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NPIC/TP-16/64
August 1964

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT
MISSION 4006
11 MARCH 1964

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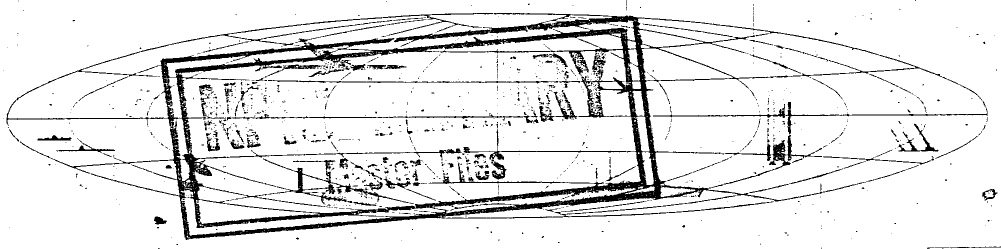
NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER



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25X1

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TABLE OF CONTENTS

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25X1

LIST OF ILLUSTRATIONS

Many examples referred to in the text by index number and grid co-ordinates relate to the following photographs. All photographs are first generation positive prints made from the original negative.

25X1

25X1

25X1

LIST OF ILLUSTRATIONS (Continued)

25X1

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SYNOPSIS

Mission 4006 was launched into a retrograde orbit on 11 March 1964. The mission completed 51 revolutions including 35 photographic passes. The payload consisted of 430 photographic frames. One hundred forty-three targets were reported in the preliminary target readout. The quality of the photography and its suitability for photographic interpretation is slightly better than that obtained from Mission 4003. The high quality of the photography permitted confirmation of suspected activities and additional information on previously identified targets. Snow cover caused several frames to be overexposed; however, exposure was generally satisfactory. Clouds covered 35% of the mission. The main camera operated satisfactorily throughout the mission. The fiducial line, timing track and binary record were operational throughout the mission; however, one of the yaw slits on the non-timing track edge was blocked. Although present, the stellar and index cameras were not utilized. Sixteen programmed experiments were accomplished during this mission. No color film was included on Mission 4006.

GENERAL FLIGHT DATA

Date of Launch: 11 March 1964
Time of Launch: 2014:23Z

25X1

PART I. CAMERA OPERATION

1. Main Camera No FM-6: The main camera was operational and functioned properly throughout the mission. A continuous minus density line parallel to and 3.7" from the timing track edge of the film is present on all frames. This line was probably caused by foreign matter on the aperture plate. Numerous, randomly located comet-shaped plus density areas are present intermittently throughout the mission. These "comets" are formed around a nucleus of foreign matter in or on the emulsion and are most numerous in passes D09, D11, D17, D19, D20, and D21. The incorrect film velocity (inherent at the start of a camera operation and as the unit comes to rest in the off position) severely degrades both ends of each frame. Although this condition is expected and no targets are programmed for this area of the format, approximately 2.0" to 4.0" of film are lost on each frame, resulting in a total loss of about 143' of film in this mission. The wrap-up employed between passes as a safety factor to prevent possible fogging of exposed film and as a means of eliminating setting impressions on good film consumed approximately 234'. The most serious degrading factor of the camera operation is the transverse banding caused by an incorrect film speed due to looper loading action on the longer monoscopic frames. This variation in film velocity causes an error in IMC resulting in image distortion and smearing. Accurate interpretation and mensuration of imagery in this banding area is difficult. The film was badly creased during the final wrap-up after frame 02 in pass D49.

2. Stellar Camera No D37*: The unit was present but nonoperational for this mission.

3. Index Camera No D37*: The unit was present but nonoperational for this mission.

*During pre-launch test it was learned that the S I film cutter would not function when there was no tension on the film. To avoid jeopardizing the success of the mission the S I film was wrapped up prior to launch, rendering the units inoperable.

25X1

25X1

25X1

4. Collateral Equipment:

a. Both time tracks were operational and functioned properly throughout the mission. The bits are of excellent density and well defined.

b. The smaller aperture of the yaw slit on the non-timing track edge was blocked resulting in the recording of a single image. The yaw slits on the timing track edge functioned properly but the image was slightly vignetted at the outboard edge. Since both yaw slits are necessary for accurate determination of yaw, these measurements are unobtainable.

---

units inoperable. The film was processed upon recovery. The stellar negatives contained recorded images of correlation fiducials for 14 frames, four readable camera numbers and an outline of the format. Double images of the reseau occur where exposure was adequate to record an image. The index contained no images other than seven of correlation fiducials.

25X1

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FIGURE 1. YAW SLIT ON TIMING TRACK EDGE.

NPIC J-2498 (8 64)

25X1

25X1

25X1

NPIC/TP-16/64

The yaw slit on the timing track edge functioned properly throughout the mission but the image is slightly vignetted at the outboard edge. Note the excellent quality of the time track bits.

Pass: Di5
Frame: 13
Index: 18 (56.1-1.2)
Enlargement: 10X

25X1

NPIC/TP-16/64

25X1

25X1

NPIC/TP-16/64

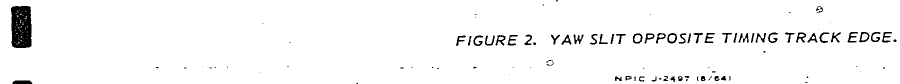


FIGURE 2. YAW SLIT OPPOSITE TIMING TRACK EDGE.

NPIC J-2497 (8/64)

25X1

[redacted]

[redacted]

25X1
25X1

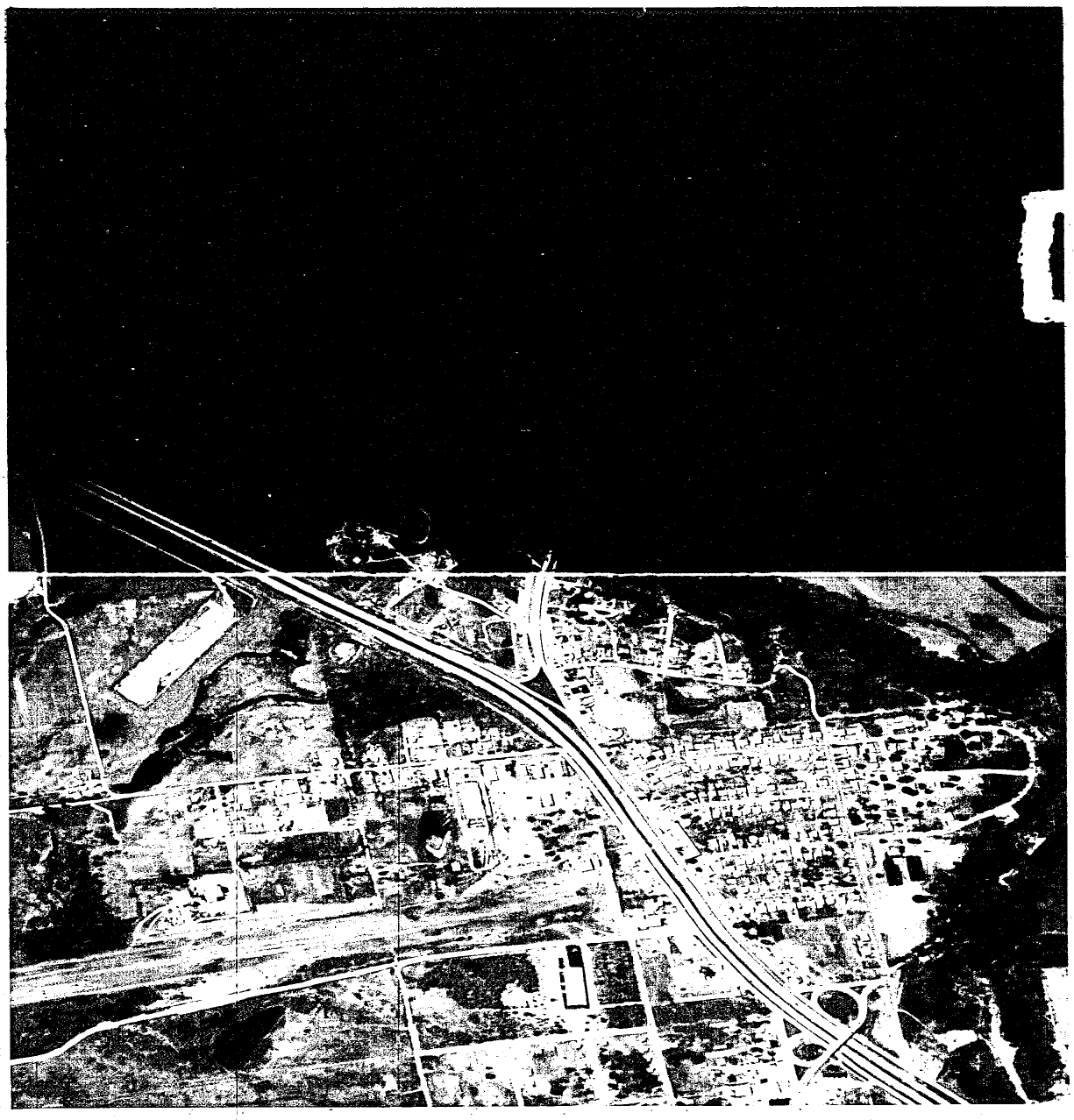
NPIC/TP-16/64

The smaller aperture of the yaw slit opposite the timing track edge was blocked. This resulted in only partial exposure and the recording of a single image.

Pass: D15
Frame: 13
Index: 17 (55-23)
Enlargement: 10X

[redacted]

25X1



[redacted]

[redacted] 25X1

PART II. FILM

1. Film Processing: This section provides a descriptive evaluation of the exposure and processing and comments on the exposure, density, processing and physical condition of the original negatives. Pertinent data were collected during various phases of the processing and again during the evaluation of the negatives. (This is a standard procedure. The community is immediately informed by cable of any extensive defects in the photography which affect the PI suitability of the mission.) While the film was being prepared for processing it was inspected for physical damage which could cause processing difficulties. During processing, data were recorded giving the processing conditions and film footage locations where processing changes occur. Deviations from the normal course of processing which may affect the film quality were recorded. After processing, the original negatives were examined frame by frame for defects and damage.

Most of the film on this mission received adequate exposure. The solar elevation varied from -0.4° in pass D11 to 88.8° in pass D05. Acceptable photography was accomplished with a minimum solar elevation of 3.8° in pass D11. Photographs taken at a lower latitude where the solar elevation was relatively high (20° and higher) are of better density.

Thirty-six percent of the mission was processed at the primary level, 51 percent at the intermediate level, and 13 percent received the full level of processing. (These percentages include transitional periods.) The gross fog density readings range from a minimum of 0.05 to a maximum of 0.20.

2. Film Degradations: This section lists the major film degradations and the frames on which examples of each may be found:

Minus Density Comets	Present randomly throughout the mission. Pass D09, frames 06. 11, and 13. Pass D11, frames 07, 08, and 10. Pass D20, frames 02, 05, 07, and 08.
Minus Density Streak (line)	Continuous minus and plus density lines exist throughout the mission. The most degrading of these is located .3.85'' from and parallel to the timing track edge of the film.
Creases	The final wrap-up frame (06, of pass D49) was severely creased.
Dendritic Static	Discharges are associated with the creases on wrap-up on pass D49.
Skiving	Intermittent throughout the mission. Pass D39, frame 08.

