39	59	01	39.983		11.142
Cru	12	52	27.8	12.875	15.518	-56	58	58	56.983		11.628
Cen	13	04	47.9	13.080	15.606	-49	42	50	49.714		11.420
Vir	13	08	05.0	13.134	15.629	- 5	20	50	5.347		10.153
Com	13	08	14.2	13.137	15.630	+17	43	09	17.719	-0.506	9.494
Com	13	10	11.6	13.170	15.644	+28	03	36	28.060	-0.802	9.198
C Vn	13	15	55.8	13.265	15.685	+40	45	42	40.762	-1.165	8.835
Cen	13	20	17.3	13.338	15.716	-60	48	01	60.800		11.737
Cen	13	21	34.1	13.359	15.725	-64	20	53	64.348		11.838
C Vn	13	32	59.1	13.549	15.807	+49	11	58	49.199	-1.306	8.694
U Ma	13	39	22.4	13.656	15.853	+54	51	48	54.863	-1.567	8.433
Cen	13	43	38.1	13.728	15.883	-32	51	45	32.863		10.939
Cen	13	44	21.9	13.739	15.888	-51	15	11	51.253		11.464
Boo	13	45	33.0	13.759	15.897	+17	38	07	17.635	-0.504	9.496
Cen	13	47	21.1	13.789	15.910	-34	16	18	34.272		10.979
Boo	13	47	44.4	13.795	15.912	+15	58	33	15.976	-0.456	9.544
Cen	13	49	44.5	13.830	15.927	-32	49	00	32.817		10.938
G. Cen	13	55	01.3	13.917	15.964	-63	30	41	63.511		11.815
Cen	13	56	26.7	13.941	15.975	-44	37	43	44.629		11.275
Cen	13	59	28.1	13.991	15.996	-45	25	48	45.430		11.298
Vir	13	59	48.7	13.997	15.999	+ 1	43	05	1.718	-0.049	9.951
Cen	14	03	50.4	14.064	16.027	-41	00	29	41.008		11.172
Vir	14	10	58.3	14.183	16.078	-10	06	26	10.107		10.289
Boo	14	12	11.6	14.203	16.087	+51	57	28	51.958	-1.484	8.516

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION				DECLINATION					
			HOURS	PLOT			DEGREES	INCHES	PLOT
	14h	14'	07.4"	14.235h	16.101"	- 5°	49'	46"	5.830°	10.167"
Vir	14	15	00.9	14.250	16.107	+46	15	10	46.253	8.679
Boo	14	17	05.3	14.284	16.122	-45	53	34	45.892	11.311
Lup	14	17	09.4	14.285	16.122	-13	12	23	13.206	10.377
Vir	14	17	47.7	14.296	16.127	-56	13	18	56.222	11.606
Cen	14	18	21.5	14.306	16.131	-37	43	14	37.721	11.078
Cen	14	20	55.3	14.348	16.149	-83	30	20	83.506	12.386
Oct	14	20	48.6	14.347	16.149	-39	20	55	39.348	11.124
Cen	14	23	49.0	14.397	16.170	-45	03	35	45.060	11.287
Lup	14	23	51.3	14.397	16.170	-45	13	04	45.218	11.292
Lup	14	23	58.2	14.399	16.171	+52	00	59	52.016	8.514
Boo	14	27	34.7	14.460	16.197	+75	51	21	75.856	7.833
U Mi	14	30	10.7	14.503	16.216	-50	17	55	50.298	11.437
Lup	14	33	06.7	14.552	16.237	+29	54	02	29.901	9.116
Boo	14	35	27.2	14.591	16.253	-49	16	12	49.270	11.408
Lup	14	39	42.9	14.662	16.284	-37	38	25	37.640	11.075
Cen	14	41	26.9	14.691	16.296	-35	01	12	35.020	11.001
Cen	14	43	33.6	14.726	16.311	+17	06	57	17.116	9.511
Boo	14	48	10.1	14.803	16.344	-27	48	42	27.812	10.795
Hya	14	49	16.8	14.822	16.352	-43	25	40	43.428	11.241
Lup	14	49	43.6	14.829	16.355	+19	14	58	19.249	9.150
Boo	14	55	18.0	14.922	16.395	- 4	12	04	4.201	10.120
Lib	14	01	04.7	15.018	16.436	+ 2	13	53	2.232	9.936
Vir	15	02	54.1	15.048	16.449	+27	05	13	27.087	9.226
Boo	15	06	24.5	15.107	16.474	-45	08	34	45.142	11.290
Lup	15	09	25.3	15.157	16.496	-48	36	09	48.602	11.389
Lup	15	10	09.9	15.170	16.501	-19	39	24	19.657	10.562
Lib	15	14	40.7	15.244	16.533	-58	40	07	58.669	11.676
Cir	15	15	38.0	15.261	16.540	-30	01	04	30.018	10.858
Lup	15	16	01.1	15.267	16.543	-47	44	39	47.744	11.364
Lup	15	20	29.6	15.341	16.575	-59	11	34	59.192	11.691
Cir	15	20	50.9	15.347	16.577	-36	43	51	36.731	11.049
Lup	15	22	59.6	15.384	16.593	-38	36	27	38.608	11.103
Lup	15	23	07.7	15.385	16.594	+37	30	09	37.502	8.929
Boo	15	31	28.6	15.525	16.654	+31	28	46	31.480	9.101
Cr B	15	33	21.1	15.557	16.667	-56	11	54	66.198	11.691
Tr A	15	33	04.8	15.551	16.665	+10	39	29	10.658	9.696
Ser										

G.

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
Lup	15h	35'	15.593h	16.683"	-42°	27'	03"	42.151°		11.213"
Lup	15	37	15.625	16.696	-34	17	45	34.296		10.980
Lup	15	38	15.645	16.705	-44	32	37	44.543		11.273
Ser	15	39	15.666	16.714	+19	47	06	19.785	-0.565	9.435
Ser	15	44	15.745	16.748	+ 7	27	53	7.465	-0.213	9.787
U Mi	15	45	15.755	16.752	+77	54	22	77.906	-2.226	9.774
Ser	15	47	15.785	16.765	+18	15	05	18.251	-0.521	9.479
Cr B	15	48	15.801	16.772	+26	10	38	26.178	-0.748	9.252
Lup	15	48	15.811	16.776	-33	31	09	33.519		10.958
Sco	15	51	15.858	16.796	-25	13	16	25.221		10.721
Her	15	51	15.857	16.796	+42	33	05	42.551	-1.216	8.784
Lib	15	51	15.863	16.798	-16	37	31	16.626		10.475
Lib	15	56	15.936	16.830	-11	10	37	11.177		10.405
Cr B	15	56	15.935	16.829	+26	58	51	26.981	-0.771	9.229
Nor	16	00	16.009	16.861	-49	07	52	49.131		11.404
Dra	16	01	16.021	16.866	+58	39	39	58.661	-1.676	8.324
Her	16	01	16.028	16.869	+46	08	09	46.135	-1.318	8.682
Sco	16	02	16.039	16.874	-11	16	31	11.276		10.322
Lup	16	04	16.071	16.888	-36	42	22	36.706		11.049
Sco	16	04	16.079	16.891	-20	34	24	20.574		10.588
Sco	16	05	16.088	16.895	-20	46	23	20.773		10.593
Her	16	07	16.128	16.912	+45	01	42	45.029	-1.286	8.714
Sco	16	09	16.165	16.928	-19	22	07	19.369		10.553
Sco	16	10	16.168	16.929	-27	50	05	27.834		10.795
Nor	16	17	16.285	16.979	-50	01	09	50.069		11.130
Cr B	16	20	16.345	17.005	+30	58	28	30.975	-0.885	9.115
Oph	16	21	16.367	17.011	-19	57	17	19.955		10.570
Her	16	23	16.396	17.027	+14	06	53	14.115	-0.403	9.597
Oph	16	25	16.431	17.042	- 8	17	34	8.292		10.237
Sco	16	29	16.484	17.065	-34	37	40	34.628		10.989
Oph	16	29	16.484	17.065	-16	32	09	16.535		10.472
Oph	16	29	16.500	17.071	-21	23	28	21.391		10.611
Her	16	32	16.548	17.092	+42	30	37	42.510	-1.215	8.785
Sco	16	34	16.567	17.100	-35	11	00	35.183		11.005
Aps	16	37	16.632	17.128	-77	26	45	77.446		12.213
Oph	16	47	16.797	17.199	-10	43	16	10.721		10.306
U Mi	16	49	16.827	17.212	+82	05	57	82.099	-2.346	7.654

