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May 1967

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STATEMENT OF WORK - VIEWER NOD-120

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[redacted] proposes to furnish all necessary labor, material and facilities required to design, develop, fabricate, assemble, and test one Rear Projection Viewer as described in the attached specification dated May 1967.

The program shall be conducted in three steps which shall be defined as:

Step I The effort to design and analyze the optical system, including the Zoom Projection Lens (s) and Preliminary Design of the condenser/illumination system for the projection lens. Execution time, three (3) months.

what are performance characteristics to be considered

what will they provide

Step II Complete the mechanical design, documentation and the fabrication, assembly, alignment, and test of the projection/illumination system. Execution time, seven (7) months.

semi finished optics > 16 mo
JUNE 67
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Report who gets what.

Step III The design, fabrication, assembly, alignment and test of the remaining viewer components including, but not limited to, film transport, power supplies, structure/enclosure, mirrors and related components. Execution time, six (6) months.

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6,000

~~54,000~~

27,000

Step I (Con't)

transition points. Analyze first order solutions on basis of probability of successfully meeting performance requirements, total systems requirements and suitability of incorporation within general viewer configuration.

2. Perform optimization of one or more potential solutions. Continue optimization to a point where one of the potential solutions displays an obvious superiority.

3. Initial design of condenser/illumination system to arrive at first order solution.

Step II

1. Finalize lens (s) mechanical configuration and prepare necessary drawings and documentation required for fabrication, assembly and alignment.

2. Submit condenser lens design for optimization and complete optical design and prescriptions for condenser lens elements.

3. Make mechanical layouts of condenser/illumination system to define configuration and permit analysis of suitability within overall system configuration.

4. Prepare detail drawings and documentation required for fabrication, assembly, and alignment of condenser/illumination system.

5. Prepare test procedure and submit for customer review and mutual approval prior to drawing release.

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Step II (Con'd)

6. [illegible] plates (estimated 44 required).

7. Procure all raw material, castings, and component parts for projection lens and condenser/illumination system.

8. Fabricate all parts, assemble and align projection lens and condenser/illumination assembly.

9. Design film holder and necessary fixture to hold projection lens, film holder and condenser/illumination system together during system alignment and test.

10. Fabricate film holders and holding fixtures for projection system.

11. Assemble film holder and assemble holder into fixture. Assemble projection lens and condenser/illumination system with holding fixtures. Align and collimate optical projection and condenser system.

12. Perform optical measurements and tests with customer personnel in accordance with test procedure.

13. Order long lead items required for Step III (long lead being defined as any material, components, or supplies which cannot be procured within 60 days).

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3. Fabricate and assemble all parts in accordance with the appropriate drawings.

4. Perform system tests and checkout of complete viewer with customer personnel in accordance with test procedure.

5. Prepare viewer for shipment in accordance with good commercial practice and ship [redacted] STAT

6. Prepare maintenance and operational manuals in accordance with good commercial practice.

7. Provide technical support to customer during evaluation and final acceptance.

8. Provide spare parts

9. Install viewer at customer facility

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May 1967

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TECHNICAL REQUIREMENTS [illegible]

[illegible]

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1. INTRODUCTION

This paper describes the specifications and requirements to be met in the fabrication of an advanced rear projection viewer.

2. CONTENT

2.1 Purpose - This instrument will allow the photo interpreter to obtain more information than is now possible with existing rear projection viewers and will also provide more flexibility in the overall scanning operation.

2.2 Scope - The scope of this contract will be the design and fabrication of an operational, advanced rear projection viewer.