3. Film Expenditure: The operational film length for the mission was approximately 879 feet. The orbital research and development (R & D) portion amounted to about 231 feet and the final wrap-up consumed 81 feet. Due to the large amount of film utilized in strip mode operations on the first two days, wrap-up lengths were shortened from 15.35' to 1.29' during passes, and from 12.93' to 3.47' at the end of passes after pass D14. The following table gives the approximate breakdown of film utilization:

Approximate Distribution of Film Load

Total initial film load	2,000 feet
Film expended in pre-launch testing	451 feet
Footage remaining	1,549 feet
Film expended on pass 02 (unexposed)	44 feet
Footage remaining	1,505 feet
Film utilized for end-of pass wrap-up	235 feet
Footage remaining	1,270 feet
Film utilized for in-pass wrap-up	55 feet
Footage remaining	1,215 feet
Film expended in final wrap-up	81 feet
Footage remaining	1,134 feet
Film loss due to start-up & stopping	143 feet
Footage remaining	991 feet
Film utilized for R&D photography	112 feet
Remaining footage is approximate take of operational photography	879 feet

[redacted] 25X1

[redacted]

25X1
25X1

[redacted]

NPIC/TP-16/64

FIGURE 3. MINUS DENSITY COMET.

NPIC J-2498 8 64

25X1

[redacted]

25X1

25X1

NPIC/TP-16/64

Minus density comets, which appear as plus density comets on the positive print, occur randomly throughout the mission. Note the area obscured by the comet in relationship to the buildings and roadways present on the photograph.

Pass: D15
Frame: 13
Index: 17 (47-8)
Enlargement: 10X

25X1

NPIC/TP-16/64

[redacted]

[redacted]

25X1
25X1

NPIC/TP-16/64

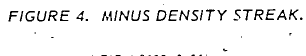


FIGURE 4. MINUS DENSITY STREAK.

NPIC J-2499 (8 64)

[redacted]

25X1

[redacted]

25X1

25X1

[redacted]
NPIC/TP-16/64

This minus density streak is present throughout the mission and is located 3.85" from and parallel to the timing track edge of the film.

Pass: D19
Frame: 01
Index: 04 (69-9)
Enlargement: 20X

25X1

[redacted]

25X1

25X1

NPIC/TP-16/64

FIGURE 5. CREASES AND DENDRITIC STATIC.

NPIC J-2500 (8 64)

25X1

25X1

25X1

NPIC/TP-16/64

The final wrap-up frame (06 of pass D49) was severely creased. Dendritic static discharges associated with this creasing are also present on this frame.

Pass: D49
Frame: 06
Index: 32 (67-12)
Enlargement: 20X

25X1

25X1

25X1

NPIC/TP-16/64

FIGURE 6. SKIVING.

NPIC J-2501 (8 64)

25X1

25X1

25X1

NPIC/TP-16/64

Skiving occurs intermittently throughout the mission.

Pass: D39
Frame: 08
Index: 15 (47-15)
Enlargement: 10X

25X1

25X1
25X1

NPIC/TP-16/64

PART III. IMAGE QUALITY

1. Photographic Interpretation (PI) Suitability: This is an assessment of the information content of photographic reconnaissance material and its interpretability. A number of interrelated factors are involved, such as the quality of the photography, the extent of target coverage, scale, weather limitations, and similar considerations. However, the criteria for assigning a PI suitability rating may be reduced to (a) the scope of the photographic coverage and (b) the degree to which a photo interpreter may extract useful and reliable information from the material.

PI suitability ratings are categorized as Excellent, Good, Fair, Poor, and Unusable. These ratings refer to the overall interpretive value of the photography obtained from a particular reconnaissance mission. Individual targets may also be assigned PI suitability ratings if that is necessary or desirable. The standards that determine assignment of the various ratings are as follows:

Excellent: The photography is free of degradation by camera malfunctions or processing faults and weather conditions are favorable throughout. The imagery contains sharp, well-defined edges and corners, with no unusual distortions. Contrast is optimal and shadow details, as well as details in the highlight areas, are readily detectable. Observation of small objects and a high order of mensuration are made possible by the consistently good quality of the photography.

Good: The photography is relatively free of degradation or limiting atmospheric conditions. Edges and corners of objects are well defined. No unusual distortions are present. Detection and accurate mensuration of small objects is feasible, but to a lesser degree than in material rated as "Excellent".

Fair: Degradation is minimal but the acuity of the photography is less than optimum. Edges and corners of objects are not crisply defined and there is loss of detail in shadow and/or highlight areas. Detection and identification of small objects is possible but accuracy of mensuration is reduced by the fall-off in image quality and the less-than-optimum contrast that prevails.

Poor: Camera-induced degradations and/or weather limitations severely reduce the quality of the photography. Definition of edges and corners is not sharp. Only gross terrain features and culture may be detected or identified and distortion of form may exist. Accurate mensuration of even large objects is doubtful.

Unusable: Degradation of the photography completely precludes detection, identification, and mensuration of cultural details.

2. PI Suitability for Mission 4006: The PI suitability of this mission is considered good in that fine detail is readily discernible throughout most of the mission. Photo interpreters reported on 143 targets in the preliminary target readout. Four of these are considered to be of poor quality because the photography was seriously degraded by haze or snow conditions. Low solar elevation, snow and haze conditions degraded the photography of several other targets but not to the extent that they could be rated as poor. Extreme obliquity degrades the photography on 9 targets. Target highlights include:

2 Newly identified missile launch sites
2 Newly identified missile support areas
4 Newly identified radar installations
84 Submarines

Plus Order of Battle information on aircraft and naval activity.

Mission 4006 produced the best photography to date from this system. No serious problems were encountered in the operation of the main camera.

25X1

Those factors which degrade the imagery and directly affect PI suitability are:

Imagery Degraded by Roll: In two instances of operational photography the camera was actuated while the vehicle was in a roll maneuver, pass D23, frame 05 and pass D36, frame 03. After completion of the roll, the photography appears normal. This roll affected the stereo coverage on pass D36, frames 03 and 04, as the overlap is only about 55%. On pass D23, frames 15 and 16 no stereo overlap is present. This roll motion is possibly due to expansion of burst time by the command generation program and crowding by manual target selections.

Stereo Mirror Movement: The stereo mirror was in motion for the first half of frame 08 on pass D06. Mirror bounce and settling time is present about mid-frame. After that the imagery is normal. This mirror motion is possibly due to variable settling times and crowding of the command system by manual target selection.

Photography Degraded by Improper IMC:

a. Start-Up - The loss of film due to improper IMC at the start of each camera operation ranges from 0.5" to 2.0". This difficulty, caused by an incorrect film speed as the film drive mechanism reaches operational speed, consumes an average of 1.0" of film in each frame of this mission.

b. Slow-Down - The film transport mechanism being incapable of stopping immediately at the end of a camera operation transported from 2.5" to 4.5" of film during its pre-stopping slow-down. On Mission 4006 the average film loss is approximately 3.0" per frame.

c. Banding - An interruption of proper film speed, due to looper loading action, causes an error in IMC approximately every 12 inches on long monoscopic frames. These errors appear as plus or minus transverse bands on the film and are most serious at the start-up and stopping of the looper actions.

d. Obliquity Error - On oblique photography, the IMC is not correct transversely across the entire format because of constant changes in the relative ground motion. The IMC is programmed to be correct in the target area of the format, introducing an error in IMC across the balance of the format on either side of the target.

Obliquity: Photo interpretation of nine targets in this mission was degraded by extreme obliquity. Stereo pairs and triplets, although always preferred over monoscopic coverage, are difficult to work with when the target is at a high oblique angle, since only point by point stereo registration is possible. Mensuration difficulty also increases as the scale of the photography increases. The most precise photo interpretation is obtainable from stereo pairs or triplets with a roll angle of near 0°, and becomes more difficult as the obliquity increases due to image distortion and a reduction in image size.

Atmospherics: Thirty-five percent of the photography of Mission 4006 is degraded by cloud and haze conditions. An example of the latter condition, resulting in a quality rating of poor, is present on pass D25, index 21. Snow cover degrades several other targets but not to the extent that they could be considered poor.

Solar Elevation: Low solar elevation affects the PI suitability in varying degrees depending upon terrain reflectivity and the bearing of the solar azimuth from the principal ray. In most cases, the higher the solar elevation, the better the quality of the photography. An example of a target photographed at a solar elevation of 5.6° is present on pass D41, frame 02, index 03 (44-20).

Solar Bearing: The solar bearing from the principal ray affects the PI suitability in varying degrees; however, there is no bearing which is optimum. The change in the bearing is necessarily present in all convergent photographic pairs. Example: pass D33, frame 01, index 01 (60-20); and pass D33, frame 02, index 03 (64-18).

25X1

25X1

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FIGURE 7. GOOD QUALITY PHOTOGRAPHY (AIRFIELD).

