

Specification for Prototype Surface Panels
for
25 m Diameter mm Wave Radio Telescope

October 20, 1975

I. General

The National Radio Astronomy Observatory (NRAO), is planning to design and build a 25 m diameter radio telescope for wavelengths as short as 1 mm. One critical element of such a telescope is the reflecting surface, which has to be manufactured to have and maintain a very high accuracy. It is imperative that the total telescope surface deviation from the theoretical parabolic shape be less than 75 μ m rms. Many factors contribute to this error, one of them being the errors of a single surface panel of which there are 528 on the telescope. This requires that a single panel shall have manufacturing errors of less than 40 μ m rms in order to achieve the 75 μ m rms for the total telescope error and result in the required telescope performance. It is expected that this tolerance, along with other tolerances outlined in the specifications to follow, is close to the limit of what can be achieved with today's technology. NRAO wishes to enter into a contract with a suitable manufacturer for the purpose of developing, manufacturing, testing and reporting on one typical surface panel.

The proposed telescope will use a 25 m diameter paraboloid "dish." The dish will be supported by a special "homology" back-up structure which will adjust and retain a parabolic shape in all attitudes of the dish. The "dish" will be maneuverable for pointing toward any point in the sky above the horizon with a pointing accuracy of 1.2 arc seconds.

II. Scope of Work

Furnish best effort design services, materials, equipment, labor, supervision, and measuring equipment to manufacture and measure two prototype surface panels with a brief report of the complete procedure.

III. Panel Parameters

The prototype panel shall be a typical ring 4 panel shown in the attached schedule having the dimension shown and meeting the following specifications when delivered.

1. Will properly fit into a paraboloid with 10.5 m focal length (a), 25 m diameter and the surface contour of the equation $x^2 + y^2 = 4az$ mm ($f/D = 0.42$) when mounted at the four corners.

2. The statistical deviation of the final machined reflector surface from the theoretical paraboloid surface going through the reference points at the four corners of the panel should be less than 40 μ m rms. The maximum allowable error of any point on the surface shall be less than 120 μ m.

3. The analytical gravitational deflection, when the plate is horizontally supported at four corners shall be less than 25 μm rms from the final manufactured surface.

4. Have a maximum analytical deformation due to 30 km/hr. wind of 20 μm from the final manufactured surface.

5. The maximum analytical thermal deformation shall be 64 μm , with a ΔT of 1°C between front and rear surface of panel.

6. The machined edges shall have a maximum dimensional error at any point of ± 0.5 mm.

7. Analytically survive a wind load of 150 km/hr. without permanent deformation.

8. Analytically survive a distributed load of 100 kg/m^2 or 115 kg over a 15 cm square or a heavy man standing on the panel without permanent deformation.

9. Shall not have machining cusps of heights exceeding 15 μm .

10. Have a maximum weight of 20 kg/m^2 and a minimum weight of 17.5 kg/m^2 .

11. Be equipped with a mounting receptacle in each corner machined to within 25 μm of the mounting plane and equipped with required receptacles to receive an adjustable mounting bracket as shown on attached sketches.

12. The panel shall be solid surface having a nominal thickness of 3.2 mm in areas between reinforcing ribs (thinnest areas of the panel).

13. Width of panel surface (flange) beyond ribs around edges of panel shall not exceed 2 cm.

IV. Manufacturing

The panels shall be cast-machined aluminum using A 356 aluminum or better, stress relieved and aged to T51 conditions. Reflective surfaces shall be machined to grade C or better, while other machined surfaces on the panel shall be machined to grade D or better.

Casting shall generally follow the requirements of MIL-C6021G specifications using wood patterns.

V. Measuring

Measuring shall consist of the manufacturer's standard measurement procedure to establish the rms error of the finished surface from the

theoretical surface passing through the control points at the corners of the panel. Measurements shall be made with instruments other than those on the equipment used to machine the finished surface. Measurement procedure shall be submitted for review and approval before measurements are made. All data taken, properly identified, shall be included in the report.