3. REQUIREMENTS

3.1 General Configuration -

3.1.1 Overall width of any one section of the viewer shall not exceed 34-1/2 inches, which will facilitate movement through a 36-inch office door. The overall height shall not exceed 78 inches. The depth shall be no greater than 83 inches. Maximum time for preparing the instrument for movement through doors shall not exceed 15 minutes. OK OK

3.1.2 The center of the viewing screen shall be 55.5 inches from the floor. OK

3.1.3 The viewer will be configured to allow two or more interpreters to view the screen at the same time.

3.2 Optical System -

3.2.1 Quality -

3.2.1.1 The prime objective of this contract is to provide a practical viewer having the optical quality exhibited in Figure 1. The resolution specifications are 10 lp/mm/magnification power @ 3X decreasing linearly to 6 lp/mm/magnification power @ 70X using a high contrast resolution target. These values are to be read on the viewing side of the screen, and shall ~~should~~ not vary more than 20% over the entire ~~screen~~ area bounded by a thirty inch ~~circle~~ diameter circle concentric with the optical axis.

3.2.1.2 The optical system is to be so designed that when the image is in sharp focus there will be no apparent color fringing of the screen when the screen is inspected with a 10X magnifier. When a calibrated grid is projected; geometric distortion of the images at the screen shall not exceed two percent across the screen.

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3.2.2 Magnification - The system shall provide continuous magnification with a minimum magnification of 3X and a maximum of 7X. If two OK optical systems are used they must be par focused so that when changed, the images will remain in focus. The time required to change from one magnification range to the other will be less than five seconds.

3.2.3 Screen -

3.2.3.1 The size of the screen shall be 30 inches square.

3.2.3.2 Unless otherwise directed by the Contracting OK Officer, a Polacoat LS-60 screen shall be used.

3.2.4 Illumination -

3.2.4.1 Screen Brightness - The screen brightness, as viewed from the position of the observer, will have a minimum acceptable luminance of 20 ft.-lamberts at [illegible] magnification. This luminance will be measured with a silver halide film of ~~neutral density~~ fogged (1.5) filling the film plane, or an open gate screen brightness of 600 ft. lamberts. The screen will be evenly illuminated and at no point will the illumination deviate by more than 10% of the maximum value. This brightness requirement will not be obtained 1-1/4 inches on the corners of the film decreasing linearly and disappearing at 3.7X when viewing 9-1/2 inch film. OK It is required that the light intensity be continuously variable from 100% to 50% of the above values. The color temperature of the illumination shall never fall below 3400°K. The brightness of the original light source shall not diminish by more than 10% during the first 1000 hours of operation.

3.2.4.2 Cooling - Adequate cooling of the light source shall be provided to minimize premature burnout (as defined in 3.2.4.1) and other glass breakage due to heat. Maximum acceptable film temperature in the film gate is 100°F when used in an ambient room temperature of 80° or below. Temperature tests will be made with silver halide film, in a static state, with a fogged density of 1.5, completely filling the entire gate, with the light source burning continuously at maximum brightness for three hours.

3.2.5 Focus - The instrument will maintain maximum film flatness in both static and dynamic modes. In the static condition, the entire projected image will remain in sharp focus regardless of magnification. When the film is transported there will be no apparent focal shift of the projected image during the transport mode. The projected image shall remain in sharp focus at all points on the screen; any focus adjustment required shall be faster than the normal perception of the human eye.

3.2.6 Image Rotation - Image rotation through 360° shall be provided. This should be easily controlled from the instrument panel.

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3.3 Film Transport System -

3.3.1 Film transport shall be provided to accommodate various widths of roll film ranging from 1000 foot rolls of 70mm to 500 foot rolls of 9-1/2 inch material of standard film thickness. However, the transport should be so designed to permit use of thin base material. A wide variety of film spools may be used; however, they shall generally conform to Air Force specifications. The viewer should accommodate any size between 70mm and 9.5 inches, inclusive.

3.3.1.1 Design of the transport shall insure safe handling of film, both standard and thin base, at all speed, i.e., no stretching, tearing, frilling edges, scratching, etc. can be tolerated.

3.3.1.2 Two film drive speed ranges are to be provided. OK

3.3.1.2.1 High speed, rapid, advance/rewind. The maximum speed will be dictated by safe film handling practices, but should have a range of at least 0.9 to 40 inches/second parallel to the film and 0.05 to 2.0 inches/second transverse to the film. Sufficient control of the braking system shall be maintained to insure smooth stop motion when the variable control is returned to the stop position.

