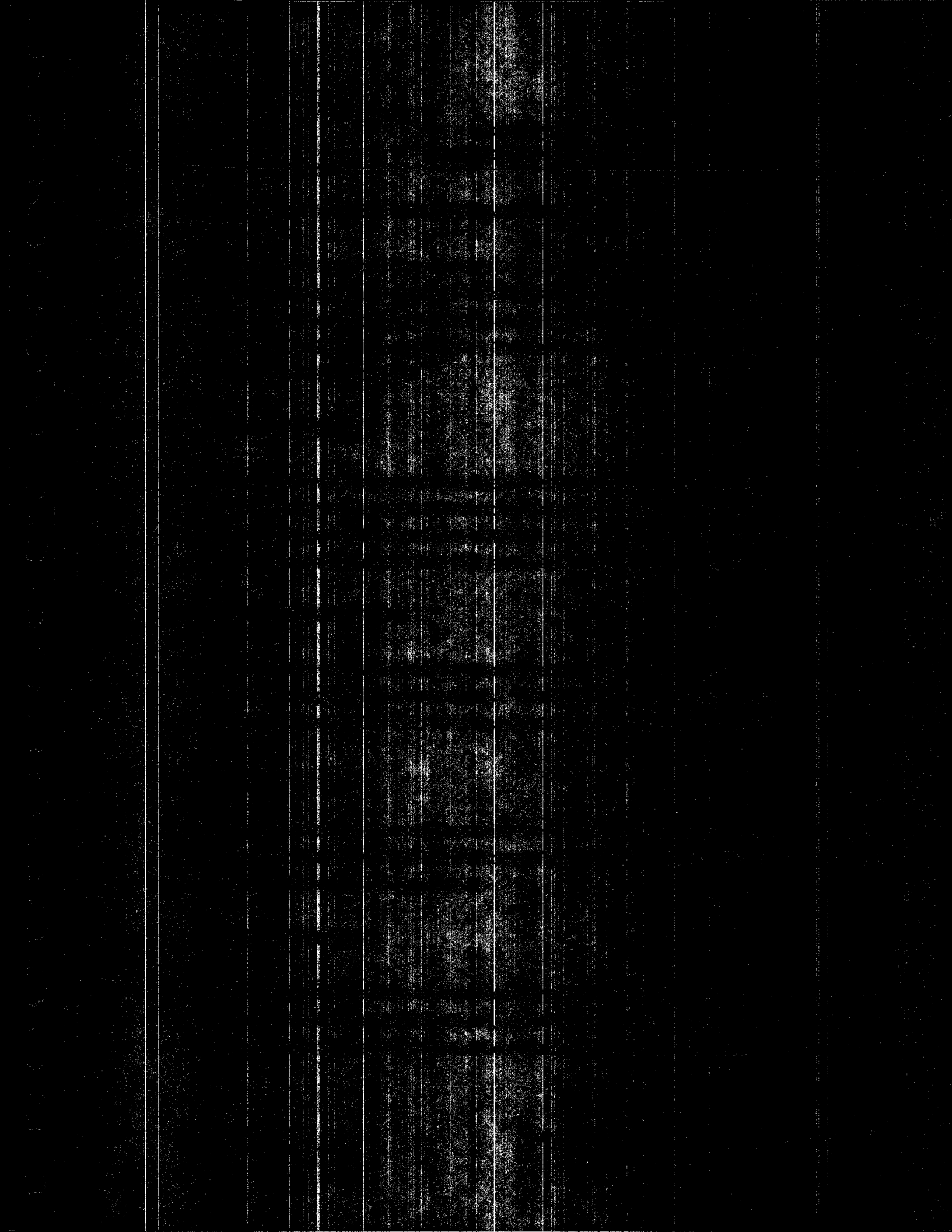
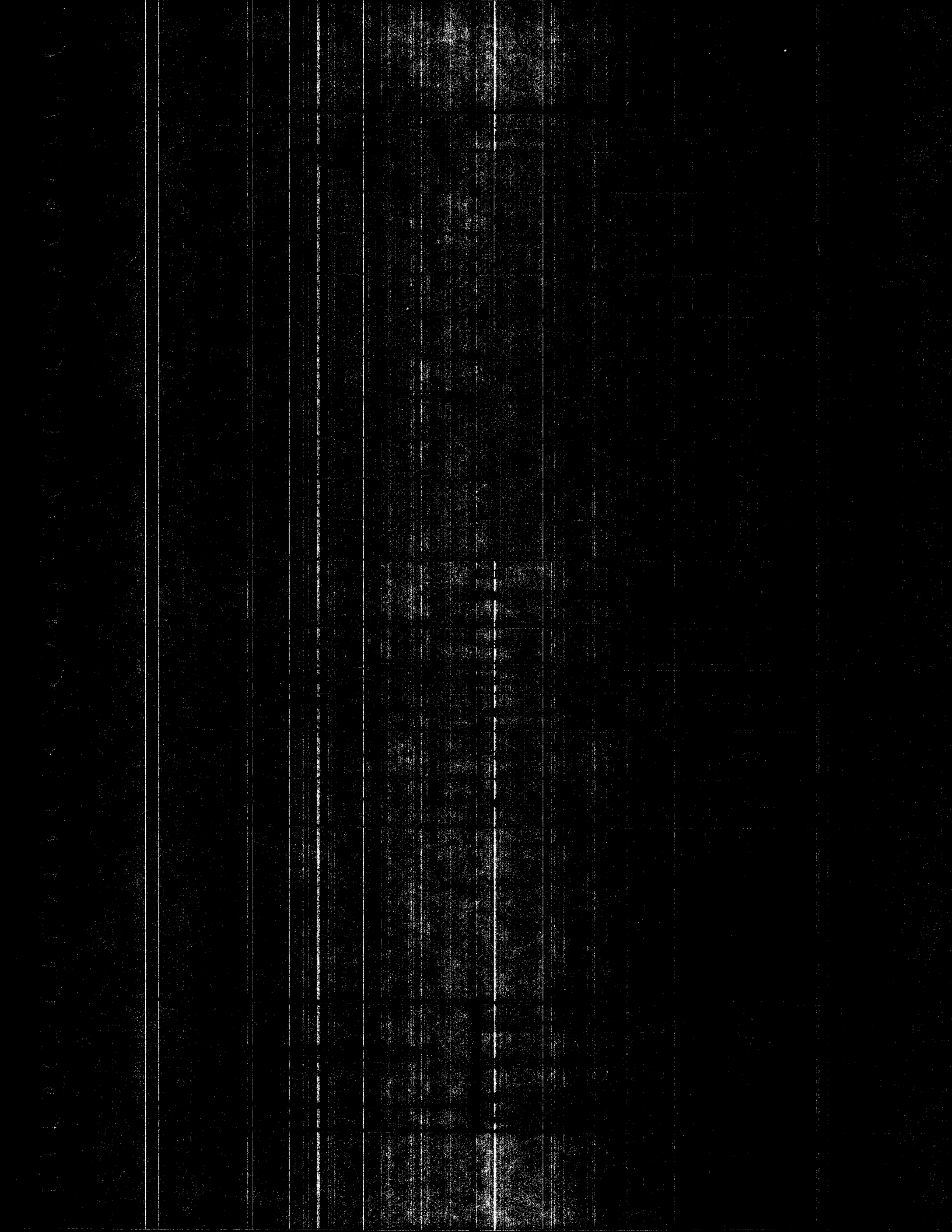




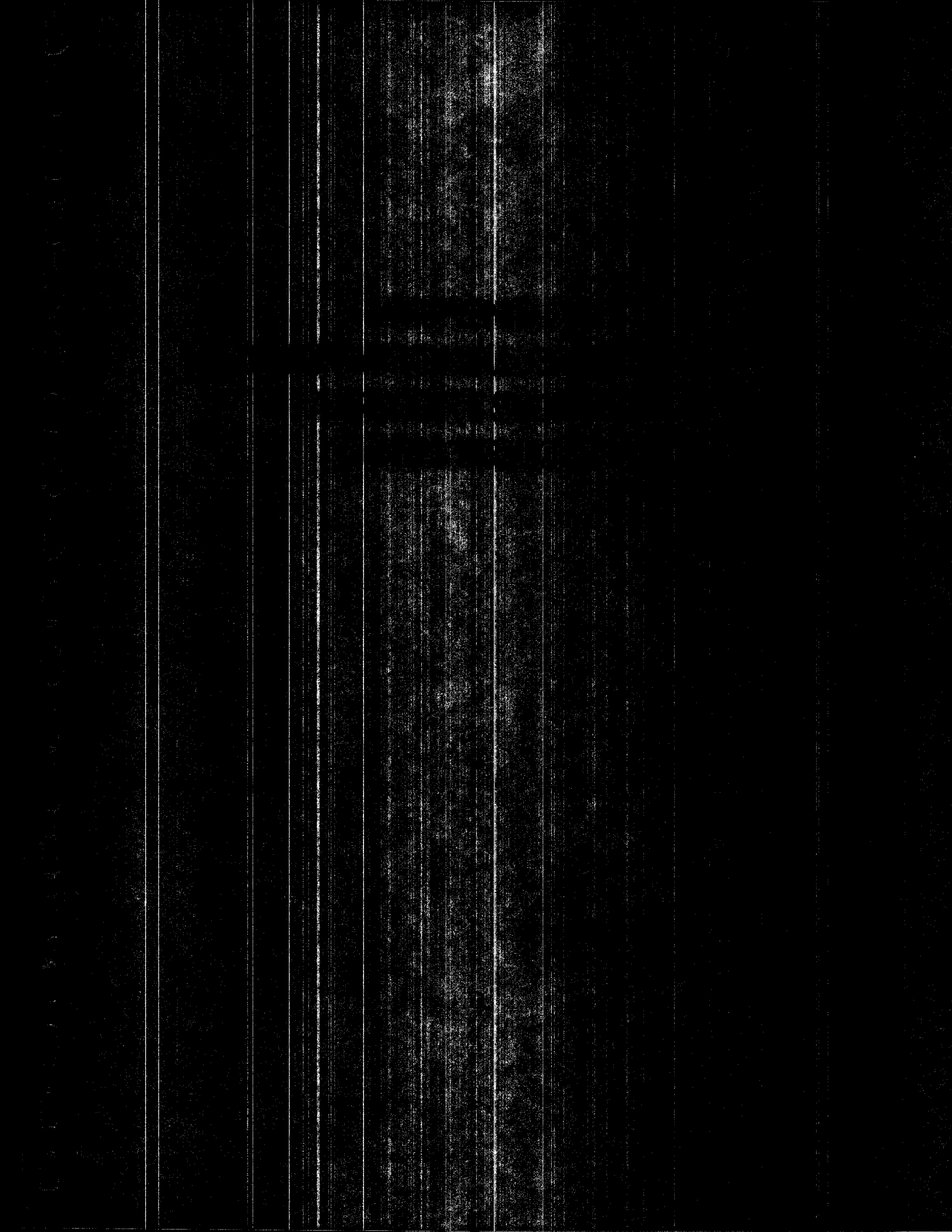
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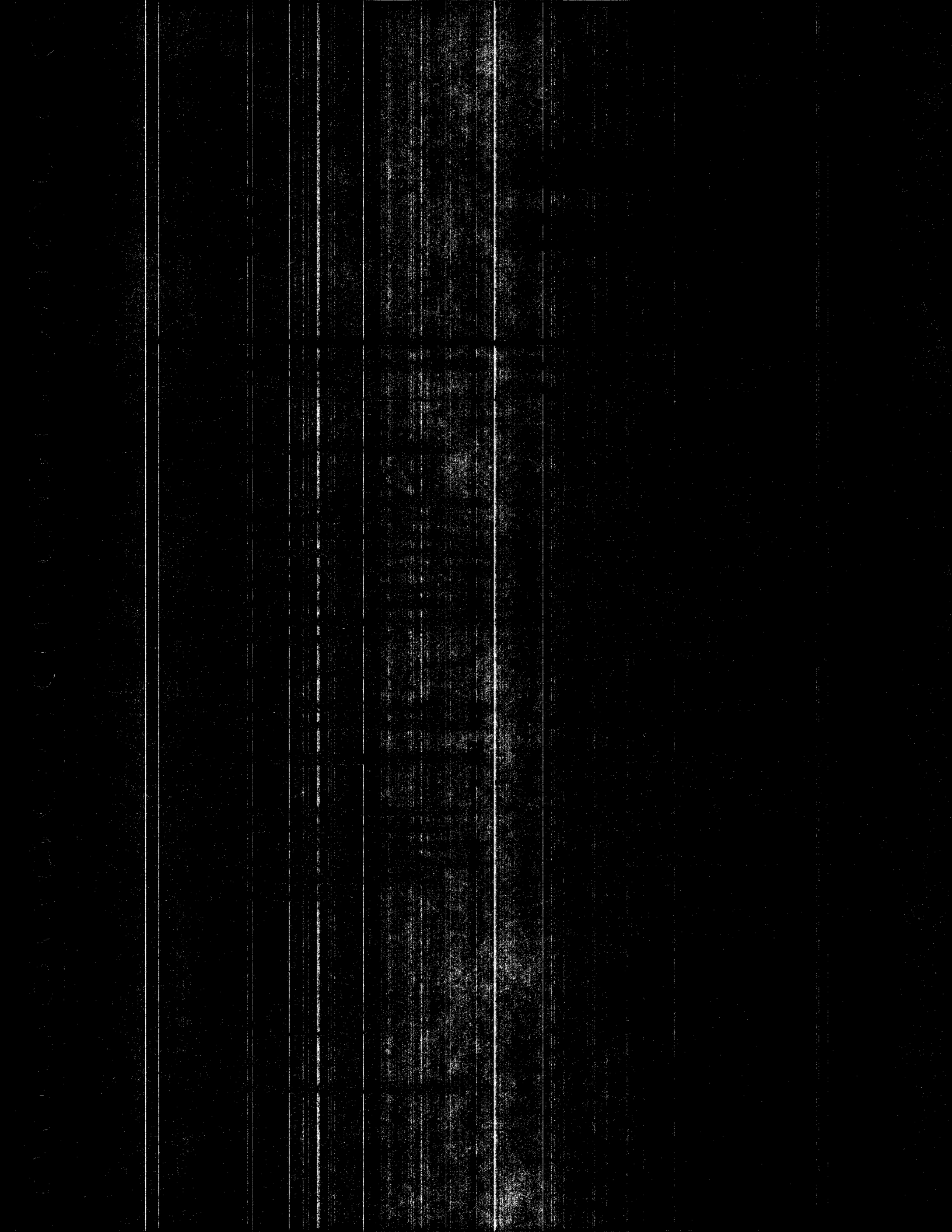




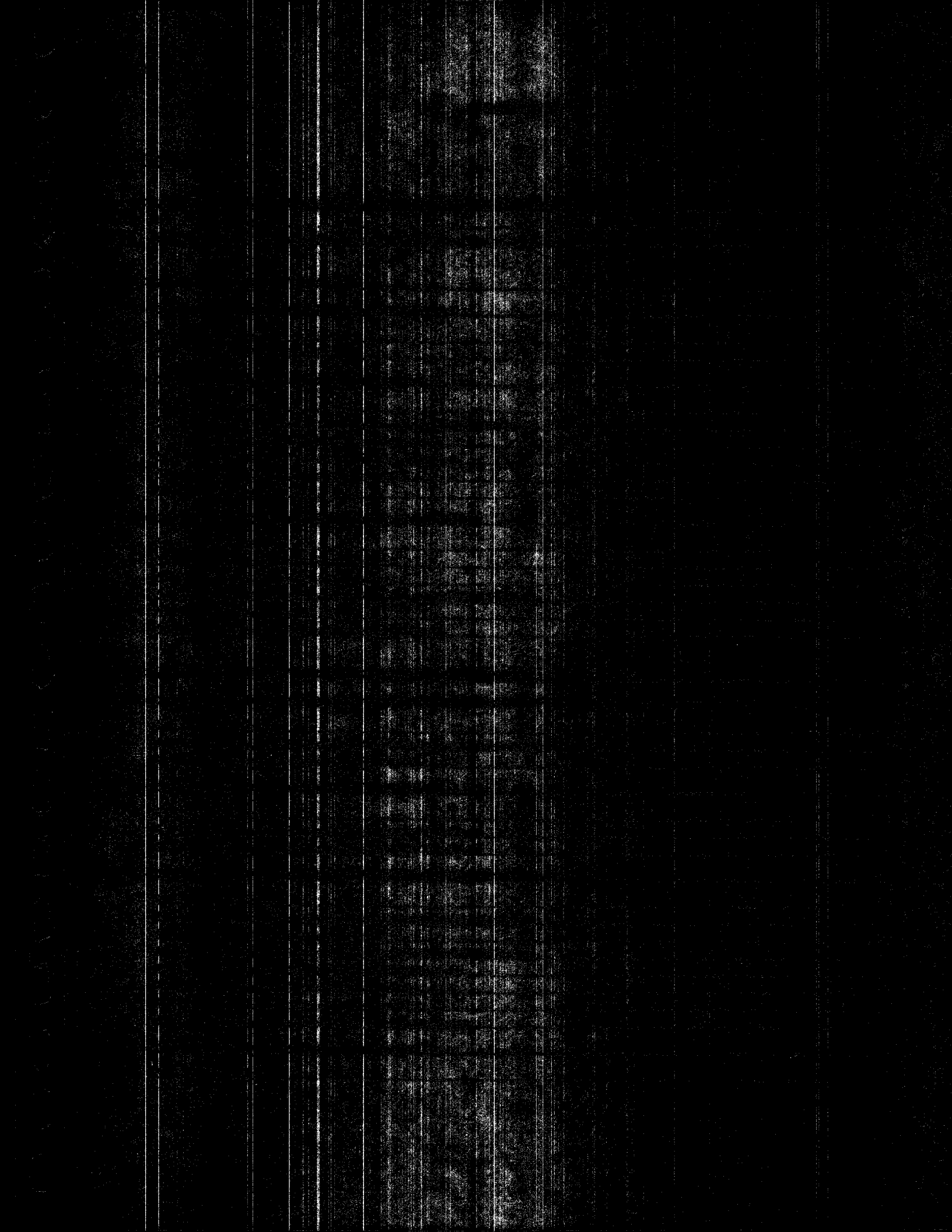
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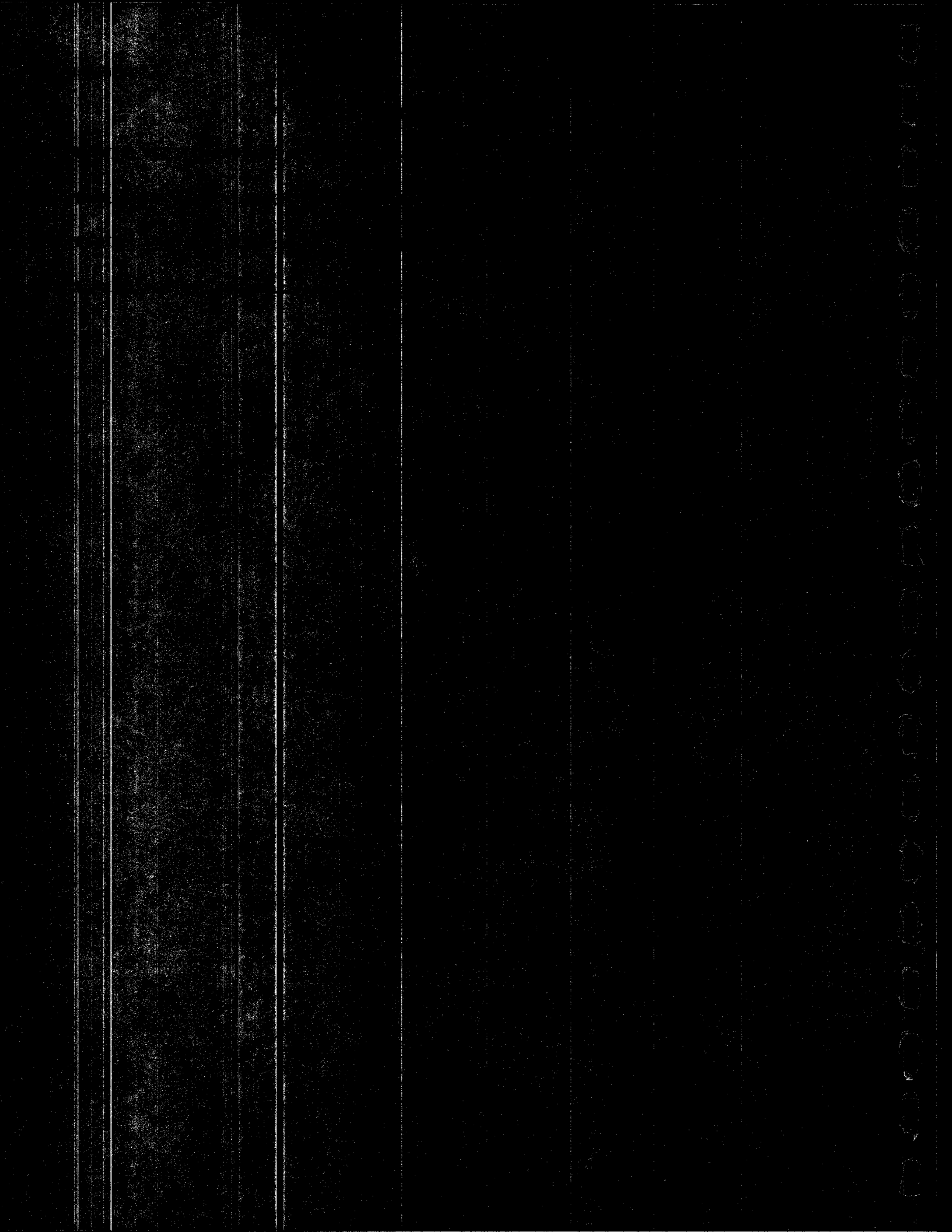