VI. Report:

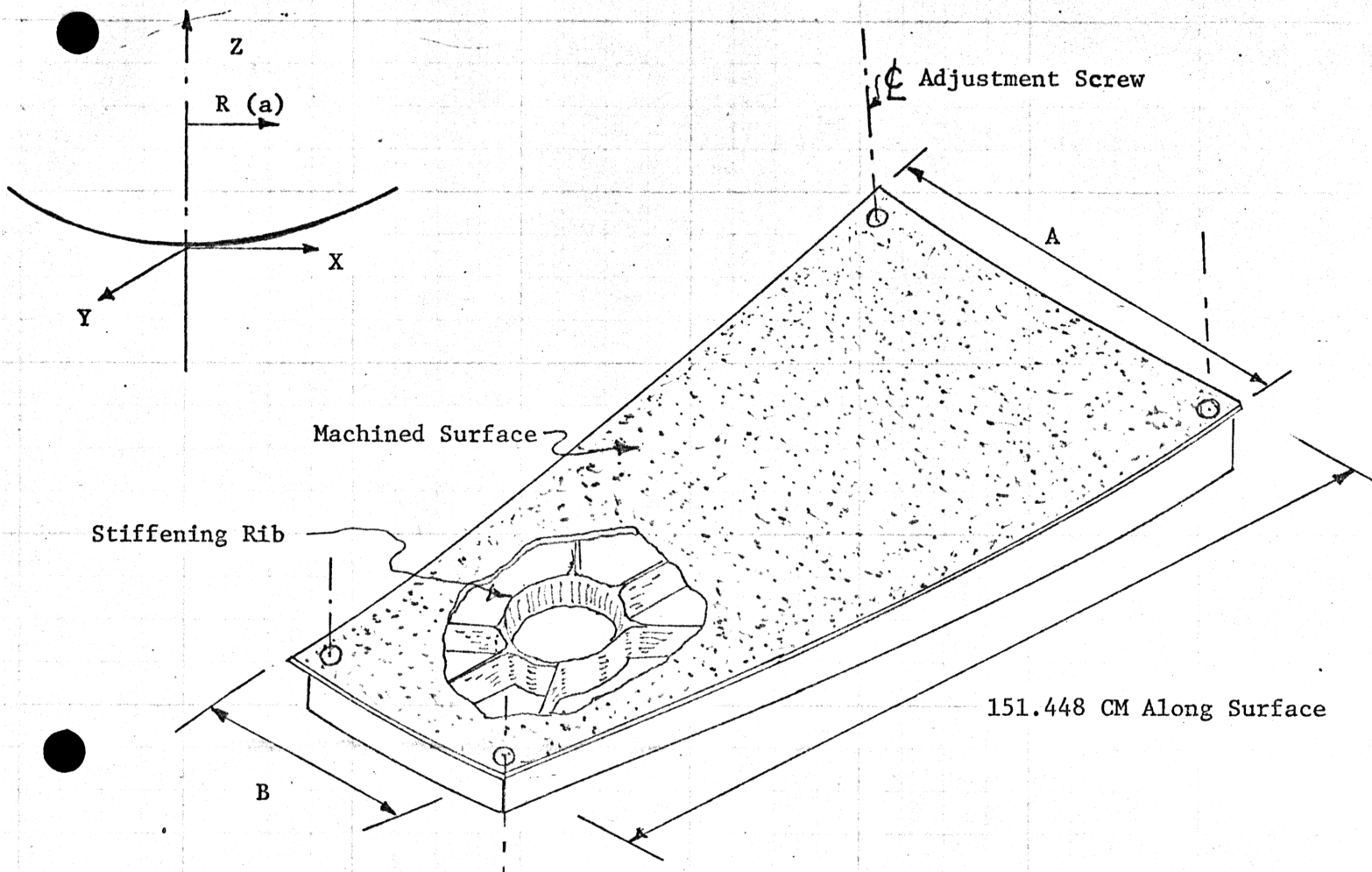
A brief report shall be prepared to provide a brief history of the design, manufacturing and measuring of the panel. The report shall include all design calculations, including all calculations establishing analytical values for parameters specified in section III, all drawings, specifications and special manufacturing instructions. A cost estimate, with estimated delivery time, for 528 similar panels in 1976 dollars shall be included.

VII. Progress Reports

During design, manufacturing and measuring regular letter progress reports shall be issued. Complete design calculations shall be submitted for review and approval before proceeding with casting and machining. Where calculations indicate conflicts between parameters specified, alternate shall be given holding each parameter constant and allowing the other to vary. An example of possible conflict would be unit weight and gravitational deflection. Representatives of NRAO will make frequent visits to the manufacturers facilities for verbal reports and discussions, and to observe manufacturing and measuring procedures.