3.3.1.2.2 A variable scan speed will provide suitable viewing speed at all magnifications. Film speed is to be variable at a ratio of at least 1000:1 or 0.002 to 2.0 inches/second and must be smooth at all speeds. The speed range shall vary from just barely moving on the screen at 70X to the fastest at which an operator can adequately view the film. The ranges of speed must be consistent with the ranges of magnification. Smooth image movement is interpreted to mean there shall be no noticeable jerking or sporadic movement of the projected image detectable by the unaided eye.

3.3.2 Image positioning controls shall be provided which allow the operator to bring any portion of the film frame into view at the center of the projection screen. The mid-point of all the various film widths will always be positioned at the mid-point of the film projection gate. Pushbutton controls shall be provided to automatically center the projection system over the mid-point of the film. Another pushbutton control shall provide automatic image rotation to a reference position. The joystick motion control shall be extremely sensitive -- the film speed will not vary when the joystick is maintained at a constant deflection. The null position shall be positive and limited in range. The joystick control assembly shall be removable from the viewer to permit the operator to control the image motion at a distance up to 4 feet away from the viewer.

3.3.3 Film transport control logic shall interlock the film transport operations so that it will be impossible for an operator to damage film by improper sequencing of the film transport controls.

3.3.4 The film gate and transport system shall be so constructed to prevent any damage to the film either in the static or dynamic mode. No scratches will be evident on an unexposed developed 500 foot spool of 9.5 inch film after it has been transported through the film gate ten times.

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3.3.5 The operation of the film transport should be from a single joystick type control to allow forward or reverse translation of the film using this control. The direction of deflection of the joystick will correspond directly to the motion of the image across the screen, regardless of the degree of image rotation involved.

3.3.6 The ease of loading the film will be of extreme importance in this instrument. Rapid, positive loading and easy access to load are mandatory. The time required for an experienced operator to complete the entire film loading operation will be no greater than 30 seconds (film preparation excluded). The system will be fabricated to allow the operator to simply load the film spool in the transport, which is automatically positioned to the front and fully exposed when the front door is opened, and attaches the end of the film to a leader which then carries it through the projection platen and onto the take-up spool. No additional operations will be required after this step and the film is now loaded for viewing. The take-up spool will be a special design; whereby, no adjustment will be required to accommodate various film sizes. The removal of the take-up spool will not be required.

3.3.7 The film aperture shall measure no less than 9-1/2" x 9-1/2" and shall hold the film flat while viewing. The entire width of 9.5 inch wide film will be projected. The platen shall be designed to accommodate sizes from 70mm to 9-1/2" film of various thicknesses. On transport scanning and film slew positions, the film gate shall be designed to prevent the film from coming in contact with the platen. Adequate control shall be exercised to maintain the entire projected image automatically in sharp focus in either the scanning or static mode as described in 3.2.5.

3.3.8 A mensuration system will enable the operator to measure film distances in one millimeter increments in both the "X" and "Y" axis. Maximum "X" axis measurement (parallel to the film length) will be 40 inches and "Y" axis will be 9.5 inches.

3.4 Construction -

3.4.1 Electrical -

3.4.1.1 All electrical and electronic parts will be of the heavy duty, maximum reliability type. Indicatory lamps shall be provided for each fuse holder and relay, and the fuse holder shall be marked to indicate the correct amperage.

3.4.1.2 A chassis and cabinet grounding wire shall be included in the AC line cord. The chassis grounding wire shall be connected to all major electrical sub-assemblies within the cabinet so as not to rely upon the cabinet itself as a conductor. All electrical parts shall be attached to the chassis so as to insure a positive ground (eliminating any effects from paint and anodizing).

3.4.1.3 To expedite maintenance, an electrical circuit diagram shall be permanently attached to the inside of one of the cabinet covers.

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3.4.1.4 The viewer shall be designed to operate on a production line basis. Therefore, it shall feature top reliability and maintainability, even though operated by semi-trained personnel on a 10-hour, 6-day week schedule - relatively trouble free performance is mandatory. All circuits will be designed to be fail-safe, properly fused and dust covers or sealed components used when required.