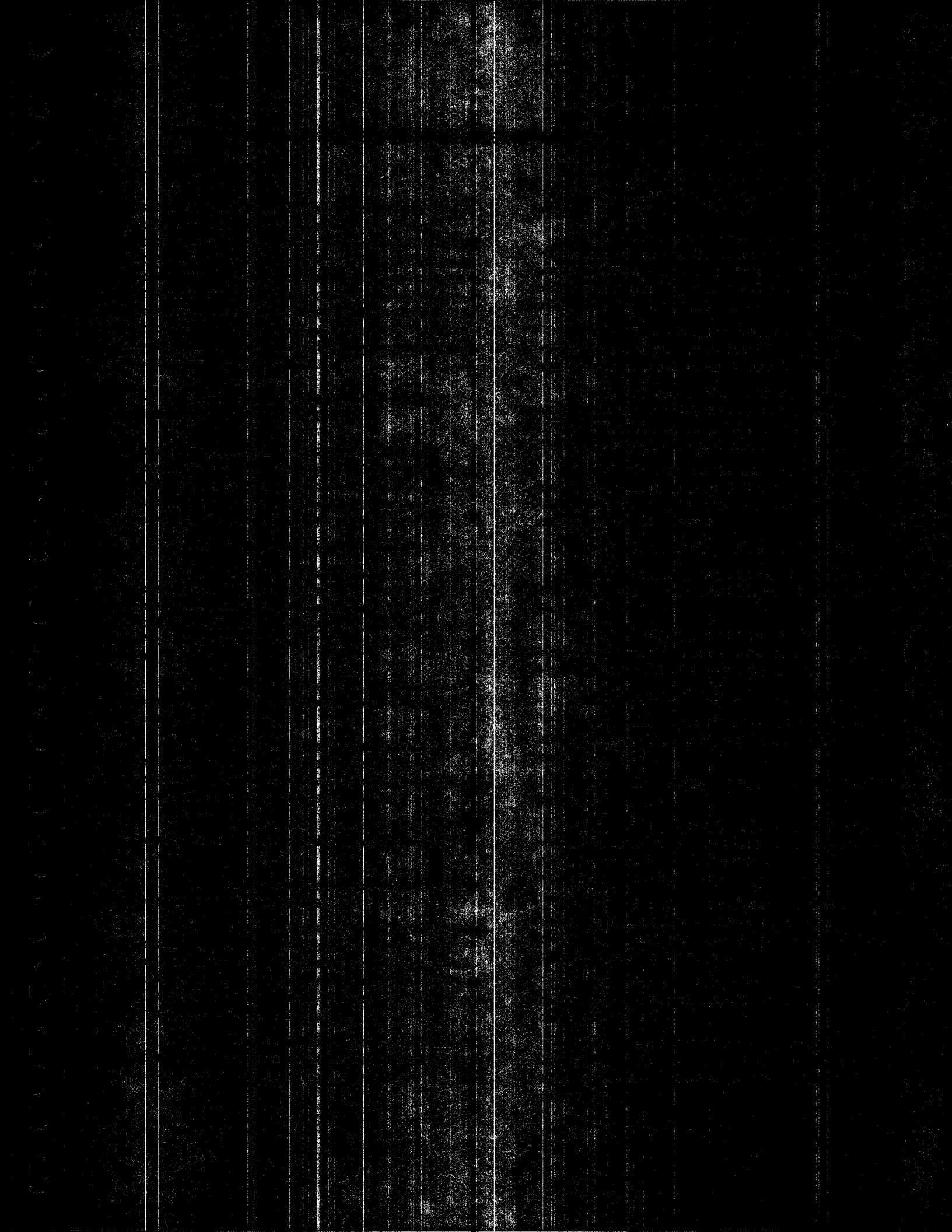




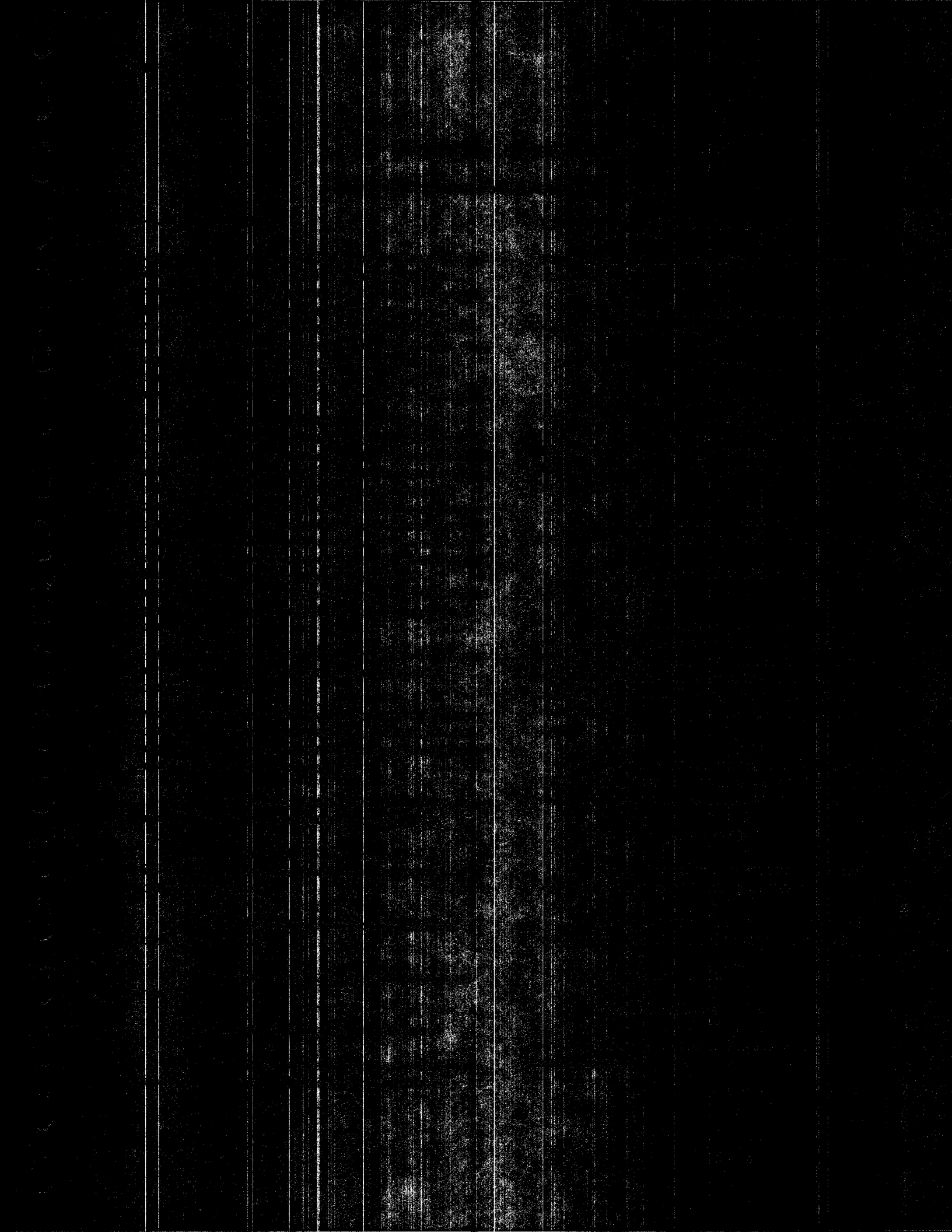


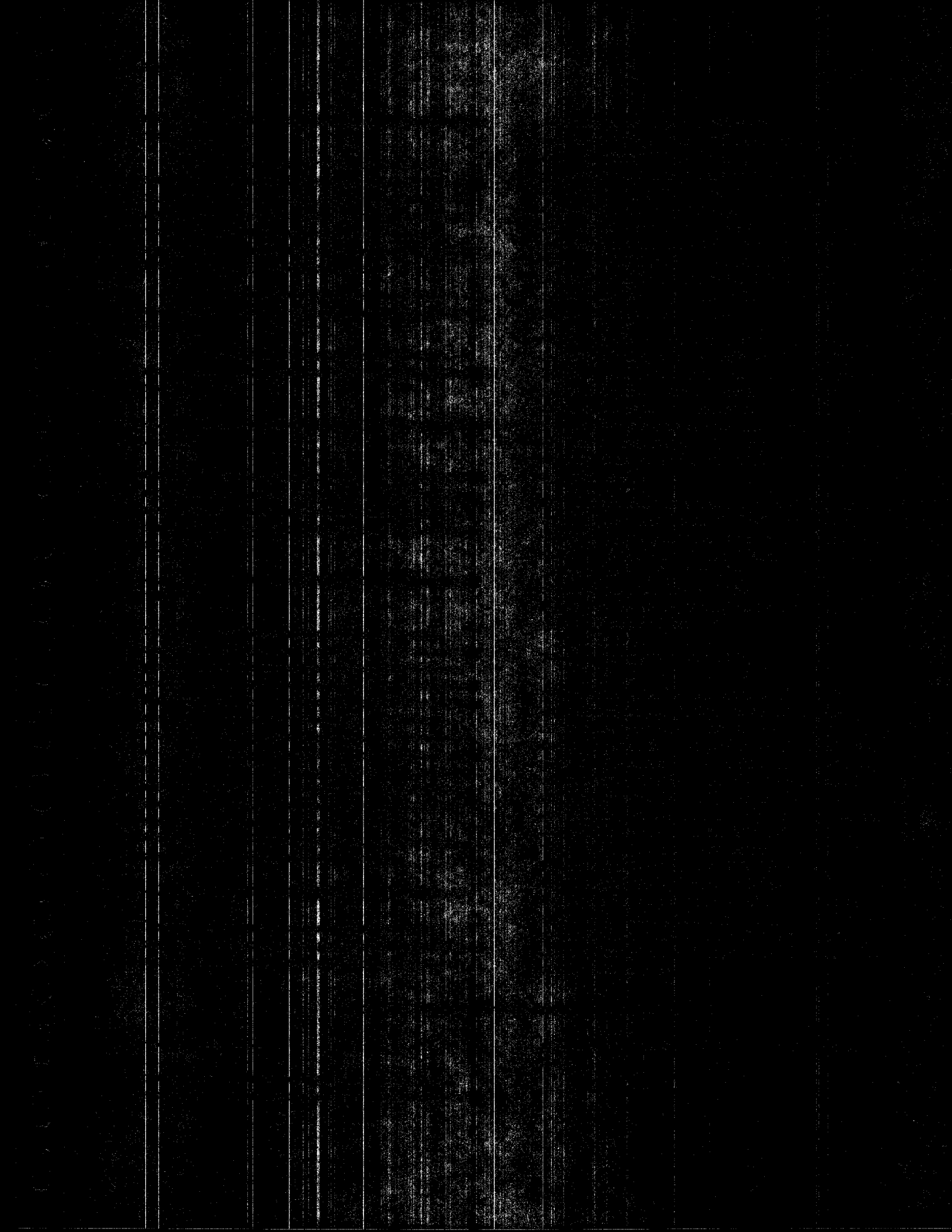






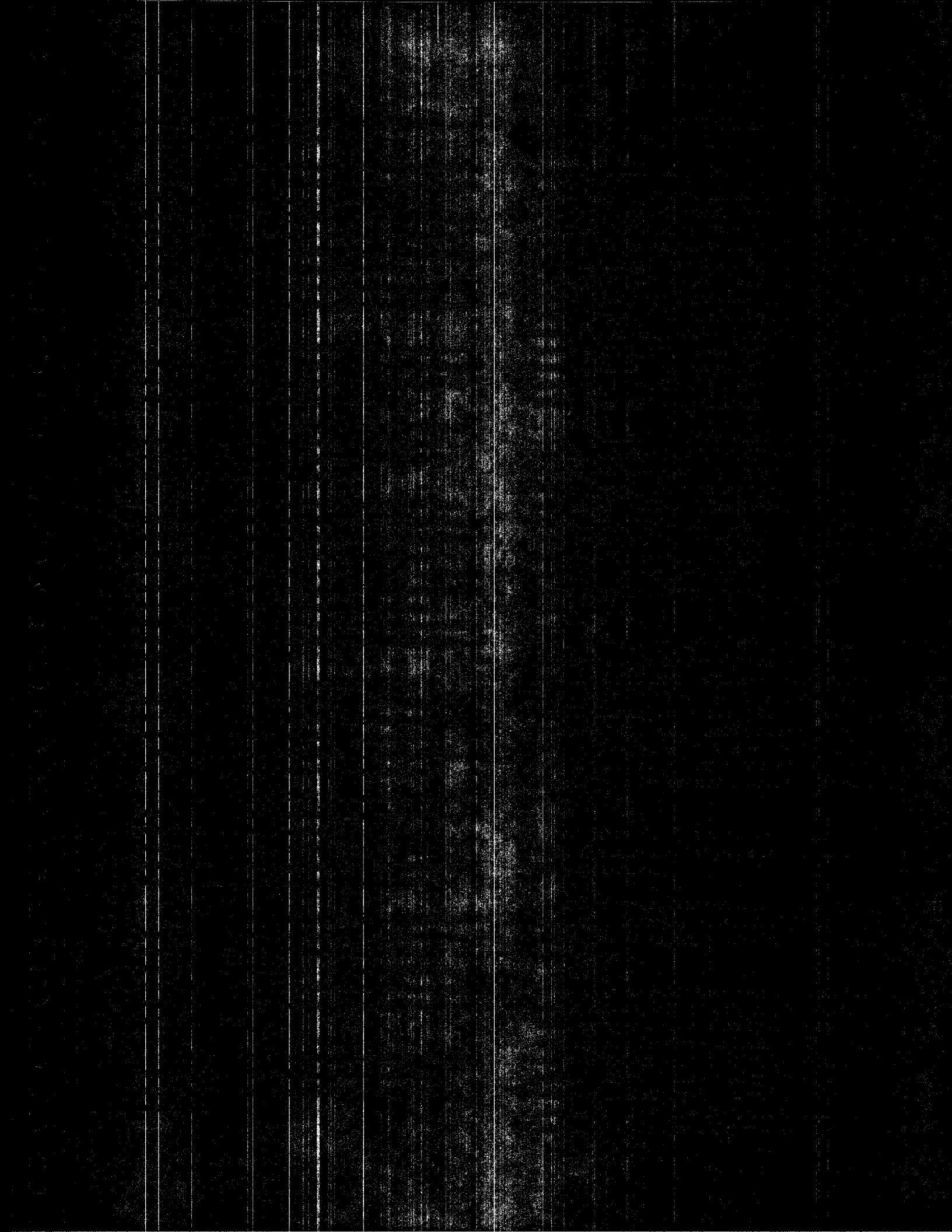






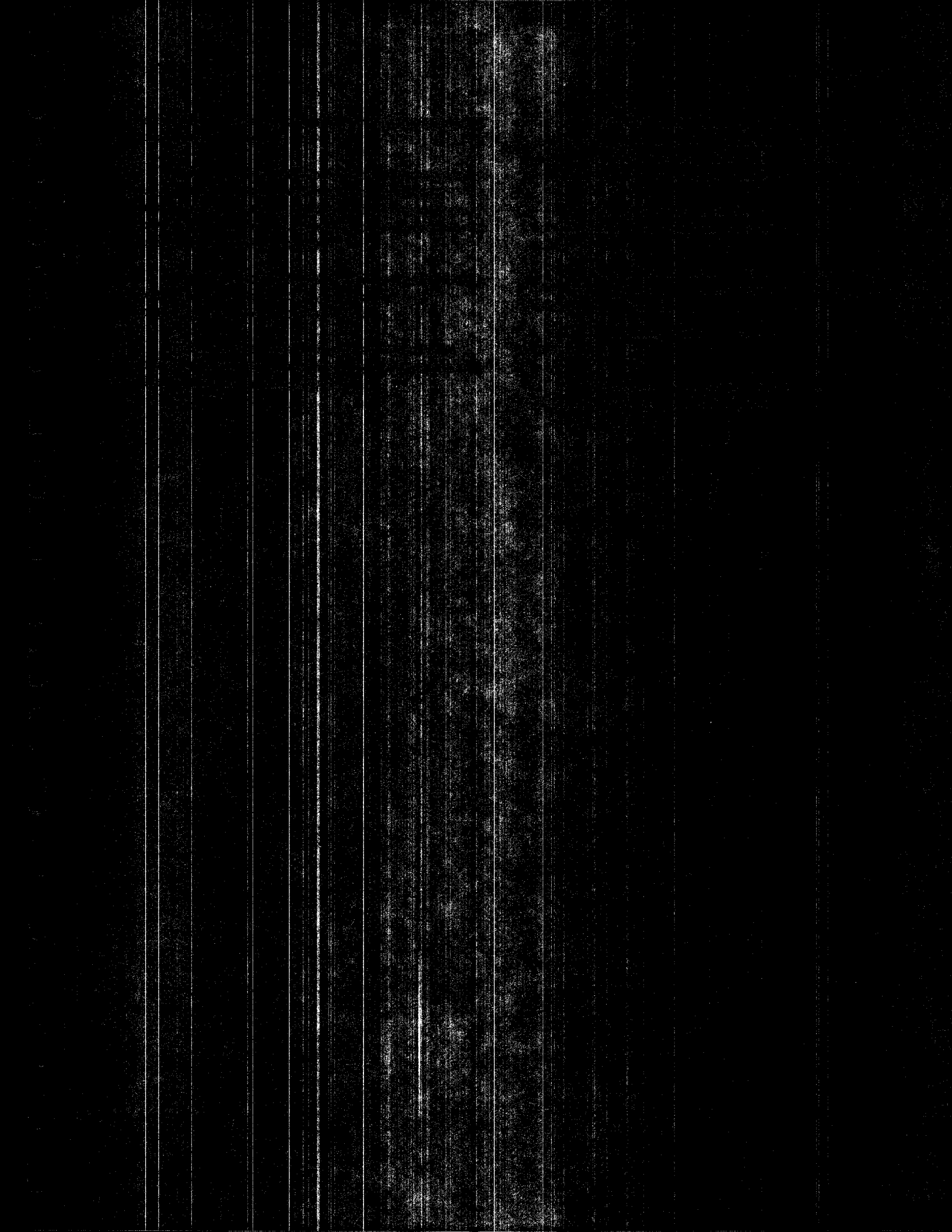


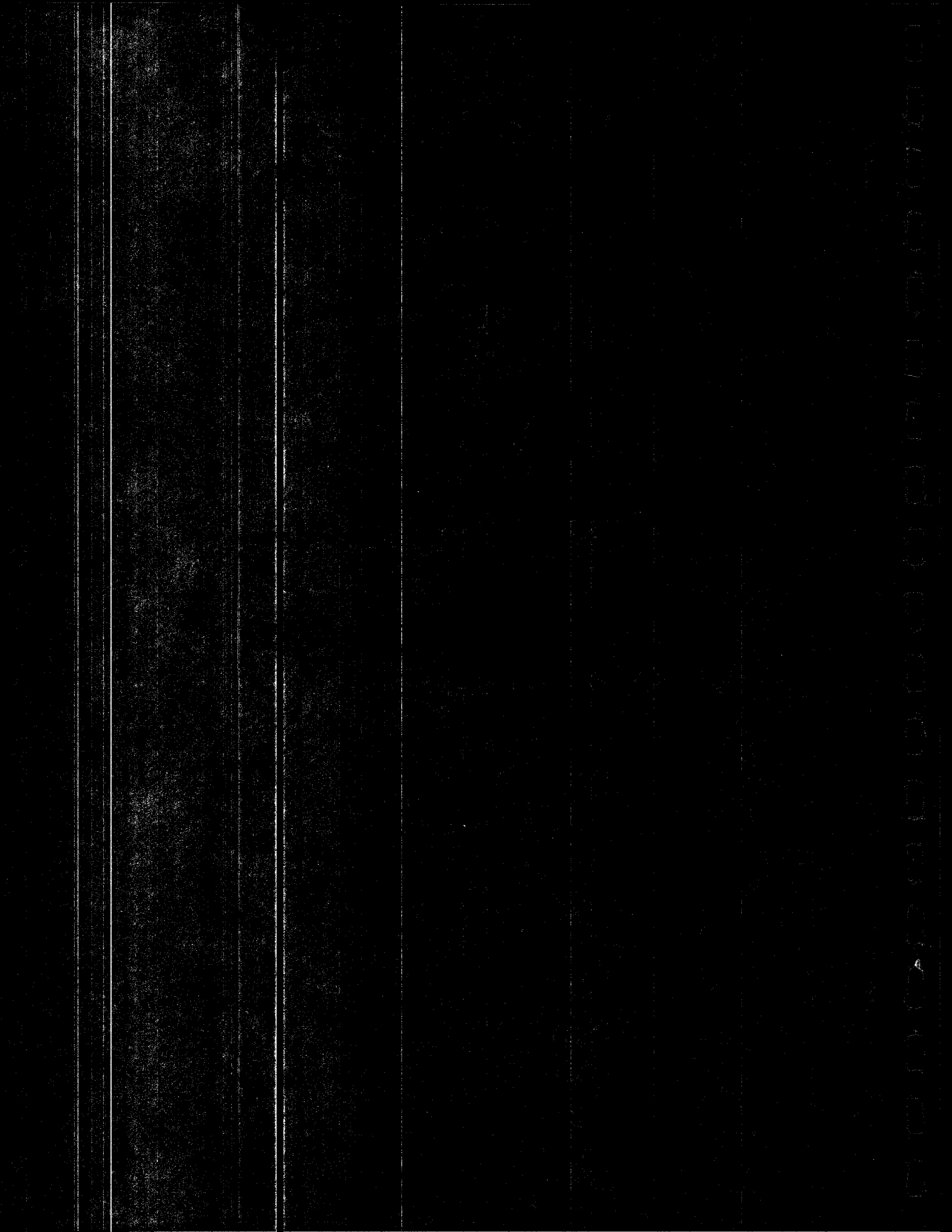


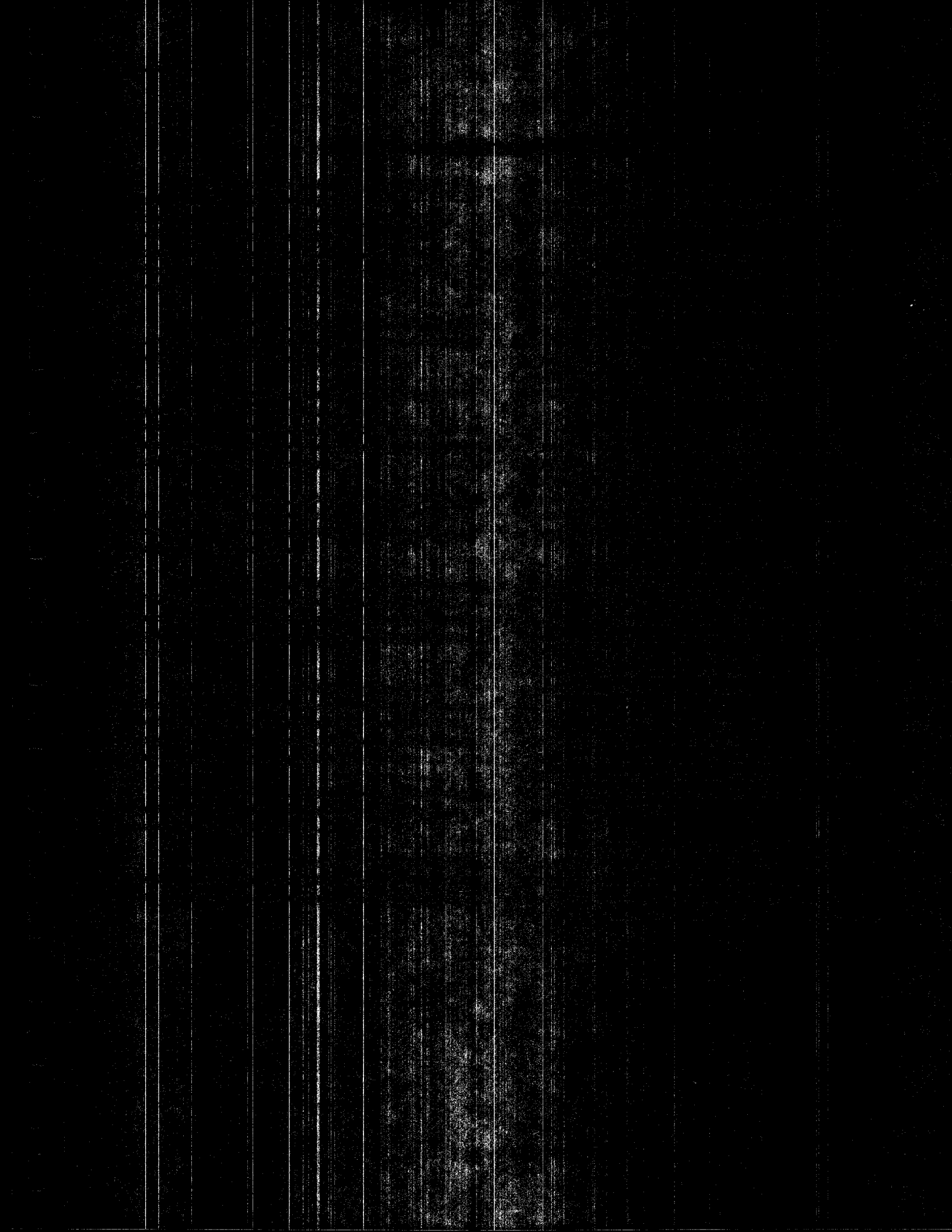










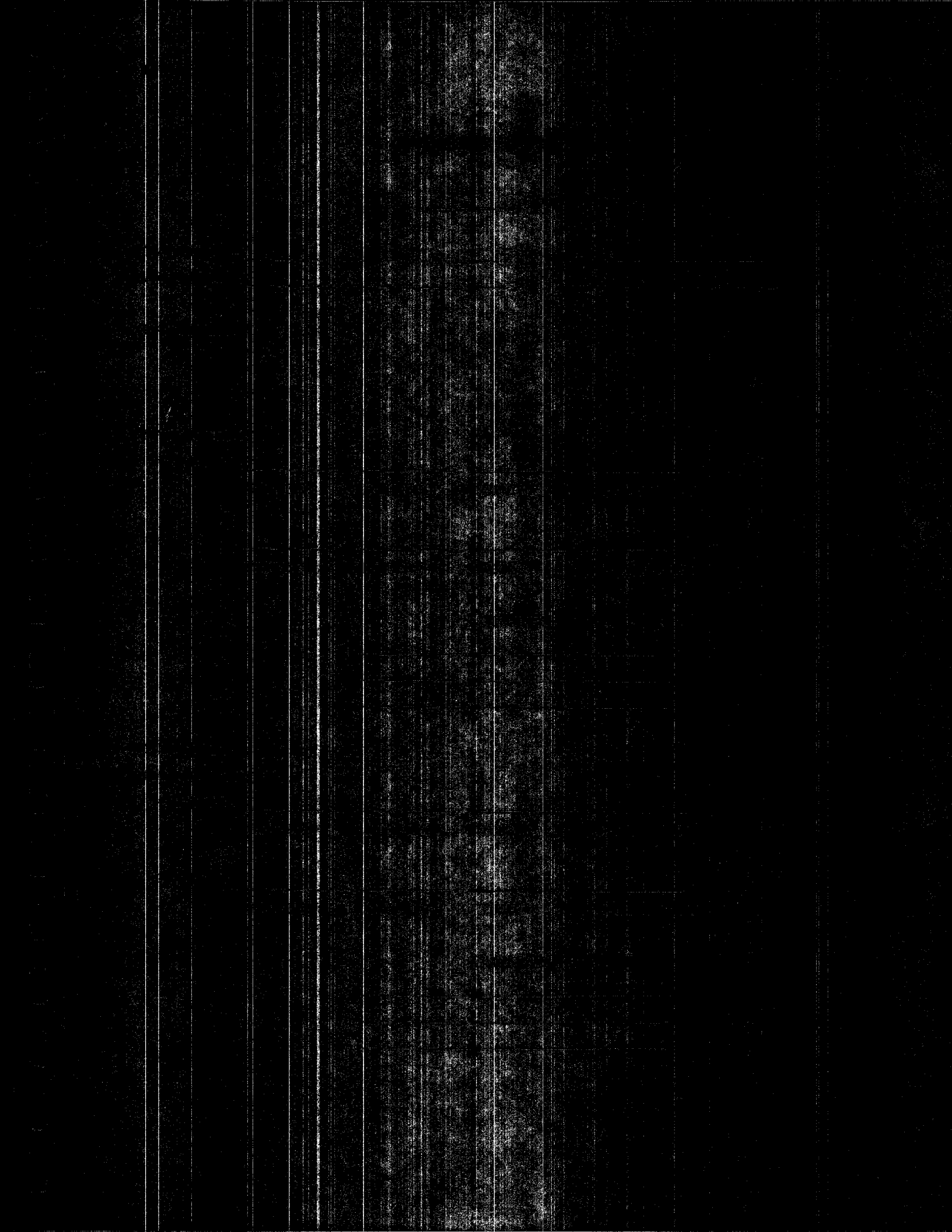


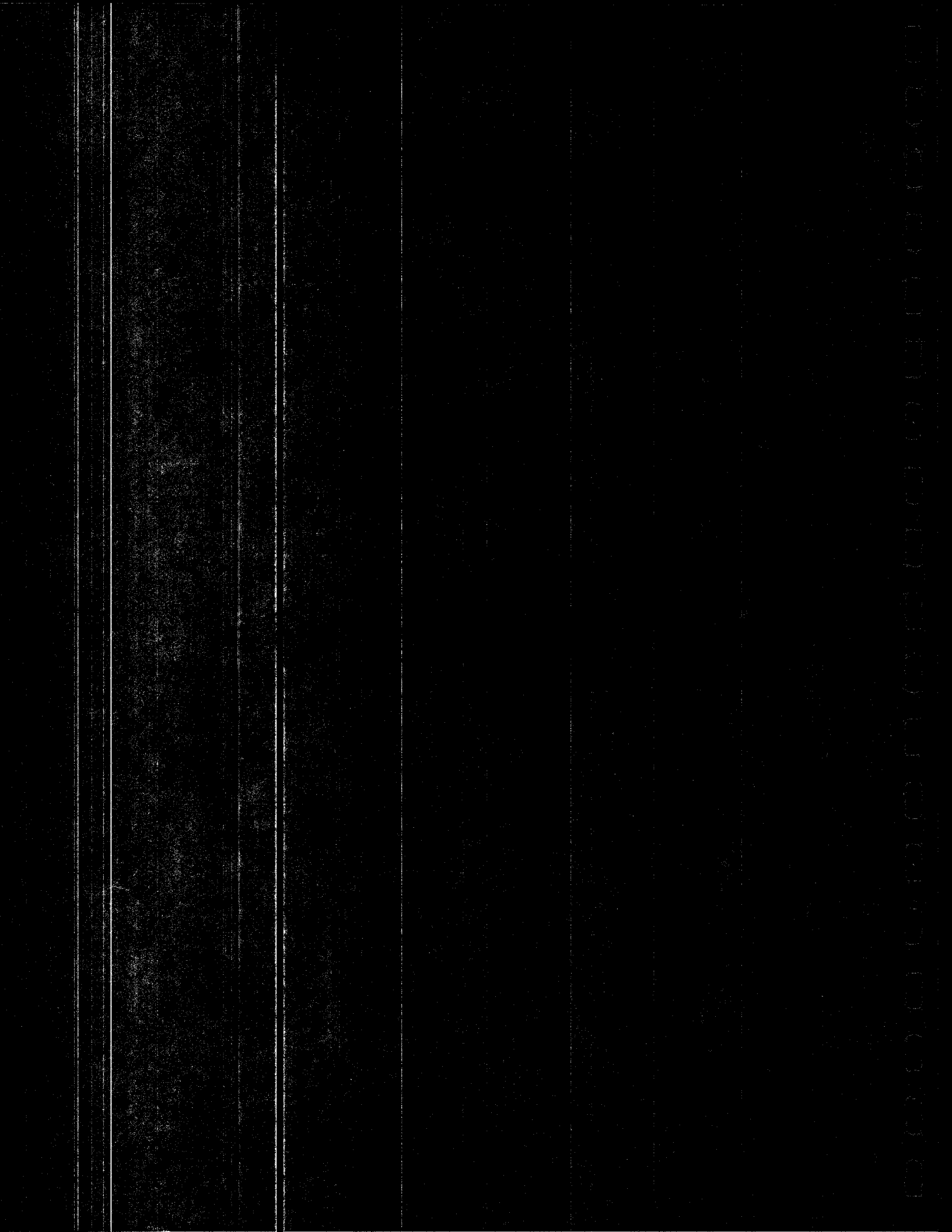






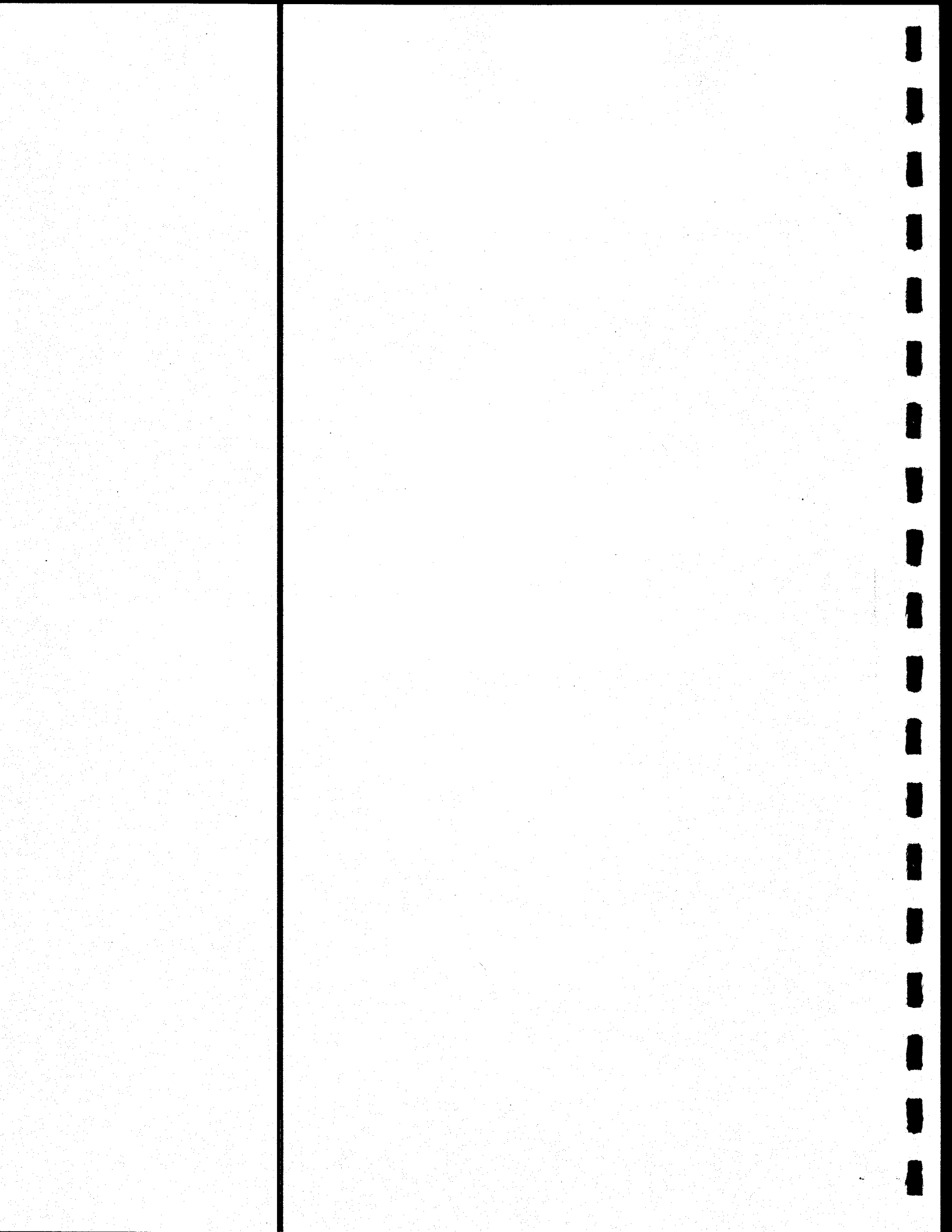






DIVISION V

Technical Specifications



DIVISION V
SECTION 1
MOBILIZATION

1-1.1 GENERAL. Mobilization shall consist of preparatory work and operations, including, but not limited to, attending preconstruction meetings; preparing project schedules; submittal documents; those actions necessary for the movement of personnel, equipment, supplies, traffic control devices, barricades, and incidentals to the project site; establishing of all other facilities necessary for work on the Project; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various CONTRACT items on the Project site.

1-1.2 SUBMITTALS. All materials and equipment used to construct this item shall be submitted to the ENGINEER for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are of good a quality and legible. Any deviations or substitutions from SPECIFICATIONS shall be identified, in writing, at the time the submittals are made.

Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting only is not acceptable). CONTRACTOR is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

The data submitted shall be sufficient, in the opinion of the ENGINEER, to determine compliance with the plans and specifications. The CONTRACTOR's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The ENGINEER reserves the right to reject any and all equipment, materials or procedures, which, in the ENGINEER's opinion, does not meet the system design and the standards and codes, specified.

1-1.3 AIRFIELD SAFETY AND TRAFFIC CONTROL. Airfield Safety and Traffic Control shall include the special requirements with respect to safely conducting construction activities, coordinating construction with aircraft operations, and maintaining the construction site in a manner that is compatible with aircraft. All items required in Safety Requirements and Special Provisions for Airport Construction, Division IV, shall be included in Airfield Safety and Traffic Control.

MEASUREMENT AND PAYMENT

1-2.1 MEASUREMENT. Mobilization and Airfield Safety and Traffic Control will be measured separately as lump sum items.

1-2.2 PAYMENT FOR MOBILIZATION.

- A. When the monthly partial payment estimate of the amount earned, not including the amount earned for Mobilization, is 5 percent or more of the original CONTRACT amount, 50 percent of the CONTRACT item price for Mobilization will be included in the estimate for payment.
- B. When the monthly partial payment estimate of the amount earned, not including the amount earned for Mobilization, is 10 percent or more of the original CONTRACT amount, the total amount earned for Mobilization shall be 75 percent of the CONTRACT item price for Mobilization and said amount will be included in the estimate for payment.
- C. When the monthly partial payment estimate of the amount earned, not including the amount earned for Mobilization, is 20 percent or more of the original CONTRACT amount, the total amount earned for Mobilization shall be 95 percent of the CONTRACT item price for Mobilization and said amount will be included in the estimate for payment.
- D. When the monthly partial payment estimate of the amount earned, not including the amount earned for Mobilization, is 50 percent or more of the original CONTRACT amount, the total amount earned for Mobilization shall be 100 percent of the CONTRACT item price for Mobilization and said amount will be included in the estimate for payment.

The CONTRACT lump sum price paid for Mobilization shall include full compensation for all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in Mobilization as specified herein.

Payments made for Mobilization will be excluded from consideration in determining compensation under changed quantities.

1-2.3 PAYMENT FOR AIRFIELD SAFETY AND TRAFFIC CONTROL. Airfield Safety and Traffic Control will be paid for at the contract lump sum price. This price shall include full compensation for all labor, materials, tools, equipment, and incidentals necessary to completing the work.

END OF SECTION

DIVISION V
SECTION 2
SURFACE PREPARATION

DESCRIPTION

2-1.1 This item shall consist of providing all labor, material and equipment necessary to clean the existing apron pavement surface in preparation for seal coat application. High-pressure water jets and vacuum pick-up system or other ENGINEER-approved method shall be used. Shot-blasting or sand blasting will not be allowed. Surface preparation will be accomplished by removing 90-95% of the rubber deposits and other materials (i.e. oil, fuel, paint and dust) from the pavement's micro-texture. The pavement surfaces may be smooth or grooved. Marking removal will be considered satisfactory if not less than 50% of the marking materials is removed from the pavement's surface. Excess damage, as defined by the ENGINEER, shall be repaired at the CONTRACTOR's expense.

2-1.2 FAILED PAVEMENT REPAIR. The failed areas shall be treated or removed as specified in Section 3 AC Pavement Pulverization, Cold Milling, and Recycling, Section 4 Earthwork and Site Preparation, Section 6 Joint Sealing Filler, and Section 9 Major Crack Repair and Minor Crack Seal. All failed material including surface, base course, subbase course, and subgrade shall be removed.

MATERIALS

2-2.1 All equipment and methods used shall not cause damage to pavement that is to remain in place.