NPIC J-2552 8 64

25X1

25X1

25X1

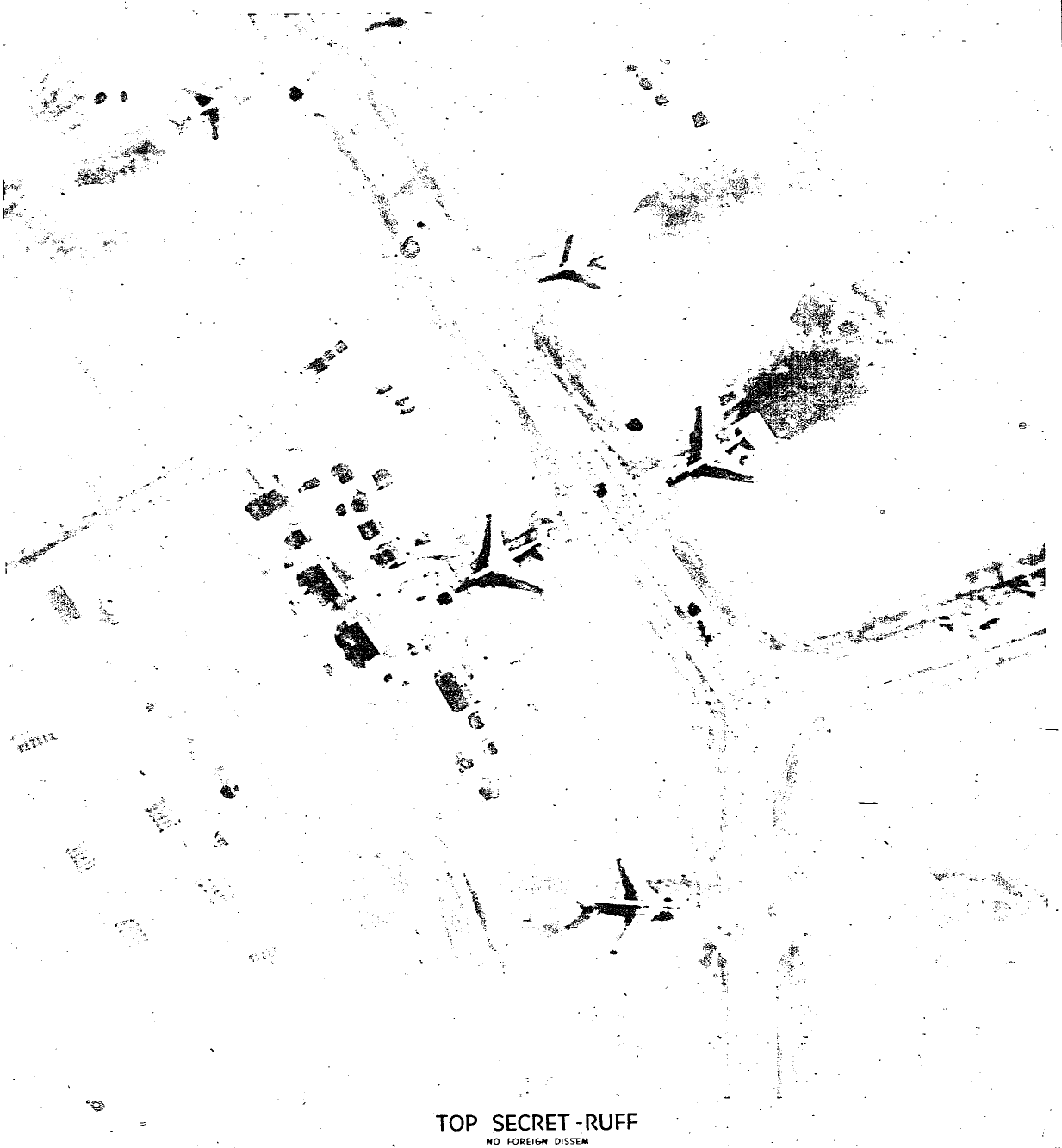
NPIC/TP-16/64

Although the terrain is snow covered, the pattern in the air strip and the aircraft are easily discernible. This is an example of good quality photography from Mission 4006.

Pass: D10
Frame: 10
Index: 16 (51-13)
Enlargement: 40X

25X1

NPIC/TP-16/64



[redacted]

[redacted]

25X1

25X1

NPIC/TP-16/64

FIGURE 8. GOOD QUALITY PHOTOGRAPHY (MISSILE SITE).

NPIC J-2503 (8/64)

[redacted]

25X1

[redacted]

[redacted]

25X1

25X1

NPIC/TP-16/64

This photograph of a missile site shows fine detail. The missiles are easily discernible. Contrast is optimal with shadow as well as highlight details readily detectable. The imagery contains sharp, well defined edges and corners with no unusual distortions.

Pass: D40
Frame: 06
Index: 23 (67-13)
Enlargement: 40X

[redacted]

25X1

NPIC/TP-16/64

25X1

25X1

NPIC/TP-16/64

FIGURE 9. START-UP ERROR.

NPIC J-2554 8 64

25X1

[redacted]

[redacted]

25X1

25X1

NPIC/TP-16/64

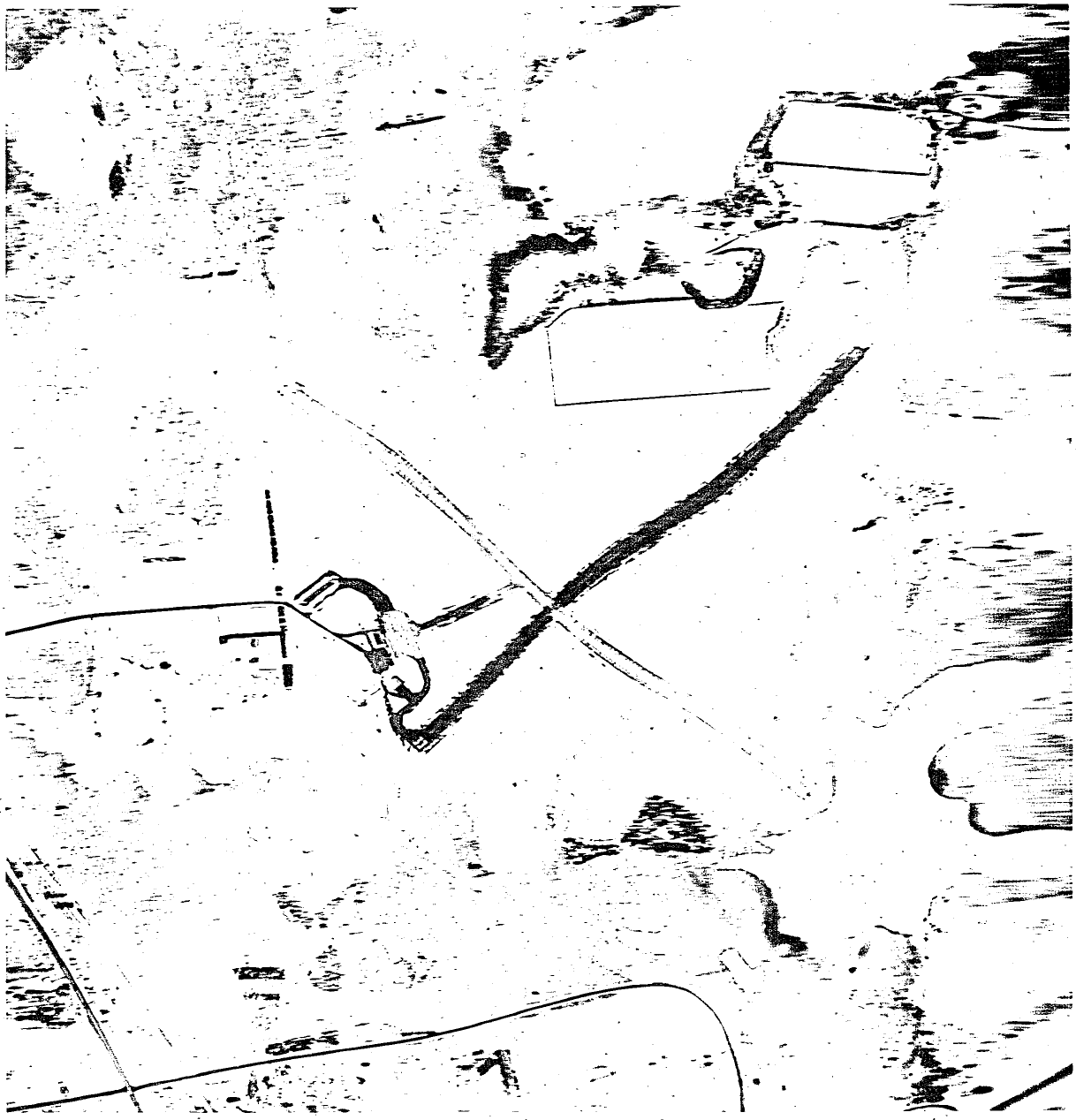
The incorrect IMC at the start of a camera operation results in distorted imagery. This distortion is quite evident in this photograph.

Pass: D15
Frame: 03
Index: 07 (67-18)
Enlargement: 10X

[redacted]

25X1

NPIC/TP-16/64



25X1
25X1

NPIC/TP-16/64

FIGURE 10. START-UP ERROR.

NPIC J-2605 (8 64)

25X1

25X1

25X1

NPIC/TP-16/64

As the film speed approaches its correct velocity the image distortions present at the start of each camera operation become less severe. The transverse dark band across the photograph is the result of underexposure due to the fast film speed.

Pass: D15
Frame: 12
Index: 16 (71-11)
Enlargement: 10X

25X1

NPIC/TP-16/64

[redacted]

25X1

[redacted]

NPIC/TP-16/64

FIGURE 11. SLOW-DOWN ERROR.

NPIC-J-2256 8-64

[redacted]

25X1

25X1

25X1

NPIC/TP-16/64

The film transport mechanism, being incapable of stopping immediately at the end of a camera operation, transports film as it slows to a stop. The photography accomplished during this period is severely degraded because of improper IMC. This slow-down begins approximately at the right hand edge of the accompanying photograph.

Pass: D15
Frame: 11
Index: 16 (82-16)
Enlargement: 10X

25X1

25X1

25X1

NPIC/TP-16/64

FIGURE 12. BANDING (FAST FILM SPEED).

NPIC-[illegible]-16-64

25X1

25X1

25X1

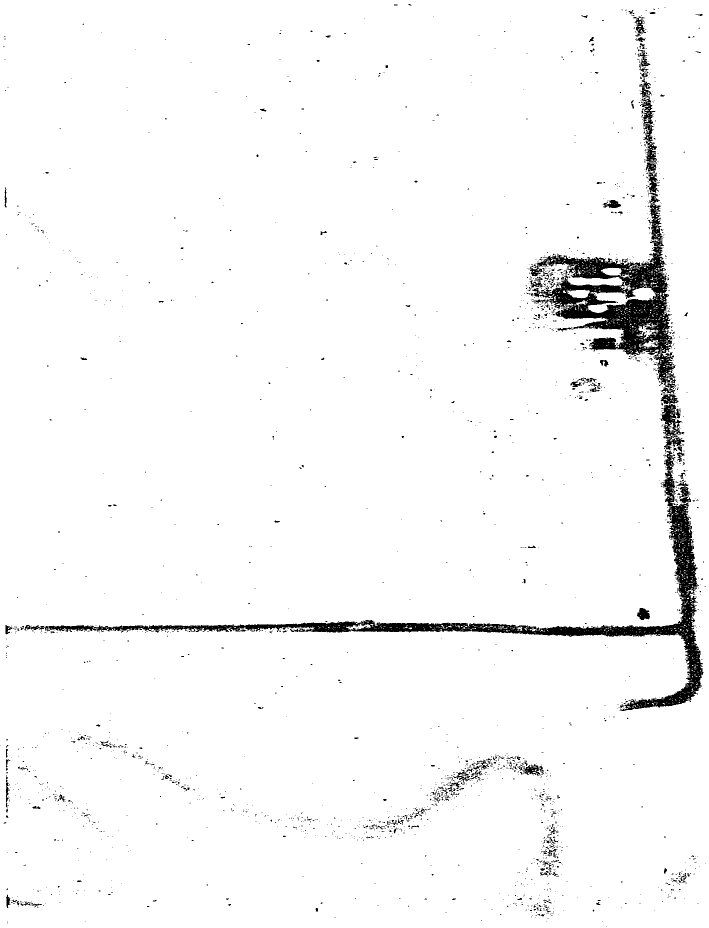
NPIC/TP-16/64

Fast film speed, possibly due to looper loading action, is the cause of the degraded imagery on this photograph.

Pass: D48
Frame: 12
Index: 15 (52-11)
Enlargement: 40X

25X1

NPIC/TP-16/64



25X1

25X1

NPIC/TP-16/64

FIGURE 13. BANDING (SLOW FILM SPEED).