3.4.1.5 All circuitry is to be designed so that intermittent variations of up to 15% of the line voltage will not materially affect the operation of the instrument.

3.4.1.6 The xenon arc lamp shall be adequately enclosed to completely protect the operator from possible explosion of the lamp.

3.4.2 Mechanical -

3.4.2.1 The cabinet, film transport and optical element shall be of sufficient rigidity to insure that moving the machine within a building (through elevators, etc.) will not affect the optical alignment and degrade the quality of the projected image.

3.4.2.2 The structural rigidity of the viewer shall be sufficient to insure that light taps on the control panel or other sections of the cabinet will not introduce any vibration or image jump visible on the screen, as viewed with the unaided eye at maximum magnification.

3.4.2.3 The viewers shall be equipped with 5" diameter casters for easy relocation within an office building. In addition, leveling jacks shall be provided for permanent installation purposes.

3.4.2.4 Projections and overhanging edges which would injure operator or maintenance personnel shall be reduced or eliminated where possible. All edges and corners of the cabinet should be rounded.

3.4.2.5 Special considerations shall be given to design for ease of maintenance. Access doors, panels, or covers must be provided for easy access to parts requiring periodic access.

3.4.2.6 All operating controls shall be conveniently located within the reach of a comfortably seated operator. Controls shall be grouped by function and suitably identified. Operation of controls shall follow established conventions, such as clockwise for increase, etc.

3.4.2.7 All hardware (screws, bolts, etc.) should be of American Standard sizes with a minimum of types and sizes used. If any special tools are required for disassembly or assembly, one each shall be furnished with each machine. Sheet metal or self-tapping screws are not to be used.

3.4.2.8 All surfaces shall be of a corrosion-resistant type or are to be suitably treated for protection against corrosion. Special consideration is to be given to weld joints for corrosion resistance. Painted surfaces shall be protected with suitable undercoating before application of finish coats. The entire interior of the cabinet exposed to the light path (other than lenses and mirrors) shall be coated with a non-reflecting, black coating to the extent that no reflected light shall enter the optical system.

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3.4.2.9 Parts requiring lubrication shall be easily accessible and oil holes and grease fittings shall be provided. Wherever possible, sealed bearings of the pre-lubricated type are to be used.

3.4.2.10 Where reflective optics are utilized within the system they should be mounted on three point suspension systems for ease of alignment. Care shall be taken to prevent losses of resolution due to vibration in the mirror system.

3.4.2.11 Thorough attention to human engineering features and ease of operation is mandatory.

3.4.2.12 The viewer, auxiliary equipment and support equipment shall be built to best commercial standards, except optical quality which shall be built to standards as defined in MIL-STD-150-A. Due consideration must be given to the requirement for operation and maintenance by semi-skilled personnel. Final acceptance tests shall be performed at the final destination as specified by the Contracting Officer.

3.5 Miscellaneous -

3.5.1 A complete testing procedure shall be submitted for the Contracting Officer's approval prior to beginning construction of the instrument.

3.5.2 A kit of initial spare parts and maintenance materials shall be delivered with each viewer. Items to be included but not necessarily restricted to are:

3.5.2.1 4 each projection lamps
3.5.2.2 2 each platen assemblies
3.5.2.3 5 each fuses (of each type used)
3.5.2.4 1 can of touch-up paint
3.5.2.5 Recommended 6-month operating spare parts list

3.5.3 An operator's instruction book and a comprehensive technician's maintenance book are to be delivered with each instrument. Instruction books will be written to good commercial practice and contain a minimum of cross references.

3.5.4 Testing will be progressive throughout the fabrication. Periodic inspections will be performed at the Contractor's plant by the Contracting Officer's technical representative. A preliminary acceptance test is to be performed at the Contractor's plant prior to shipping. Final acceptance testing will be performed after delivery and installation of the viewer at the Customer's facility.

Installation shall consist of a complete mechanical and electrical checkout and optical alignment to insure that the viewer is operating in peak condition prior to acceptance tests.

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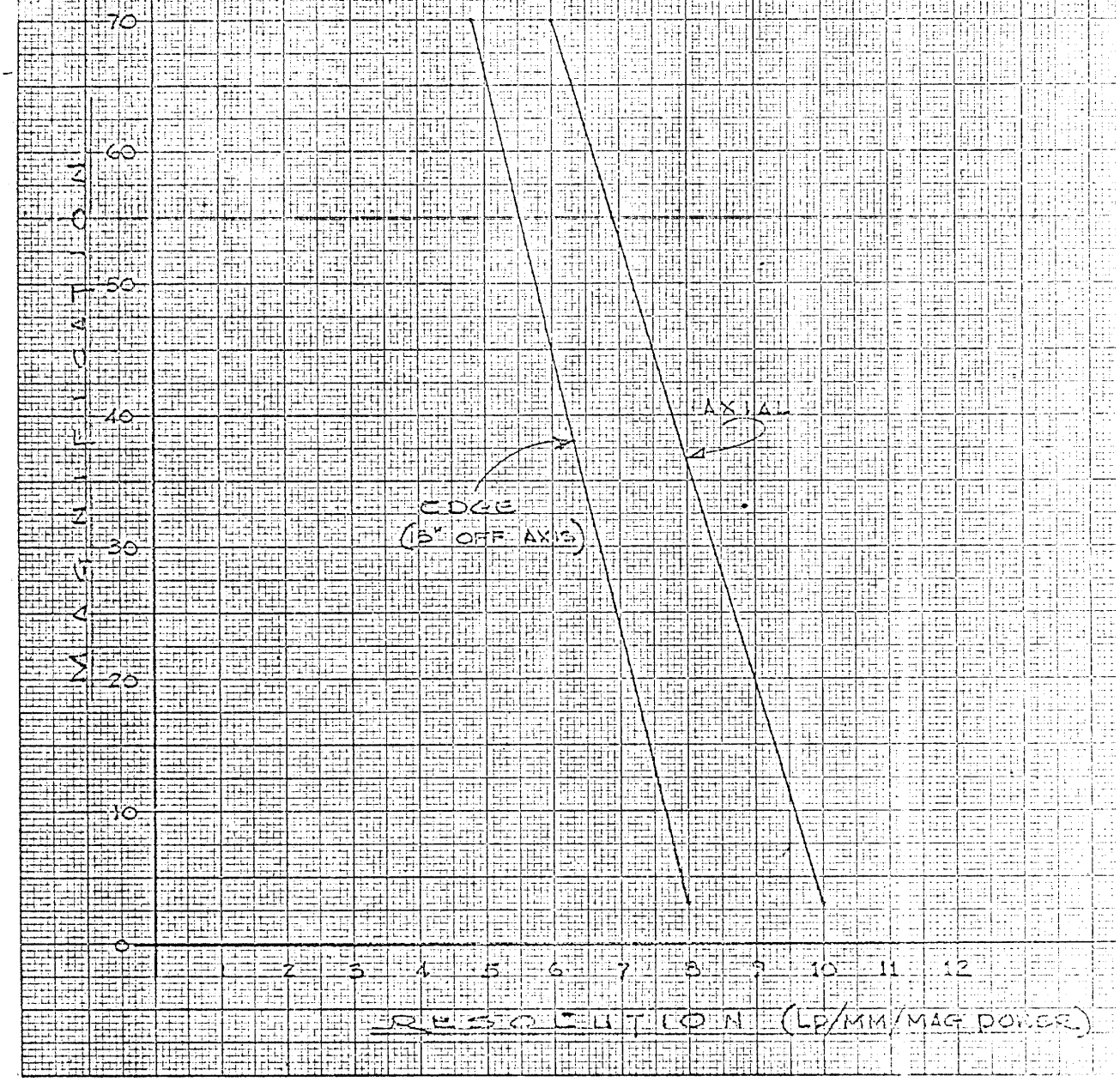
FIGURE 1

RESOLUTION SPECIFICATION



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