2-2.2 WATER. Water shall be potable water obtained from a municipal source or well. Reclaimed water will not be allowed. The use of chemicals, abrasive materials, grinders, detergents or salt water will not be allowed.

2-2.3 EQUIPMENT. Unless approved by the ENGINEER, all equipment shall contain a high pressure water pump, clean and dirty water tanks, and a vacuum pickup system. A vacuum truck, vacuum sweeper, or similar device shall be provided, capable of collecting the rubber, water and other debris from the apron surface.

The high pressure pump shall provide adequate water pressure and quantity (gpm), as necessary to be capable of cleaning a minimum of 2,500 square yards per hour. The surface cleaning equipment shall have a multi-jet spray head and be capable of carrying sufficient water to operate continuously for a minimum of four hours. The equipment shall be equipped with approved flashing yellow safety lights. Other equipment and methods will be considered by the ENGINEER for possible use.

CONSTRUCTION METHODS

2-3.1 GENERAL. The work shall be performed at the locations designated on the plans or as directed by the ENGINEER. The cleaning process shall remove 50% of the markings, 90-95% of the dirt/dust, and all other materials from the pavement surface micro-texture using ultra-high pressure water jets.

Work shall not be performed unless the temperature is a minimum of 40° F and rising and the pavement temperature is a minimum of 35° F and rising unless otherwise approved by the ENGINEER. Surface preparation work may be performed during inclement weather provided that all rubber, water, and debris

are 100% captured by the vacuum pickup system. Water collected by the vacuum system may be disposed of on site, if the rubber, debris, oils, gases, and other contaminants are removed to the satisfaction of the ENGINEER. If approved, this water can then be discharged on site at a location designated by the ENGINEER and allowed to evaporate or be absorbed into the ground. Otherwise, contaminated water shall be properly disposed of off site.

Water shall not be allowed to run in to any storm drain system, grass area, lake, river, or stream. All debris collected by the vacuum system shall be properly disposed in an approved landfill. The work shall be performed without causing damage to the light fixtures or other airfield property. Care shall be taken to prevent/minimize damage that may occur to the joints and joint sealant material.

2-3.4 TEST AREA. Prior to the start of the work the CONTRACTOR shall perform surface preparation operations in a test area, at a location designated by the ENGINEER, covering a minimum of 500 square feet to demonstrate the quality of the surface preparation. The high pressure pump shall be set at an operating pressure and flow rate, and the forward speed of the equipment as necessary to remove the paint and other materials as specified without causing excess damage to the pavement surface or joints.

The test area shall include joints, joint sealing material. Following the surface preparation test operation, if present, the ENGINEER will inspect the test area to determine if the results are acceptable. The ENGINEER has sole discretion to determine if the results are acceptable and the COUNTY reserves the right to terminate the work if unacceptable damage has occurred.

2-3.5 VISUAL INSPECTION - SURFACE CLEANING. The ENGINEER shall visually inspect prepared areas to determine if the percentage of the dust, dirt, and debris removed is acceptable. Visual inspection shall be made of the pavement surface to determine if the water jet has contacted 100% of the surface and the vacuum system has removed dust, dirt, and debris and other materials from that surface and the pavement micro-texture.

2-3.6 VISUAL INSPECTION - MARKING REMOVAL. The ENGINEER shall determine by visual inspection if 50% of the markings have been removed. Visual inspection shall consist of a close inspection of random-sample areas of the pavement surface to determine if the water jet has exposed a minimum of 50% of the painted pavement surface and that the vacuum system has removed all the marking debris.

METHOD OF MEASUREMENT

2-4.1 Surface preparation will be measured by the number of square yards of prepared pavement surface for each type of seal coat treatment in accordance with the SPECIFICATIONS and accepted by the ENGINEER.

BASIS OF PAYMENT

2-5.1 Payment shall be made for surface preparation at the CONTRACT price per square yard of rejuvenating seal surface. This price shall be full compensation for furnishing all materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified herein and as shown on the PLANS.

2-5.2 Payment shall be made for fuel resistant seal at the CONTRACT price per square yard of fuel resistant surface. This price shall be full compensation for furnishing all materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified herein and as shown on the PLANS.

END OF SECTION

DIVISION V

SECTION 3

**AC PAVEMENT PULVERIZATION, COLD MILLING
AND RECYCLING**

DESCRIPTION

3-1.1 GENERAL. This item shall consist of pulverizing and blending existing asphalt surface course and underlying base course; pavement cold milling for transitions; and stockpiling blended AC/AB material; and placing recycled materials as subbase or base courses. All work shall conform to the grades, depths, dimensions and typical sections shown on the PLANS and be in compliance with these SPECIFICATIONS.

A. AC Pavement Pulverization This work shall consist of the milling of designated asphalt concrete pavements. The CONTRACTOR is advised to review the geotechnical report (Division IV, Appendix I) for boring logs of the effected areas to obtain the depth of AC and aggregate layers. Only suitable material shall be used for recycling. All usable material shall be disposed of as indicated in Division V, Section 4, Earthwork and Site Preparation.