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

FIFTH MAGNITUDE STARS

	RIGHT ASCENSION			HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
Oph	16h	52'	18.2"	16.872h	17.231"	+10°	13'	23"	10.223°	-0.292"	9.708"
Ara	16	56	42.4	16.945	17.262	-53	06	26	53.107		11.517
Her	17	15	59.6	17.267	17.400	+33	08	16	33.137	-0.947	9.053
Aps	17	18	13.1	17.304	17.416	-67	44	08	67.735		11.935
Oph	17	18	50.6	17.314	17.420	-21	04	34	21.076		10.602
Ser	17	18	48.0	17.313	17.420	-12	48	43	12.812		10.366
Her	17	22	26.3	17.374	17.446	+37	10	41	37.178	-1.062	8.938
Oph	17	24	10.1	17.403	17.458	-24	08	38	24.144		10.690
H. Oph	17	24	43.1	17.412	17.462	- 5	03	23	5.056		10.144
Oph	17	24	43.6	17.412	17.462	+ 4	10	12	4.170	-0.119	9.881
Oph	17	25	03.2	17.418	17.465	-29	50	11	29.836		10.852
Her	17	29	16.9	17.488	17.495	+26	08	12	26.136	-0.747	9.253
Ara	17	32	58.5	17.549	17.521	-46	28	59	46.483		11.327
Sco	17	34	03.9	17.568	17.529	-38	36	43	38.612		11.103
Oph	17	35	53.2	17.598	17.542	- 8	05	55	8.098		10.231
Ser	17	39	23.3	17.656	17.567	-12	51	28	12.858		10.367
Sgr	17	45	17.5	17.755	17.609	-27	49	08	27.819		10.795
U Mi	17	43	46.7	17.730	17.599	+86	36	18	86.605	-2.474	7.526
Her	17	57	07.4	17.952	17.694	+30	11	28	30.191	-0.863	9.137
Her	17	58	27.2	17.975	17.704	+16	45	06	16.752	-0.479	9.521
Ser	17	58	34.7	17.977	17.704	- 3	41	22	3.689		10.105
Oph	17	59	55.5	17.998	17.713	+ 1	18	16	1.304	-0.037	9.963
Sgr	18	02	43.2	18.045	17.734	-29	35	01	29.583		10.345
Oph	18	03	38.1	18.061	17.740	+ 2	30	23	2.506	-0.072	9.928
Pav	18	05	06.8	18.085	17.751	-63	40	21	63.673		11.819
Oph	18	05	35.0	18.093	17.754	+ 8	43	40	8.728	-0.249	9.751
-28°14174	18	05	48.1	18.096	17.755	-28	27	47	28.463		10.813
Her	18	07	13.0	18.121	17.766	+20	48	27	20.808	-0.594	9.406
Tel	18	08	33.4	18.142	17.775	-45	57	46	45.963		11.313
-27°12684	18	15	47.9	18.263	17.827	-27	03	27	27.058		10.773
Lyr	18	18	35.9	18.310	17.847	+36	02	50	36.047	-1.030	8.970
Pav	18	19	54.5	18.332	17.857	-61	30	46	61.513		11.757
Dra	18	21	16.5	18.355	17.866	+71	19	09	71.319	-2.038	7.962
Tel	18	26	03.5	18.434	17.900	-49	05	33	49.092	-1.403	8.597
Sct	18	27	08.7	18.452	17.908	-14	35	25	14.590		10.417
Cr A	18	30	55.9	18.515	17.935	-42	20	25	42.340		11.210

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION		DEGREES	INCHES	PLOT
	18h	33'	18.551h	17.952"	- 8°	16' 15"	8.271°		10.236"
Sct	18	38	18.647	17.992	-71	27 44	71.462		12.042
Pav	18	40	18.672	18.002	- 9	05 19	9.088		10.260
Sct	18	43	18.720	18.023	+39	34 27	39.575	-1.131	8.869
Lyr	18	43	18.726	18.025	+37	33 59	37.566	-1.073	8.927
Lyr	18	44	18.735	18.029	+20	30 38	20.511	-0.586	9.414
Her	18	45	18.754	18.037	- 4	47 17	4.788		10.137
Sct	18	45	18.757	18.039	+18	08 24	18.140	-0.518	9.482
Her	18	45	18.759	18.040	- 5	44 43	5.715		10.164
Sct	18	48	18.815	18.064	-62	13 53	62.232		11.778
Pav	18	53	18.887	18.094	-67	16 53	67.282		11.922
Pav	18	53	18.887	18.094	+22	35 54	22.598	-0.646	9.354
Her	18	53	18.887	18.094	+36	51 07	36.852	-1.053	8.947
Lyr	18	53	18.887	18.094	+ 4	09 19	4.155	-0.119	9.881
Ser	18	54	18.907	18.103	+43	53 52	43.897	-1.254	8.746
Lyr	18	54	18.904	18.102	+15	01 05	15.018	-0.429	9.571
Aql	18	57	18.966	18.128	- 5	47 28	5.791		10.165
Aql	18	59	18.996	18.141	-37	07 01	37.117		11.060
Cr A	19	03	19.066	18.171	-40	33 16	40.554		11.159
Cr A	19	05	19.097	18.184	-37	57 45	37.963		11.085
Cr A	19	07	19.118	18.193	-39	23 59	39.399		11.126
Cr A	19	07	19.126	18.197	+39	04 59	39.083	-1.117	8.883
Lyr	19	12	19.209	18.232	+21	19 32	21.326	-0.609	9.391
Vul	19	14	19.244	18.247	+38	04 07	38.069	-1.088	8.912
Lyr	19	15	19.252	18.251	+73	17 21	73.289	-2.094	7.906
Dra	19	16	19.271	18.259	-16	01 27	16.025		10.458
Sgr	19	19	19.328	18.283	-44	31 43	44.529		11.272
Sgr	19	20	19.334	18.286	-44	52 10	44.870		11.282
Sgr	19	20	19.343	18.290	+65	38 42	65.645	-1.875	8.125
Dra	19	20	19.341	18.289	-40	41 08	40.685		11.162
Sgr	19	21	19.357	18.296	+24	35 27	24.591	-0.703	9.297
Vul	19	27	19.453	18.337	+ 7	18 04	7.301	-0.209	9.791
Aql	19	32	19.539	18.374	-24	57 53	24.965		10.713
Sgr	19	34	19.576	18.390	- 1	22 04	1.368		10.039
Aql	19	34	19.581	18.392	+50	08 13	50.137	-1.432	8.568
Cyg	19	35	19.591	18.396	+17	55 47	17.930	-0.512	9.488
Sge	19	38	19.641	18.418	+17	23 29	17.391	-0.497	9.503
Sge	19	39	19.657	18.424					