NPIC J-2508 (8 '64)

25X1

[redacted]

[redacted]

25X1

25X1

NPIC/TP-16/64

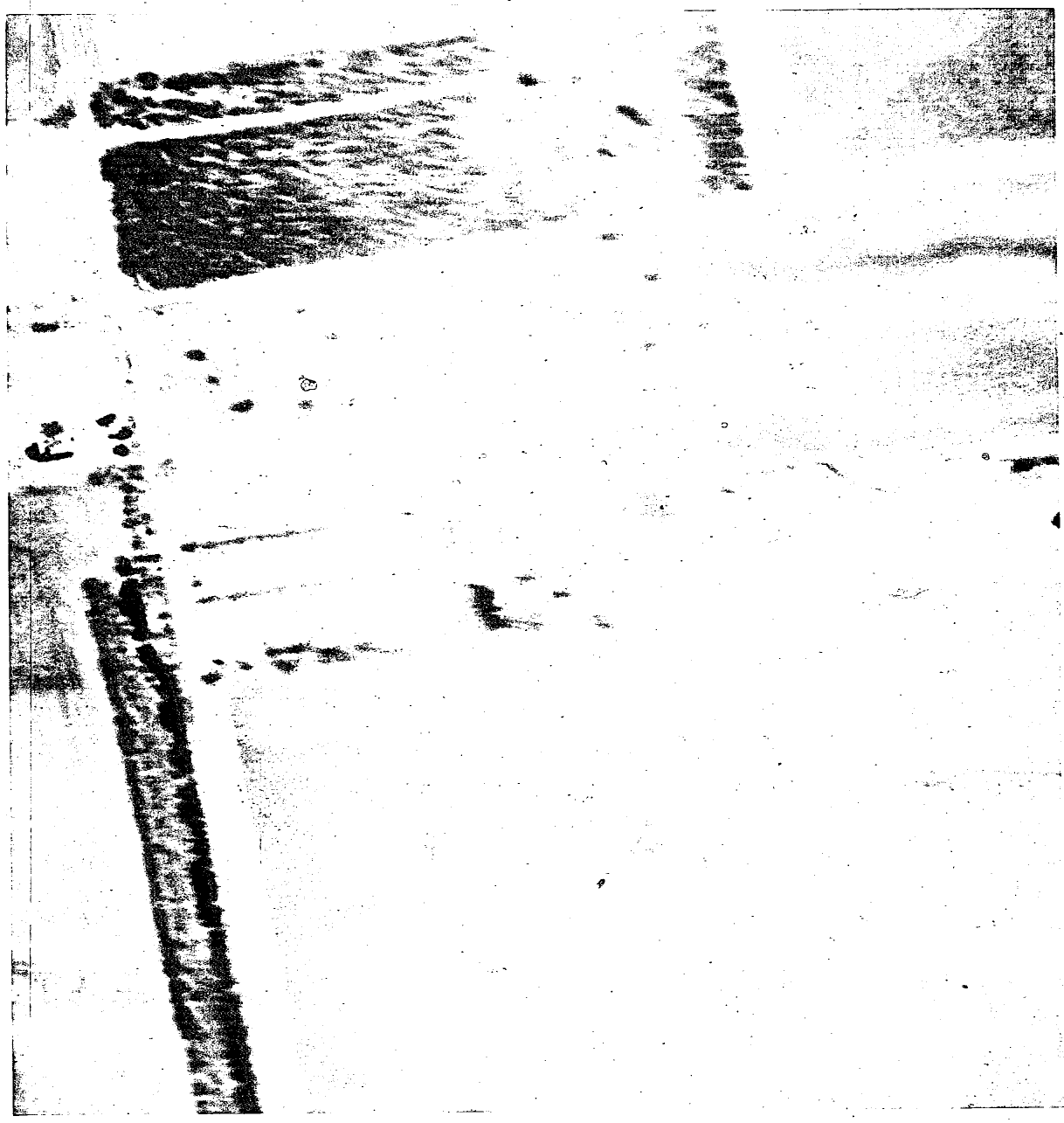
Slow film speed, due to looper loading action, is the cause of the degraded imagery and light areas on this photograph.

Pass: D48
Frame: 12
Index: 15 (57-21)
Enlargement: 40X

[redacted]

25X1

NPIC/TP-16/64



25X1

25X1

NPIC/TP-16/64

FIGURE 14. OBLIQUE STEREO.

25X1

[redacted]

[redacted]

25X1
25X1

NPIC/TP-16/64

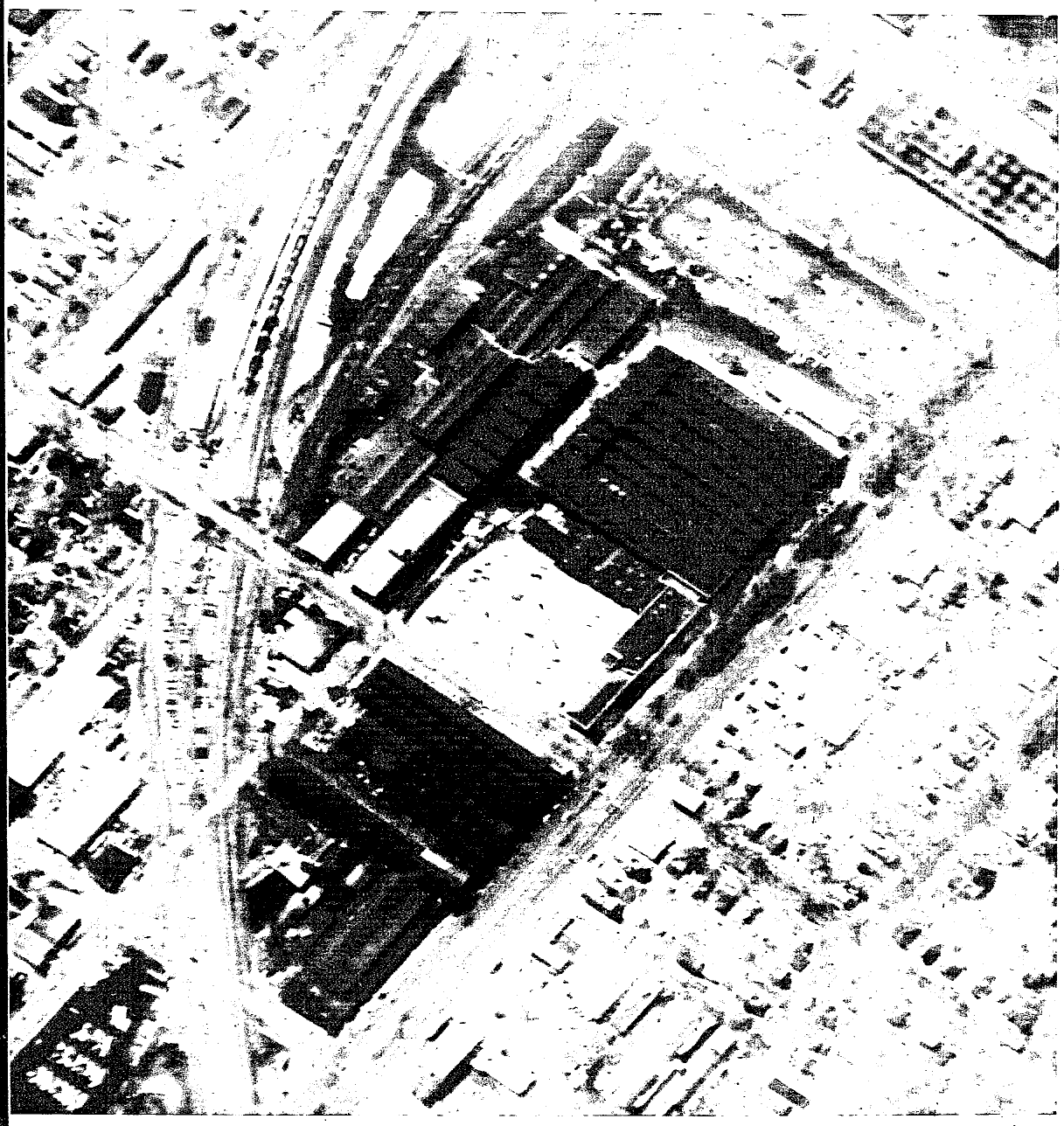
These photographs show the effect of obliquity on image quality and perspective in stereo pairs.

Left Photograph	Right Photograph
Pass: D15	Pass: D15
Frame: 04	Frame: 06
Index: 08 (59-9)	Index: 10 (59-8)
Enlargement: 40X	Enlargement: 40X
Roll Angle: 13.5°	Roll Angle: 14.9°

[redacted]

25X1

NPIC/TP-16/64



25X1

25X1

NPIC/TP-16/64

FIGURE 15. OBLIQUE STEREO.