3-1.2 PAVEMENT COLD MILLING. Cold milling for transitions, joins, and other work called for in the PLANS shall be accomplished with a self-propelled milling machine or grinder. The equipment shall be capable of accurately establishing profile grades within a tolerance of 0.02-foot by reference from either the existing pavement or from independent grade control and shall have a positive means for controlling cross slope elevations. The equipment shall incorporate a totally enclosed cutting drum with replaceable cutting teeth and effectively remove the ground material from the surface and prevent dust from escaping into the air. The use of a heating device to soften the pavement will not be permitted.

The existing pavement shall be removed to the depth, width, grade and cross-section shown on the PLANS or as directed by the ENGINEER to provide a surface profile true to specified grade and transverse slope.

The new surface resulting from the pavement removal will be tested by the ENGINEER for trueness to specified grade and transverse slope at selected locations. Testing will be with a CONTRACTOR-supplied 12-foot straightedge. The variation of the surface from the testing edge of the straightedge between any two (2) contact points shall not exceed 0.02-foot.

Materials removed by grinding shall be salvaged and blended with pulverized AC/AB, unless otherwise approved by ENGINEER.

3-1.3 PAVEMENT RECYCLING. The existing asphalt bituminous surface course and underlying aggregate base material shall be pulverized and blended together (AC/AB) to create a composite recycled material with gradation conforming to the following table:

TABLE 1

Sieve Size	Percent Passing
2 inch	100
1 1/2 inch	90 - 100
1 inch	70 - 90
3/4 inch	55 - 70

Approximately five percent (5%) oversized material (2-inch maximum) may be allowed as approved by the ENGINEER. The gradation of oversized material will be based on visual inspection by the ENGINEER. Except as noted above, no oversized material will be allowed and shall be crushed or removed from the job site. Material crushing methods shall be approved by the ENGINEER. A portable crusher and screen shall be provided as necessary to meet gradation requirements. Recycled AC/AB Material shall be stockpiled for use as a recycled subbase course.

CONSTRUCTION METHODS

3-2.1 EQUIPMENT. All equipment necessary for the proper construction of this work shall be on the PROJECT, in good working condition, and approved by the ENGINEER before construction is started.

The equipment must have a pulverization rate and capacity sufficient to keep the progress of the PROJECT on schedule. A portable crusher and screen shall be provided as necessary to meet gradation requirements.

3-2.2 MIXING AND STOCK PILING. The recycled AC/AB material shall be uniformly mixed and blended prior to stockpiling or placement. The placing methods shall not cause segregation and shall be approved by the ENGINEER.

3-2.3 PLACING MATERIALS. Recycled AC/AB material shall be constructed to form a smooth, uniform surface true to line, grade, and cross-section, spread in layers of not less than 2-1/2 inches nor more than 8 inches of compacted thickness. No material shall be placed on a soft, muddy, or frozen underlying course.

When more than one (1) layer is required, the construction procedure described herein shall apply to each layer.

The ENGINEER or his authorized representative shall sample and perform laboratory tests on the material samples to determine maximum density and optimum moisture content of a placed layer. This information will be made available to the CONTRACTOR. The material shall have satisfactory moisture content when rolling is started, and moisture content variations that may occur prior to or during rolling shall be corrected by adding water or aeration, as necessary.

3-2.4 COMPACTION. After spreading, the material shall be thoroughly compacted to the density shown on the PLANS by rolling. The rolling shall progress gradually from the sides to the center of the lane under construction, or from one side toward previously placed material by lapping uniformly each preceding pass. Rolling shall continue until the entire area of the course has been rolled and the stone is thoroughly set; the interstices of the material are reduced to a minimum; and until creeping of the stone ahead of the roller is no longer visible. Blading and rolling shall be done alternately, as required or directed, to obtain smooth, even, and uniformly compacted material. The number, type, and weight of rollers shall be sufficient to compact the material to the required density.

The course shall not be rolled when the underlying course is soft or yielding or when the rolling causes undulation in the underlying material.

The watering during rolling shall be in the amount and by equipment necessary to achieve the required compaction without causing excessive moisture.

3-2.6 FINISHING. The surface of the recycled course shall be finished by blading or with automated equipment especially designed for this purpose.

In no case will the addition of thin layers of material be added to the top layer of the recycled course to meet grade. If the elevation of the top layer is 3/8-inch or more below grade, the top layer of recycled material shall be scarified to a depth of at least 3 inches, new material added, and the layer shall be bladed to bring it to PLAN grade and compacted. If the finished surface is above plan grade, the surface shall be trimmed back to grade and rerolled.

3-2.7 SURFACE TEST. After the course has been completely compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified, reshaped, compacted, and otherwise manipulated as the ENGINEER may direct until the required smoothness and accuracy are obtained. The finished surface shall not vary more than 3/8-inch from a 12-foot straightedge when applied to the surface parallel with, and at right angles to, the centerline. The CONTRACTOR shall furnish the 12-foot straightedge for use by the ENGINEER.

3-2.8 PROTECTION. Hauling equipment may be routed over completed portions of the *recycled* course, provided no damage results and provided that such equipment is routed over the full width of the area to avoid rutting or uneven compaction. The ENGINEER shall have full and specific authority to stop all hauling over completed or partially completed course when, in his opinion, such hauling is causing damage. Any damage resulting to the *recycled* course from routing of equipment shall be repaired by the CONTRACTOR at his own expense.

3-2.9 MAINTENANCE. The CONTRACTOR shall perform all maintenance work necessary to keep the completed *recycled* course in a satisfactory condition prior to placement of subsequent courses. The recycled course shall be properly drained at all times. If cleaning is necessary, any work or restitution necessary shall be performed at the expense of the CONTRACTOR.

MEASUREMENT

3-3.1 Pavement pulverization, cold milling, blending, and stockpiling of this material shall be measured by the square yard, regardless of depth.

3-3.2 Recycled AC/AB placement shall be measured by the cubic yard as shown on the PLANS. Quantities will be calculated on the average end area basis and the typical sections shown on the PLANS.

3-3.3 No separate measurement will be made for AC pavement surface transition grind. All work associated with this task shall be covered under Division V, Section 4-1.6.

PAYMENT

3-4.1 Payment for Pavement Pulverization (depth per PLAN) shall be made at the CONTRACT unit price per square yard. This price shall be full compensation for all preparation, pulverization, cold milling, crushing, blending, screening, hauling, and stockpiling of existing asphalt and aggregate base material.

3-4.2 Payment for placing Recycled AC/AB as subbase shall be made at the CONTRACT unit price per cubic yard. This price shall be full compensation for hauling, placing, finishing and compacting recycled AC/AB material. Preparation of the existing ground prior to placement is included under Earthwork and Site Preparation.

3-4.3 No separate payment for AC Pavement Surface Transition Grind shall be made.

TESTING REQUIREMENTS

ASTM C 29	Unit Weight of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Materials Finer than 75um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregate
ASTM D 75	Sampling Aggregate
ASTM D 693	Crushed Stone, Crushed Slag, and Crushed Gravel for Dry-or Water-Bound Macadam Base Courses and Bituminous Macadam Base and Surface Pavements
ASTM D 1557	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18 in Drop
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 3665	Random Sampling of Paving Materials
ASTM 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils

END OF SECTION

DIVISION V
SECTION 4
ITEM P-152
EARTHWORK AND SITE PREPARATION

DESCRIPTION

4-1.1 This item covers excavation, grading, haul, placement, and compaction of all materials necessary or required to construct the pavement improvements called for on the PLANS in accordance with these SPECIFICATIONS and in conformance with the dimensions and typical sections shown on the PLANS. Also included in this item are elements of miscellaneous site preparation and incidental work not specifically included in other items of work.

A. Special Site Requirements. Boring logs of the geotechnical investigation are attached in Division IV, Section 2, Appendix A. The in-place native material in all areas to be paved shall be manipulated and processed to the depths called for on the PLANS. The upper layers (see PLAN for specific thickness) of material shall be removed and replaced as necessary to achieve the required compaction at the depths specified. The CONTRACTOR shall excavate and grade the site as necessary to achieve the desired subgrade elevations. Excess material may be disposed of on-site, as directed by the ENGINEER

4-1.2 CLASSIFICATION. All material excavated shall be defined as "unclassified excavation". Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature.

4-1.3 CLEARING AND GRUBBING. Deleted.

4-1.4 UNSUITABLE EXCAVATION. Any unsuitable material encountered below the natural ground surface in embankment areas or below the grading plane in excavation areas shall be excavated and disposed of as directed by the ENGINEER. Unsuitable material is defined as material the ENGINEER determines to be:

1. of such unstable nature as to be incapable of being compacted to specified density using ordinary methods at optimum moisture content; or
2. too wet to be properly compacted and circumstances prevent suitable in-place drying prior to incorporation into the work; or
3. otherwise unsuitable for the planned use.

The presence of excessive moisture in a material is not, by itself, sufficient cause for determining that the material is unsuitable.

If authorized, the removal and disposal of unsuitable material will be paid for as over excavation.

When unsuitable material is removed and disposed of, the resulting space shall be filled with material suitable for the planned use. Such suitable material shall be placed and compacted in layers as hereinafter specified for constructing embankments.

4-1.5 EROSION AND DUST CONTROL DURING CONSTRUCTION. Limits of disturbance and access corridors shall be clearly delineated at the PROJECT site by the CONTRACTOR and approved by the ENGINEER prior to any grading or site disturbance activity. Existing vegetation and ground surfaces outside of designated work areas shall not be disturbed. Any areas disturbed beyond the authorized

limits shall be restored at the CONTRACTOR's expense as directed by the ENGINEER. Dust shall be controlled at all times during construction and grading by the application of water.

4-1.6 MISCELLANEOUS SITE PREPARATION. Miscellaneous site preparation work shall include, but not be limited to, all work called for on the PLANS, pavement sawcutting, AC pavement grinding, relocating, removing, and/or adjusting (to finish grade) existing facilities (valve boxes, catch basins, edge lights, pullboxes, etc.); pot-holing; trash and debris removal and disposal; construction staking; and all work deemed incidental in nature by the ENGINEER and necessary to complete the PROJECT within the time frame allowed.

4-1.7 SOILS STABILIZATION COMPOUND. Not used.

4-1.8 DEWATERING. Not used.

4-1.9 SUBGRADE STABILIZATION ROCK. Where shown on the PLANS or as directed in the field by the ENGINEER, the subgrade will be stabilized as follows:

1. Excavate in place material, utilizing low-pressure track equipment if necessary, to the depth and cross section shown on the PLANS or as directed.
2. Place base rock into excavated area and spread with low-pressure equipment as shown on the PLANS. Rock shall meet Caltrans, Class 2 aggregate subbase specification.

4-1.10 SUBGRADE REINFORCING GEOGRID. Reinforcing geogrid shall be a biaxial grid, Tensar BX-1200 or approved equal. The manufacturer shall provide written certification that all resin used to produce the geogrid is virgin and classified as polypropylene or high-molecular-weight polyester.

The geogrid shall be a regular grid structure formed by biaxially drawing a continuous sheet of select polypropylene material and shall have aperture geometry and rib and junction cross sections sufficient to permit significant mechanical interlock with the material being reinforced. The geogrid shall have high flexural rigidity and high tensile strength at ribs and junctions of the grid structure. The geogrid shall maintain its reinforcement and interlock capabilities under repeated dynamic loads while in service and shall also be resistant to ultraviolet degradation, damage under normal construction practices, and to all forms of biological or chemical degradation normally encountered in the material being reinforced.

CONSTRUCTION METHODS

4-2.1 The suitability of material to be placed in subgrades shall be subject to approval by the ENGINEER. All unsuitable material shall be disposed of in waste areas shown on the PLANS or as directed by the ENGINEER. All waste areas shall be graded to eliminate ponding and allow positive drainage away from the area and the adjacent areas. The surface elevation of waste areas shall not extend above the surface elevation of adjacent usable areas of the Airport, unless specified on the PLANS or approved by the ENGINEER.

The top eight (8) inches of existing pavement section is to be pulverized and recycled as subbase in the new pavement section. See Division V, Section 3.

The next eight (8) inches of existing material is to be excavated and stockpiled onsite for use below the new pavement section, as detailed on the PLANS.

The CONTRACTOR shall then excavate the next eight (8) inches of existing material and dispose onsite, as directed by the ENGINEER.

Subgrade at the bottom of the excavation shall be tested for material condition and moisture content. Subgrade compaction shall be 90% RC or be treated as described in Section 4-2.7.

Stockpile material shall be placed and compacted as shown on the PLANS.

If the CONTRACTOR's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued, as provided for in Division III, Section 70-21, "Archaeological and Historical Findings." At the direction of the ENGINEER, the CONTRACTOR shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Additional costs for such excavation will be paid for as extra work.

All haul roads and/or trenchways used by the CONTRACTOR outside of the pavement areas shall be scarified and recompactd as directed by the ENGINEER.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures the CONTRACTOR shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the CONTRACTOR shall notify the ENGINEER immediately. The CONTRACTOR shall satisfactorily repair or pay the cost of all damage repairs to such facilities or structures which result from any of the CONTRACTOR's operations during the period of the CONTRACT.

4-2.2 EXCAVATION. *Excavations shall not be started until the work has been staked out by the CONTRACTOR and approved by the ENGINEER. All excavated material deemed suitable by the ENGINEER shall be used in the formation of subgrades or for other purposes shown on the PLANS. All unsuitable material shall be disposed of as directed by the ENGINEER.*

If the volume of the excavation exceeds that required to construct the subgrades to the grades indicated, the excess shall be disposed of as directed. If the volume of excavation is not sufficient for constructing the fill to the grades indicated, the deficiency shall be obtained from subgrade stabilization rock.

The grade shall be maintained so that the surface is well drained at all times. If necessary, temporary drains and/or drainage ditches shall be installed to intercept and divert surface water away from the work.

- A. Selective Grading.** *If the ENGINEER determines some native materials are more suitable than others, the more suitable material shall be used in constructing the subgrade or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed in the required pavement subgrade.*
- B. Undercutting.** *Material that is deemed unsatisfactory for the intended improvements by the ENGINEER shall be excavated to a minimum depth of 12 inches, or to the depth specified by the ENGINEER, below the subgrade. Muck, peat, matted roots, or other material deemed unsuitable for subgrade foundation, shall be removed to the depth specified by the ENGINEER. Unsuitable materials shall be disposed of at locations shown on the PLANS or as directed. The cost of excavating unsuitable material shall be paid for as extra work. The excavated area shall be refilled with suitable material, obtained from the grading operations or borrow areas and thoroughly compacted by rolling. The refilling will be considered as incidental to the construction of the subgrade and no additional compensation will be made.*
- C. Overbreak.** *Overbreak, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the ENGINEER. The ENGINEER shall determine if the displacement of such material was unavoidable and that decision shall be final. All*

overbreak shall be graded or removed by the CONTRACTOR and disposed of as directed. *Extra* payment will not be made for the removal and disposal of *avoidable* overbreak. Unavoidable overbreak will be *paid for as extra work*.

- D. Compaction Requirements.** The subgrade under areas to be paved, embankments, shoulders, and other graded areas shall be compacted to the depth(s) and density shown on the PLANS as *determined by ASTM D 1557*. The material to be compacted shall be within ± 2 percent of optimum moisture content before rolled to obtain the prescribed compaction (except for expansive soils).

Embankments compaction shall be tested for each 8-inch thick layer. Minimum compaction requirement for subgrade in all areas shall be 6 inch depth at ninety percent (90%) for cohesive soils and ninety five percent (95%) for noncohesive soils of the maximum density as determined by ASTM D 1557.

Samples of all materials for testing, both before and after placement and compaction, will be taken for each 1,000 square yard lot. Based on these tests, the CONTRACTOR shall make the necessary corrections and adjustments in methods, materials, or moisture content in order to achieve the correct embankment density.

Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in top 6 inches of the subgrade. The finished grading operations, conforming to the typical cross-section, shall be completed and maintained *prior to pavement construction operations* or as directed by the ENGINEER.

In cuts, all loose or protruding rocks on the back slopes shall be bared loose or otherwise removed to line of finished grade of slope. All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the PLANS or as directed by the ENGINEER.

Blasting will *not* be permitted *without specific written approval from the COUNTY*. The CONTRACTOR shall submit a detailed written request for the COUNTY's approval to perform any blasting.

- 4-2.3 BORROW EXCAVATION.** *Deleted.*
- 4-2.4 DRAINAGE EXCAVATION.** *Deleted.*
- 4-2.5 PREPARATION OF EMBANKMENT AREA.** *Deleted.*
- 4-2.6 FORMATION OF EMBANKMENTS.** *Deleted.*
- 4-2.7 SUBGRADE.**

- A. Finishing and Protection of Subgrade.** After the subgrade has been substantially completed the full width shall be conditioned *trimmed and finished as necessary to remove any unstable material or otherwise unsuitable material that will not compact properly*. The resulting areas and all other low areas, holes or depressions shall be brought to grade with suitable select material. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the PLANS.

Grading of the subgrade shall be performed so that it will drain readily. The CONTRACTOR shall take all precautions necessary to protect the subgrade from damage and shall limit hauling over the finished subgrade to that which is essential for construction purposes.

All ruts or rough places that develop in completed subgrade shall be smoothed and re-compacted.

Subbase, or surface course shall not be placed on the subgrade until the subgrade has been approved by the ENGINEER.

- B. Subgrade Stabilization.** At the ENGINEER's option, subgrade may be stabilized as described in Section 4-1.9 or as in Section 4-1.10 or a combination of both. Work will be directed by the ENGINEER in the field dependent on subgrade conditions encountered.

4-2.8 HAUL. All hauling is considered to be a necessary and incidental part of the work. All costs associated with hauling shall be considered by the CONTRACTOR and included in the CONTRACT PRICE for the various items of work involved. No direct payment will be made for hauling on any part of the work.

4-2.9 TOLERANCES. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 10-foot straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of 1/2-inch, or shall not be more than 0.05-foot from true grade as established by grade hubs or pins. Any deviation in excess of these amounts shall be corrected by appropriate means and methods as approved by the ENGINEER.

4-2.10 TOPSOIL. Deleted.

4-2.11 PAVEMENT DEMOLITION.

- A. Concrete.** The existing concrete to be removed shall be freed from the pavement to remain unless jackhammers are used for the complete removal. This shall be accomplished by line drilling or sawing through the complete depth of the slab one foot inside the perimeter of the final removal limits or outside the load transfer devices, whichever is greater. In this case, the limits of removal would be located on joints. If line drilling is used, the distance between holes shall not exceed the diameter of the hole. The pavement between the perimeter of the pavement removal and the saw cut or line-drilled holes shall be removed with a jackhammer. Where the perimeter of the removal limits is not located on the joint, the perimeter shall be saw cut 2 inches in depth or 1/4 the slab thickness, whichever is less. Again, the concrete shall be line drilled or saw cut the full depth of the pavement 6 inches inside the removal limits. The pavement inside the saw cut or line shall be broken by methods suitable to the CONTRACTOR; however, if the material is to be wasted on the airport site, it shall be reduced to a maximum size designated by the Airport OWNER. The CONTRACTOR's removal operation shall not cause damage to cables, utility ducts, pipelines, or drainage structures under the pavement. Any damage shall be repaired by the CONTRACTOR at no expense to the Airport OWNER.
- B. Asphaltic Concrete.** Asphaltic concrete pavement to be removed shall be cut to the full depth of the bituminous material around the perimeter of the area to be removed. The pavement shall be removed in such a manner that the joint for each layer of pavement replacement is offset one foot from the joint in the preceding layer. This does not apply if the removed pavement is to be replaced with concrete or soil. If the material is to be wasted on the Airport site, it shall be broken to a maximum size as designated by the Airport OWNER.

METHOD OF MEASUREMENT

4-3.1 No separate measurement will be made for unclassified or over excavation. All work shall be covered under Earthwork and Site Preparation and shall include all PROJECT elements required for excavation, grading, subgrade construction or similar work and related support activities; and the various items of miscellaneous and incidental site work.

4-3.2 Subgrade Stabilization Rock will be measured by the cubic yard of rock in place.

4-3.3 Subgrade Stabilization Geogrid will be measured by the square yard as delineated on the PROJECT site by the CONTRACTOR and approved by the ENGINEER, covering all elements required for its installation.

4-3.4 Pavement Demolition will be measured by the square yard for all types of pavement defined for removal.

PAYMENT

4-4.1 Unclassified Excavation and over excavation will be paid for at the CONTRACT lump sum price for Earthwork and Site Preparation and shall include all materials, equipment, and labor necessary to construct the improvements shown on the PLANS. These prices shall include excavating, sloping, rounding tops and ends of excavations; loading, hauling, depositing, spreading, watering, and compacting material completely in place; preparing subgrade at the grading plane as specified and shown on the PLANS; and all miscellaneous site preparation and incidental work not included in other items.

4-4.3 Subgrade Stabilization Rock will be paid for at the CONTRACT price per cubic yard. Subgrade Stabilization Rock shall be used if existing conditions require it, as directed by the ENGINEER. No payment will be made if Subgrade Stabilization Rock is not used. Payment made for this item will be excluded from consideration in determining compensation under changed quantities.

4-4.4 Subgrade Stabilization Geogrid will be paid for at the CONTRACT price per square yard. Subgrade Stabilization Geogrid shall be used if existing conditions require it, as directed by the ENGINEER. No payment will be made if Subgrade Stabilization Geogrid is not used. Payment made for this item will be excluded from consideration in determining compensation under changed quantities.

4-4.5 Pavement Demolition will be paid for at the CONTRACT unit price per square yard and shall include all materials, equipment, and labor necessary to construct the improvements shown on the PLANS.

TESTING REQUIREMENTS

- | | |
|-------------|---|
| ASTM D 1556 | Test for Density of Soil In-Place by the Sand Cone Method |
| ASTM D 1557 | Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10-pound Rammer and 18-inch Drop |
| ASTM D 2167 | Test for Density of Soil In-Place by the Rubber Balloon Method |
| ASTM D 6938 | Test for Density and Moisture Content of Soil In Place by the Nuclear Method. |

END OF SECTION

DIVISION V
SECTION 5
ITEM P-153
CONTROLLED LOW STRENGTH MATERIAL (CLSM)

DESCRIPTION

5.1.1 This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches *with exposed utilities under pavement sections* or at other locations shown on the PLANS or as directed by the ENGINEER.

MATERIALS

5-2.1 MATERIALS.