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

FIFTH MAGNITUDE STARS

		RIGHT ASCENSION			HOURS	PLOT		DECLINATION			DEGREES	INCHES	PLOT
	Cyg	19h	49'	10.8"	19.820h	18.494"	+32°	49'	19"		32.822°	-0.938"	9.062"
	Vul	19	51	55.8	19.865	18.514	+23	59	04		23.984	-0.685	9.315
	Sgr	19	52	46.9	19.880	18.520	-41	57	53		41.965		11.199
	Sgr	19	54	44.4	19.912	18.534	-27	16	01		27.267		10.779
	Pav	19	56	27.6	19.941	18.546	-73	00	30		73.008		12.085
	Sgr	19	57	23.8	19.957	18.553	-35	22	31		35.376		11.011
	Vul	19	59	37.0	19.993	18.568	+27	39	11		27.653	-0.790	9.210
	Sgr	20	00	26.3	20.008	18.575	-27	48	41		27.811		10.795
	Dra	20	02	39.7	20.044	18.590	+67	46	15		67.771	-1.936	8.064
	Cep	20	10	08.1	20.169	18.644	+77	36	14		77.604	-2.217	7.783
	Cyg	20	12	33.7	20.209	18.661	+56	27	25		56.457	-1.613	8.387
	Vul	20	14	16.5	20.238	18.673	+27	42	10		27.703	-0.791	9.209
	Cyg	20	14	21.4	20.239	18.674	+47	36	10		47.603	-1.360	8.640
	Cap	20	15	39.2	20.261	18.683	-12	37	15		12.621		10.361
	Cyg	20	22	25.2	20.374	18.732	+32	04	23		32.073	-0.916	9.084
	Cyg	20	27	55.4	20.465	18.771	+30	14	51		30.247	-0.864	9.136
	Cep	20	28	58.8	20.483	18.778	+62	52	22		62.873	-1.796	8.204
	Del	20	33	37.5	20.561	18.812	+14	32	56		14.548	-0.416	9.584
	Aql	20	36	28.7	20.608	18.832	- 1	13	56		1.232		10.035
	Ind	20	41	24.2	20.690	18.867	-52	03	04		52.051		11.487
	Del	20	41	46.6	20.696	18.870	+14	56	39		14.944	-0.427	9.573
	Cap	20	43	58.0	20.733	18.886	-25	24	06		25.402		10.726
	Cyg	20	44	10.4	20.736	18.887	+30	35	15		30.587	-0.874	9.126
H.	Cep	20	44	27.5	20.741	18.889	+57	27	00		57.450	-1.641	8.359
	Del	20	44	59.2	20.749	18.892	+15	59	36		15.993	-0.457	9.543
	Aqr	20	45	50.3	20.764	18.899	- 5	09	39		5.161		10.147
	Cyg	20	46	00.3	20.767	18.900	+36	21	27		36.225	-1.035	8.965
	Cap	20	49	40.6	20.828	18.926	-27	03	19		27.055		10.773
	Cyg	20	51	58.2	20.866	18.943	+44	15	01		44.250	-1.264	8.736
	Mic	20	59	05.2	20.984	18.993	-32	23	59		32.399		10.926
	Cap	21	03	55.5	21.065	19.028	-17	22	37		17.377		10.496
	Cap	21	05	01.5	21.084	19.036	-25	09	03		25.151		10.719
	Aqr	21	07	38.0	21.128	19.055	-11	31	07		11.519		10.329
	Equ	21	12	43.6	21.212	19.091	+ 9	51	36		9.860	-0.282	9.718
	Equ	21	14	01.4	21.233	19.100	+ 5	05	53		5.098	-0.146	9.854
	Cyg	21	15	59.9	21.267	19.114	+39	14	35		39.243	-1.121	8.879
	Cyg	21	16	26.1	21.274	19.117	+34	44	41		34.744	-0.993	9.007

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°

FIFTH MAGNITUDE STARS

	RIGHT ASCENSION			HOURS	PLOT	DECLINATION			DEGREES	INCHES	PLOT
Ind	21h	17'	18.6"	21.288h	19.123"	-53°	36'	06"	53.602°		11.531"
Cap	21	20	14.6	21.337	19.144	-16	59	20	16.989		10.485
Peg	21	20	25.2	21.340	19.146	+19	38	59	19.649	-0.561"	9.439
Pav	21	23	29.4	21.391	19.168	-65	31	50	65.531		11.872
Cap	21	26	40.4	21.444	19.190	-21	57	54	21.965		10.628
Cyg	21	32	37.5	21.543	19.233	+45	25	55	45.432	-1.298	8.702
Cap	21	35	04.0	21.584	19.250	-19	37	42	19.629		10.561
Cyg	21	42	31.8	21.709	19.304	+28	34	46	28.580	-0.817	9.183
Ps A	21	42	48.4	21.713	19.306	-33	11	28	33.191		10.948
Cep	21	42	24.2	21.707	19.303	+58	36	52	58.614	-1.675	8.325
Peg	21	42	48.3	21.713	19.306	+17	11	02	17.184	-0.491	9.509
Peg	21	43	00.8	21.717	19.307	+25	28	44	25.479	-0.728	9.272
Cep	21	44	24.5	21.740	19.317	+60	57	15	60.954	-1.741	8.259
Cyg	21	45	27.6	21.758	19.325	+49	08	32	49.142	-1.404	8.596
Ind	21	55	28.8	21.925	19.396	-55	09	53	55.165		11.576
Ind	22	00	37.2	22.010	19.433	-56	56	07	56.935		11.627
Aqr	22	01	27.1	22.025	19.439	- 2	19	48	2.330		10.067
Cep	22	02	44.8	22.046	19.448	+64	27	07	64.452	-1.841	8.159
Gru	22	03	57.0	22.066	19.457	-39	43	04	39.718		11.135
Aqr	22	04	29.6	22.075	19.461	-14	02	42	14.045		10.401
Ps A	22	06	17.2	22.105	19.474	-33	09	55	33.165		10.948
Peg	22	08	23.1	22.139	19.488	+33	00	03	33.001	-0.943	9.057
H. Lac	22	12	19.8	22.206	19.517	+39	32	08	39.535	-1.130	8.870
Cep	22	13	42.3	22.229	19.527	+56	51	49	56.864	-1.625	8.375
Lac	22	14	23.8	22.240	19.531	+37	34	08	37.569	-1.073	8.927
Aqr	22	14	56.1	22.248	19.535	- 7	57	48	7.963		10.228
Lac	22	19	32.1	22.326	19.568	+46	21	17	46.355	-1.324	8.676
Lac	22	22	08.4	22.369	19.587	+52	02	53	52.048	-1.487	8.513
Lac	22	23	03.1	22.384	19.593	+49	17	36	49.293	-1.408	8.592
Aqr	22	23	26.2	22.390	19.596	+ 1	11	39	1.194	-0.034	9.966
Aqr	22	26	58.8	22.449	19.621	- 0	12	18	0.205		10.006
Gru	22	27	36.8	22.460	19.626	-43	56	03	43.934		11.255
Lac	22	28	01.6	22.468	19.629	+47	31	20	47.523	-1.358	8.642
Lac	22	28	55.8	22.482	19.635	+42	56	18	42.938	-1.227	8.773
Ps A	22	29	27.8	22.491	19.639	-32	31	52	32.531		10.929
Aqr	22	33	30.3	22.558	19.668	- 0	18	13	0.304		10.009
Ps A	22	38	40.0	22.644	19.705	-27	13	55	27.232		10.778

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
STAR MAP PLOT VALUES AT A SCALE OF 1" = 35°
FIFTH MAGNITUDE STARS

	RIGHT ASCENSION		HOURS	PLOT	DECLINATION		DEGREES	INCHES	PLOT
	22h	38'	22.648h	19.706"	+44°	05' 17"	44.088°	-1.260"	8.740"
Lac	22	42	22.708	19.732	-81	34 17	81.572		12.331
Oct	22	44	22.746	19.748	+23	22 32	23.376	-0.668	9.332
Peg	22	44	22.748	19.749	+11	59 16	11.987	-0.342	9.658
Peg	22	47	22.794	19.768	-13	46 59	13.783		10.394
Aqr	22	50	22.842	19.789	-33	04 01	33.067		10.945
Ps A	22	53	22.899	19.814	-32	43 57	32.733		10.935
Ps A	22	58	22.980	19.849	-52	56 52	52.947		11.513
Gru	23	02	23.034	19.872	+ 3	37 33	3.626	-0.104	9.896
Psc	23	04	23.081	19.892	-43	42 55	43.715		11.249
Gru	23	05	23.086	19.894	+ 9	12 53	9.215	-0.263	9.737
Peg	23	06	23.113	19.906	+75	11 34	75.192	-2.148	7.852
Cep	23	08	23.139	19.917	-45	26 32	45.442		11.298
Gru	23	10	23.182	19.935	+49	12 34	49.209	-1.406	8.594
And	23	12	23.208	19.946	- 6	14 36	6.243		10.178
Aqr	23	14	23.233	19.957	- 9	17 03	9.284		10.265
Aqr	23	15	23.256	19.967	-58	26 00	58.433		11.669
Tuc	23	16	23.268	19.972	- 9	22 46	9.380		10.268
Aqr	23	16	23.282	19.978	-32	43 42	32.729		10.935
Scl	23	18	23.314	19.992	+23	32 35	23.543	-0.673	9.327
Peg	23	21	23.351	20.008	-20	17 50	20.297		10.580
Aqr	23	23	23.393	20.026	+23	12 20	23.206	-0.663	9.337
Peg	23	24	23.402	20.029	-20	50 22	20.839		10.595
Aqr	23	26	23.435	20.044	+ 6	10 51	6.181	-0.177	9.823
Psc	23	27	23.456	20.053	+12	33 43	12.562	-0.359	9.641
Peg	23	31	23.518	20.079	-38	01 04	38.018		11.086
Scl	23	36	23.606	20.117	+43	04 07	43.069	-1.230	8.770
And	23	38	23.635	20.129	+ 5	25 52	5.431	-0.155	9.845
Psc	23	38	23.644	20.133	+44	08 04	44.134	-1.261	9.739
And	23	40	23.671	20.145	+ 1	34 55	1.582	-0.045	9.955
Psc	23	40	23.681	20.149	-14	44 39	14.744		10.421
Aqr	23	47	23.784	20.193	-28	19 46	28.330		10.809
Scl	23	52	23.877	20.233	+57	17 57	57.299	-1.637	8.363
Cas	23	55	23.932	20.257	+24	56 29	24.941	-0.713	9.287
Peg	23	58	23.968	20.272	-65	46 39	65.778		11.879
Tuc	23	59	23.996	20.284	-77	15 52	77.264		12.207
Oct	13	27	13.462	15.769	-23	05 45	23.096		10.660
Hya									

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
35°00' ORBITAL CURVE PLOT VALUES

SCALE: 1" = 35°
1° = 0.02857"

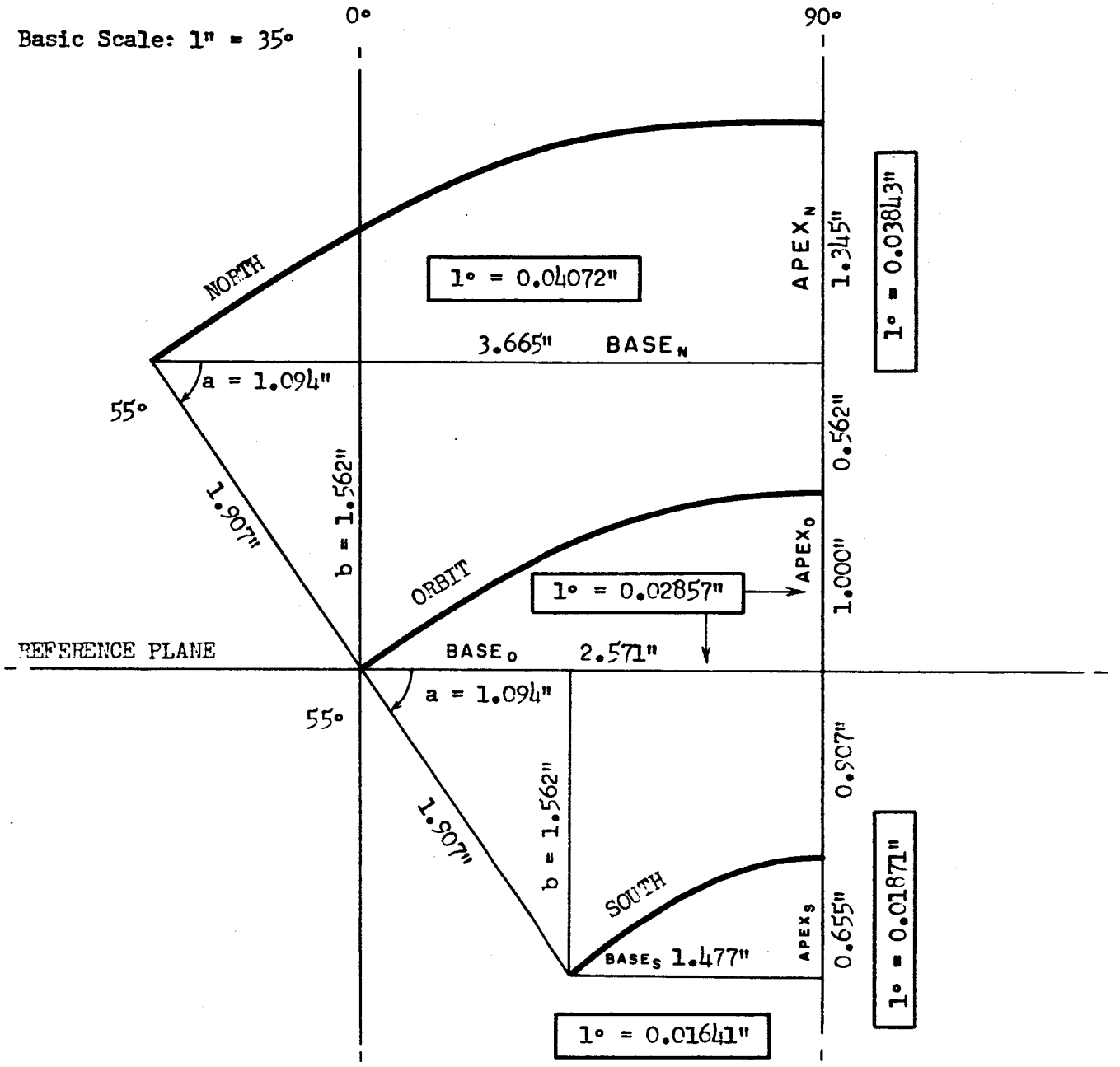
Tan ϕ = Tan 35° 00' (Sin λ)
= 0.70021 (Sin λ)