VIII. Deliverable Items

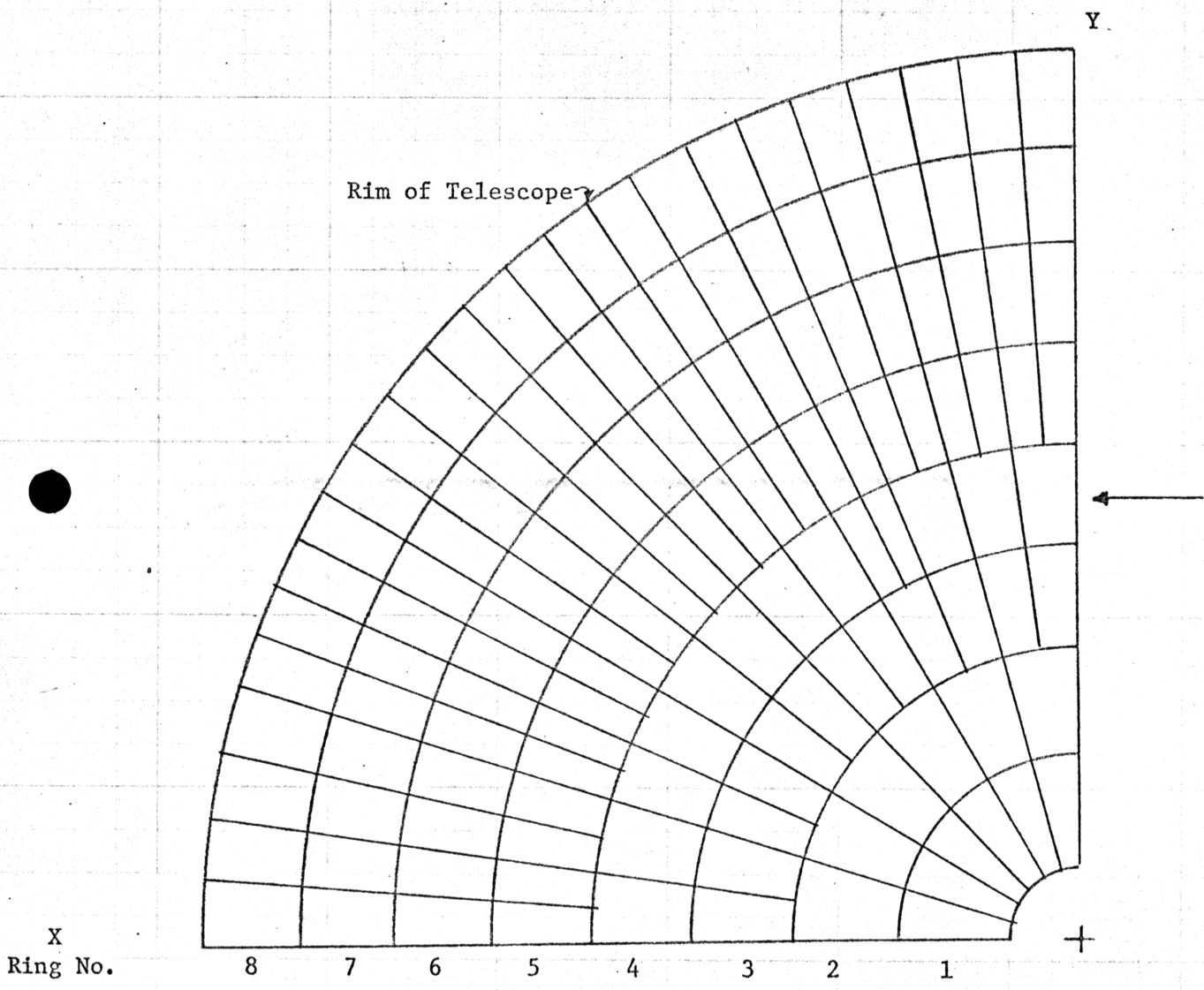
1. Design calculations for approval prior to making casting.
2. Measuring procedure for approval prior to making measurements.
3. Progress reports as appropriate.
4. Eight (8) rough castings on unit cost basis. This number might be changed when contract is negotiated.
5. Two (2) machined panels meeting the above specification on a best effort basis with measurement data and calculations showing how they compare with the specifications.
6. Three (3) copies of the report specified above.