25X1

25X1

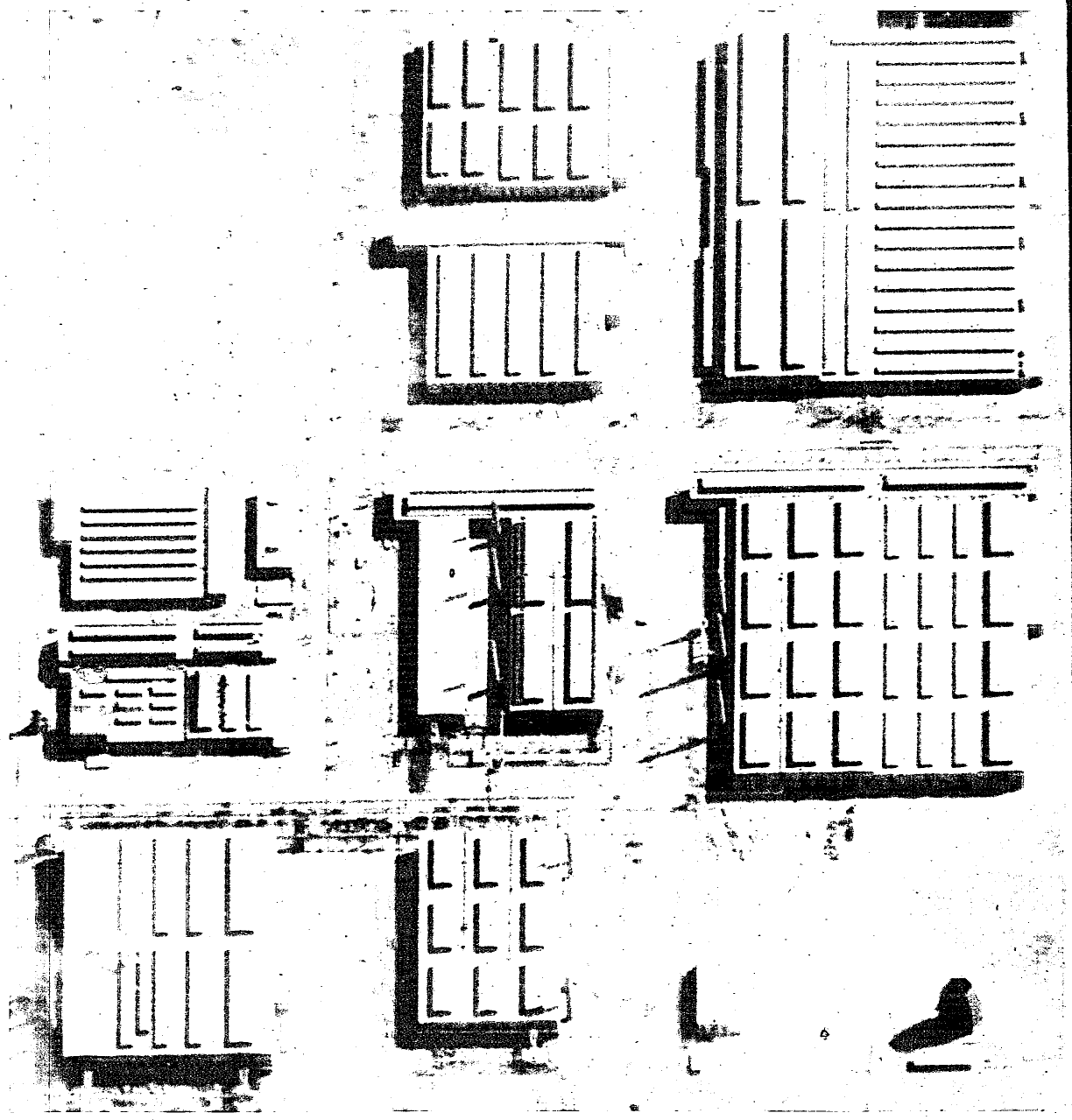
25X1

NPIC/TP-16/64

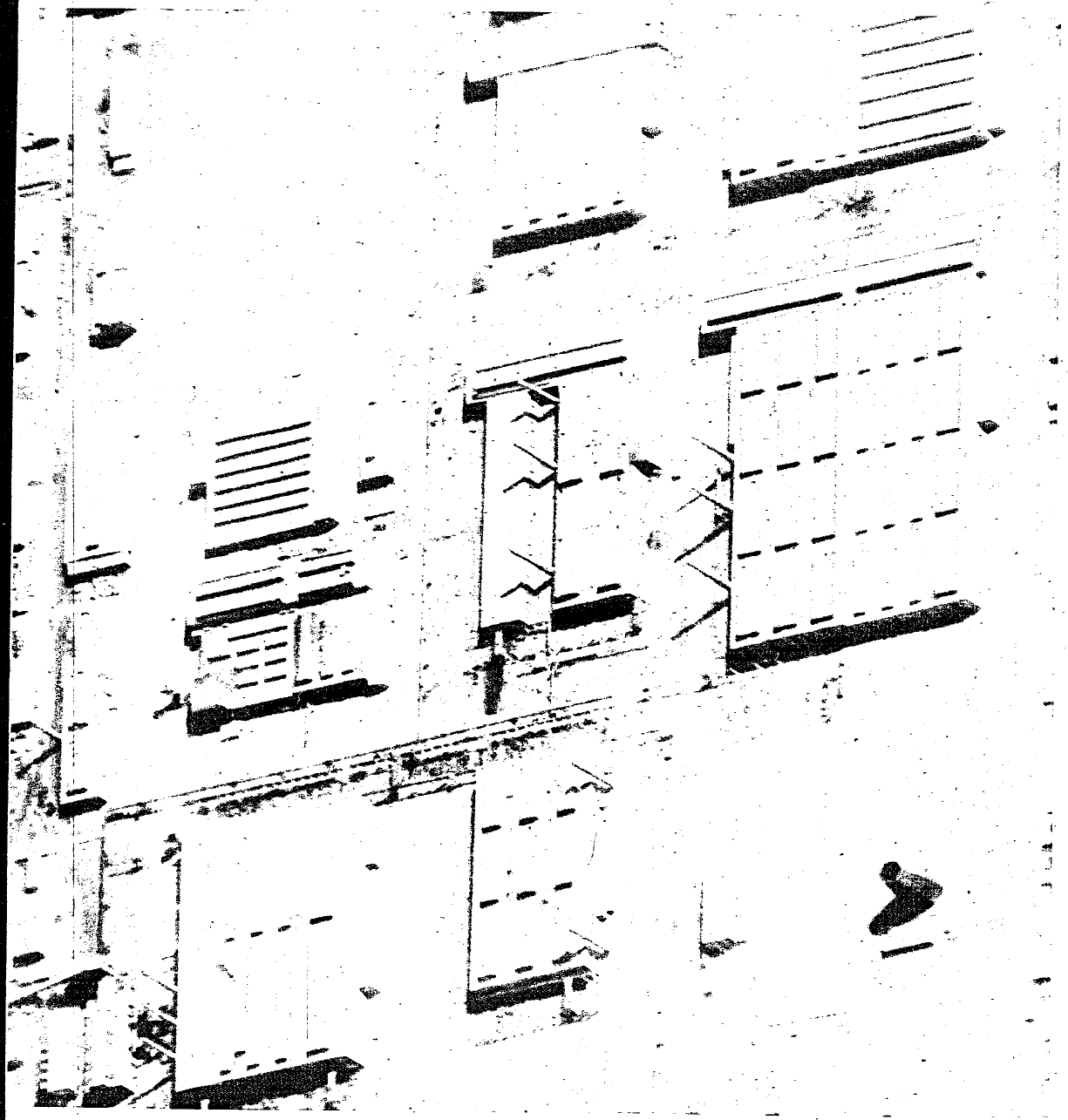
These photographs show the effect of extreme obliquity on image quality and perspective in stereo pairs.

Left Photograph	Right Photograph
Pass: D06	Pass: D06
Frame: 10	Frame: 11
Index: 36 (66-17)	Index: 37 (48-14)
Enlargement: 40X	Enlargement: 40X
Roll Angle: 37.6°	Roll Angle: 37.6°

25X1



NPIC/TP-16/64



25X1

25X1

NPIC/TP-16/64

FIGURE 16. HAZE DEGRADED IMAGERY.

NPIC D-5711 8 64

25X1

25X1

25X1

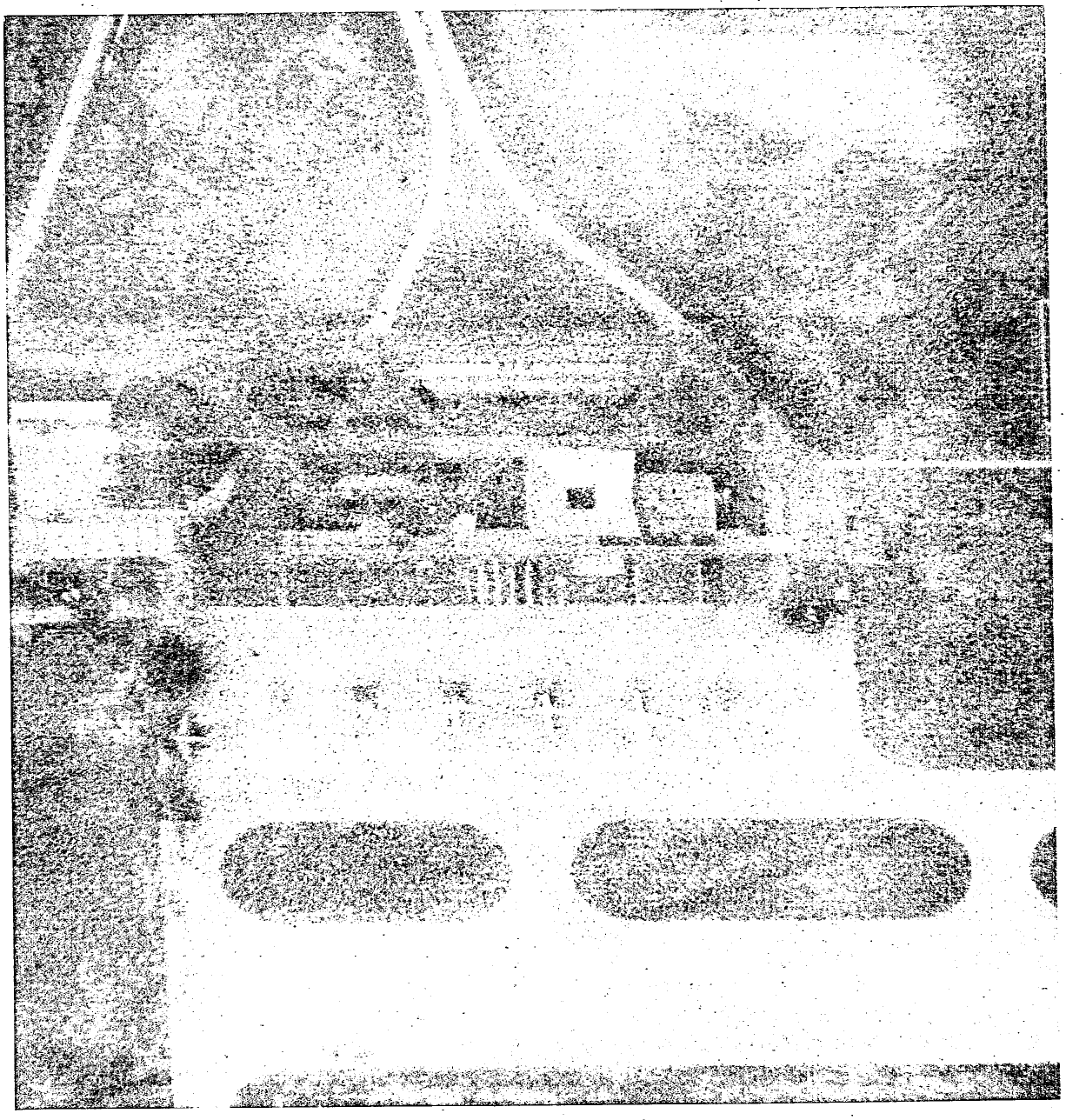
NPIC/TP-16/64

Haze conditions degraded several targets to varying degrees. Four targets were rated as poor due to haze. This is an example of poor quality photography.

Pass: D10
Frame: 18
Index: 28 (74-16)
Enlargement: 40X

25X1

NPIC/TP-16/64



25X1

25X1

NPIC/TP-16/64

FIGURE 17. LOW SOLAR ELEVATION.

NPIC J-2512 (8-64)

25X1

25X1

25X1

NPIC/TP-16/64

Solar elevation affects the PI suitability in varying degrees. In this photograph the solar elevation was 5.6°; however, the terrain reflectivity is high because of the snow cover. Therefore, dark objects and shadows are discernible. Even so, the photography is rated as poor although the light conditions available justify the low quality.

Pass: D41
Frame: 02
Index: 03 (44-20)
Enlargement: 20X
Solar Elevation: 5.6°

25X1

[redacted]

[redacted]

25X1
25X1

NPIC/TP-16/64

FIGURE 18. SOLAR BEARING.