LONGITUDE				LATITUDE			
λ	PLOT	SIN λ	TAN ϕ	ϕ		DEGREES	PLOT
0°	0.000"	0.00000	0.00000	0°	00'	0.000°	0.000"
5	0.143	0.08715	0.06102	3	30	3.500	0.100
10	0.286	0.17365	0.12159	6	56	6.933	0.198
15	0.429	0.25882	0.18123	10	16	10.267	0.293
20	0.571	0.34202	0.23949	13	28	13.467	0.385
25	0.714	0.42262	0.29592	16	29	16.483	0.471
30	0.857	0.50000	0.35010	19	18	19.300	0.551
35	1.000	0.57358	0.40163	21	53	21.883	0.625
40	1.143	0.64279	0.45009	24	14	24.233	0.692
45	1.286	0.70711	0.49513	26	21	26.350	0.753
50	1.429	0.76604	0.53639	28	13	28.217	0.806
55	1.571	0.81915	0.57358	29	50	29.833	0.852
60	1.714	0.86603	0.60640	31	14	31.233	0.892
65	1.857	0.90631	0.63461	32	24	32.400	0.926
70	2.000	0.93969	0.65798	33	21	33.350	0.953
75	2.143	0.96592	0.67635	34	04	34.067	0.973
80	2.286	0.98481	0.68957	34	35	34.583	0.988
85	2.428	0.99619	0.69754	34	54	34.900	0.997
90	2.571	1.00000	0.70021	35	00	35.000	1.000

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

35° 00' ORBIT CURVE TRACK SCALE FACTORS FOR 90° OF ORBIT



a = 1.907 Cos 55° = 1.907 (0.57358) $\quad$ a = 1.094"

b = 1.907 Sin 55° = 1.907 (0.81915) $\quad$ b = 1.562"

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

1" = 35°

NORTH CURVE TRACK PLOT VALUES FOR 90° OF A 35°00' ORBIT

L O N G I T U D E Scale: 1° = 0.04072"		L A T I T U D E Scale: 1° = 0.03843"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.000°	0.000"
5	0.204	3.500	0.135
10	0.407	6.933	0.266
15	0.611	10.267	0.395
20	0.814	13.467	0.518
25	1.018	16.483	0.633
30	1.222	19.300	0.742
35	1.425	21.883	0.841
40	1.629	24.233	0.931
45	1.832	26.350	1.013
50	2.036	28.217	1.084
55	2.240	29.833	1.146
60	2.443	31.233	1.200
65	2.647	32.400	1.245
70	2.850	33.350	1.282
75	3.054	34.067	1.309
80	3.258	34.583	1.329
85	3.461	34.900	1.341
90	3.665	35.000	1.345

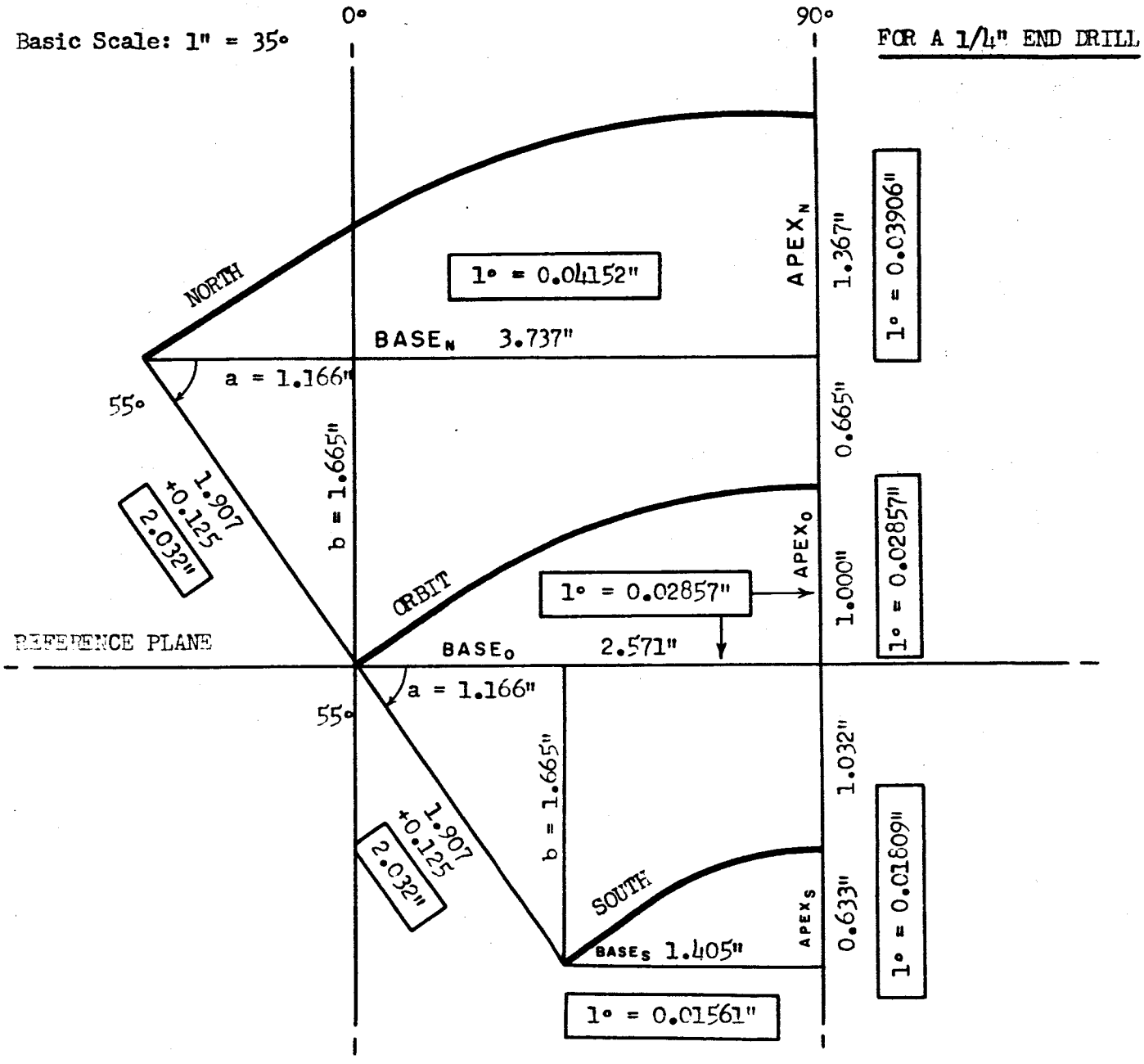
SOUTH CURVE TRACK PLOT VALUES FOR 90° OF A 35°00' ORBIT

L O N G I T U D E Scale: 1° = 0.01641"		L A T I T U D E Scale: 1° = 0.01871"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.000°	0.000"
10	0.164	6.933	0.130
20	0.328	13.467	0.252
30	0.492	19.300	0.361
40	0.656	24.233	0.453
50	0.821	28.217	0.528
60	0.985	31.233	0.584
70	1.149	33.350	0.624
80	1.313	34.583	0.647
90	1.477	35.000	0.655

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

35° 00' ORBIT CURVE TRACK SCALE FACTORS FOR 90° OF ORBIT



a = 2.032 Cos 55° = 2.032 (0.57358) a = 1.166"

b = 2.032 Sin 55° = 2.032 (0.81915) b = 1.665"

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA

1" = 35°

NORTH CURVE TRACK PLOT VALUES FOR 90° OF A 35°00' ORBIT
(FOR MILLING WITH A 1/4" END DRILL)

L O N G I T U D E Scale: 1° = 0.04152"		L A T I T U D E Scale: 1° = 0.03906"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.000°	0.000"
5	0.208	3.500	0.137
10	0.415	6.933	0.271
15	0.622	10.267	0.401
20	0.830	13.467	0.526
25	1.038	16.483	0.644
30	1.246	19.300	0.754
35	1.453	21.883	0.855
40	1.661	24.233	0.947
45	1.868	26.350	1.029
50	2.076	28.217	1.102
55	2.283	29.833	1.165
60	2.491	31.233	1.220
65	2.699	32.400	1.266
70	2.906	33.350	1.303
75	3.114	34.067	1.331
80	3.322	34.583	1.351
85	3.529	34.900	1.363
90	3.737	35.000	1.367

SOUTH CURVE TRACK PLOT VALUES FOR 90° OF A 35°00' ORBIT
(FOR MILLING WITH A 1/4" END DRILL)

L O N G I T U D E Scale: 1° = 0.01561"		L A T I T U D E Scale: 1° = 0.01809"	
Degrees	Inches	Degrees	Inches
0°	0.000"	0.000°	0.000"
10	0.156	6.933	0.125
20	0.312	13.467	0.244
30	0.468	19.300	0.349
40	0.624	24.233	0.438
50	0.781	28.217	0.510
60	0.937	31.233	0.565
70	1.093	33.350	0.603
80	1.249	34.583	0.626
90	1.405	35.000	0.633

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
CONVERSION OF MINUTES AND SECONDS INTO DECIMALS OF A DEGREE

	SECONDS								
MINUTES	0"	10"	15"	20"	30"	40"	45"	50"	MINUTES
0	.00000	.00278	.00417	.00556	.00833	.01111	.01250	.01389	0
1	.01667	.01944	.02083	.02222	.02500	.02778	.02917	.03056	1
2	.03333	.03611	.03750	.03889	.04167	.04444	.04583	.04722	2
3	.05000	.05278	.05417	.05556	.05833	.06111	.06250	.06389	3
4	.06667	.06944	.07083	.07222	.07500	.07778	.07917	.08056	4
5	.08333	.08611	.08750	.08889	.09167	.09444	.09583	.09722	5
6	.10000	.10278	.10417	.10556	.10833	.11111	.11250	.11389	6
7	.11667	.11944	.12083	.12222	.12500	.12778	.12917	.13056	7
8	.13333	.13611	.13750	.13889	.14167	.14444	.14583	.14722	8
9	.15000	.15278	.15417	.15556	.15833	.16111	.16250	.16389	9
10	.16667	.16944	.17083	.17222	.17500	.17778	.17917	.18056	10
11	.18333	.18611	.18750	.18889	.19167	.19444	.19583	.19722	11
12	.20000	.20278	.20417	.20556	.20833	.21111	.21250	.21389	12
13	.21667	.21944	.22083	.22222	.22500	.22778	.22917	.23056	13
14	.23333	.23611	.23750	.23889	.24167	.24444	.24583	.24722	14
15	.25000	.25278	.25417	.25556	.25833	.26111	.26250	.26389	15
16	.26667	.26944	.27083	.27222	.27500	.27778	.27917	.28056	16
17	.28333	.28611	.28750	.28889	.29167	.29444	.29583	.29722	17
18	.30000	.30278	.30417	.30556	.30833	.31111	.31250	.31389	18
19	.31667	.31944	.32083	.32222	.32500	.32778	.32917	.33056	19
20	.33333	.33611	.33750	.33889	.34167	.34444	.34583	.34722	20
21	.35000	.35278	.35417	.35556	.35833	.36111	.36250	.36389	21
22	.36667	.36944	.37083	.37222	.37500	.37778	.37917	.38056	22
23	.38333	.38611	.38750	.38889	.39167	.39444	.39583	.39722	23
24	.40000	.40278	.40417	.40556	.40833	.41111	.41250	.41389	24
25	.41667	.41944	.42083	.42222	.42500	.42778	.42917	.43056	25
26	.43333	.43611	.43750	.43889	.44167	.44444	.44583	.44722	26
27	.45000	.45278	.45417	.45556	.45833	.46111	.46250	.46389	27
28	.46667	.46944	.47083	.47222	.47500	.47778	.47917	.48056	28
29	.48333	.48611	.48750	.48889	.49167	.49444	.49583	.49722	29
30	.50000	.50278	.50417	.50556	.50833	.51111	.51250	.51389	30

SPECIFIC DATA
CONVERSION OF MINUTES AND SECONDS INTO DECIMALS OF A DEGREE (cont)

SECONDS

MINUTES '	0"	10"	15"	20"	30"	40"	45"	50"	'
31	.51667	.51944	.52083	.52222	.52500	.52778	.52917	.53056	31
32	.53333	.53611	.53750	.53889	.54167	.54444	.54583	.54722	32
33	.55000	.55278	.55417	.55556	.55833	.56111	.56250	.56389	33
34	.56667	.56944	.57083	.57222	.57500	.57778	.57917	.58056	34
35	.58333	.58611	.58750	.58889	.59167	.59444	.59583	.59722	35
36	.60000	.60278	.60417	.60556	.60833	.61111	.61250	.61389	36
37	.61667	.61944	.62083	.62222	.62500	.62778	.62917	.63056	37
38	.63333	.63611	.63750	.63889	.64167	.64444	.64583	.64722	38
39	.65000	.65278	.65417	.65556	.65833	.66111	.66250	.66389	39
40	.66667	.66944	.67083	.67222	.67500	.67778	.67917	.68056	40
41	.68333	.68611	.68750	.68889	.69167	.69444	.69583	.69722	41
42	.70000	.70278	.70417	.70556	.70833	.71111	.71250	.71389	42
43	.71667	.71944	.72083	.72222	.72500	.72778	.72917	.73056	43
44	.73333	.73611	.73750	.73889	.74167	.74444	.74583	.74722	44
45	.75000	.75278	.75417	.75556	.75833	.76111	.76250	.76389	45
46	.76667	.76944	.77083	.77222	.77500	.77778	.77917	.78056	46
47	.78333	.78611	.78750	.78889	.79167	.79444	.79583	.79722	47
48	.80000	.80278	.80417	.80556	.80833	.81111	.81250	.81389	48
49	.81667	.81944	.82083	.82222	.82500	.82778	.82917	.83056	49
50	.83333	.83611	.83750	.83889	.84167	.84444	.84583	.84722	50
51	.85000	.85278	.85417	.85556	.85833	.86111	.86250	.86389	51
52	.86667	.86944	.87083	.87222	.87500	.87778	.87917	.88056	52
53	.88333	.88611	.88750	.88889	.89167	.89444	.89583	.89722	53
54	.90000	.90278	.90417	.90556	.90833	.91111	.91250	.91389	54
55	.91667	.91944	.92083	.92222	.92500	.92778	.92917	.93056	55
56	.93333	.93611	.93750	.93889	.94167	.94444	.94583	.94722	56
57	.95000	.95278	.95417	.95556	.95833	.96111	.96250	.96389	57
58	.96667	.96944	.97083	.97222	.97500	.97778	.97917	.98056	58
59	.98333	.98611	.98750	.98889	.99167	.99444	.99583	.99722	59