- A. **Portland Cement.** Portland cement shall conform to the requirements of ASTM C 150 Type II. If for any reason, cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.
- B. **Fly Ash.** Fly Ash shall conform to ASTM C 618, Class C or F.
- C. **Fine Aggregate (Sand).** Fine aggregate shall conform to the requirements of ASTM C 33 except for aggregate gradation. Any aggregate gradation which produces performance characteristics of the CLSM specified herein will be accepted, except as follows.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
3/4 inch	100
No. 200	0 - 12

- D. **Water.** Water used in mixing shall be free of oil, salt, acid, alkali, sugar, vegetable matter, or other substances injurious to the finished product.

MIX DESIGN

5-3.1 **PROPORTIONS.** The CONTRACTOR shall submit, to the ENGINEER, a mix design including the proportions and source of materials, admixtures, and dry cubic yard batch weights. The mix shall contain a minimum of 50 pounds of cement and 250 pounds fly ash per cubic yard, with the remainder of the volume composed of sand, water, and any approved admixtures.

- A. **Compressive Strength.** CLSM shall be designed to achieve a 28-day compressive strength of 100 to 200 psi when tested in accordance with ASTM C 39. There should be no significant strength gain after 28 days. Test specimens shall be made in accordance with ASTM C 31 except that the samples will not be rodded or vibrated and shall be air cured in their molds for the duration of the cure period.

- B. Consistency.** Consistency of the fresh mixture shall be such that the mixture may be placed without segregation. A desired consistency may be approximated by filling an open-ended, 3-inch diameter cylinder, 6 inches high to the top, with the mixture and the cylinder immediately pulled straight up. The correct consistency of the mixture will produce an approximately 8-inch diameter, circular-type spread without segregation. Adjustments of the proportions of materials should be made to achieve proper solid suspension and flowable characteristics; however the theoretical yield shall be maintained at one cubic yard for the given batch weights.

CONSTRUCTION METHODS

5-4.1 PLACEMENT.

- A. Placement.** CLSM may be placed by any reasonable means from a mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed in such a manner that structures or pipes are not displaced from their desired final position and intrusion of CLSM into undesirable areas is avoided. The material shall be brought up uniformly to the fill line shown on the PLANS or as directed to the ENGINEER. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one layer, the base layer shall be free of surface water and loose of foreign material prior to placement of the next layer.
- B. Limitations of Placement.** CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35°F and rising. At the time of placement, CLSM shall have a temperature of at least 40°F. Mixing and placement shall stop when the air temperature is 40°F and falling or when the anticipated air or ground temperature will be 35°F or less in the 24-hour period following proposed placement.

5-4.2 CURING AND PROTECTION.

- A. Curing.** The air in contact with the CLSM should be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32°F, the material may be rejected by the ENGINEER if damage to the material is observed.
- B. Protection.** The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 psi is obtained. The CONTRACTOR shall be responsible for providing evidence to the ENGINEER that the material has reached the desired strength. Acceptable evidence shall be based upon compressive tests made in accordance with paragraph 5-3.1a.

MATERIAL ACCEPTANCE

5-5.1 ACCEPTANCE. Acceptance of CLSM delivered and placed as shown on the PLANS or as directed by the ENGINEER shall be based on mix design approval and batch tickets provided by the CONTRACTOR to confirm that the delivered material conforms to the mix design. The CONTRACTOR shall verify by additional testing, each 5,000 cubic yards of material used. Verification shall include confirmation of material proportions and tests of compressive strength to confirm that the material meets the original mix design and the requirements of CLSM as defined in this SPECIFICATION. Adjustments shall be made as necessary to the proportions and materials prior to further production.

METHOD OF MEASUREMENT

5-6.1 MEASUREMENT. Controlled low strength material shall be measured by the number of cubic yards as computed from the neatline plan and section, adjusted for the quantities for any embedments, and as specified, completed, and accepted.

BASIS OF PAYMENT

5-7.1 PAYMENT. Accepted quantities of controlled low strength material shall be paid for at the CONTRACT unit price per cubic yard. Payment shall be full compensation for all materials, equipment, labor, and incidentals required to complete the work as specified.

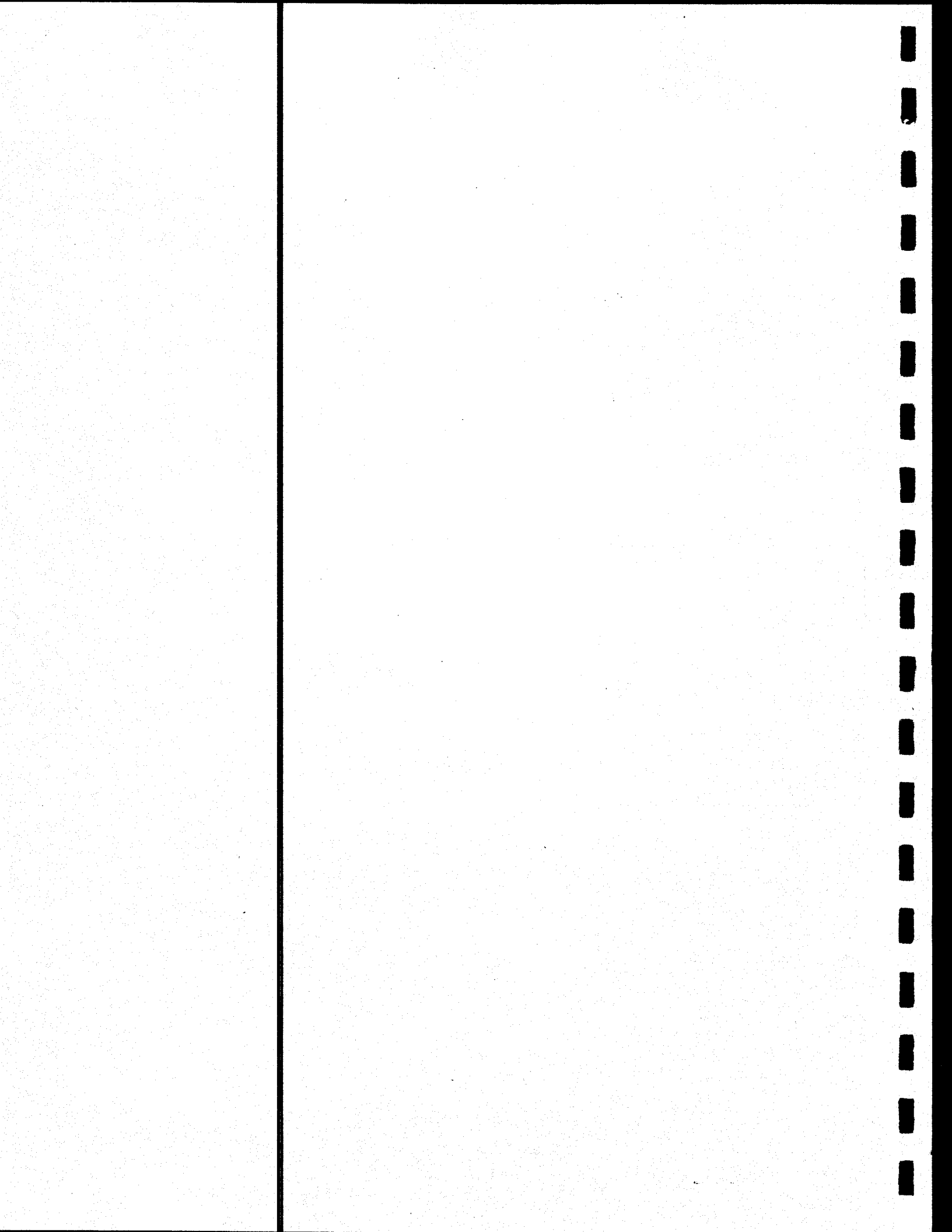
TESTING REQUIREMENTS

ASTM C 31	Making and Curing Concrete Test Specimens in the Field
ASTM C 39	Compressive Strength of Cylindrical Concrete

MATERIAL REQUIREMENTS

ASTM C 33	Specification for Concrete Aggregates
ASTM C 150	Specification for Portland Cement
ASTM C 618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 595	Specification for Blended Hydraulic Cements

END OF SECTION



DIVISION V

SECTION 6

**ITEM P-605
JOINT SEALING FILLER**

DESCRIPTION

6-1.1 This item shall consist of *the removal of existing joint seals*, providing and installing a resilient and adhesive *new joint sealing filler* capable of effectively sealing joints *between AC and PCC, as well as the construction of joints in new PCC aprons and valley gutters.*

MATERIALS

6-2.1 JOINT SEALERS. Joint sealing materials shall meet the requirements of ASTM D 6690 - *Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements.*

CONSTRUCTION METHODS

6-3.1 TIME OF APPLICATION. Joints shall be sealed as soon after completion of the *sealcoat operations* as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be above 50°F at the time of installation of the poured joint sealing material.

6-3.2 PREPARATION OF JOINTS BETWEEN PCC AND AC.

- A. Existing Joint Material.** *All existing material between PCC valley gutter and asphalt pavement shall be removed prior to sawing.*
- B. Sawing.** All joints shall be sawed in accordance with SPECIFICATIONS and PLAN details. Immediately after sawing the joint, the resulting *sealcoat* shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.
- C. Sealing.** Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, and other foreign material. Cleaning shall be accomplished by sandblasting. Sandblasting shall be accomplished in a minimum of two passes. One pass per joint face with the nozzle held at an angle directly toward the joint face and not more than 3 inches from it. Upon completion of cleaning, the joints shall be blown out with compressed air free of oil and water. Only air compressors with operable oil and water traps shall be used to prepare the joints for sealing. The joint faces shall be surface dry when the seal is applied.

6-3.3 PREPARATION OF JOINTS FOR APRON AND VALLEY GUTTERS. *Joints shall be constructed as shown on the PLANS and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the PLANS. Joints shall not vary more than 1/2 inch from their designated position and shall be true to line with no more than 1/4-inch variation in 10 feet. The surface across the joints shall be tested with a 10-foot straightedge as the joints are finished and any irregularities in excess of 1/4-inch shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the PLANS.*

- A. Construction.** Longitudinal construction joints shall be slip-formed or formed against side forms with or without keyways, as shown in the PLANS.

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the CONTRACTOR shall remove the excess concrete back to the previous planned joint.

- B. Contraction.** Contraction joints shall be installed at the locations and spacing as shown on the PLANS. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch wide and to the depth shown on the PLANS.

- C. Expansion.** Expansion joints shall be installed as shown on the PLANS. The premolded filler of the thickness as shown on the PLANS, shall extend for the full depth and width of the slab at the joint, except for space for sealant at the top of the slab. The filler shall be securely staked or fastened into position perpendicular to the proposed finished surface. A cap shall be provided to protect the top edge of the filler and to permit the concrete to be placed and finished. After the concrete has been placed and struck off, the cap shall be carefully withdrawn leaving the space over the premolded filler. The edges of the joint shall be finished and tooled while the concrete is still plastic. Any concrete bridging the joint space shall be removed for the full width and depth of the joint.

- D. Keyways.** Keyways (only female keys permitted) shall be formed in the plastic concrete by means of side forms or the use of keyway liners that are inserted during the slip-form operations. The keyway shall be formed to a tolerance of 1/4 inch in any dimension and shall be of sufficient stiffness to support the upper keyway flange without distortion or slumping of the top of the flange. The dimensions of the keyway forms shall not vary more than plus or minus 1/4 inch from the mid-depth of the pavement. Liners that remain in place permanently and become part of the keyed joint shall be made of galvanized, copper clad, or of similar rust-resistant material compatible with plastic and hardened concrete and shall not interfere with joint reservoir sawing and sealing.

- E. Installation.** All devices used for the installation of expansion joints shall be approved by the ENGINEER.

- F. Sawing of Joints.** Joints shall be cut as shown on the PLANS. The circular cutter shall be capable of cutting a groove in a straight line and shall produce a slot at least 1/8 inch wide and to the depth shown on the PLANS. The top portion of the slot shall be widened by sawing to provide adequate space for joint sealers as shown on the PLANS. Sawing shall commence as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs. Sawing shall be carried on both during the day and night as required. The joints shall be sawed at the required spacing,

consecutively in sequence of the concrete placement. Curing compound, if being used as the cure type, shall be reapplied in the initial sawcut and maintained for the remaining cure period. Curing compound shall not be applied, and used as the cure method, to any final concrete face that is to receive a sealant

The top of an assembled joint device shall be set at the proper distance below the pavement surface and the elevation shall be checked. Such devices shall be set to the required position and line and shall be securely held in place by stakes or other means to the maximum permissible tolerances during the pouring and finishing of the concrete. The premolded joint material shall be placed and held in a vertical position; if constructed in sections, there shall be no offsets between adjacent units.

6-3.4 INSTALLATION OF SEALANTS. Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the ENGINEER before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

- A. Hot Poured Sealants.** The joint sealant shall be applied uniformly solid from bottom to top and shall be filled without formation of entrapped air or voids. A backing material shall be placed as shown on the PLANS and shall be *both nonreactive and nonadhesive* to the concrete or the sealant material. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated to more than 20°F below the safe heating temperature. The safe heating temperature can be obtained from the manufacturer's shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint shall be provided. Any sealant spilled on the surface of the pavement, structures and/or lighting fixtures, shall be removed immediately.

METHOD OF MEASUREMENT

6-4.1 Joint sealing *between PCC valley gutter and asphalt pavement* shall be measured by the linear foot of sealant in place, completed, and accepted.

6-4.2 *No separate measurement shall be made for construction, contraction, expansion, or keyways in apron pavement.*

BASIS OF PAYMENT

6-5.1 Payment for joint sealing shall be made at the CONTRACT unit price per linear foot. The price shall be full compensation for *removing existing joint material*, furnishing all materials, for all preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

6-5.2 *No separate payment shall be made for construction, contraction, expansion, or keyway joints. All costs associated with this work shall be included in the unit bid price for each respective item under Portland Cement Concrete.*

TESTING REQUIREMENTS

ASTM D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
ASTM D 1644 Test Methods for Nonvolatile Content of Varnishes

MATERIAL REQUIREMENTS

ASTM D 1854 Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 3406 Joint Sealants, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements
ASTM D 3569 Joint Sealant, Hot-Applied, Elastometric, Jet-Fuel-Resistant Type, for Portland Cement Concrete Pavements
ASTM D 3581 Joint Sealant, Hot-Applied, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements
ASTM D 5893 Standard SPECIFICATIONS for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D 6690 Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements
FED SPEC Sealants, Joint, Two-Component, Jet-Blast Resistant, Cold Applied
SS-S-200E(2)

END OF SECTION

DIVISION V
SECTION 7
ITEM P-609B
ASPHALT REJUVENATING SEAL

DESCRIPTION

7-1.1 GENERAL. This item shall consist of applying a polymer modified, emulsified asphalt rejuvenation agent placed on the properly prepared asphalt concrete surface, in accordance with these SPECIFICATIONS, and the dimensions shown on the PLANS. Surface preparation shall be in conformance with Division V, Section 2 of these SPECIFICATIONS.

7-1.2 MATERIAL CONTRACTOR'S RESPONSIBILITY. Samples of all materials that the CONTRACTOR proposes to use, together with a statement as to their source and character, shall be submitted and approval in writing obtained by the ENGINEER before use of such materials begins.

7-1.3 SUBMITTALS. The CONTRACTOR shall furnish vendor's certified test reports for each load of rejuvenator seal delivered to the project. The report shall be submitted to the ENGINEER before permission will be granted for use of the material. The furnishing of the vendor's certified test report for the bituminous material shall not be interpreted as a basis for final acceptance. All such test reports shall be subject to verification by testing performed by the ENGINEER on samples of materials as received for use on the project and subsequent to in-place sampling.

A Certificate of Compliance shall be submitted ten (10) working days, minimum, and prior to the application of the test sections. In addition to the required signature of the vendor or the vendor's representative certifying compliance with job requirements, the certificate shall show the shipment number, type of material, refinery, consignee, destination, quantity, contract number or purchase order number, and date of shipment.

7-1.4 APPLICATION RATE. The application rate of the surface treatment shall be 0.12 gal per square yard for bidding purposes. The actual application rate shall be based on the results of test sections. Application rates from 0.10 to 0.14 gallons per square yard shall be paid for at the bid price. Any cost adjustments that may be warranted for a change in application rate will be negotiated in the field.

QUALITY CONTROL AND ASSURANCE

7-2.1 CONTRACTOR QUALITY CONTROL. The rejuvenating seal manufacturer's authorized representative shall be at the jobsite during all material application. The manufacturer's representative shall inspect the distributor truck(s) and verify that the truck(s) is in good working order and have the proper size spray nozzles. The manufacturer's representative shall be thoroughly knowledgeable of the materials, procedures, and equipment necessary to apply the product in accordance with this specification; shall be responsible for determining the final application rate and spray nozzle tip size; and shall oversee material storage and handling, the mixing of the component materials, and all application procedures of the rejuvenator seal. The manufacturer's representative shall have a minimum of two years' experience in the use of the approved seal. Documentation of this experience shall be furnished to the ENGINEER prior to the start of operations. The cost of the manufacturer's representative shall be included in the bid price.

The CONTRACTOR shall submit a contingency plan to the ENGINEER at least ten (10) days prior to applying asphalt rejuvenating agent. The contingency plan shall describe in detail the corrective actions the CONTRACTOR will use if the asphalt rejuvenating agent does not break within the times specified for pavement closures, or if treated surface friction characteristics are not in compliance. The plan shall include any materials required to be on hand, or additional equipment that must be available for contingency situations, and recommended corrective action to improve friction characteristics. The use of a corrective action(s) must be approved by ENGINEER before implementation.

Additionally, the CONTRACTOR shall place test sections as follows:

A. Test Sections. At least ten (10) working days prior to full production, the CONTRACTOR shall place a series of 3 feet wide by 50 feet long test sections at initial application rates of 0.10, 0.12, and 0.14 gallons per square yard. One test section (3 application rates minimum) shall be required for each different asphalt surface. Additional application rates shall be provided as necessary to determine the optimum rate for each different pavement in the project. The test sections shall be subjected to the tests and examinations called for in paragraphs B below.

B. Friction Characteristics. Deleted.

MATERIALS

7-3.1 MATERIAL. The emulsion for asphalt rejuvenating agent shall be a quick-break polymer modified pavement sealant and rejuvenator made from a base of asphalt, petroleum based recycling agent, and a polymer. The emulsion shall conform to either Table 1-A, and Table 1-B:

**Table 1-A
Polymer Modified Rejuvenating Emulsion**

Test on Emulsion	Method	Test Results
Viscosity @77 (SFS)	ASTM D244	20-100
Residue, w%, min.	ASTM D244	65
pH	ASTM E70	2.0-5.0
Sieve, w%, max.	ASTM D244	0.1
Oil distillate, w%, max.	ASTM D244	0.5
Test on Residue⁽¹⁾		
Viscosity @ 140°F, P, maximum.	ASTM D2171	3000
Penetration @ 39.2°F, minimum.	ASTM D5	70
Elastic Recovery on residue by distillation ^(1,2) , %, minimum.	AASHTO T59, T301	50
Test on Latex⁽³⁾:		
Tensile strength, die C dumbbell, psi, minimum	ASTM D412	500
Swelling in rejuvenating agent, % maximum;	ASTM D471 ⁽⁴⁾	40%
48 hours exposure @ 144°F	Modified	intact film
<u>Specific Gravity</u>	ASTM 1475	1.08-1.15
Test on rejuvenating agent:		
Flash point, COC, °F	ASTM D92	> 380
Hot Mix Recycling Agent Classification	ASTM D4552	See Specification

Product Specification:

- (1) Exception to AASHTO T59: Bring the temperature on the lower thermometer slowly to 350°F plus or minus 10°F. Maintain at this temperature for 20 minutes. Complete total distillation in 60 plus or minus 5 minutes from first application of heat.
- (2) Elastic Recovery @ 10°C (50°F): Hour glass sides; pull 20 cm, hold 5 minutes then cut, let sit 1 hour.
- (3) Tensile Strength Determination: Samples for testing for tensile strength in accordance with ASTM D412 shall be cut using a die dumbbell at a crosshead speed of 20 in/min.
- (4) Latex Testing: Suitable substrate for film formation shall be polyethylene boards, silicone rubber sheeting, glass, or any substrate which produces a cured film of uniform cross-section. Polymer film shall be prepared from latex as follows:
 Resistance to Swelling: Polymer films shall be formed by using a 50 mil drawdown bar and drawing down 50 mils of the latex on polyethylene boards. Films shall be cured for 14 days at 75°F and 50% humidity. Samples for resistance to swelling in rejuvenating agent shall be 1-inch by 2-inch rectangles cut from the cured film. Cut at least 3 specimens for each sample to be tested for swelling. Fill three 8 oz. ointment tins with at least a 1/2-inch deep of rejuvenating agent. Swelling samples shall be weighed and then placed in the ointment tins on top of the rejuvenating agent. Then, add at least another 1/2-inch deep of rejuvenating agent over each of the latex samples. The ointment tins shall be covered and placed in an oven at 104°F for the specified 48 hours ± 15 minutes. The ointment tins are allowed to cool to 75°F and then the latex films are removed from the tins. Unabsorbed rejuvenating agent is removed from the intact latex film by scraping with a rubber policeman and blotting with paper towels. If the latex film does not remain intact during removal from the tins or while removing the unabsorbed rejuvenating agent, the sample shall be rejected. After the rejuvenating agent is removed from the samples they are then weighed. Percent swelling is reported as weight increase of the polymer film; report mass increase as a percent by weight of the original latex film mass upon exposure of films to the recycling agent.

Recycling Agent Specification:

Table 1-B

Product Tests	Rejuvenating Agent	
	Specs	Typical
Viscosity, 140°F, CST	50-175	150
Flash Point, °F, COC	380 Min.	400
Saturate, % by wt.	30 Max.	17
Asphaltenes	1.0 Max.	0
Chemical Composition	0.2-1.0	0.66
<u>N+A</u> P+A Compatibility	0.5 Min	0.83
<u>N</u> P Test on Residue		
Weight Change, %	6.5 Max.	3
Viscosity Ratio	3 Max.	1.3

7-3.2 MATERIAL QUALIFICATIONS. The emulsion supplier shall provide the ENGINEER with certified test results not older than 3 months, and two 1-quart samples of the finished polymer modified rejuvenating emulsion concentrate, rejuvenating agent, and the latex used in the emulsion. For the latex, certification must be from a laboratory with an ISO 17025 certification and accredited by IAS. Laboratories must be accredited in the test procedures described herein for the latex and the rejuvenating agents. Quality control testing of the samples shall be at the CONTRACTOR's expense.