NPIC Graphic 6-64

[redacted]

25X1

[redacted]

[redacted]

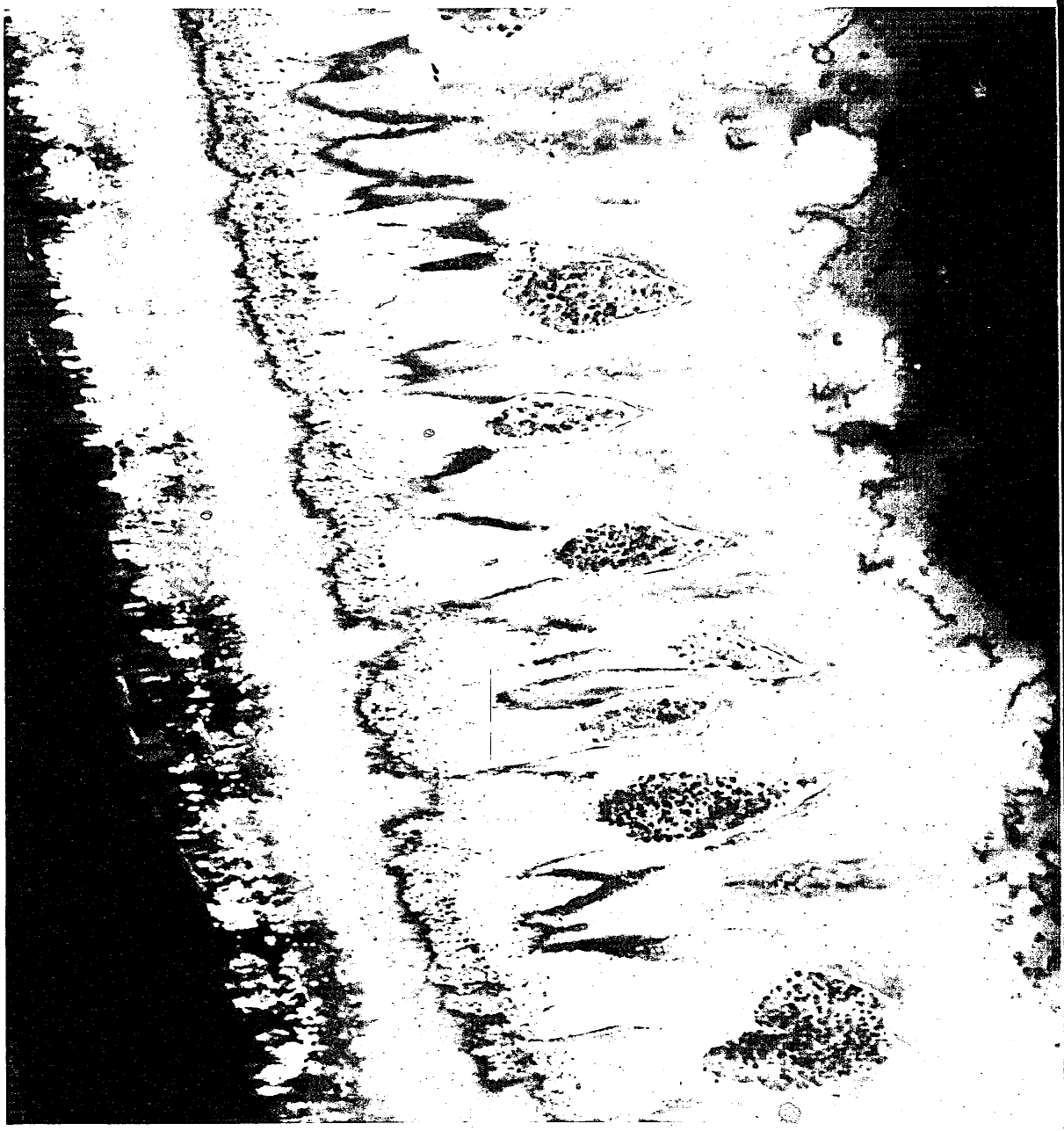
25X1
25X1

The effect of the difference in solar bearing from the principal ray is illustrated in these photographs of an atoll. The different reflectance angle darkens the water and beach in one instance and lightens it in another.

Left Photograph	Right Photograph
Pass: D33	Pass: D33
Frame: 01	Frame: 02
Index: 01 (60-20)	Index: 03 (64-18)
Enlargement: 20X	Enlargement: 20X
Solar Bearing: 202°	Solar Bearing: 324°

[redacted]

25X1



NPIC/TP-16/64

25X1

25X1

NPIC/TP-16/64

FIGURE 19. RESOLUTION ACROSS FRAME.

NPIC J-2517 (8-64)

25X1

25X1

25X1

NPIC/TP-16/64

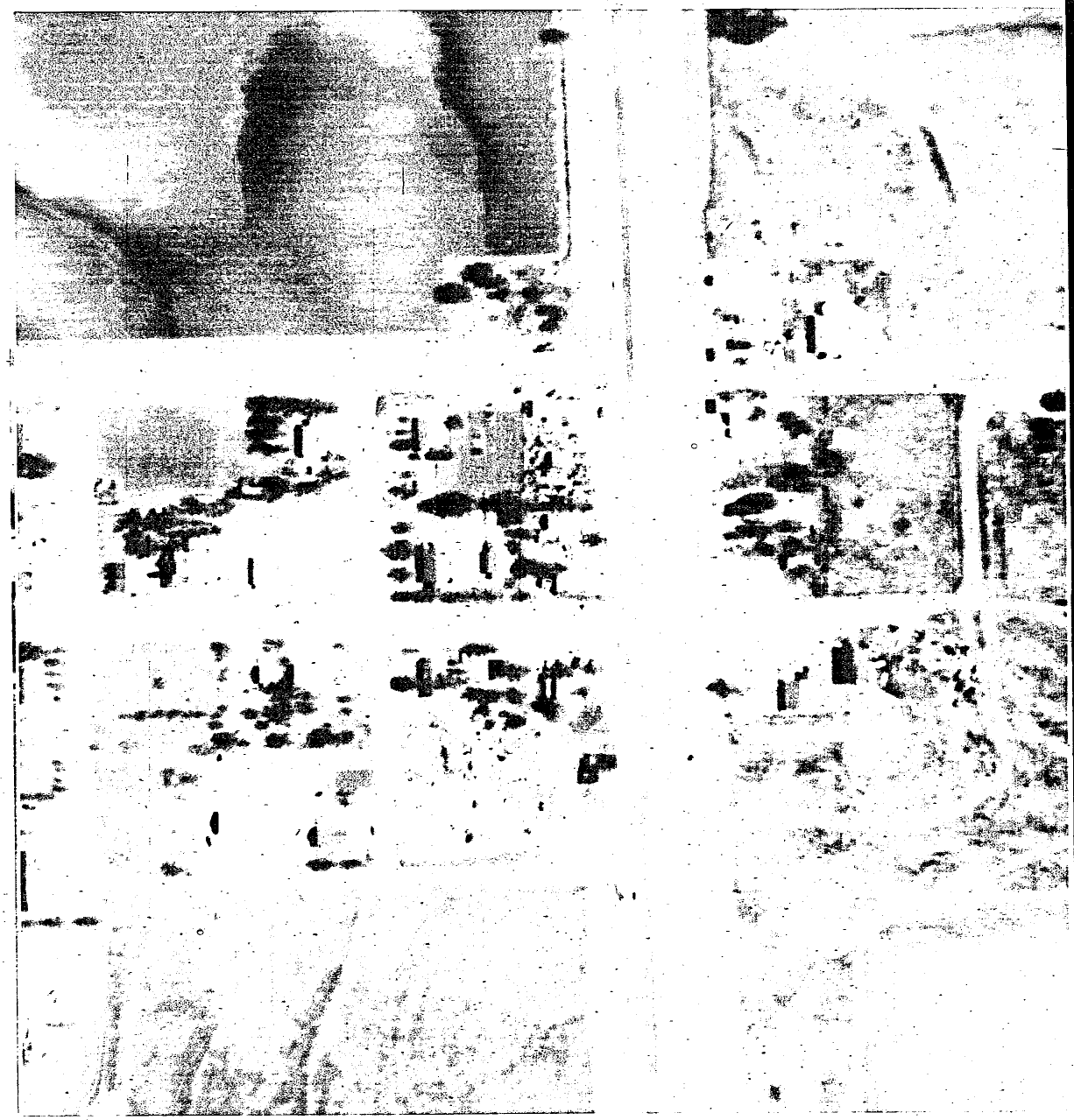
These photographs illustrate the resolution across one frame.

Left Photograph (top of frame)	Center Photograph (center of frame)	Right Photograph (bottom of frame)
Pass: D48.	Pass: D48	Pass: D48
Frame: 13	Frame: 13	Frame: 13
Index: 17 (80-21)	Index: 17 (81-12)	Index: 17 (83-5)
Enlargement: 40X	Enlargement: 40X	Enlargement: 40X
Roll Angle: 2.8°	Roll Angle: 2.8°	Roll Angle: 2.8°

25X1

NPIC/TP-16/64

NPIC/TP-16/64



25X1

25X1

PART IV. EXPERIMENTAL OPERATIONS

1. Sunline Experiment: The first eight frames of pass D11 consist of eight second strips covering a range in solar elevation from -3° to 18° in 3° increments. The determination of the capability of the film to provide proper exposure at low sun angles is inconclusive because of heavy cloud cover in 75% of the frames.

2. Illumination Experiment: Pass D12, frames 1 thru 17, consist of five second strips starting at a sunline and covering approximately 80° of latitude at specific intervals. This experiment was conducted to compile statistics on illumination at various solar elevations. Because of heavy cloud cover on 90% of the frames, these statistics could not be obtained.

3. New Operational Modes:

a. Stereo Triplet: This mode consists of:

(1) A strip taken with the stereo mirror in the forward position.

(2) A strip taken with the stereo mirror in the vertical position.

(3) A strip taken with the stereo mirror in the aft position.

Identical coverage is obtained on all strips, providing a normal stereo pair with a convergence angle of 30°, two pairs with a convergence angle of 15° (half stereo), and a vertical strip of the same area. This mode satisfies the desire of the photo interpreters for normal stereo on all targets. At near 0° roll it furnishes vertical coverage enabling an additional check in mensuration, a better view into open-topped objects such as smoke stacks and silos, and extra coverage enabling calculation of such items as ground speeds of trucks, tanks, etc.

Stereo Triplet Examples:

Pass D15, frames 04, 05, and 06
Pass D31, frames 13, 14, and 15
Pass D48, frames 08, 09, and 10

b. Back-to-Back Stereo: The sequence of the back-to-back stereo is essentially the same as that of the stereo triplet. The results, however, are quite different. In this case the initial strip (shot with the stereo mirror in the forward position) and the beginning of the vertical strip provide coverage of the same area in the form of a 15° (half-stereo) pair. Likewise, the end of the vertical strip and the following shot of the identical area made with the stereo mirror in the aft position provide a 15° (half-stereo) pair. In this mode, 15° (half-stereo) photography of two targets is obtained in addition to unbroken coverage of the area between them. For photo interpretation purposes, the 15° (half-stereo) pair appears to be an acceptable substitute for normal stereo when it is necessary for additional coverage between targets. A reduction in the air base, however, obviously decreases the strength of the geometry of the stereo model for mensuration purposes. The effect of a reduced air base upon measurements is unknown and therefore the back-to-back stereo cannot be recommended as a standard mode until further analysis and study is performed.

Back-to-Back Stereo Examples:

Pass D15, frames 01, 02, and 03
Pass D31, frames 03, 04, and 05

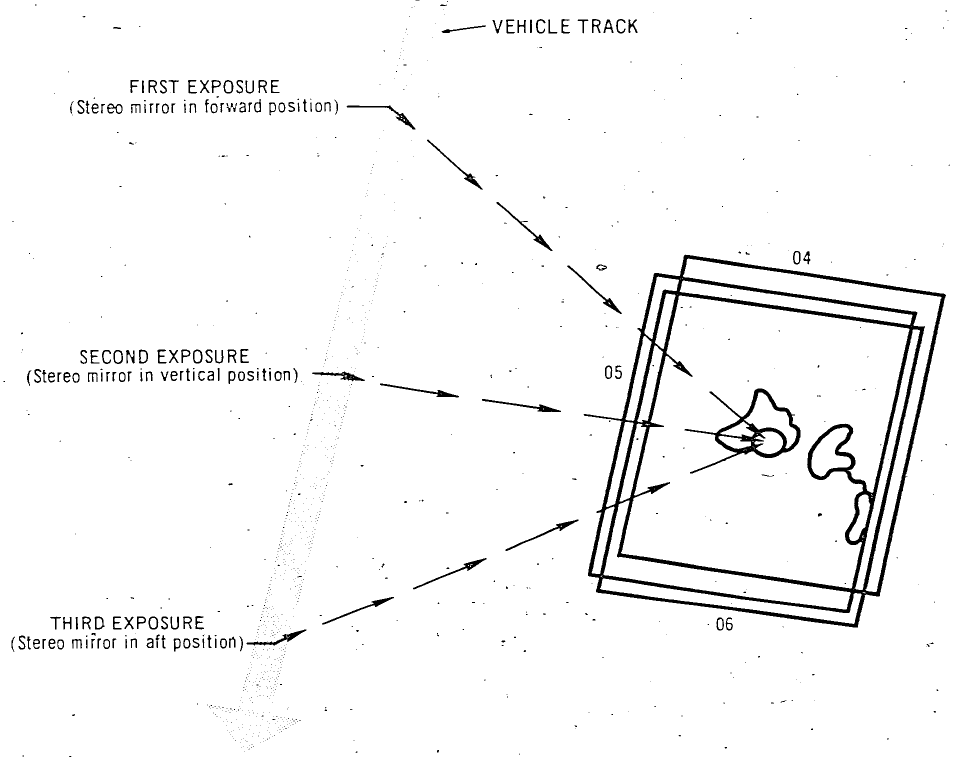
c. Lateral Triplet: A lateral triplet consists of three nearly parallel strips whose centers lie on a line perpendicular to the ground track. A different position of the stereo mirror is utilized for each photograph and the strips are separated laterally by rolling the vehicle. These strips may overlap depending upon the degree of roll between exposures. Although full stereo is unobtainable in this mode, the lateral triplet is capable of providing monoscopically three times the lateral coverage of a single strip. This mode is not as acceptable as the stereo triplet for photo interpretation and should only be selected when there is a necessity for extended lateral coverage.

25X1

Lateral Triplet Examples:
Pass D15, frames 08, 09, and 10
Pass D31, frames 07, 08, and 09

d. Displaced Lateral Triplet: A displaced lateral triplet consists of three strips with an area common to the first and second frames and a second area common to the second and third frames. Extended cross track angular coverage is obtainable by means of this mode. The displaced lateral triplet is a variation of the lateral triplet and should be used only when the target covers an area which corresponds to its specific coverage pattern.

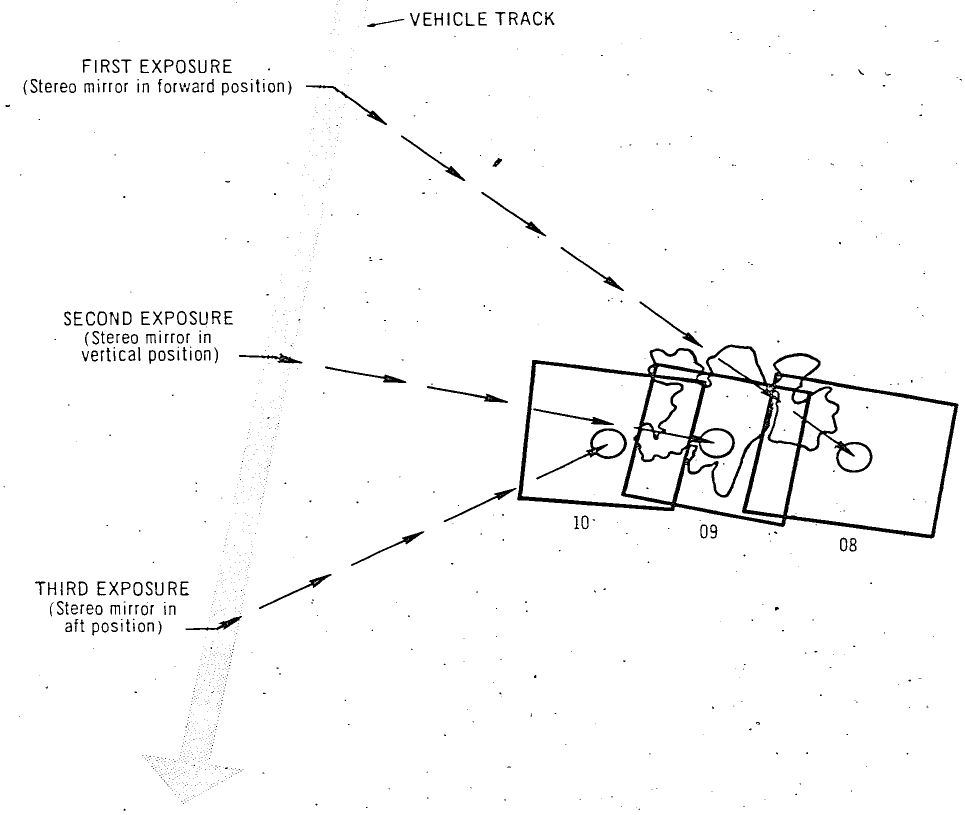
Displaced Lateral Triplet Examples:
Pass D15, frames 11, 12, and 13
Pass D31, frames 10, 11, and 12



NPIC J-2527 (8/64)

25X1
25X1

NPIC/TP-16/64



NPIC J-2528 (8/64)

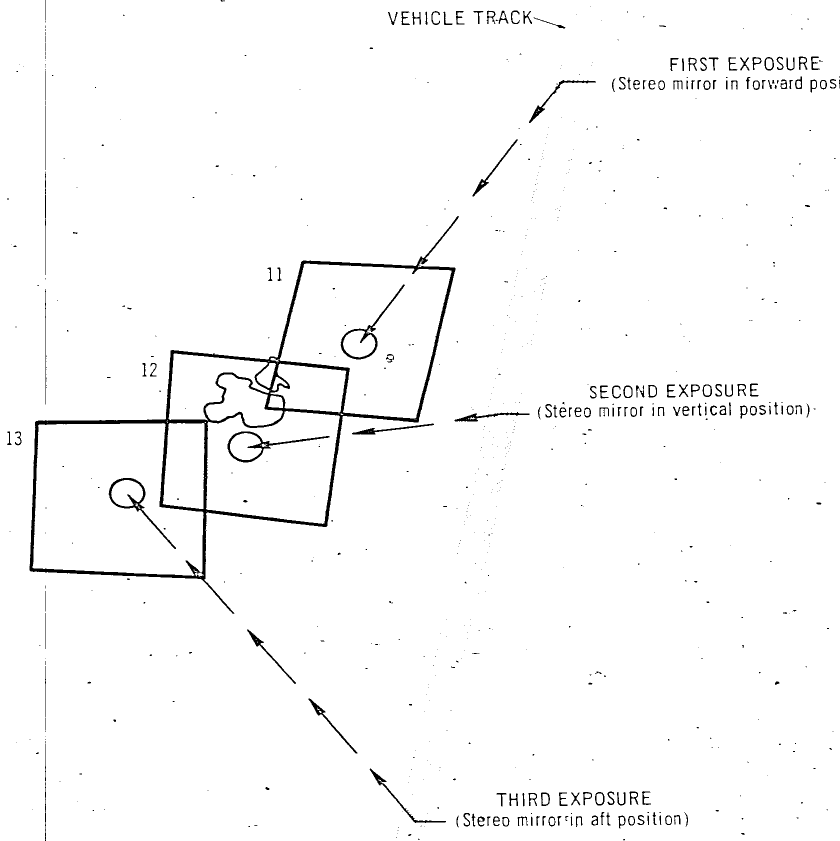
25X1

25X1

[redacted]

[redacted]

NPIC/TP-16/64



NPIC J-2529 (6 '64)

[redacted]

[redacted]

25X1
25X1
25X1
25X1
25X1

25X1

25X1

NPIC/TP-16/64

FIGURE 20. STEREO TRIPLET QUALITY.

NPIC-TP-16-64

25X1

[redacted]

[redacted]

25X1

25X1

NPIC/TP-16/64

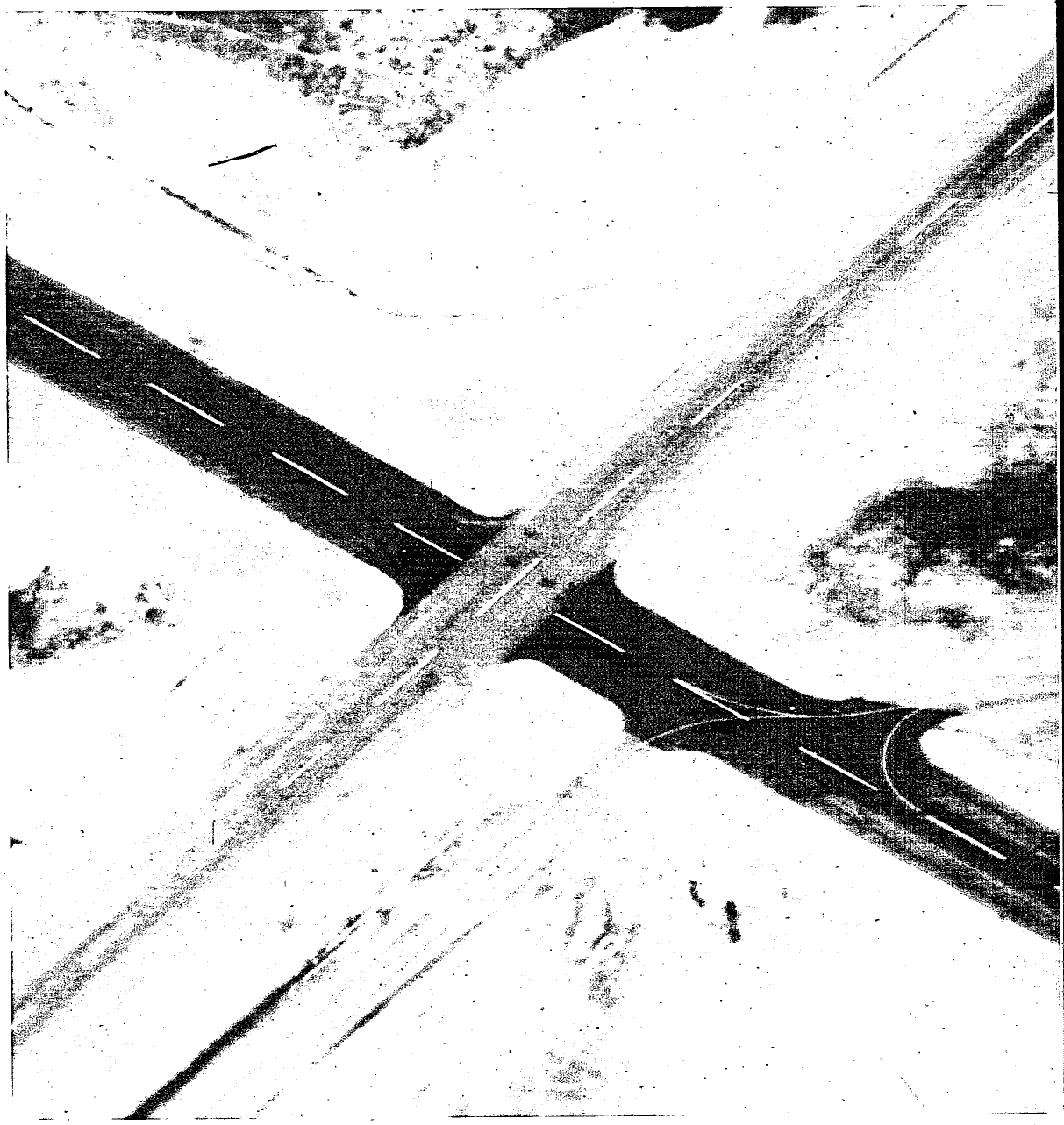
Frame 14 (center) of this stereo triplet is slightly degraded by smear, and frame 15 (right) is severely degraded by smear.

Left Photograph	Center Photograph	Right Photograph
Pass: D31	Pass: D31	Pass: D31
Frame: 13	Frame: 14	Frame: 15
Index: 26 (64-11)	Index: 27 (63-13)	Index: 28 (66-12)
Enlargement: 40X	Enlargement: 40X	Enlargement: 40X
Roll Angle: 12.1°	Roll Angle: 13.5°	Roll Angle: 14.2°
Mirror Position: 15°F	Mirror Position: 0°V	Mirror Position: 15°A

[redacted]

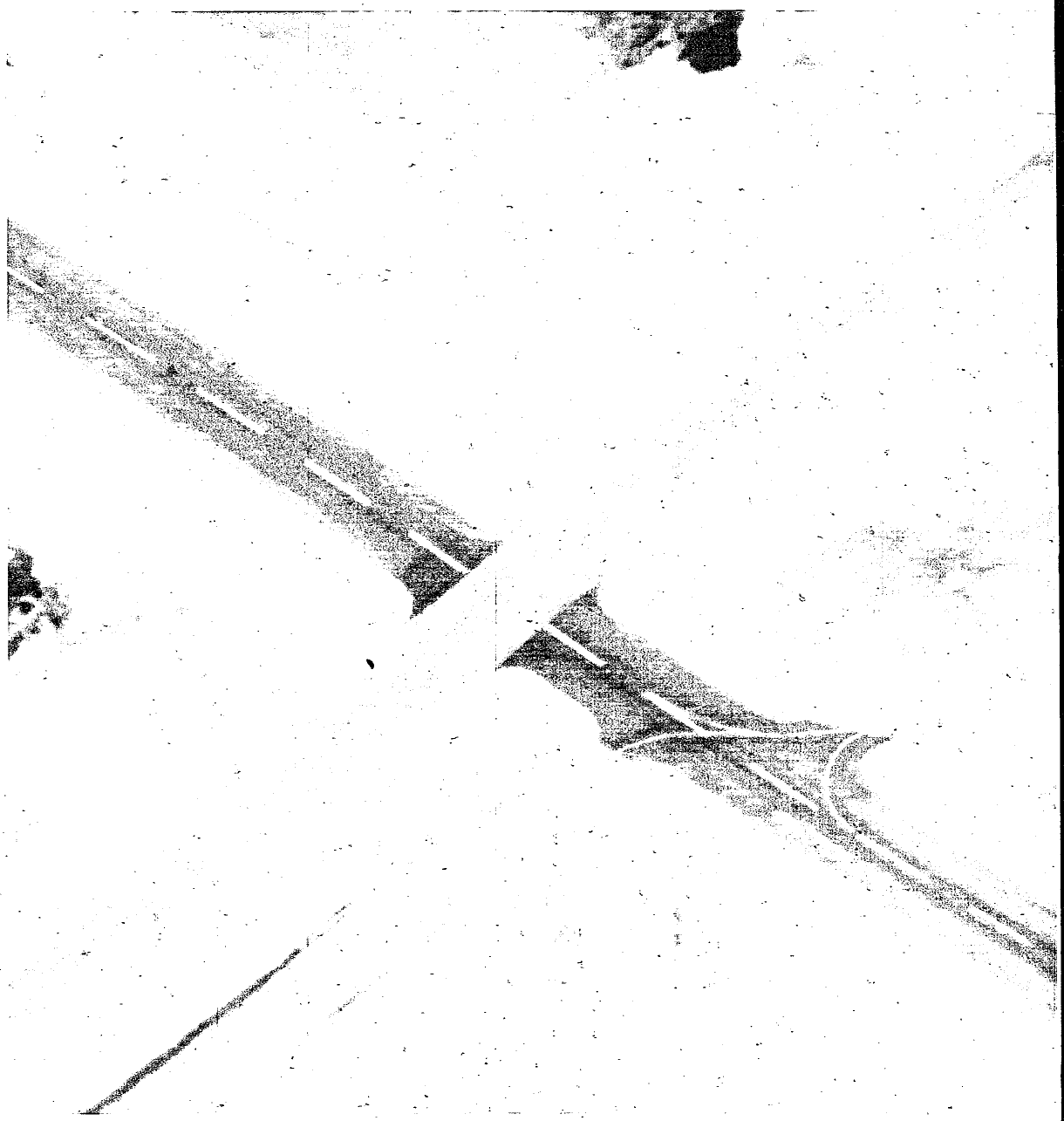
25X1

NPIC/TP-16/64



NPIC/TP-16/64

NPIC/TP-16/64



25X1

25X1

NPIC/TP-16/64

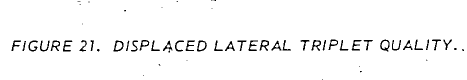


FIGURE 21. DISPLACED LATERAL TRIPLET QUALITY.

NPIC J-2519 (8 64)

25X1

25X1

25X1

NPIC/TP-16/64

To show quality, the same general area of the format appears in each frame of this displaced lateral triplet.

Left Photograph

Pass: D15
Frame: 11
Index: 15 (55-13)
Enlargement: 40X
Roll Angle: 8.5°
Mirror Position: 15°F

Center Photograph

Pass: D15
Frame: 12
Index: 16 (61-12)
Enlargement: 40X
Roll Angle: 12.8°
Mirror Position: 0°V

Right Photograph

Pass: D15
Frame: 13
Index: 17 (62-12)
Enlargement: 40X
Roll Angle: 17.0°
Mirror Position: 15°A

25X1

NPIC/TP-16/64

4. Malfunction Modes:

a. Programmed IMC in Error: To demonstrate the effect of incorrect IMC during oblique photography three successive exposures were made with a vehicle attitude of 30° roll. The first exposure was made with the IMC speed 4% below the correct velocity, the second exposure at the correct IMC, and the third exposure at an IMC speed 4% above the correct velocity. Photographs on both of the frames programmed with the IMC in error were degraded. Degradation is greater in the frame which was exposed at the +4% speed. This however, may be a condition induced by target location in the format area combined with the degree of roll.

Programmed IMC in Error Example:

Pass D48, frames 14, 15, and 16

b. Planned Mirror Movement: An experiment was conducted on pass D48, frames 01 and 02, to measure the effect and settling time of the stereo mirror. Two photographs were taken as follows:

(1) A 2.0 second strip with the stereo mirror in the aft position.

(2) A 0.3 second rest interval.

(3) A 6.0 second strip with stereo mirror in the aft position at T1 and in the forward position at T2. The results indicate that about 4.4 seconds were required for the stereo mirror to change from the aft to the forward position. This includes nearly a second of mirror settling time.

c. High Roll Rate Settling Time: Pass D48, frame 03, was exposed with the stereo mirror in the vertical position while the vehicle was rolled at a high rate of roll. The imagery is degraded from the start of the roll to its completion including settling time. This maneuver was accomplished in approximately 5 seconds. A similar experiment was conducted in the following frame (pass D48, frame 04) utilizing a medium roll rate. A combination of roll and settling time of about 2.5 seconds was required for this maneuver.

d. Yaw Error: This experiment was conducted to determine the actual degrading effects caused by an error in yaw angle during high oblique photography. A one degree change in yaw angle between frames 11 and 12 in pass D48 showed little difference in image quality. A slight difference in image quality is apparent, with frame 11 (smaller yaw angle) being the better.

e. Attitude Control:

(1) Pass D31, frames 01 and 02 were taken using the coarse and fine vehicle attitude control respectively. This experiment, intended as a means of determining the degradation, if any, between the use of the coarse versus fine attitude control, is inconclusive because of 95% cloud cover.

25X1

25X1

NPIC/TP-16/64

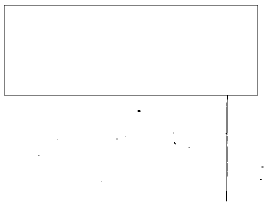


FIGURE 22. PROGRAMMED IMC IN ERROR.

NPIC J-2522 8 64

25X1

25X1
25X1

NPIC/TP-16/64

The results of this IMC experiment show that the degradation apparent in the -4% (slow film speed, left photograph) error is not as severe as that induced by the +4% (fast film speed, right photograph) error.

Left Photograph	Center Photograph	Right Photograph
Pass: D48	Pass: D48	Pass: D48
Frame: 14	Frame: 15	Frame: 16
Index: 19 (58-8)	Index: 20 (50-10)	Index: 21 (60-2)
Enlargement: 40X	Enlargement: 40X	Enlargement: 40X
Roll Angle: 28.4°	Roll Angle: 29.8°	Roll Angle: 30.5°
IMC Error: -4%	IMC Error: 0%	IMC Error: +4%

25X1

TOP SECRET - RUFF
NO FOREIGN DISSEM

NPIC/TP-16/64

TOP SECRET - RUFF
NO FOREIGN DISSEM

25X1

25X1

NPIC/TP-16/64

FIGURE 23. MIRROR BOUNCE.

NPIC J-2521 (8/64)

25X1

25X1
25X1

Degradation caused by the bouncing of the stereo mirror as it settles after a change in position is illustrated here. This bounce exists for nearly a second after the mirror stops.

Pass: D48
Frame: 02
Index: 2 (60-17)
Enlargement: 10X

25X1

NPIC/TP-16/64

25X1

25X1

NPIC/TP-16/64

FIGURE 24. YAW ERROR EXPERIMENT.

NPIC J-2522 (8/64)

25X1

25X1
25X1

NPIC/TP-16/64

These photographs show the result of a 1° change in yaw angle.

Left Photograph	Right Photograph
Pass: D48	Pass: D48
Frame: 11	Frame: 12
Index: 14 (59-13)	Index: 15 (50-13)
Enlargement: 40X	Enlargement: 40X
Roll Angle: 35.4°	Roll Angle: 35.4°
Yaw Error: Nominal	Yaw Error: 1°

25X1

NPIC/TP-16/64