GEMINI CELESTIAL DISPLAY DEVICE STUDY

SPECIFIC DATA
COORDINATE PLOT VALUES TO CONSTRUCT A 35°00' ORBIT FRAME
PATTERN AT A SCALE OF 1" = 35°

L O N G I T U D E			L A T I T U D E	
Degrees	Applied Value	Plot	Applied Value	Plot
Origin		10.000"		15.000"
A	-2.000	08.000		15.000
B	+13.500	21.500		15.000
C		10.000	+4.000	19.000
D		10.000	-4.000	11.000
Origin		10.000		15.000
Corner 1	-1.150	08.850	+3.657	18.657
Corner 2	+11.984	20.834		
Corner 3		20.834	-7.314	11.343
Corner 4	-11.984	08.850		
Check 1			+7.314	
Origin		10.000		15.000
Edge	-1.150	08.850	+1.032	16.032
0 - 90	+1.150	10.000		16.032
0 - 80	+0.1561	10.156	+0.003	16.035
0 - 70	+0.1561	10.312	+0.023	16.058
0 - 60	+0.1561	10.468	+0.038	16.096
0 - 50	+0.1561	10.624	+0.055	16.151
0 - 40	+0.1561	10.781	+0.072	16.223
0 - 30	+0.1561	10.937	+0.089	16.312
0 - 20	+0.1561	11.093	+0.105	16.417
0 - 10	+0.1561	11.249	+0.119	16.536
0	+0.1561	11.405	+0.125	16.665
0 + 5	+0.2076	11.613	+0.137	16.802
0 + 10	+0.2076	11.820	+0.134	16.936
0 + 15	+0.2076	12.028	+0.130	17.066
0 + 20	+0.2076	12.235	+0.125	17.191
0 + 25	+0.2076	12.443	+0.118	17.309
0 + 30	+0.2076	12.651	+0.110	17.419
0 + 35	+0.2076	12.858	+0.101	17.520
0 + 40	+0.2076	13.066	+0.092	17.612
0 + 45	+0.2076	13.273	+0.082	17.694
0 + 50	+0.2076	13.481	+0.073	17.767
0 + 55	+0.2076	13.689	+0.063	17.830
0 + 60	+0.2076	13.896	+0.055	17.885
0 + 65	+0.2076	14.104	+0.046	17.931
0 + 70	+0.2076	14.311	+0.037	17.968
0 + 75	+0.2076	14.519	+0.028	17.996

COORDINATE PLOT VALUES TO CONSTRUCT A 35°00' ORBIT FRAME PATTERN AT A SCALE OF 1" = 35° (cont)

LONGITUDE			LATITUDE	
Degrees	Applied Value	Plot	Applied Value	Plot
0°+ 80°	+0.2076	14.727"	+0.020	18.016"
0 + 85	+0.2076	14.934	+0.012	18.028
0 + 90	+0.2076	15.142	+0.004	18.032
0 + 95	+0.2076	15.349	-0.004	18.028
0 + 100	+0.2076	15.557	-0.012	18.016
0 + 105	+0.2076	15.765	-0.020	17.996
0 + 110	+0.2076	15.972	-0.028	17.968
0 + 115	+0.2076	16.180	-0.037	17.931
0 + 120	+0.2076	16.387	-0.046	17.885
0 + 125	+0.2076	16.595	-0.055	17.830
0 + 130	+0.2076	16.803	-0.063	17.767
0 + 135	+0.2076	17.010	-0.073	17.694
0 + 140	+0.2076	17.218	-0.082	17.612
0 + 145	+0.2076	17.425	-0.092	17.520
0 + 150	+0.2076	17.633	-0.101	17.419
0 + 155	+0.2076	17.841	-0.110	17.309
0 + 160	+0.2076	18.048	-0.118	17.191
0 + 165	+0.2076	18.256	-0.125	17.066
0 + 170	+0.2076	18.463	-0.130	16.936
0 + 175	+0.2076	18.671	-0.134	16.802
0 + 180	+0.2076	18.879	-0.137	16.665
0 + 190	+0.1561	19.035	-0.125	16.536
0 + 200	+0.1561	19.191	-0.119	16.417
0 + 210	+0.1561	19.347	-0.105	16.312
0 + 220	+0.1561	19.503	-0.089	16.223
0 + 230	+0.1561	19.659	-0.072	16.151
0 + 240	+0.1561	19.815	-0.055	16.096
0 + 250	+0.1561	19.971	-0.038	16.058
0 + 260	+0.1561	20.127	-0.023	16.035
0 + 270	+0.1561	20.284	-0.003	16.032
Edge	+0.55	20.834		16.032
Origin		10.000		15.000
0 - 90	+1.150	10.000	-1.000	14.000
0 - 85	+0.14285	10.143	+0.003	14.003
0 - 80	+0.14285	10.286	+0.009	14.012
0 - 75	+0.14285	10.429	+0.015	14.027
0 - 70	+0.14285	10.571	+0.020	14.047
0 - 65	+0.14285	10.714	+0.027	14.074
0 - 60	+0.14285	10.857	+0.034	14.108
0 - 55	+0.14285	11.000	+0.040	14.148
0 - 50	+0.14285	11.143	+0.046	14.194
0 - 45	+0.14285	11.286	+0.053	14.247

COORDINATE PLOT VALUES TO CONSTRUCT A 35°00' ORBIT FRAME PATTERN AT A SCALE OF 1" = 35° (cont)