For QA purposes, at any time during the execution of the work, the ENGINEER may require one quart samples be submitted for each of the following: 1) The emulsion from the emulsion delivery truck, 2) the rejuvenating agent from the emulsion manufacture's supplier, and 3) the polymer from the emulsion manufacture's supplier. Samples will be sent to an independent testing laboratory selected by the COUNTY. All testing shall be at the COUNTY's expense.

CONSTRUCTION METHODS

7-4.1 MIXING. The rejuvenator seal material shall be obtained by blending bituminous concentrate material, water, and polymer. The rejuvenator seal mixture shall be delivered to the site ready for application, unless otherwise approved by the ENGINEER. The weight of polymer added to the mix at the plant and the total weight of the mixture shall be submitted to the ENGINEER.

7-4.2 WEATHER LIMITATIONS. Bituminous material shall be applied only when the existing surface is dry and the atmospheric temperature is above 60°F. No material shall be applied when rain is imminent or when dust or sand is blowing.

7-4.3 EQUIPMENT AND TOOLS. The CONTRACTOR shall furnish all equipment, tools, and machines necessary for the performance of the work.

A. Pressure Distributor. The distributor shall be designed, equipped, maintained, and operated so that bituminous material may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 10 percent during application operations. Distributor equipment shall include a tachometer, pressure gages, volume-measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically. Spray nozzle tips shall be properly sized for the product being applied in accordance with the rejuvenator seal manufacturer's recommendations.

B. Power Broom. A power broom/vacuum, Swartz 7000, or equivalent, shall be provided for removing loose material from the surfaces to be treated and final clean up of treated areas prior to opening to air traffic.

7-4.4 PREPARING UNDERLYING COURSE. The surface of the underlying course shall be prepared in accordance with Division V, Section 2. All loose dirt and other objectionable material shall be removed from the surface by power broom/vacuum sweeper. Crack sealing shall be performed subsequent to placement of the rejuvenator seal.

7-4.5 APPLICATION OF BITUMINOUS MATERIAL. Bituminous material shall be applied upon the properly prepared surface at the rate and temperature specified using a pressure distributor to obtain uniform distribution at all points. To insure proper coverage, the strips shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope. During all applications, the surfaces of any adjacent structures or objects shall be protected in such manner as to prevent their being spattered or otherwise marred.

The rejuvenator seal shall be spread at the rate (gallons per square yard) determined by test section, or as directed by the manufacturer's agent, subject to the ENGINEER's approval. Any change in rate of application must be approved by the ENGINEER. The application shall provide uniform coverage and shall be free of streaks and voids.

The CONTRACTOR shall schedule seal coat operations such that the asphalt rejuvenation seal will break (turn from brown to black) before the atmospheric temperature falls below 50°F, and with a sufficient allowance for cure time so that the pavement is marked and opened to traffic as scheduled.

7-4.7 CORRECTION OF DEFECTS. Any defects, such as lack of uniformity in the application coverage (streaking or voids), or other imperfections caused by faulty workmanship or application methods, shall be corrected to the satisfaction of the ENGINEER.

All defective materials resulting from improper storage, handling, workmanship, or application procedures shall be removed by the CONTRACTOR and replaced with approved materials as provided for in these specifications.

METHOD OF MEASUREMENT

7-5.1 The Asphalt Rejuvenator Seal shall be measured by the square yard of applied and accepted by the ENGINEER rejuvenator seal.

BASIS OF PAYMENT

7-6.1 Payment will be made at the CONTRACT unit price per square yard for Asphalt Rejuvenating Seal. These prices shall be full compensation for furnishing all materials and for all preparation, hauling and application of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

TESTING REQUIREMENTS

Federal Aviation Administration Advisory Circular 150/5320-12, "Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces, Chapter 3, Section IV, Conducting Friction Evaluation with CFME."

ASTM D 2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 3666	Inspection and Testing Agencies for Bituminous Paving Materials

ASTM E 303

Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

CT 342

California Portable Test

ASTM E 274

Skid Trailer

ASTM E 503

Diagonal Brake Vehicle equipped with ASTM E 524 (smooth test tire inflated to 24 psi).

END OF SECTION

DIVISION V
SECTION 8
FUEL-RESISTANT SEAL

DESCRIPTION

8-1.1 GENERAL. This item shall consist of an application of fuel-resistant seal on bituminous surface, in accordance with the PLANS and SPECIFICATIONS and as designated by the ENGINEER.

MATERIAL

8-2.1 GENERAL. Fuel-resistant seal shall be Seal Master, coal tar sealer with latex additives, or equal, manufactured by Seal Master, Inc., P. O. Box 2277, Sandusky, Ohio 44870 (800) 395-7325. The seal shall be a uniform blend of Seal Master and sand in conformance with the manufacturer's recommendations.

8-2.2 SEALER. Seal-Master sealer shall be thoroughly mixed as received in its original state to ensure all material is in a homogenous consistency.

8-2.3 SAND. Sand shall be graded to form a tight, hard, non-absorbent film matrix. Sand must be clean and contain an average particle size distribution as shown below:

U.S. SIEVE	% PASSING
No. 16	100
No. 20	85 - 100
No. 30	15 - 85
No. 40	2 - 15
No. 100	0 - 2

CONSTRUCTION METHODS

8-3.1 SURFACE PREPARATION.

- A. Clean.** Asphalt concrete areas to be sealed shall be clean, surface-cured, and sound. The surface shall be free from clay, dust, sand, salt, oil, grease, and any other foreign matter. Fines from tie-down anchor installation shall be removed by sweeping, high-pressure wash, or other method to the satisfaction of the ENGINEER.
- B. Cured.** The area to be sealed shall be free of all surface oils and cured to a point that when water is poured on the surface, the light oils do not rise into it. The normal cure period is 30 days, depending upon composition of asphaltic concrete, weather conditions, and time of year. If oil is still present when surface is tested with water, the surface shall be thoroughly cleaned with TSP and water, then allowed to dry and tested again prior to application of seal.

C. **Sound.** The area to be sealed shall be sound, free of alligatored sections or softened spots due to oil saturation. Scrape and clean oil spots with products recommended by the manufacturer.

1. Repair and patch all areas that have base failure, oil-softened areas, chuck or pot holes, or badly weathered areas.
2. Clean surface of all foreign matter, oil, grease, and vegetation.
3. Clean out all minor cracks of 1/2-inch or less to a reasonable depth, removing all dirt and vegetation. Fill cracks with Seal-Master pourable, trowelable, or hot-pour joint sealing material.
4. Scrape and clean oil spots and coat with Seal-Master Petro Seal.

8-3.2 APPLICATION OF MATERIAL. The material shall be applied in two coats and according to the manufacturer's recommendations. Do not apply if rain is imminent. Temperatures should be 50°F minimum and rising. Temperature should not go below 50° in any of the 24 hours following application.

8-3.3 MIXING. Seal-Master, water, and sand shall be mixed together to an even, smooth consistency, starting with the Seal-Master then the proper percent of water and sand.

When the sand is added to the mix, 1% to 2% Top Tuff should be added to give better retention of the sand in the mix. It may also be necessary to use additional water due to absorption onto the sand.

Timing	Emulsion	Sand	Top Tuff	Water	Application Rate
1st Coat	100 Gal.	400-800 Lbs.	1-2 Gal.	30 Gal.	.07 - .15 per S.Y.

Application rates of material will vary slightly with the mode of application and the texture of the pavement. Complete coverage of the pavement shall be achieved. Application rates are based on undiluted emulsion.

Application may be made by squeegee, brush, or mechanical equipment designed for squeegee, spray, or any combination of the above.

8-3.4 QUALITY CONTROL. The CONTRACTOR shall furnish manufacturer certification that each consignment of the fuel resistant seal shipped to the Project meets the requirements of this specification. The manufacturer certification shall not be interpreted as a basis for final acceptance.

8-3.5 FREIGHT AND WEIGH BILLS. The CONTRACTOR shall furnish the ENGINEER copies of all shipments. The CONTRACTOR shall not remove any materials from storage or release shippers equipment until outage and temperature recording have been made.

MEASUREMENT AND PAYMENT

8-4.1 Fuel-resistant seal shall be measured and paid for by the square yard. Payment under this item shall include all materials, labor, equipment, tools, and incidentals necessary to complete the item.

END OF SECTION

DIVISION V
SECTION 9
MAJOR CRACK REPAIR AND MINOR CRACK SEAL

DESCRIPTION

9-1.1 This item shall consist of performing crack repair and crack seal repairs on the properly prepared existing pavement.

9-1.2 CRACK SEALING AND REPAIR. All vegetation in pavement cracks in areas designated for treatment shall be pre-treated with a pre-emergent herbicide that kills and prevents the re-growth of existing and new vegetation. A dye shall be added to the herbicide to show treated areas. Herbicide shall be Hivar X or approved equal. Treated vegetation shall be removed from the cracks. Following vegetation removal, all cracks shall be blown clean with a high-pressure air nozzle. Cracks shall be filled or repaired as follows:

- A. Incidental Cracks Less Than or Equal to 3/8 Inch in Width.** Cracks 3/8 inch or less in width shall be blown clean and treated with herbicide. No crack filling will be required. No separate measurement or payment shall be made for this item. No direct payment will be made for incidental crack cleaning. All costs to be included in Section 2, Surface Preparation.
- B. Minor Cracks.** Cracks in existing pavement greater than 3/8 inch, but less than 1 inch, shall be blown clean and treated with an herbicide, and filled with crack sealing material. Sealer shall be hot-melt rubberized asphalt material, Craftco Polyflex 2, or approved equal.
- C. Major Crack Repair.** Cracks greater than 1 inch in width or as shown on the PLANS require special treatment. A 24-inch (±) wide by 2 inch deep notch shall be cold-milled into the existing AC surface. The crack shall be approximately centered in the notch. The remaining crack below the 2-inch notch shall be cleaned, treated with herbicide, and then filled with fine aggregate hot mix AC to the bottom of the notch. The fine aggregate asphalt filler shall be compacted by tamping or other ENGINEER-approved method. The 24-inch wide notch shall be paved with AC, except that the provision for payment adjustments shall not apply.

No crack repair shall be started until the CONTRACTOR has identified and field marked the cracks for each repair type and the work limits and types are approved by the ENGINEER.

METHOD OF MEASUREMENT

9-2.1 Minor Crack Seal and Major Crack Repair shall be measured for payment by the lineal foot as separate pay items.

PAYMENT

9-3.1 Minor Crack Seal shall be paid for at the CONTRACT price per the lineal foot of work accepted by the ENGINEER. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment, and incidentals necessary to complete the item.

9-3.2 Major Crack Repair shall be paid for at the CONTRACT price per the lineal foot of work accepted by the ENGINEER. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment, and incidentals necessary to complete the item.

END OF SECTION

DIVISION V
SECTION 10
AGGREGATE BASES
(MODIFIED CALTRANS)

DESCRIPTION

10-1.1 GENERAL. This work shall consist of furnishing, spreading and compacting aggregate bases as specified in these specifications and the special provisions.

Aggregate bases are designated as Class 2, 3/4-inch maximum. The class of aggregate base will be shown on the PLANS or specified in the special provisions.

10-1.2 PREQUALIFICATION OF MATERIALS. The CONTRACTOR shall provide test results for prequalification of materials used in this item. Submittals of these test results must be received by the ENGINEER no less than ten (10) working days prior to placement of materials. No separate payment shall be made for prequalifying tests.

10-1.3 MATERIALS. Aggregate for the various classes of aggregate base at the time it is deposited on the roadbed shall conform to the following requirements:

- A. Class 2 Aggregate Base.** Aggregate for Class 2 aggregate base shall be free from organic matter and other deleterious substances, and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base. Aggregate may include material processed from reclaimed asphalt concrete, portland cement concrete, lean concrete base, cement treated base or a combination of any of these materials. The amount of reclaimed material shall not exceed 50 percent of the total volume of the aggregate used.

Aggregate shall conform to the grading and quality requirements shown in the following tables.

AGGREGATE GRADING REQUIREMENTS

Sieve Sizes	Percentage Passing			
	1 1/2" Maximum		3/4" Maximum	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance
2"	100	100	—	—
1 1/2"	90-100	87-100	—	—
1"	—	—	100	100
3/4"	50-85	45-90	90-100	87-100
No. 4	25-45	20-50	35-60	30-65
No. 30	10-25	6-29	10-30	5-35
No. 200	2-9	0-12	2-9	0-12

QUALITY REQUIREMENTS

Test	Operating Range	Contract Compliance
Resistance (R-value)	—	78 Min.
Sand Equivalent	25 Min.	22 Min.
Durability Index	—	35 Min.

The aggregate shall not be treated with lime, cement or other chemical material before the Durability Index test is performed. Untreated reclaimed asphalt concrete and portland cement concrete will not be considered to be treated with lime, cement or other chemical material for purposes of performing the Durability Index test.

If the results of either or both the aggregate grading and Sand Equivalent tests do not meet the requirements specified for "Operating Range" but meet the "Contract Compliance" requirements, placement of the aggregate base may be continued for the remainder of that day. However, another day's work may not be started until tests, or other information, indicate to the satisfaction of the ENGINEER that the next material to be used in the work will comply with the requirements specified for "Operating Range."

If the results of either or both the aggregate grading and Sand Equivalent tests do not meet the requirements specified for "Contract Compliance," the aggregate base which is represented by these tests shall be removed. However, if requested by the CONTRACTOR and approved by the ENGINEER, the aggregate base may remain in place, and the CONTRACTOR shall pay to the COUNTY \$2.25 per cubic yard for the aggregate base represented by the tests and left in place. The Department may deduct this amount from any moneys due, or that may become due, the CONTRACTOR under the contract. If both the aggregate grading and Sand Equivalent do not conform to the "Contract Compliance" requirements, only one adjustment shall apply.

No single aggregate grading or Sand Equivalent test shall represent more than 500 cubic yards or one day's production whichever is smaller.

B. Class 3 Aggregate Base. Deleted.

10-1.4 SUBGRADE. The subgrade to receive aggregate base, immediately prior to spreading shall conform to the compaction and elevation tolerance specified for the material involved, and shall be free of loose or extraneous material.

When aggregate base is paid for by the cubic yard, areas of the finished surface of aggregate subbase which are lower than the grade established by the ENGINEER shall be filled with aggregate base. Volumes of aggregate base so placed will not be included in the volume calculated for payment.

When aggregate subbase is not specified and aggregate base is paid for by the cubic yard, areas of the grading plane which are lower than the grade established by the ENGINEER may be filled with aggregate base. Volumes of aggregate base so placed will not be included in the volume calculated for payment as stated above. If basement material consists of imported borrow, aggregate base placed below the grade established by the ENGINEER will not be measured or paid for as imported borrow.

- A. **Adding Water.** At the time aggregate base is spread it shall have a moisture content sufficient to obtain the required compaction. The moisture shall be uniformly distributed throughout the material.

10-1.5 SPREADING. Aggregate bases shall be delivered to the roadbed as uniform mixtures. The mixture shall be deposited and spread to the required compacted thickness within the tolerances specified in Section 10-1.5, "Compacting," by means which will maintain the uniformity of the mixture. Each layer shall be free from pockets of coarse or fine material.

Where the required thickness is 0.50-foot or less, the base material may be spread and compacted in one layer. Where the required thickness is more than 0.50-foot, the base material shall be spread and compacted in 2 or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 0.50-foot.

Aggregate bases, placed on road approaches and connections, street intersection areas, median strip areas, shoulder areas, and at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any means to obtain the specified results.

When the subgrade for aggregate base consists of cohesionless sand, and written permission is granted by the ENGINEER, a portion of the aggregate base may be dumped in piles upon the subgrade and spread ahead from the dumped material in sufficient quantity to stabilize the subgrade. Segregation of aggregate shall be avoided and each layer shall be free from pockets of coarse or fine material.

10-1.6 COMPACTING. The relative compaction of each layer of compacted base material shall be not less than 95 percent.

The surface of the finished aggregate base at any point shall not vary more than 0.05-foot above or below the grade established by the ENGINEER.

When aggregate base is paid for by the cubic yard, and at locations where the planned thickness of aggregate base, less allowable tolerance, is not obtained, the CONTRACTOR shall take such corrective measures as are necessary to obtain that thickness. If requested by the CONTRACTOR and permitted by the ENGINEER, a deduction will be made from contract payment for aggregate base in lieu of correcting the deficient thickness. The deduction will be computed as the product of (a) the deficient thickness less allowable tolerance; (b) the planned width; and (c) the longitudinal distance between locations showing specified thickness, all as determined by the ENGINEER, multiplied by a fixed price of \$17.00 per cubic yard, or the contract bid price, whichever is higher.

Base which does not conform to the above requirements shall be reshaped or reworked, watered and thoroughly recompacted to conform to the specified requirements.

MEASUREMENT

10-2.1 Quantities of aggregate base to be paid for by the cubic yard will be calculated on the basis of the dimensions shown on the PLANS adjusted by the amount of any change ordered by the ENGINEER. No allowance will be made for aggregate base placed outside those dimensions unless otherwise ordered by the ENGINEER.

PAYMENT

10-3.1 Quantities of aggregate base will be paid for at the CONTRACT price per cubic yard.

The above price shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing aggregate base, complete in place, as shown on the PLANS, and as specified in these specifications and the special provisions, and as directed by the ENGINEER.

END OF SECTION

DIVISION V
SECTION 11
ASPHALT CONCRETE
(MODIFIED 2006 CALTRANS)

DESCRIPTION

11-1.1 GENERAL. This work shall consist of furnishing and mixing aggregate and asphalt binder at a central mixing plant, spreading, and compacting the mixture as specified in these SPECIFICATIONS and as shown on the PLANS.

Asphalt concrete shall be California State Type A, 1/2 inch maximum aggregate (medium) and shall be produced in a batch mixing plant, a continuous pugmill mixing plant or a drier-drum mixing plant. Proportioning shall be either by hot-feed control or cold feed control.

11-1.2 JOB MIX FORMULA. No bituminous mixture for payment shall be produced until a job mix formula conforming to California State Standards has been approved by the ENGINEER. The Type A, 1/2-inch maximum, medium job mix formula shall be a recent (less than 6 months old) Caltrans mix design or a mix design shall be prepared specifically for this Project. The job mix formula shall be submitted in writing by the CONTRACTOR to the ENGINEER *within the first ten (10) days of the Mobilization phase*. The job mix formula submittal shall include test property curves (unit weight, percent voids, and Hveem stability vs. percent asphalt) and all test data used to develop the job mix formula.

With the job mix formula (JMF) submittal, submit the following:

1. California Test 204 plasticity index results
2. California Test 371 tensile strength ratio (TSR) results for untreated HMA
3. California Test 371 tensile strength ratio (TSR) results for treated HMA if untreated HMA tensile strength is below 70. Asphalt with TSR below 70 shall be treated with a liquid antistripping agent approved by the ENGINEER and the resulting TSR shall be at least 70.

The approved job mix formula shall be in effect until modified in writing by the ENGINEER. Should a change in sources of materials be made, a new job mix formula shall be established before the new material is used.

11-1.3 PREQUALIFICATION OF MATERIALS. The CONTRACTOR shall provide all test results for prequalification of materials used in this item. Submittals of these test results shall be made with the job mix formula. No separate payment will be made for prequalification tests

MATERIALS

11-2.1 ASPHALT CEMENT. Asphalt cement shall be PG 64-10. Asphalt shall conform to Section 92, "Asphalts", of the State Standard Specifications.

11-2.2 AGGREGATE. All aggregates shall be clean and free from decomposed materials, organic material and other deleterious substances. Coarse aggregate is material retained on the No. 4 sieve; fine aggregate is material passing the No. 4 sieve; and supplemental fine aggregate is added fine material passing the No. 30 sieve, including dust from dust collectors.

The combined aggregate, prior to the addition of asphalt binder, shall conform to the requirements of this Section. Aggregate samples for testing will be obtained from plant bins or the cold feed in advance of the mixing drum. Conformance with the grading requirements will be determined by California Test 202, modified by California Test 105 when there is a difference in specific gravity of 0.2 or more between the coarse and fine portions of the aggregate or between blends of different aggregates. If the results do not fall within the limits shown under "Operating Range", but are within limits for "Contract Compliance", placement of asphalt concrete may be continued for the remainder of that day. However, another day's work may not be started until tests, or other information, indicate to the satisfaction of the ENGINEER that the next material to be used in the work will comply with the requirement for "Operating Range".

If the results of grading tests are not within the limits for "Contract Compliance", the asphalt concrete represented by these tests shall be removed unless the ENGINEER determines that said asphalt concrete is structurally adequate and may remain in place. No single grading test shall represent more than 500 tons of aggregate for one day's paving, whichever is smaller.

In the table below, the symbol "X" is the gradation which the CONTRACTOR proposed to furnish for the specific sieve. The proposed gradation shall meet the gradation shown in the table under "Limits of Proposed Gradation". Changes from one mix design to another shall not be made during the progress of the work unless permitted by the ENGINEER. However, changes in proportions to conform to the approved job mix formula shall not be considered changes in mix design.

Sieve Sizes	Limits of Proposed Gradation	Operating Range	Contract Compliance
3/4"	100	100	100
1/2"	95-100	95-100	89-100
3/8"	80-95	80-95	75-100
No. 4	59-66	X±5	X±8
No. 8	43-49	X±5	X±8
No. 30	22-27	X±5	X±8
No. 200	3-8	3-8	0-11

The combined aggregate shall conform to the following quality requirements prior to addition of the asphalt cement:

Tests	Test Method No. California	Asphalt Concrete Type A
Percentage of Crushed Particles Coarse Aggregate (Min.) Fine Aggregate (Passing No. 4, Retained on No. 8) (Min.)	205	90% 70%
Los Angeles Rattler Loss at 500 rev. (Max.)	211	45%
Sand Equivalent Contract Compliance (Min.) Operating Range (Min.)	217	47 50
k_c Factor (Max.)	303	1.7
k_f Factor (Max.)	303	1.7

The water absorption value of the entire blend of aggregate shall not exceed 2.5 percent as determined by ASTM C 127 and C 128. These tests shall be included in the prequalification tests provided by the CONTRACTOR. Testing during construction for quality control will be performed by the ENGINEER at no cost to the CONTRACTOR. The frequency of this testing will be determined by the ENGINEER except that sand equivalent tests will be performed concurrently with aggregate gradation tests. If the test results do not meet the requirements listed, above production shall be terminated until the CONTRACTOR can satisfy the ENGINEER that the necessary corrections have been made and that production meets specification. The CONTRACTOR shall be responsible for all testing required to bring the materials back into specification.