Sizes and Configurations of Surface Panels

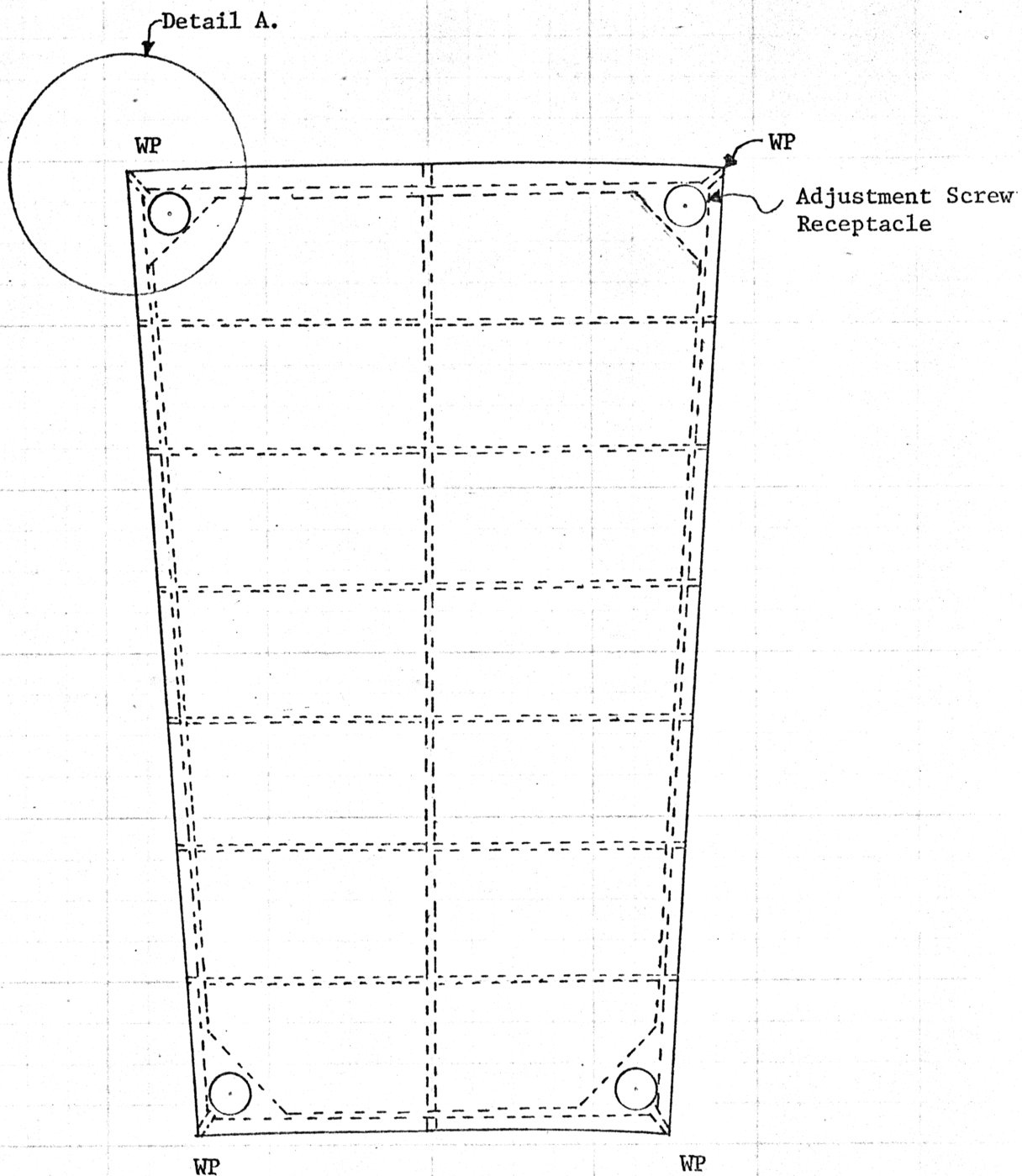
Ring No.	R	R	Z	A	B	No. Panels
	108.501		2.804			
1	---		---	67.904	28.405	24
	259.372		16.017			
2	---		---	107.058	67.904	24
	408.937		39.817			
3	---		---	72.850	53.531	48
	556.534		73.746			
4	---		---	91.841	72.850	48
	701.612		117.206			
5	---		---	55.222	45.910	96
	843.745		169.502			
6	---		---	64.313	55.222	96
	982.629		229.895			
7	---		---	73.177	64.313	96
	1118.078		297.642			
8	---		---	81.813	73.177	96
	1250.000		372.024			
Total						528

All dimensions in centimeters. The dimensions are analytical without considering clearance. They are based on coordinates of working points (WP)



Surface Panels arrangement on one quarter of the aperture

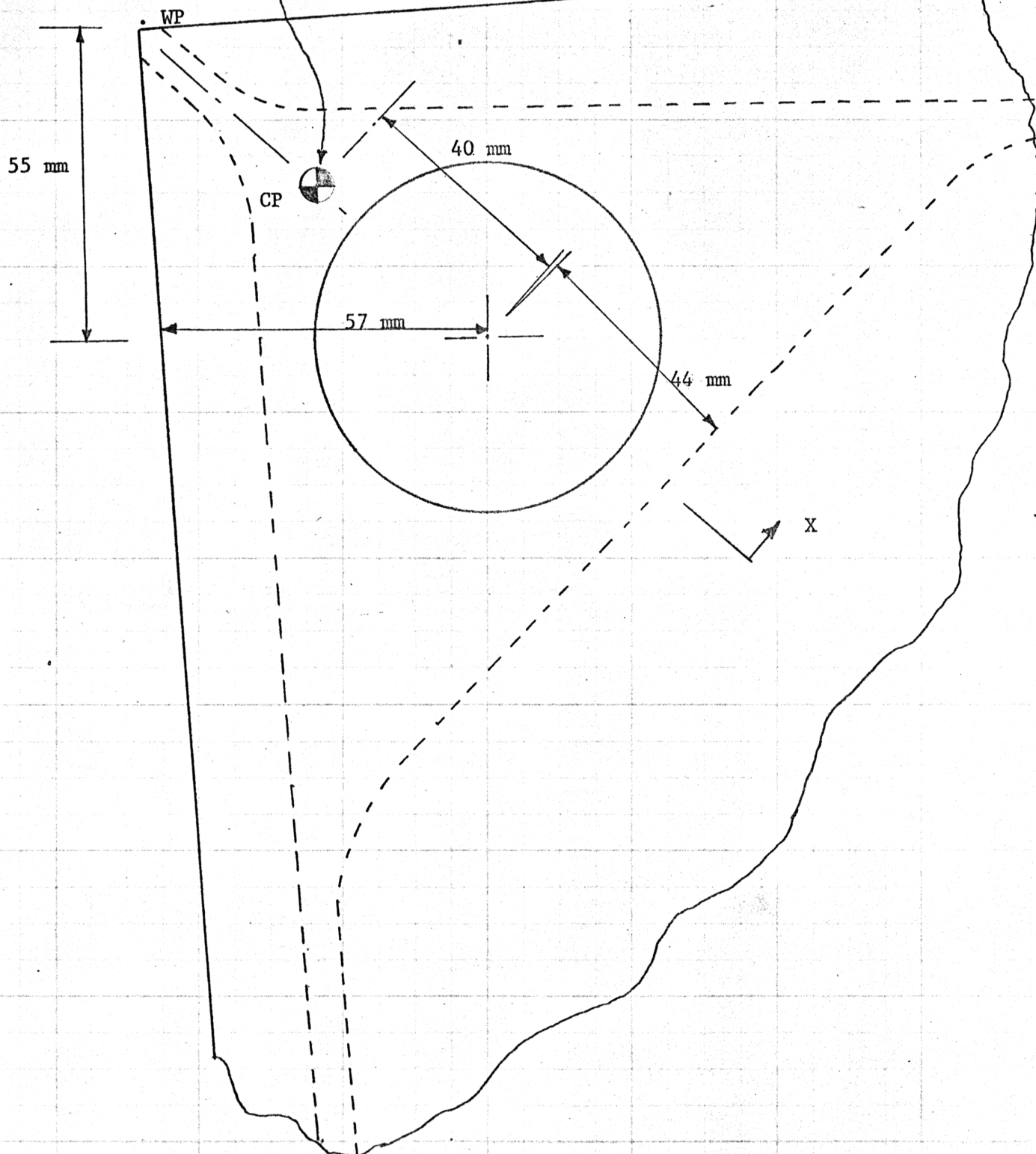
BY _____ DATE _____ SUBJECT _____ SHEET NO. _____ OF _____
CHKD. BY _____ DATE _____ 6 _____ JOB NO. _____



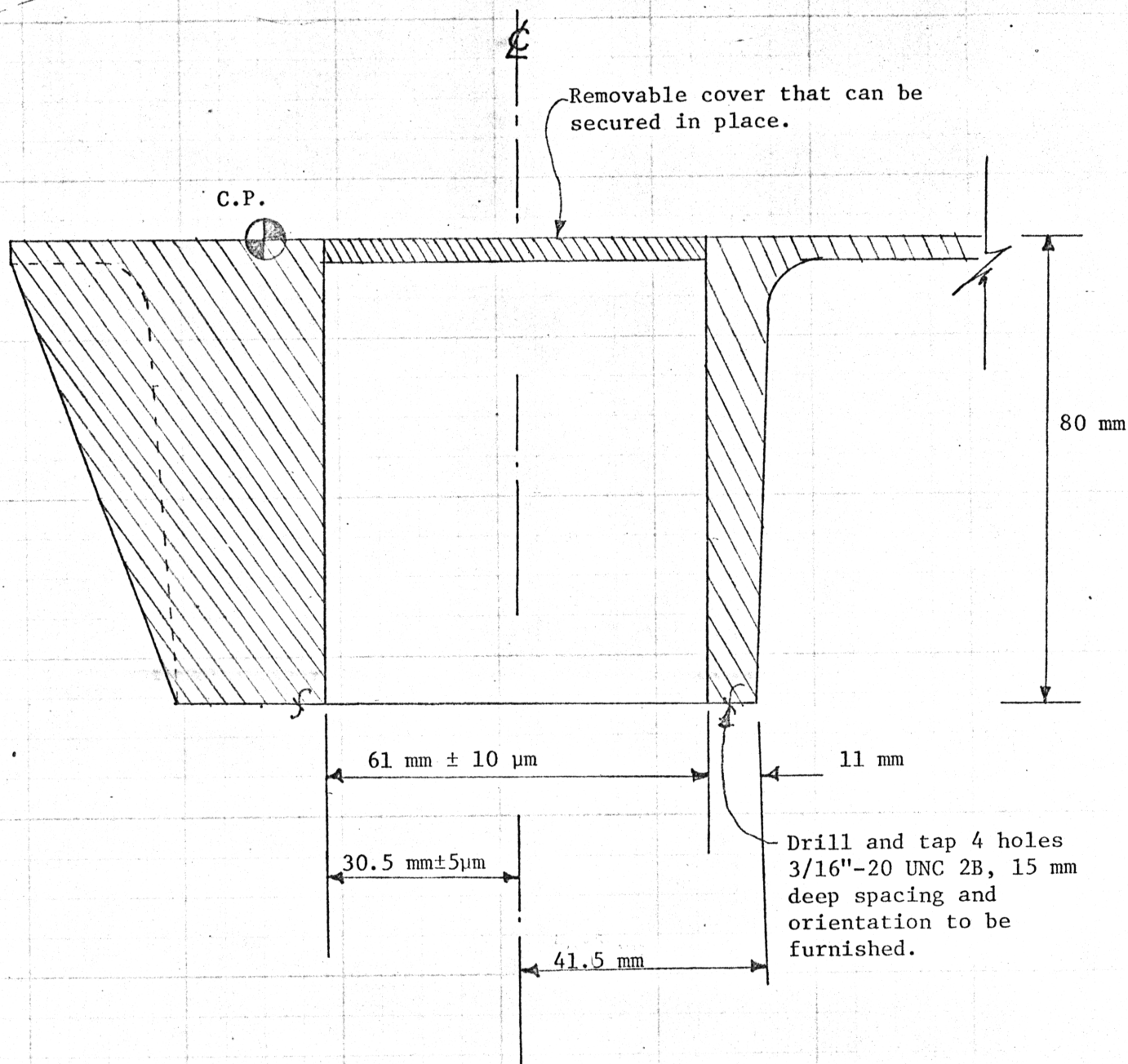
Typical Panel showing adjustment screw receptacles and Hypothetical rib structure.

SKETCH 3

Control Point
Typical-Four Corners



Detail A
SKETCH 4



Alignment of for holes are $90^\circ (\pm 18'')$
 to the plane defined by the control
 points (CP) at four corners.

SECTION X-X

SKETCH 5