LONGITUDE			LATITUDE	
Degrees	Applied Value	Plot	Applied Value	Plot
0° - 40°	+0.14285	11.429"	+0.059	14.306"
0 - 35	+0.14285	11.571	+0.067	14.373
0 - 30	+0.14285	11.714	+0.074	14.447
0 - 25	+0.14285	11.857	+0.080	14.527
0 - 20	+0.14285	12.000	+0.086	14.613
0 - 15	+0.14285	12.143	+0.092	14.705
0 - 10	+0.14285	12.286	+0.095	14.800
0 - 5	+0.14285	12.428	+0.098	14.898
0	+0.14285	12.571	+0.100	15.000
0 + 5	+0.14285	12.714	+0.100	15.100
0 + 10	+0.14285	12.857	+0.098	15.198
0 + 15	+0.14285	13.000	+0.095	15.293
0 + 20	+0.14285	13.143	+0.092	15.385
0 + 25	+0.14285	13.286	+0.086	15.471
0 + 30	+0.14285	13.428	+0.080	15.551
0 + 35	+0.14285	13.571	+0.074	15.625
0 + 40	+0.14285	13.714	+0.067	15.692
0 + 45	+0.14285	13.857	+0.059	15.751
0 + 50	+0.14285	14.000	+0.053	15.804
0 + 55	+0.14285	14.143	+0.046	15.850
0 + 60	+0.14285	14.286	+0.040	15.890
0 + 65	+0.14285	14.428	+0.034	15.924
0 + 70	+0.14285	14.571	+0.027	15.951
0 + 75	+0.14285	14.714	+0.020	15.971
0 + 80	+0.14285	14.857	+0.015	15.986
0 + 85	+0.14285	15.000	+0.009	15.995
0 + 90	+0.14285	15.143	+0.003	16.000
0 + 95	+0.14285	15.285	-0.003	15.995
0 + 100	+0.14285	15.428	-0.009	15.986
0 + 105	+0.14285	15.571	-0.015	15.971
0 + 110	+0.14285	15.714	-0.020	15.951
0 + 115	+0.14285	15.857	-0.027	15.924
0 + 120	+0.14285	16.000	-0.034	15.890
0 + 125	+0.14285	16.143	-0.040	15.850
0 + 130	+0.14285	16.285	-0.046	15.804
0 + 135	+0.14285	16.428	-0.053	15.751
0 + 140	+0.14285	16.571	-0.059	15.692
0 + 145	+0.14285	16.714	-0.067	15.625
0 + 150	+0.14285	16.857	-0.074	15.551
0 + 155	+0.14285	17.000	-0.080	15.471
0 + 160	+0.14285	17.143	-0.086	15.385
0 + 165	+0.14285	17.286	-0.092	15.293

COORDINATE PLOT VALUES TO CONSTRUCT A 35°00' ORBIT FRAME PATTERN AT A SCALE OF 1" = 35° (cont)

LONGITUDE			LATITUDE	
Degrees	Applied Value	Plot	Applied Value	Plot
0° + 170°	+0.14285	17.428"	-0.095	15.198"
0 + 175	+0.14285	17.571	-0.098	15.100
0 + 180	+0.14285	17.714	-0.100	15.000
0 + 185	+0.14285	17.857	-0.100	15.398
0 + 190	+0.14285	18.000	-0.098	14.800
0 + 195	+0.14285	18.142	-0.095	14.705
0 + 200	+0.14285	18.285	-0.092	14.613
0 + 205	+0.14285	18.428	-0.086	14.527
0 + 210	+0.14285	18.571	-0.080	14.447
0 + 215	+0.14285	18.714	-0.074	14.373
0 + 220	+0.14285	18.857	-0.067	14.306
0 + 225	+0.14285	19.000	-0.059	14.247
0 + 230	+0.14285	19.142	-0.053	14.194
0 + 235	+0.14285	19.285	-0.046	14.148
0 + 240	+0.14285	19.428	-0.040	14.108
0 + 245	+0.14285	19.571	-0.034	14.074
0 + 250	+0.14285	19.714	-0.027	14.047
0 + 255	+0.14285	19.857	-0.020	14.027
0 + 260	+0.14285	20.000	-0.015	14.012
0 + 265	+0.14285	20.142	-0.009	14.003
0 + 270	+0.14285	20.285	-0.003	14.000
Origin		10.000		15.000
Edge	-1.15	08.850	-3.032	11.968
0 - 90		10.000		11.968
0 - 85	+0.2076	10.208	+0.004	11.972
0 - 80	+0.2076	10.415	+0.012	11.984
0 - 75	+0.2076	10.623	+0.020	12.004
0 - 70	+0.2076	10.830	+0.028	12.032
0 - 65	+0.2076	11.038	+0.037	12.069
0 - 60	+0.2076	11.246	+0.046	12.115
0 - 55	+0.2076	11.453	+0.055	12.170
0 - 50	+0.2076	11.661	+0.063	12.233
0 - 45	+0.2076	11.868	+0.073	12.306
0 - 40	+0.2076	12.076	+0.082	12.388
0 - 35	+0.2076	12.284	+0.092	12.480
0 - 30	+0.2076	12.491	+0.101	12.581
0 - 25	+0.2076	12.699	+0.110	12.691
0 - 20	+0.2076	12.906	+0.118	12.809
0 - 15	+0.2076	13.114	+0.125	12.934
0 - 10	+0.2076	13.322	+0.130	13.064
0 - 5	+0.2076	13.529	+0.134	13.198

COORDINATE PLOT VALUES TO CONSTRUCT A 35°00' ORBIT FRAME PATTERN AT A SCALE OF 1" = 35° (cont)

LONGITUDE			LATITUDE	
Degrees	Applied Value	Plot	Applied Value	Plot
0°	+0.2076	13.737"	+0.137	13.335"
0 + 10	+0.1561	13.893	+0.125	13.460
0 + 20	+0.1561	14.049	+0.119	13.579
0 + 30	+0.1561	14.205	+0.105	13.684
0 + 40	+0.1561	14.361	+0.089	13.773
0 + 50	+0.1561	14.517	+0.072	13.845
0 + 60	+0.1561	14.673	+0.055	13.900
0 + 70	+0.1561	14.830	+0.038	13.938
0 + 80	+0.1561	14.986	+0.023	13.961
0 + 90	+0.1561	15.142	+0.003	13.968
0 + 100	+0.1561	15.298	-0.003	13.961
0 + 110	+0.1561	15.454	-0.023	13.938
0 + 120	+0.1561	15.610	-0.038	13.900
0 + 130	+0.1561	15.766	-0.055	13.845
0 + 140	+0.1561	15.922	-0.072	13.773
0 + 150	+0.1561	16.078	-0.089	13.684
0 + 160	+0.1561	16.234	-0.105	13.579
0 + 170	+0.1561	16.391	-0.119	13.460
0 + 180	+0.1561	16.547	-0.125	13.335
0 + 185	+0.20760	16.754	-0.137	13.198
0 + 190	+0.20760	16.962	-0.134	13.064
0 + 195	+0.20760	17.169	-0.130	12.934
0 + 200	+0.20760	17.377	-0.125	12.809
0 + 205	+0.20760	17.585	-0.118	12.691
0 + 210	+0.20760	17.792	-0.110	12.581
0 + 215	+0.20760	18.000	-0.101	12.480
0 + 220	+0.20760	18.207	-0.092	12.388
0 + 225	+0.20760	18.415	-0.082	12.306
0 + 230	+0.20760	18.623	-0.073	12.233
0 + 235	+0.20760	18.830	-0.063	12.170
0 + 240	+0.20760	19.038	-0.055	12.115
0 + 245	+0.20760	19.245	-0.046	12.069
0 + 250	+0.20760	19.453	-0.037	12.032
0 + 255	+0.20760	19.661	-0.028	12.004
0 + 260	+0.20760	19.868	-0.020	11.984
0 + 265	+0.20760	20.076	-0.012	11.972
0 + 270	+0.20760	20.284	-0.004	11.968
Edge	+0.55	20.834		11.968

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