11-2.3 BITUMINOUS MIXTURE. The asphalt concrete mixture, composed of the asphalt concrete and aggregate proposed for use and at the job mix formula optimum percentages as determined by Test Method No. California 367, shall have the following material properties:

Tests	California Test	Asphalt Concrete Type A
Swell (Max.)	305	0.030"
Moisture Vapor Susceptibility (Min.)	307	30
Stabilometer Value (Min.)	366	37

11-2.4 STORAGE. Storage and drying of materials shall be as indicated in the State Standard Specifications, Section 39-3.01, "Storage" and 39-3.02, as appropriate for the type of material and plant.

11-2.5 PROPORTIONING. Proportioning of materials shall conform to appropriate methods in the State Standard Specifications, Section 39-3.03, "Proportioning".

11-2.6 MIXING. Mixing shall be in conformance with Section 39-3.04 of the State Standard Specifications.

11-2.7 TEST SECTION. Prior to full production, the CONTRACTOR shall prepare and place a quantity of bituminous mixture according to the job mix formula. The amount of mixture should be sufficient to construct a test section 300 feet long and 20 feet wide, placed in two lanes with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

Random samples shall be taken at the plant, or behind the paver, and tested for stabilometer value, aggregate gradation, and asphalt content. Three randomly selected cores shall be taken from the finished pavement mat, and three from the longitudinal joint, and tested in accordance with Paragraph 3.4.

The test section shall be considered acceptable if: (1) the stabilometer value exceeds the specified minimum, (2) aggregate gradations are within the operating range limits specified in Paragraph 2.2, (3) the percentage asphalt is within 0.5% of the optimum amount in the job mix formula, and (4) the relative compaction exceeds 95%.

If the initial test section should prove to be unacceptable, the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the CONTRACTOR's expense. Additional test sections, as required, shall be constructed and evaluated for conformance to the SPECIFICATIONS. Any additional sections that are not acceptable shall be removed at the CONTRACTOR's expense. Full production shall not begin until an acceptable section has been constructed and accepted by the ENGINEER. Testing of the initial test sections shall be paid for by the OWNER. Should the initial test section fail to meet specification requirements, testing of subsequent test sections shall be paid for by the CONTRACTOR.

Job mix control testing shall be performed by the CONTRACTOR at the start of plant production and in conjunction with the calibration of the plant for the job mix formula. It should be recognized that the aggregates produced by the plant may not satisfy the gradation requirements or produce a mix that exactly meets the job mix formula. In those instances, it will be necessary to re-evaluate and re-design the mix using plant-produced aggregates. Specimens should be prepared, and the optimum bitumen content determined in the same manner as for the original design tests.

CONSTRUCTION METHODS

11-3.1 GENERAL REQUIREMENTS. Unless lower temperatures are directed by the ENGINEER, all mixtures, shall be spread, and the first coverage of initial or breakdown compaction shall be performed when the temperature of the mixture is not less than 275°F, and all breakdown compaction shall be completed before the temperature of the mixture drops below 250°F.

Asphalt concrete shall be placed only when the atmospheric temperature is above 50°F. Asphalt concrete base shall be placed only when the atmospheric temperature is above 40°F.

Asphalt concrete and asphalt concrete base shall not be placed when the underlying layer or surface is frozen, or when, in the opinion of the ENGINEER, weather conditions will prevent the proper handling, finishing, or compaction of the mixtures.

Asphalt concrete base shall be spread and compacted in one or more layers. Each layer of asphalt concrete shall not exceed 0.25-foot in compacted thickness unless approved by the ENGINEER.

A layer shall not be placed over another layer until the temperature of the lower layer is less than 160°F at mid depth.

Asphalt concrete and asphalt concrete base to be placed on shoulders and other areas off the traveled way having a width of 5 feet or more, shall be spread in the same manner as specified above. When the shoulders and other areas are less than 5 feet in width, the material may be deposited and spread in one or more layers by any mechanical means that produce a uniform smoothness and texture. Unless otherwise shown on the PLANS, asphalt mixtures shall not be handled, spread or windrowed in a manner that will stain the finished surface of any pavement or other improvements.

The completed mixture shall be deposited on the roadbed at a uniform quantity per linear foot, as necessary to provide the required compacted thickness without resorting to spotting, picking-up or otherwise shifting the mixture.

Segregation shall be avoided, and the surfacing shall be free from pockets of coarse or fine material. Asphalt concrete or asphalt concrete base containing hardened lumps shall not be used.

Longitudinal joints in all other layers shall be offset not less than 1-foot alternately each side of the edges of traffic lanes. The ENGINEER may permit other patterns of placing longitudinal joints if he considers that such patterns will not adversely affect the quality of the finished product.

Unless otherwise provided herein or permitted by the ENGINEER, the top layer of asphalt concrete for shoulders, tapers, transitions, curve widenings, and other such areas, shall not be spread before the top layer of asphalt concrete for the adjoining pavement has been spread and compacted. At locations where the number of lanes is changed, the top layer for the through lanes shall be paved first. When existing pavement is to be surfaced and the specified thickness of asphalt concrete to be spread and compacted on the existing pavement is 0.20-foot or less, shoulders or other adjoining areas may be spread simultaneously with the through lane provided the completed surfacing conforms to the requirements of these specifications. Tracks or wheels of spreading equipment shall not be operated on the top layer of asphalt concrete in any area until final compaction has been completed.

At locations shown on the PLANS, specified in the special provisions or as directed by the ENGINEER, the asphalt concrete shall be tapered or feathered to conform to existing surfacing or to other facilities.

At locations where the asphalt concrete is to be placed over the areas inaccessible to spreading and rolling equipment, the asphalt concrete shall be spread by any means to obtain the specified results and shall be compacted thoroughly to the required lines, grades and cross sections by means of pneumatic tampers, or by other methods that will produce the same degree of compaction as pneumatic tampers.

11-3.2 SPREADING. In advance of spreading asphalt concrete over an existing base, surfacing, or pavement, if ordered by the ENGINEER, asphalt concrete shall be spread to level irregularities, and to provide a smooth base in order that subsequent layers will be of uniform thickness. No additional compensation will be allowed for spreading asphalt concrete as above specified, and full compensation for all work incidental to such operations will be considered as included in the contract price paid for the asphalt concrete.

When directed by the ENGINEER, bituminous binder shall be applied to any layer in advance of spreading the next layer.

Before placing the top layer adjacent to cold transverse construction joints, such joints shall be trimmed to a vertical face and to neat line. Transverse joints shall be tested with a 12 foot straightedge and shall be cut back as required to conform to the requirements specified in Paragraph 11-3.3, "Compacting", for surface smoothness. Connections to existing surfacing shall be feathered to conform to the requirements for smoothness. Longitudinal joints shall be trimmed to a vertical face and to a neat line if the edges of the previously laid surfacing are, in the opinion of the ENGINEER, in such condition that the quality of the completed joint will be affected.

All layers, except as otherwise provided in these SPECIFICATIONS, shall be spread with an asphalt paver. Asphalt pavers shall be operated in such a manner as to insure continuous and uniform movement of the paver.

11-3.3 COMPACTING. Compacting equipment shall conform to the provisions of Paragraph 11-4.2, "Compacting Equipment".

A pass shall be one movement of a roller in either direction. A coverage shall be as many passes as are necessary to cover the entire width being paved. Overlap between passes during any coverage, made to ensure compaction without displacement of material in accordance with good rolling practice, shall be considered to be part of the coverage being made and not part of a subsequent coverage. Each coverage shall be completed before subsequent coverages are started.

Rolling shall commence at the lower edge and shall progress toward the highest portion, except that when compacting layers which exceed 0.25 foot in compacted thickness, and if directed by the ENGINEER, rolling shall commence at the center and shall progress outward.

Asphalt concrete shall be compacted to relative compaction of not less than 95 percent as determined in accordance with Paragraph 11-3.4, "Relative Compaction Acceptance and Testing."

The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. Any ridges, indentations or other objectionable marks left in the surface of the asphalt concrete by blading or other equipment shall be eliminated by rolling or other means. The use of any equipment that leaves ridges, indentations, or other objectionable marks in the asphalt concrete shall be discontinued, and other acceptable equipment shall be furnished by the CONTRACTOR.

11-3.4 RELATIVE COMPACTION ACCEPTANCE SAMPLING AND TESTING. Asphalt concrete shall be compacted to a relative compaction of not less than 95 percent of the density of laboratory specimens compacted in conformance with California Test 304. In-place density of asphalt concrete will be determined from cores in accordance with California Test 308. Three cores of the finished pavement shall be taken for each lot. A lot shall be 1/2-day's paving.

A. Sampling. Cores of the finished, compacted pavement shall be taken by the CONTRACTOR. Core locations shall be marked by the ENGINEER. Samples shall be neatly cut with a core drill. The cutting edge of the core drill bit shall be of hardened steel or other suitable material with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be

3 inches. Samples that are clearly defective, as a result of sampling, shall be discarded and another sample taken. The CONTRACTOR shall furnish all tools, labor, and materials for cutting samples and filling the cored pavement. Cored holes shall be filled with hot mix asphalt concrete in a manner acceptable to the ENGINEER and within one day after sampling.

If the test results for any lot of asphalt concrete indicate that the relative compaction is below 95.0 percent, but above 92.9 percent, the CONTRACTOR will be advised that he is not attaining the required relative compaction and that his materials or his procedures, or both, need adjustment. Asphalt concrete spreading operations shall not continue until the CONTRACTOR has notified the ENGINEER of the adjustment that will be made in order to meet the required compaction.

If the test results for any lot of asphalt concrete indicate that the relative compaction is less than 93.0 percent, the asphalt concrete represented by that lot shall be removed, except as otherwise provided below. Asphalt concrete spreading operations shall not continue until the CONTRACTOR makes significant adjustments to his materials or procedures or both in order to meet the required compaction.

The adjustments shall be as agreed to by the ENGINEER. However, if requested by the CONTRACTOR and approved by the ENGINEER, asphalt concrete with a relative compaction of 90.0 percent or greater may remain in place and the CONTRACTOR shall pay to the OWNER the amount of reduced compensation for such lot with low compaction. The OWNER may deduct an amount of reduced compensation from any monies due, or that may become due the CONTRACTOR under the CONTRACT. The amount of reduced compensation the CONTRACTOR shall pay to the OWNER will be calculated using the total tons represented in the lot with low compaction times the CONTRACT price per ton for the CONTRACT items of asphalt concrete involved times the following reduced compensation factors:

Relative Compaction (Percent)	Reduced Compensation Factor	Relative Compaction (Percent)	Reduced Compensation Factor
93.0	0.000	91.4	0.062
92.9	0.002	91.3	0.068
92.8	0.004	91.2	0.075
92.7	0.006	91.1	0.082
92.6	0.009	91.0	0.090
92.5	0.012	90.9	0.098
92.4	0.015	90.8	0.108
92.3	0.018	90.7	0.118
92.2	0.022	90.6	0.129
92.1	0.026	90.5	0.142
92.0	0.030	90.4	0.157
91.9	0.034	90.3	0.175
91.8	0.039	90.2	0.196
91.7	0.044	90.1	0.225
91.6	0.050	90.0	0.300
91.5	0.056		

11-3.5 SURFACE TOLERANCES. The CONTRACTOR shall have on site a 12-foot straightedge for testing the AC surface when said straightedge is laid on the finished surface and parallel with the center line, the surface shall not vary more than 0.01 foot from the lower edge of the straightedge. The transverse slope of the finished surface shall be uniform to a degree such that no depressions greater than 0.02 foot are present when tested with a straightedge 12 feet long. No skin patching will be allowed to correct depressions.

11-3.6 THICKNESS TOLERANCE. The pavement thickness shall be determined by measuring the average thickness of core samples taken from the pavement for density determination. Thickness will be determined from the cores and shall be based upon the average of the cores per lot and subplot as described for density determination. The asphalt thickness indicated on the cross sections shall be maintained. Thickness deficiencies in excess of 3/8-inch shall be corrected by removal and replacement or overlay at the ENGINEER's discretion. No skin patches or overlays less than 1-1/2 inches will be allowed. The pay amount shall be reduced for thickness deficiencies equal to or less than 3/8-inch in proportion to two times the percent of thickness deficiencies to the specified pavement thickness (i.e., a 1/4-inch thickness deficiency in a pavement with a 2-inch specified thickness would result in a reduction of the unit price of $(2 \times 0.25)/2.0 = 25$ percent) for the lot containing a thickness deficiency. No payment shall be made for thickness in excess of 1/4-inch of those specified. Adjusted pay quantities shall be deducted from the CONTRACT in accordance with Paragraph 11-6.1.

EQUIPMENT

11-4.1 SPREADING EQUIPMENT. Asphalt pavers shall be self-propelled mechanical spreading and finishing equipment, provided with a screed or strike-off assembly capable of distributing the material to not less than the full width of a traffic lane. Screed action shall include any cutting, crowding, or other practical action which is effective on the mixture without tearing, shoving or gouging, and which produces a surface texture of uniform appearance. The screed shall be adjustable to the required section and thickness. The paver shall be provided with a full width roller or tamper or other suitable compacting devices. Pavers that leave ridges, indentations or other marks in the surface that cannot be eliminated by rolling or prevented by adjustment in operation shall not be used.

The asphalt paver shall operate independently of the vehicle being unloaded or shall be capable of propelling the vehicle being unloaded in a satisfactory manner and, if necessary, the load of the haul vehicle shall be limited to that which will insure satisfactory spreading. While being unloaded the haul vehicle shall be in contact with the machine at all times, and the brakes on the haul vehicle shall not be depended upon to maintain contact between the vehicle and the machine.

The procedure whereby material is deposited in a windrow, then picked up and placed in the asphalt paver with loading equipment will be permitted for all asphalt concrete except Open Graded, provided the asphalt paver is of such design that the material will fall into a hopper which has a movable bottom conveyor to feed the screed and the loading equipment is constructed so that substantially all of the material deposited on the roadbed is picked up and deposited in the paving machine.

The controls on the asphalt paver shall be capable of working in conjunction with any of the following attachments:

- Ski-type device not less than 25 feet in length.
- Taut stringline (wire) set to grade
- Laser

The 25-foot ski is required for all overlays unless waived by the ENGINEER.

No portion of the weight of hauling or loading equipment, other than the connection, shall be supported by the asphalt paver, and no vibrations or other motions of the loader, which could have a detrimental effect on the riding quality of the completed pavement, shall be transmitted to the paver.

11-4.2 COMPACTING EQUIPMENT. For each asphalt paver, the CONTRACTOR shall furnish sufficient number of rollers to achieve the compaction and surface finish required by these SPECIFICATIONS. Each roller shall have a separate operator. All rolling equipment shall be self-propelled and reversible.

All rollers shall be equipped with pads and water systems which prevent sticking of asphalt mixtures to the pneumatic- or steel-tired wheels. A parting agent, which will not damage the asphalt mixture as determined by the ENGINEER, may be used to aid in preventing the sticking of the mixture to the wheels.

Other equipment, approved by the ENGINEER in accordance with California Test 113, may be substituted for 3-wheel or tandem rollers when used as specified in Paragraph 11-3.3, "Compacting."

Pneumatic-tired rollers shall be the oscillating type having a width of not less than 4 feet with pneumatic tires of equal size, diameter and having treads satisfactory to the ENGINEER. Wobble-wheel rollers will not be permitted. The tires shall be spaced so that the gaps between adjacent tires will be covered by the following tires, or shall be spaced so that any resulting uncovered gap will not exceed 1-1/2 inches in width when the tires are inflated to 90 psi and the operating weight is 2,000 pounds per tire.

When the pneumatic-tired roller furnished by the CONTRACTOR is constructed so that there is a resulting gap between tire tracks as permitted in the preceding paragraph, the complete coverages of asphalt concrete with the roller required in Paragraph 11-3.3, "Compacting", shall be increased by one complete coverage for each 1/2 inch, or fraction thereof, of the maximum uncovered gap between any 2 tire tracks.

The tires shall be inflated to 90 psi, or such lower pressure as designated by the ENGINEER, and maintained so that the air pressure will not vary more than 5 psi from the designated pressure. Pneumatic-tired rollers shall be constructed so that the total weight of the roller can be varied to produce an operating weight per tire of not less than 2,000 pounds. The total operating weight of the roller shall be varied as directed by the ENGINEER.

METHOD OF MEASUREMENT

11-5.1 Asphalt concrete pavement shall be measured by the number of tons of bituminous mixture used in the accepted work.

BASIS OF PAYMENT

11-6.1 Payment for asphalt concrete pavement shall be made at the contract unit price per ton.

Asphalt concrete in a lot that is accepted on the basis of reduced payment will be paid for at the contract prices for the items of asphalt concrete involved, adjusted by the factors detailed in Paragraph 11-3.4. Price adjustments for deficiencies in pavement thickness shall be according to Paragraph 11-3.6. If payment factors for both thickness and mass density apply, the reduced price will be determined by successively multiplying the contract price by both pay factors.

END OF SECTION

DIVISION V
SECTION 12
PORTLAND CEMENT CONCRETE
(CALTRANS MODIFIED)

GENERAL

12-1.1 DESCRIPTION. Portland cement concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, admixtures if used, and water, proportioned and mixed as specified in these specifications.

The CONTRACTOR shall determine the mix proportions for concrete in conformance with these specifications. Unless otherwise specified, cementitious material shall be a combination of cement and mineral admixture. Cementitious material shall be:

- a. "Type II/V cement;
- b. Pavement section, Portland cement concrete shall be Class 2 mix and not less than 3,000 psi.
- c. Valley gutters shall be minor concrete and not less than 3,000 psi.

Type III Portland cement shall be used only as allowed in the special provisions or with the approval of the ENGINEER.

Class 1 concrete shall contain not less than 675 pounds of cementitious material per cubic yard.

Class 2 concrete shall contain not less than 590 pounds of cementitious material per cubic yard.

Class 3 concrete shall contain not less than 505 pounds of cementitious material per cubic yard.

Class 4 concrete shall contain not less than 420 pounds of cementitious material per cubic yard.

Minor concrete shall contain not less than 550 pounds of cementitious material per cubic yard unless otherwise specified in these specifications or the special provisions.

Unless otherwise designated on the PLANS or specified in these SPECIFICATIONS or the Special Provisions, the amount of cementitious material used per cubic yard of concrete in structures or portions of structures shall conform to the following:

Use	Cementitious Material Content pounds/CY
Concrete designated by compressive strength:	
Deck slabs and slab spans of bridges	675 min., 800 max.
Roof sections of exposed top box culverts	675 min., 800 max.
Other portions of structures	590 min., 800 max.
Concrete not designated by compressive strength:	
Deck slabs and slab spans of bridges	675 min.
Roof sections of exposed top box culverts	675 min.
Prestressed members	675 min.
Seal courses	675 min.
Other portions of structures	590 min.
Concrete for precast members	590 min., 925 max.

Whenever the 28-day compressive strength shown on the PLANS is greater than 3,600 psi, the concrete shall be designated by compressive strength. If the PLANS show a 28-day compressive strength that is 4,000 psi or greater, an additional 14 days will be allowed to obtain the specified strength. The 28-day compressive strengths shown on the PLANS that are 3,600 psi or less are shown for design information only and are not a requirement for acceptance of the concrete.

Concrete designated by compressive strength shall be proportioned such that the concrete will attain the strength shown on the PLANS or specified in the special provisions.

Before using concrete for which the mix proportions have been determined by the CONTRACTOR, or in advance of revising those mix proportions, the CONTRACTOR shall submit in writing to the ENGINEER a copy of the mix design.

Compliance with cementitious material content requirements will be verified in conformance with procedures described in California Test 518 for cement content. For testing purposes, mineral admixture shall be considered to be cement. Batch proportions shall be adjusted as necessary to produce concrete having the specified cementitious material content.

If any concrete has a cementitious material, Portland cement, or mineral admixture content that is less than the minimum required, the concrete shall be removed. However, if the ENGINEER determines that the concrete is structurally adequate, the concrete may remain in place and the CONTRACTOR shall pay to the State \$0.25 for each pound of cementitious material, Portland cement, or mineral admixture that is less than the minimum required. The Department may deduct the amount from any moneys due, or that may become due, the CONTRACTOR under the contract. The deductions will not be made unless the difference between the contents required and those actually provided exceeds the batching tolerances permitted by Section 9005, "Proportioning" of the Caltrans Specifications. No deductions will be made based on the results of California Test 518.

The requirements of the preceding paragraph shall not apply to minor concrete or commercial quality concrete.

MATERIALS

12-2.1 CEMENT. Unless otherwise specified, cement shall be Type II/V Portland cement.

"Type II Modified" Portland cement shall conform to the requirements for Type II Portland cement in ASTM Designation: C 150-02a.

Type V Portland cements shall conform to the requirements in ASTM Designation: C 150-02a and the additional requirements listed above for "Type II Modified" Portland cement, except that when tested in conformance with California Test 527, mortar containing Type III Portland cement shall not contract in air more than 0.075-percent.

Cement used in the manufacture of cast-in-place concrete for exposed surfaces of like elements of a structure shall be from the same cement mill.

Cement shall be protected from exposure to moisture until used. Sacked cement shall be piled to permit access for tally, inspection, and identification of each shipment.

Adequate facilities shall be provided to assure that cement meeting the provisions specified in Caltrans Specifications Section 90-2.01 shall be kept separate from other cement in order to prevent any but the specified cement from entering the work. Safe and suitable facilities for sampling cement shall be provided at the weigh hopper or in the feed line immediately in advance of the hopper, in conformance with California Test 125.

If cement is used prior to sampling and testing and the cement is delivered directly to the site of the work, the Certificate of Compliance shall be signed by the cement manufacturer or supplier of the cement. If the cement is used in ready-mixed concrete or in precast concrete products purchased as such by the CONTRACTOR, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product.

Cement furnished without a Certificate of Compliance shall not be used in the work until the Engineer has had sufficient time to make appropriate tests and has approved the cement for use.

12-2.2 AGGREGATES. Aggregates shall be free from deleterious coatings, clay balls, roots, bark, sticks, rags, and other extraneous material.

Natural aggregates shall be thoroughly and uniformly washed before use.

The CONTRACTOR, at the CONTRACTOR's expense, shall provide safe and suitable facilities, including necessary splitting devices for obtaining samples of aggregates, in conformance with California Test 125.

Aggregates shall be of such character that it will be possible to produce workable concrete within the limits of water content provided in Caltrans Specifications Section 90-6.06, "Amount of Water and Penetration."

Aggregates shall have not more than 10 percent loss when tested for soundness in conformance with the requirements in California Test 214. The soundness requirement for fine aggregate will be waived, provided that the durability index, D_r , of the fine aggregate is 60, or greater, when tested for durability in conformance with California Test 229.

If the results of any one or more of the Cleanness Value, Sand Equivalent, or aggregate grading tests do not meet the requirements specified for "Operating Range" but all meet the "Contract Compliance" requirements, the placement of concrete shall be suspended at the completion of the current pour until tests or other information indicate that the next material to be used in the work will comply with the requirements specified for "Operating Range."

If the results of either or both the Cleanness Value and coarse aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete that is represented by the tests shall be removed. However, if the ENGINEER determines that the concrete is structurally adequate, the concrete may remain in place, and the CONTRACTOR shall pay to the State \$3.50 per cubic yard for paving concrete and \$5.50 per cubic yard for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the CONTRACTOR under the contract.

If the results of either or both the Sand Equivalent and fine aggregate grading tests do not meet the requirements specified for "Contract Compliance," the concrete which is represented by the tests shall be removed. However, if the ENGINEER determines that the concrete is structurally adequate, the concrete may remain in place, and the CONTRACTOR shall pay to the State \$3.50 per cubic yard for paving concrete and \$5.50 per cubic yard for the concrete represented by these tests and left in place. The Department may deduct the amount from any moneys due, or that may become due, the CONTRACTOR under the contract.

The 2 preceding paragraphs apply individually to the "Contract Compliance" requirements for coarse aggregate and fine aggregate. When both coarse aggregate and fine aggregate do not conform to the "Contract Compliance" requirements, both paragraphs shall apply. The payments specified in those paragraphs shall be in addition to any payments made in conformance with the provisions in Section 12-1.1, "Description."

No single Cleanness Value, Sand Equivalent or aggregate grading test shall represent more than 300 cubic yards of concrete or one day's pour, whichever is smaller.

When the source of an aggregate is changed, the CONTRACTOR shall adjust the mix proportions and submit in writing to the ENGINEER a copy of the mix design before using the aggregates.

A. Coarse Aggregate.

Coarse aggregate shall consist of gravel, crushed gravel, crushed rock, crushed air-cooled iron blast furnace slag or combinations thereof. Crushed air-cooled blast furnace slag shall not be used in reinforced or prestressed concrete.

Coarse aggregate shall conform to the following quality requirements:

Tests	California Test	Requirements
Loss in Los Angeles Rattler (after 500 revolutions)	211	45% max.
Cleanness Value		
Operating Range	227	75 min.
Contract Compliance	227	71 min.

In lieu of the above Cleanness Value requirements, a Cleanness Value "Operating Range" limit of 71, minimum, and a Cleanness Value "Contract Compliance" limit of 68, minimum, will be used to determine the acceptability of the coarse aggregate if the CONTRACTOR furnishes a Certificate of Compliance, certifying that:

- a. coarse aggregate sampled at the completion of processing at the aggregate production plant had a Cleanness Value of not less than 82 when tested by California Test 227; and
- b. prequalification tests performed in conformance with the requirements in California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

B. Fine Aggregate

Fine aggregate shall consist of natural sand, manufactured sand produced from larger aggregate or a combination thereof. Manufactured sand shall be well graded.

Fine aggregate shall conform to the following quality requirements:

Test	California Test	Requirements
Organic Impurities	213	Satisfactory ^a
Mortar Strengths Relative to Ottawa Sand	515	95%, min.
Sand Equivalent: Operating Range	217	75, min.
Contract Compliance		71, min.

^a Fine aggregate developing a color darker than the reference standard color solution may be accepted if it is determined by the ENGINEER, from mortar strength tests, that a darker color is acceptable.

In lieu of the above Sand Equivalent requirements, a Sand Equivalent "Operating Range" limit of 71 minimum and a Sand Equivalent "Contract Compliance" limit of 68 minimum will be used to determine the acceptability of the fine aggregate if the CONTRACTOR furnishes a Certificate of Compliance, certifying that:

- a. fine aggregate sampled at the completion of processing at the aggregate production plant had a Sand Equivalent value of not less than 82 when tested by California Test 217; and
- b. prequalification tests performed in conformance with California Test 549 indicated that the aggregate would develop a relative strength of not less than 95 percent and would have a relative shrinkage not greater than 105 percent, based on concrete.

12-2.3 WATER In conventionally reinforced concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 1,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO₄, when tested in conformance with California Test 417. In prestressed concrete work, the water for curing, for washing aggregates, and for mixing shall be free from oil and shall not contain more than 650 parts per million of chlorides as Cl, when tested in conformance with California Test 422, nor more than 1,300 parts per million of sulfates as SO₄, when tested in conformance with California Test 417. In no case shall the water contain an amount of impurities that will cause either:

- 1) a change in the setting time of cement of more than 25 percent when tested in conformance with the requirements in ASTM Designation: C 191 or ASTM Designation: C 266; or
- 2) a reduction in the compressive strength of mortar at 14 days of more than 5 percent when tested in conformance with the requirements in ASTM Designation: C 109, compared to the results obtained with distilled water or deionized water tested in conformance with the requirements in ASTM Designation: C 109.

In non-reinforced concrete work, the water for curing, for washing aggregates and for mixing shall be free from oil and shall not contain more than 2,000 parts per million of chlorides as Cl, when tested in conformance with California Test 422, or more than 1,500 parts per million of sulfates as SO₄, when tested in conformance with California Test 417.

In addition to the above provisions, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of the concrete or produce etching of the surface.

Water reclaimed from mixer wash-out operations may be used in mixing concrete. The water shall not contain coloring agents or more than 300 parts per million of alkalis ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$) as determined on the filtrate. The specific gravity of the water shall not exceed 1.03 and shall not vary more than ± 0.010 during a day's operations.

12-2.4 ADMIXTURE MATERIALS. Admixture materials shall conform to the requirements in the following ASTM Designations:

- A. **Chemical Admixtures**—ASTM Designation: C 494.
- B. **Air-entraining Admixtures**—ASTM Designation: C 260.
- C. **Calcium Chloride**—ASTM Designation: D 98.
- D. **Mineral Admixtures**—Coal fly ash; raw or calcined natural pozzolan as specified in ASTM Designation: C 618; silica fume conforming to the requirements in ASTM Designation: C 1240, with reduction of mortar expansion of 80 percent, minimum, using the cement from the proposed mix design.

Unless otherwise specified in the special provisions, mineral admixtures shall be used in conformance with the provisions in Subsection 12-4.8, "Required Use of Mineral Admixtures."

AGGREGATE GRADINGS

12-3.1 GENERAL. Before beginning concrete work, the CONTRACTOR shall submit in writing to the ENGINEER the gradation of the primary aggregate nominal sizes that the CONTRACTOR proposes to furnish. If a primary coarse aggregate or the fine aggregate is separated into 2 or more sizes, the proposed gradation shall consist of the gradation for each individual size, and the proposed proportions of each individual size, combined mathematically to indicate one proposed gradation. The proposed gradation shall meet the grading requirements shown in the table in this section, and shall show the percentage passing each of the sieve sizes used in determining the end result.

The ENGINEER may waive, in writing, the gradation requirements in this Section 90-3.01 and in Sections 90-3.02, "Coarse Aggregate Grading," 90-3.03, "Fine Aggregate Grading," and 90-3.04, "Combined Aggregate Gradings," if in the ENGINEER's opinion, furnishing the gradation is not necessary for the type or amount of concrete work to be constructed.

Gradations proposed by the CONTRACTOR shall be within the following percentage passing limits:

Primary Aggregate Nominal Size	Sieve Size	Limits of Proposed Gradation
1 1/2" x 3/4"	1"	19 - 41
1" x No. 4	3/4"	52 - 85
1" x No. 4	3/8"	15 - 38
1/2" x No. 4	3/8"	40 - 78
3/8" x No. 8	3/8"	50 - 85
Fine Aggregate	No. 16	55 - 75
Fine Aggregate	No. 30	34 - 46
Fine Aggregate	No. 50	16 - 29

Should the CONTRACTOR change the source of supply, the CONTRACTOR shall submit in writing to the ENGINEER the new gradations before their intended use.

12-3.2 COARSE AGGREGATE GRADING. The grading requirements for coarse aggregates are shown in the following tables for each size of coarse aggregate:

Percentage Passing Primary Aggregate Nominal Sizes

Sieve Sizes	1 1/2" x 3/4"		1" x No. 4	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance
2"	100	100	—	—
1 1/2"	88-100	85-100	100	100
1"	X ± 18	X ± 25	88-100	86-100
3/4"	0-17	0-20	X ± 15	X ± 22
1/2"	—	—	—	—
3/8"	0-7	0-9	X ± 15	X ± 22
No. 4	—	—	0-16	0-18
No. 8	—	—	0-6	0-7

Sieve Sizes	1/2" x No. 4		3/8" x No. 8	
	Operating Range	Contract Compliance	Operating Range	Contract Compliance
2"	—	—	—	—
1 1/2"	—	—	—	—
1"	—	—	—	—
3/4"	100	100	—	—
1/2"	82-100	80-100	100	100
3/8"	X ± 15	X ± 22	X ± 15	X ± 20
No. 4	0-15	0-18	0-25	0-28
No. 8	0-6	0-7	0-6	0-7

In the above tables, the symbol X is the gradation that the CONTRACTOR proposes to furnish for the specific sieve size as provided in Subsection 12-3.1, "General."

Coarse aggregate for the 1 1/2-inch, maximum, combined aggregate grading as provided in Subsection 12-3.4, "Combined Aggregate Gradings," shall be furnished in 2 or more primary aggregate nominal sizes. Each primary aggregate nominal size may be separated into 2 sizes and stored separately, provided that the combined material conforms to the grading requirements for that particular primary aggregate nominal size.

When the one-inch, maximum, combined aggregate grading as provided in Subsection 12-3.4, "Combined Aggregate Gradings," is to be used, the coarse aggregate may be separated into 2 sizes and stored separately, provided that the combined material shall conform to the grading requirements for the 1" x No. 4 primary aggregate nominal size.

12-3.3 FINE AGGREGATE GRADING. Fine aggregate shall be graded within the following limits:

Sieve Sizes	Percentage Passing	
	Operating Range	Contract Compliance
3/8"	100	100
No. 4	95-100	93-100
No. 8	65-95	61-99
No. 16	X ± 10	X ± 13
No. 30	X ± 9	X ± 12
No. 50	X ± 6	X ± 9
No. 100	2-12	1-15
No. 200	0-8	0-10

In the above table, the symbol X is the gradation that the CONTRACTOR proposes to furnish for the specific sieve size as provided in Subsection 12-3.1, "General."

In addition to the above required grading analysis, the distribution of the fine aggregate sizes shall be such that the difference between the total percentage passing the No. 16 sieve and the total percentage passing the No. 30 sieve shall be between 10 and 40, and the difference between the percentage passing the No. 30 and No. 50 sieves shall be between 10 and 40.

Fine aggregate may be separated into 2 or more sizes and stored separately, provided that the combined material conforms to the grading requirements specified in this Subsection 12-3.3.

12-3.4 COMBINED AGGREGATE GRADINGS. Combined aggregate grading limits shall be used only for the design of concrete mixes. Concrete mixes shall be designed so that aggregates are combined in proportions that shall produce a mixture within the grading limits for combined aggregates as specified herein.

The combined aggregate grading, except when otherwise specified in these specifications or the special provisions, shall be either the 1 1/2-inch, maximum grading, or the one-inch, maximum grading, at the option of the CONTRACTOR.

Sieve Sizes	Percentage Passing			
	1 1/2" Max.	1" Max.	1/2" Max.	3/8" Max.
2"	100	—	—	—
1 1/2"	90-100	100	—	—
1"	50-86	90-100	—	—
3/4"	45-75	55-100	100	—
1/2"	—	—	90-100	100
3/8"	38-55	45-75	55-86	50 - 100
No. 4	30-45	35-60	45-63	45 - 63
No. 8	23-38	27-45	35-49	35 - 49
No. 16	17-33	20-35	25-37	25 - 37
No. 30	10-22	12-25	15-25	15 - 25
No. 50	4-10	5-15	5-15	5 - 15
No. 100	1-6	1-8	1-8	1 - 8
No. 200	0-3	0-4	0-4	0 - 4

Changes from one grading to another shall not be made during the progress of the work unless permitted by the ENGINEER.

12-3.5 STEEL REINFORCEMENT. Reinforcing shall consist of welded steel wire fabric and bar mats of ASTM A 185 and ASTM A 184 or A 704.

ADMIXTURES

12-4.1 GENERAL. Admixtures used in Portland cement concrete shall conform to and be used in conformance with the provisions in this Section and the special provisions. Admixtures shall be used when specified or ordered by the ENGINEER and may be used at the CONTRACTOR's option as provided herein.

Chemical admixtures and air-entraining admixtures containing chlorides as Cl in excess of one percent by weight of admixture, as determined by California Test 415, shall not be used in prestressed or reinforced concrete.

Calcium chloride shall not be used in concrete except when otherwise specified.

Mineral admixture used in concrete for exposed surfaces of like elements of a structure shall be from the same source and of the same percentage.

Admixtures shall be uniform in properties throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.

If more than one admixture is used, the admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.

12-4.2 MATERIALS. Admixture materials shall conform to the provisions in Caltrans Specifications Section 90-2.04, "Admixture Materials."

12-4.3 ADMIXTURE APPROVAL. No admixture brand shall be used in the work unless it is on the Department's current list of approved brands for the type of admixture involved.

Admixture brands will be considered for addition to the approved list if the manufacturer of the admixture submits to the Transportation Laboratory a sample of the admixture accompanied by certified test results demonstrating that the admixture complies with the requirements in the appropriate ASTM Designation and these specifications. The sample shall be sufficient to permit performance of all required tests. Approval of admixture brands will be dependent upon a determination as to compliance with the requirements, based on the certified test results submitted, together with tests the Department may elect to perform.

When the CONTRACTOR proposes to use an admixture of a brand and type on the current list of approved admixture brands, the CONTRACTOR shall furnish a Certificate of Compliance from the manufacturer, certifying that the admixture furnished is the same as that previously approved. If a previously approved admixture is not accompanied by a Certificate of Compliance, the admixture shall not be used in the work until the ENGINEER has had sufficient time to make the appropriate tests and has approved the admixture for use. The ENGINEER may take samples for testing at any time, whether or not the admixture has been accompanied by a Certificate of Compliance.

If a mineral admixture is delivered directly to the site of the work, the Certificate of Compliance shall be signed by the manufacturer or supplier of the mineral admixture. If the mineral admixture is used in ready-mix concrete or in precast concrete products purchased as such by the CONTRACTOR, the Certificate of Compliance shall be signed by the manufacturer of the concrete or product.

12-4.4 REQUIRED USE OF CHEMICAL ADMIXTURES AND CALCIUM CHLORIDE. When the use of a chemical admixture or calcium chloride is specified, the admixture shall be used at the dosage specified, except that if no dosage is specified, the admixture shall be used at the dosage normally recommended by the manufacturer of the admixture.

Calcium chloride shall be dispensed in liquid, flake, or pellet form. Calcium chloride dispensed in liquid form shall conform to the provisions for dispensing liquid admixtures in Caltrans Specifications Section 90-4.10, "Proportioning and Dispensing Liquid Admixtures."

12-4.5 OPTIONAL USE OF CHEMICAL ADMIXTURES. The CONTRACTOR will be permitted to use Type A or F, water-reducing; Type B, retarding; or Type D or G, water-reducing and retarding admixtures as described in ASTM Designation: C 494 to conserve cementitious material or to facilitate any concrete construction application subject to the following conditions:

- A. When a water-reducing admixture or a water-reducing and retarding admixture is used, the cementitious material content specified or ordered may be reduced by a maximum of 5 percent by weight, except that the resultant cementitious material content shall be not less than 505 pounds per cubic yard, and
- B. When a reduction in cementitious material content is made, the dosage of admixture used shall be the dosage used in determining approval of the admixture.

Unless otherwise specified, a Type C accelerating chemical admixture conforming to the requirements in ASTM Designation: C 494, may be used in Portland cement concrete. Inclusion in the mix design submitted for approval will not be required provided that the admixture is added to counteract changing conditions that contribute to delayed setting of the Portland cement concrete, and the use or change in dosage of the admixture is approved in writing by the ENGINEER.

12-4.6 REQUIRED USE OF AIR-ENTRAINING ADMIXTURES. When air-entrainment is specified or ordered by the ENGINEER, the air-entraining admixture shall be used in amounts to produce a concrete having the specified air content as determined by California Test 504.

12-4.7 OPTIONAL USE OF AIR-ENTRAINING ADMIXTURES. When air-entrainment has not been specified or ordered by the ENGINEER, the CONTRACTOR will be permitted to use an air-entraining admixture to facilitate the use of any construction procedure or equipment provided that the average air content, as determined by California Test 504, of 3 successive tests does not exceed 4 percent, and no single test value exceeds 5.5 percent. If the CONTRACTOR elects to use an air-entraining admixture in concrete for pavement, the CONTRACTOR shall so indicate at the time the CONTRACTOR designates the source of aggregate as provided in Caltrans Specifications Section 40-1.015, "Cement Content."

12-4.8 REQUIRED USE OF MINERAL ADMIXTURES. Unless otherwise specified, mineral admixture shall be combined with cement to make cementitious material.

The calcium oxide content shall not exceed 10 percent when determined in conformance with the requirements in ASTM Designation: C 114. The available alkali content (as sodium oxide equivalent) shall not exceed 1.5 percent when determined in conformance with the requirements in ASTM Designation: C 311, or the total alkali content (as sodium oxide equivalent) shall not exceed 5.0 percent when determined in conformance with the requirements in ASTM Designation: D 4326.

The amounts of cement and mineral admixture used in cementitious material shall be sufficient to satisfy the minimum cementitious material content requirements specified in Subsection 12-1.1, "Description," or Subsection 12-4.5, "Optional Use of Chemical Admixtures," and shall conform to the following:

- A. The minimum amount of cement shall not be less than 75 percent by weight of the specified minimum cementitious material content;
- B. The minimum amount of mineral admixture to be combined with cement shall be determined using one of the following criteria:
 - 1. When the calcium oxide content of a mineral admixture is equal to or less than 2 percent by weight, the amount of mineral admixture shall not be less than 15 percent by weight of the total amount of cementitious material to be used in the mix;
 - 2. When the calcium oxide content of a mineral admixture is greater than 2 percent, the amount of mineral admixture shall not be less than 25 percent by weight of the total amount of cementitious material to be used in the mix;
 - 3. When a mineral admixture that conforms to the provisions for silica fume in Subsection 12-2.4, "Admixture Materials," is used, the amount of mineral admixture shall not be less than 10 percent by weight of the total amount of cementitious material to be used in the mix.
- C. The total amount of mineral admixture shall not exceed 35 percent by weight of the total amount of cementitious material to be used in the mix. Where Subsection 12-1.1, "Description," specifies a maximum cementitious content in pounds per cubic yard, the total weight of cement and mineral admixture per cubic yard shall not exceed the specified maximum cementitious material content.

12-4.10 PROPORTIONING AND DISPENSING LIQUID ADMIXTURES. Chemical admixtures and air-entraining admixtures shall be dispensed in liquid form. Dispensers for liquid admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within ± 5 percent of the prescribed quantity for each batch. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each measuring unit shall be clearly marked for the type and quantity of admixture.

Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn slowly by the ENGINEER.

If more than one liquid admixture is used in the concrete mix, each liquid admixture shall have a separate measuring unit and shall be dispensed by injecting equipment located in such a manner that the admixtures are not mixed at high concentrations and do not interfere with the effectiveness of each other. When air-entraining admixtures are used in conjunction with other liquid admixtures, the air-entraining admixture shall be the first to be incorporated into the mix.

When automatic proportioning devices are required for concrete pavement, dispensers for liquid admixtures shall operate automatically with the batching control equipment. The dispensers shall be equipped with an automatic warning system in good operating condition that will provide a visible or audible signal at the point at which proportioning operations are controlled when the quantity of admixture measured for each batch of concrete varies from the preselected dosage by more than 5 percent, or when the entire contents of the measuring unit are not emptied from the dispenser into each batch of concrete.

Unless liquid admixtures are added to premeasured water for the batch, their discharge into the batch shall be arranged to flow into the stream of water so that the admixtures are well dispersed throughout the batch. Air-entraining admixtures may be dispensed directly into moist sand in the batching bins provided that adequate control of the air content of the concrete can be maintained.

Liquid admixtures requiring dosages greater than one-half gallon per cubic yard shall be considered to be water when determining the total amount of free water as specified in Section 90-6.06, "Amount of Water and Penetration."

Special admixtures, such as "high range" water reducers that may contribute to a high rate of slump loss, shall be measured and dispensed as recommended by the admixture manufacturer and as approved by the ENGINEER.

12-4.11 STORAGE, PROPORTIONING, AND DISPENSING OF MINERAL ADMIXTURES. Mineral admixtures shall be protected from exposure to moisture until used. Sacked material shall be piled to permit access for tally, inspection, and identification of each shipment.

Adequate facilities shall be provided to assure that mineral admixtures meeting the specified requirements are kept separate from other mineral admixtures in order to prevent any but the specified mineral admixtures from entering the work. Safe and suitable facilities for sampling mineral admixtures shall be provided at the weigh hopper or in the feed line immediately in advance of the hopper.

Mineral admixtures shall be incorporated into concrete using equipment conforming to the requirements for cement weigh hoppers, and charging and discharging mechanisms in ASTM Designation: C 94, in Subsection 12-5.3, "Proportioning," and in this Subsection 12-4.11.

When concrete is completely mixed in stationary paving mixers, the mineral admixture shall be weighed in a separate weigh hopper conforming to the provisions for cement weigh hoppers and charging and discharging mechanisms in Subsection 12-5.3A, "Proportioning for Pavement," and the mineral admixture and cement shall be introduced simultaneously into the mixer proportionately with the aggregate. If the mineral admixture is not weighed in a separate weigh hopper, the CONTRACTOR shall provide certification that the stationary mixer is capable of mixing the cement, admixture, aggregates and water uniformly prior to discharge. Certification shall contain the following: