

Revised Regulatory Proposals Crane Borer Engineering Assessment



Part of the Energy Queensland Group

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1 Introduction

This document summarises Energy Queensland's engineering assessment regarding the viability and costs of refurbishing crane borer plant to enable an extended service life up to 20 years.

1.1 Purpose of document

The purpose of this engineering report is to present Energy Queensland's position on the refurbishment of crane borers in conjunction with the mandatory 10 year major inspection (YMI) and associated costs. The cost estimates included within this document are consistent with the crane borer unit costs included within the Energex and Ergon Energy fleet models for the Revised Regulatory Proposals (RRPs) .

1.2 Scope of document

This report applies to:

- In-service crane borer plant due to reach 10 years of service in the 2020-2025 regulatory control period (RCP), and
- Associated crane borer trucks (i.e. the heavy vehicle carrier on which the crane borers are installed, transported and operated).

1.3 Background

Bottom-up fleet replacement programs for Energex and Ergon Energy were provided to the AER to support the 2020-2025 RCP funding requirements. Full replacement funding for crane borer units was forecast within these submissions, including replacement of both the crane borer plant and the associated truck.

This position was premised on the rapid improvements in crane borers as a result of evolving Australian Standards, updates and technological progress for cranes, crane safety control systems, trucks and truck safety systems for an improved workplace. The originally proposed approach would leverage these improvements to ensure ongoing compliance with legislative, standards and manufacturers' requirements.

Through the AER's draft decisions, feedback was received that a large majority of Energy Queensland's crane borer fleet (97%) should undergo refurbishment in conjunction with the 10YMI, enabling a total service life of 20 years.

In response to the AER draft decisions, this engineering evaluation has been conducted to assess the viability of extending crane borer service lives in place of the previously planned plant replacements.

2 Crane borer obligations

This section describes Energex and Ergon Energy's obligations and best practice procedures for maintaining a safe, reliable and operationally serviceable crane borer fleet.

2.1 Australian standards, manufacturers' instructions and industry guides

Table 1 below summarises the relevant Australian Standards, manufacturers' instructions and industry guides related to Energex and Ergon Energy's crane borer fleet.

Document number	Document name	Document type
AS 1418.1 - 2002	Cranes, hoists and winches – Safe Use Part 1: General Requirements	Standard
AS 1418.5 - 2013	Cranes, hoists and winches – Safe Use Part 5: Mobile Cranes	Standard
AS 2550.1 - 2011	Cranes, hoists and winches – Safe Use Part 1: General Requirements	Standard
AS 2550.5 - 2016	Cranes, hoists and winches – Safe Use Part 5: Mobile Cranes	Standard
Safe Work Australia	Guide to Inspecting and Maintaining Cranes	Guide
D4000A Maint 2013 749-10059	Altec D4050 Maintenance Manual	Manufacturer's Instruction
Doc 64D (OZZY Cranes)	Doc 64d OZZY crane borer 10 year major inspection	Manufacturer's Instruction
Doc 67 (OZZY Cranes)	Doc 67 OZZY crane borer major inspection schedule	Manufacturer's Instruction
Doc 64D (OZZY Cranes)	Doc 68 OZZY crane borer major inspection (commissioning) schedule	Manufacturer's Instruction
Doc #17102019	Premier Proline Major Inspection	Manufacturer's Instructions
PCR940	Premier Proline Manual	Manufacturer's Instructions
23081	Regulation Impact Statement Improving the Stability and Control of Heavy Vehicles	Report – Australian Government

Table 1: Relevant Australian Standards, Manufacturer's Instructions and Industry Guides

2.2 Legislation, regulations and codes

Table 2 below summarises the legislation, regulations and codes with which Energex and Ergon Energy must comply as operators of crane borer plant and the associated heavy vehicle fleet.

Legislation, regulations, rules, and codes	Document type
Professional Engineers Act – 2002 (Queensland)	Legislation
Queensland Mobile Crane Code of Practice 2006	Code
Queensland Work Health and Safety Act 2011	Legislation
Queensland Work Health and Safety Regulation 2011	Regulation
Heavy Vehicle National Law Act (Queensland) 2012	Legislation

Legislation, regulations, rules, and codes	Document type
Heavy Vehicle National Law Regulation (Queensland) 2014	Regulation
Heavy Vehicle National Law – Chain of Responsibility 2018	Legislation
National Heavy Vehicle Inspection Manual Version 2.3	Regulation

Table 2: Legislation, Regulations and Codes

2.3 Queensland specific obligations

The Professional Engineers Act Queensland requires:

- a) Engineering services shall be carried out by a Registered Professional Engineer Queensland (RPEQ); and
- b) The Act is aligned with the Mobile Crane Code of Practice Queensland, where the requirement for a 10YMI (an engineering service) is required to be carried out by an engineer, i.e. RPEQ.

The Mobile Crane Code of Practice Queensland requires:

- a) Where a 10YMI is to be carried out, the competent person certifying the inspection must to be an engineer;
- b) Competent Person Qualifications: Professional Engineering Qualification, Membership of a professional organisation and crane industry experience”, or “Professional Engineering Qualification and crane industry experience; and
- c) Compliance with manufacturer’s instructions and relevant Australian Standards.

Consistent with the above obligations, this crane borer engineering assessment and the associated assumptions supporting Energex and Ergon Energy’s revised regulatory proposals have been prepared by a qualified and registered engineer (RPEQ). The assessment has been performed with detailed knowledge of the above listed Australian standards, manufacturers’ instructions, industry guides, legislation, regulations and codes of practice, as well as significant crane and distribution industry experience.

2.4 Manufacturers’ instructions

Obligations as defined through manufacturers’ instructions (and as required for compliance with the Mobile Crane Code of Practice Queensland) include:

- a) For all manufacturers, compliance with AS1418 and 2550, where:
 - I. The major inspection shall include mechanical inspection, assessment and repair or replacement of components as necessary to ensure a crane borer unit is safe for continued use.
 - II. The major inspection shall occur at a maximum interval of 10 years in service, or after a crane overload.
 - III. Achieving the maximum 10 years in service major inspection interval, a crane’s load management system must be automated and capture the crane’s duty history of the crane’s operation. Load duty represents the load dimension and frequency of the load. If automated load duty recording is not present, the prescribed major inspection point is a diminishing value and can be as low as 6.67 years.

- IV. The crane's duty history is used to determine the current design working period (DWP) - the crane's life point per its design requirements and classification. It should be noted that crane operations, frequency of use and greater than 100% loading, can result in greater than 10 years of design life being consumed in the nominal 10 years of service, i.e. at 10 calendar years in service, severe operation could achieve equate to greater than 10 years of service by the crane manufacturer's design requirements. In such a case the crane's major inspection shall be brought forward.
- b) Altec cranes
 - I. Nominally require the initial major inspection to occur after 10 years in service.
 - II. The subsequent (second) major inspection shall occur after a further 10 years of service, i.e. the crane borer is expected to achieve a nominal 20 years in service, before the next major inspection is due.
- c) OZZY cranes
 - I. Nominally require the initial major inspection to occur after 10 years in service.
 - II. The subsequent (second) major inspection shall occur after a further 10 years of service, i.e. the crane borer is expected to achieve a nominal 20 years in service, before the next major inspection is due.
- d) Proline cranes
 - I. Nominally require the initial major inspection to occur after 10 years in service.
 - II. The subsequent (second) major inspection shall occur after a further five years of service, i.e. the crane borer is expected to achieve a nominal 15 years in service, before the next major inspection is due.

Note that subsequent (i.e. second) major inspection timing will be dependent on in-service use, maintenance, repairs and DWP assessment.

3 Analysis approach

The condition of 8 units was assessed, including units approaching 10 years of service and units that have received 10YMI. The sampling of these units and associated actual or expected costs has been used to determine the 10YMI refurbishment cost estimating model.

3.1 Crane borer plant 10YMI outcomes

Three units have undergone condition assessment through the 10YMI process. I.e. Two OZZY crane borers and one Proline crane borer.

OZZY crane borers

- Through the 10YMI process, the two OZZY crane borers underwent safety upgrades in control systems, completed for compliance with the current version of AS1418. The plant was also transferred to replacement trucks (i.e. “retrucking”).
- Since re-commissioning these two OZZY units following the 10YMI, the units have suffered from greater than expected in-service component issues, resulting in down time and additional works.
- Appendix 2 provides the quote for an OZZY crane borer 10YMI as well as the actual invoices for the 10YMI and for additional works identified following disassembly. [REDACTED]
- Appendix 3 provides another quote for an OZZY crane borer 10YMI as well as the actual invoices for the 10YMI and for additional works identified following disassembly. [REDACTED]

Proline crane borer

- Through the 10YMI process, the Proline crane borer also underwent safety upgrades in control systems, completed for compliance with the current version of AS1418.
- The plant was scheduled for “retrucking” in August 2019, but this has been temporarily delayed subject to availability of the replacement truck and workshop capacity. As an interim measure, the existing truck has been serviced pending replacement.
- As a Proline unit, this plant will require a subsequent major inspection following an additional 5 years of service. i.e. nominally at 15 years of age.
- Appendix 4 provides the invoices for the Proline crane borer 10YMI refurbishment. [REDACTED]

3.2 Crane borer plant pre-10YMI condition assessments

Five units nearing 10 years in-service have also undergone engineering condition inspection. Major components were inspected and assessed for continued safe use (subject to 10YMI refurbishments) to enable an expected 10 years further service. Through these inspections it was found that:

- Critical structural components are suffering from cracks, i.e. boom, turret and sub-frame.
- Stabilizer leg tubes have suffered from wear and will require replacement or significant repair.
- Slew drive units have suffered deterioration and component failure, i.e. output shaft cracking, brake wear and drive motor wear.
- Slew bearing components worn beyond serviceable limits, requiring replacement.

3.3 Truck condition assessments

The predominant truck in use is an Isuzu, with assessment observations as follows:

- Engine stationary operation must be assessed in a manner equivalent to distance travelled. I.e. a stationary engine operating hour is equivalent to 50km travelled, or a rate of 50km/hr.
- Stationary operation affects engine, cooling and electrical systems and transmission components.
- Average physical distance travelled for assessed units is 270,000km.
- Average Power Take-Off (PTO) hours operating the crane are 5800, equivalent to an additional 290,000km wear on critical components. Equivalent distance travelled for mechanical assessment is therefore nominally 560,000km (i.e. 270,000km travelled + 290,000 equivalent stationary kilometres).
- As a rule of thumb in the electricity industry, for tipper and concrete agitator operation, trucks are nominally retired at a maximum 500,000km. This is particularly relevant in the frequently-harsh Queensland operating environment. Across typical truck vocations, assets are nominally loaded for 50% of the truck's working life, i.e. 50% travel delivering a load to maximum RGVM one-way and 50% unloaded on a return trip. In contrast, an Energy Queensland Crane Borer is operating at 95-100% of its RGVM for 100% of its time (loaded to RGVM constantly). This represents an equivalent loaded distance travelled double the truck's odometer reading. Constant loading affects durability of structural, axle and suspension components of a truck. With this consideration, the equivalent distance travelled for structural assessment, is nominally 1,120,000km (i.e. 560,000km x 2).

4 Analysis outcomes

4.1 Crane borer service life extensions

Energy Queensland recognises the AER's position that a high proportion of crane borer plant can be refurbished in conjunction with the 10YMI (97%) to enable a further 10 years of service (i.e. a total service life of 20 years). Based on the engineering assessment, it is determined that in order for this position to be viable, investment is required in each asset to ensure safety, compliance and serviceability.

The total forecast cost associated with the service life extension is estimated at [REDACTED] as summarised in Table 3 below.

This amount includes costs for the 10YMI refurbishment with components identified through the equipment manufacturers' instructions as required for compliance with the Mobile Crane Code of Practice Queensland. It also includes additional amounts to address further issues identified through the inspections as tabulated below (i.e. stabiliser tubes, slew drive componentry, hydraulic pumps and auger drives).

10YMI Refurbishment Item	Related condition assessment findings	Scope	Cost
10YMI as per manufacturers' instructions	Crane borer components and overhaul as identified by equipment manufacturer	Minimum requirement for 10YMI. Includes disassembly, inspection and assessment.	[REDACTED]
Rear stabiliser tube	Cross tubes worn beyond a point where a further 10 years of service is unlikely along with deterioration of strength	Replace tubes and include current design replaceable wear-pad, increasing in-service durability	
Front stabiliser tube	Cross tubes worn beyond a point where a further 10 years of service is unlikely along with deterioration of strength	Replace tubes and include current design replaceable wear-pad, increasing in-service durability	
Replacement slew drive	Output shaft cracked, brake unit worn, drive motor worn and transmission components worn	Replace unit	
Slew bearing	Bearings worn beyond equipment manufacturer replacement criteria	Replace bearing and mounting bolts	
Hydraulic pump	Hydraulic pump housing and component wear, significantly reduce efficiency and performance (hydraulic output)	Replace hydraulic pump	
Auger drive, carrier and boom attachment point	Drive motor reduced efficiency and performance. Auger drive carrier cracking and cracking in boom at attachment point	Overhaul auger drive motor, repair auger drive carrier and boom attachment point	
Truck re-installation	Transfer and reinstallation of plant	Transfer and reinstallation of plant	
Total crane borer plant 10YMI & refurbishment cost to enable a further 10 years of service			[REDACTED]

Table 3: Crane borer plant 10YMI refurbishment cost estimate to enable a 10 year service life extension

4.2 Truck service life extensions

Existing inspected trucks have accumulated substantial wear and tear as a result of distance travelled and stationary hours of operation. It is unlikely that significant investment into 10 year old crane borer trucks would achieve a further 10 years of life without reliability issues and/or the need for substantial additional maintenance and repair during the period of extended life.

That is, works to restore a truck to a suitable level would require very significant cost, with further maintenance costs then expected to occur midway through the subsequent 10 year period.

Recent changes within the transport industry regulation now include greater accountability in terms of chain of responsibility and safety features now inherent in currently available trucks add to compliance measures. On this basis, the engineering assessment has determined that a new truck should be a component of the investment to extend the life of a crane borer unit beyond 10 years of service.

Table 4 below summarises a set of key considerations associated with crane borer truck service life extensions as identified through the condition assessment process.

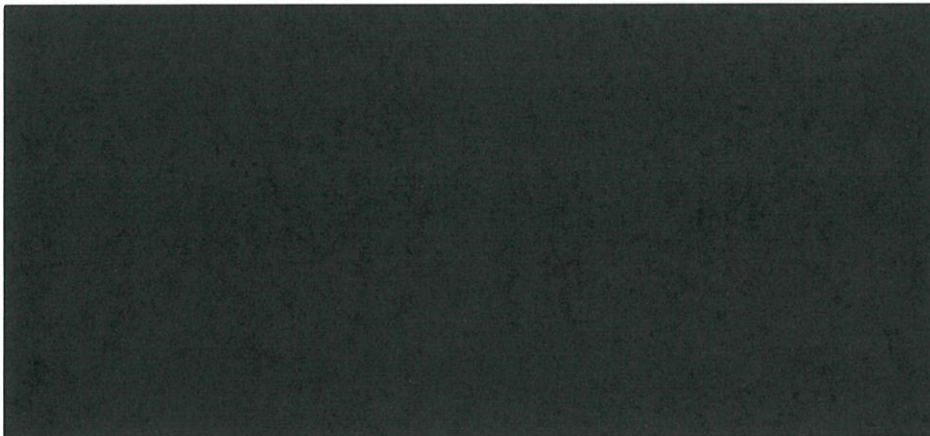
Items considered for a further 10 years of operation	Minimal requirements
Major Service	Equivalent to 250,000km service
Cab Refurbishment	Repair or replace worn and damaged components. Nil consideration for cab paint
Cab Repaint	Restore truck cab
Engine Overhaul or Replacement	Includes engine, fuel system, turbo and manifolds, and cooling system
Engine Emissions	Compliance of engine emissions controls to current Australian Design Rule (ADR) requirements. Note: emissions compliance is a requirement for approved Front Underrun Protection System (FUPS) to achieve increased front axle mass limits per regulation
Transmission refurbishment or Replacement	Full disassembly required. For complete costing anticipate clutch packs, torque converter and valve body overhaul or replacement
Driveline & axle refurbishment	Axle inspection and repair, drive shaft repair or replacement plus bearing and seal replacement
Suspension Overhaul	Spring reset, spring bushing replacement, torque rod and trunnion bearing replacement
Braking, Stability and Control	Adaption of existing truck to include Antilock Braking System (ABS), Electronic Braking System (EBS), Electronic Stability Control (ESC) to meet emerging Heavy Vehicle National Law (HVNL) and ADR requirements for heavy vehicles for the subsequent 10 years in-service
Chassis Frame Certification	Inspection, assessment and certification of chassis frame by RPEQ
Chassis Repair and Repaint	Restore chassis frame
Tow Coupling	Inspect and overhaul or replace as required

Table 4: Truck service life extension considerations

5 Recommendations

It is recommended that Energex and Ergon Energy:

- a) Perform 10YMI refurbishments on crane borer plant through the 2020-2025 RCP in accordance with relevant legislation, codes of practice, manufacturers' instructions and relevant Australian standards. Estimated costs to complete the 10YMI refurbishment to enable an additional 10 years of service for the crane borer plant is [REDACTED]
- b) "Retruck" the crane borer plant onto a new truck for the subsequent 10 years of plant service. Costs for replacement trucks are as per Energex and Ergon Energy's respective unit rate lists. Costs associated with physically transferring and reinstalling the plant onto the new truck are included in the [REDACTED] plant refurbishment estimate.



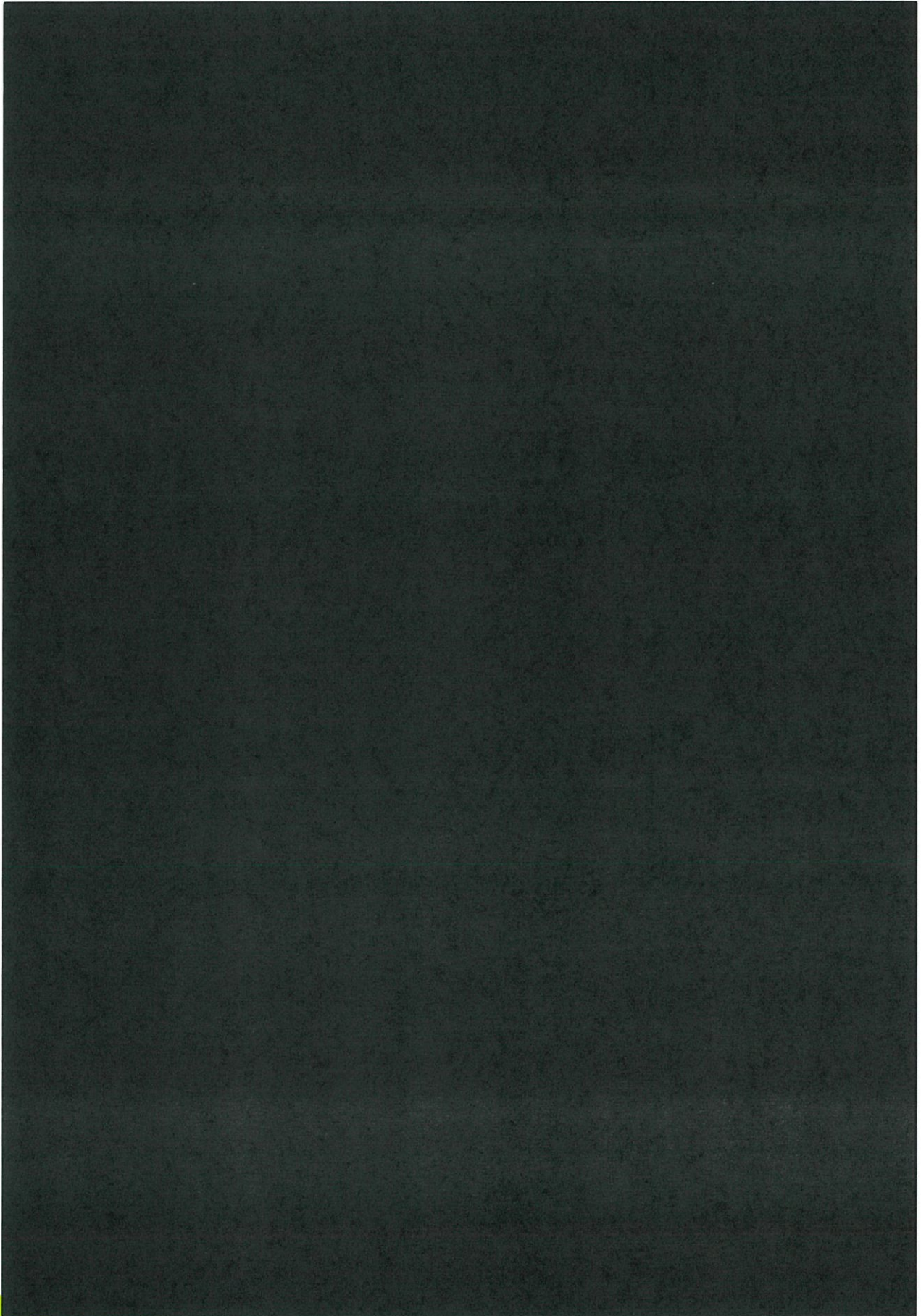
Appendix 1. Definitions, acronyms and abbreviations

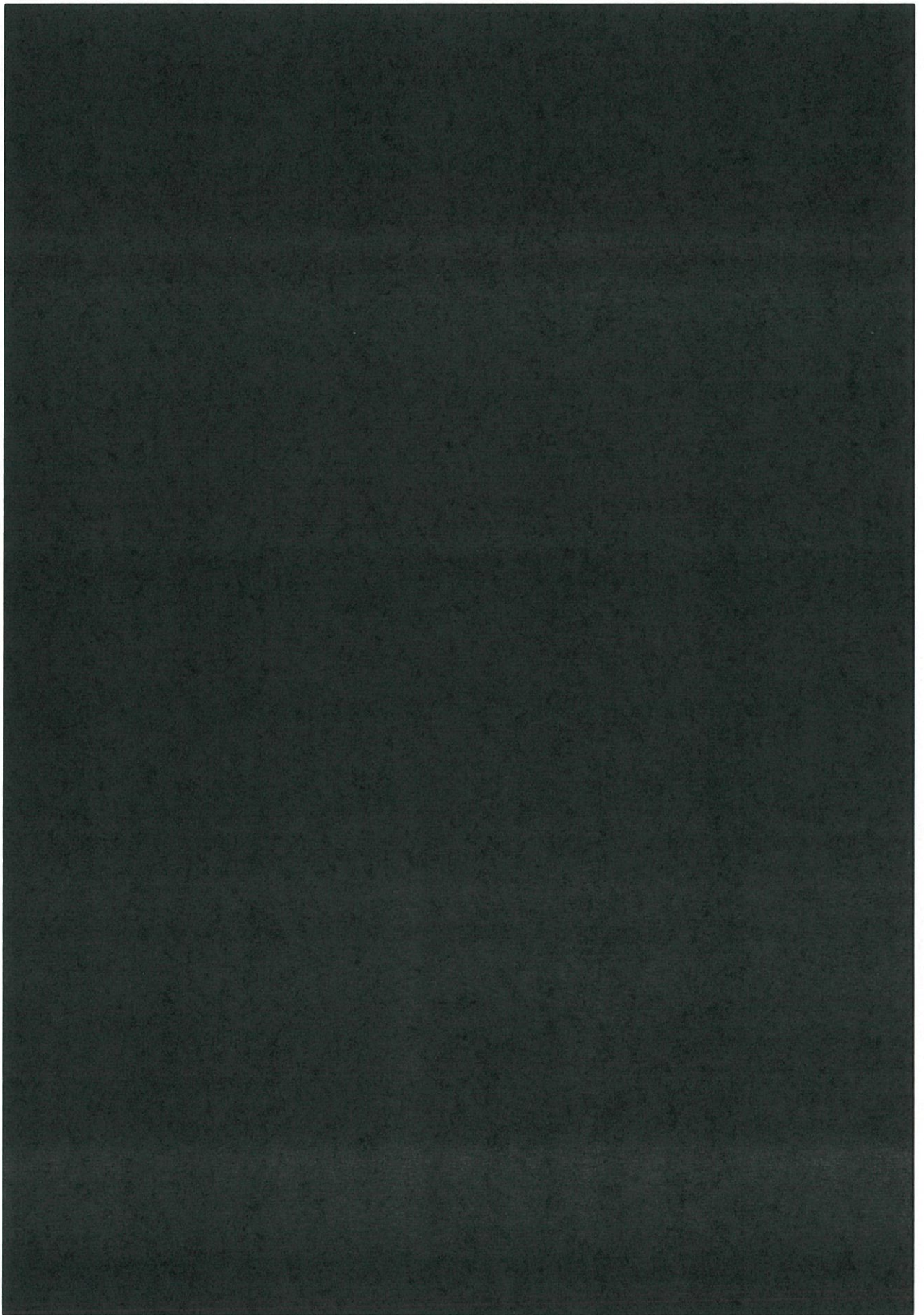
The following terms, abbreviations and acronyms appear in this engineering report.

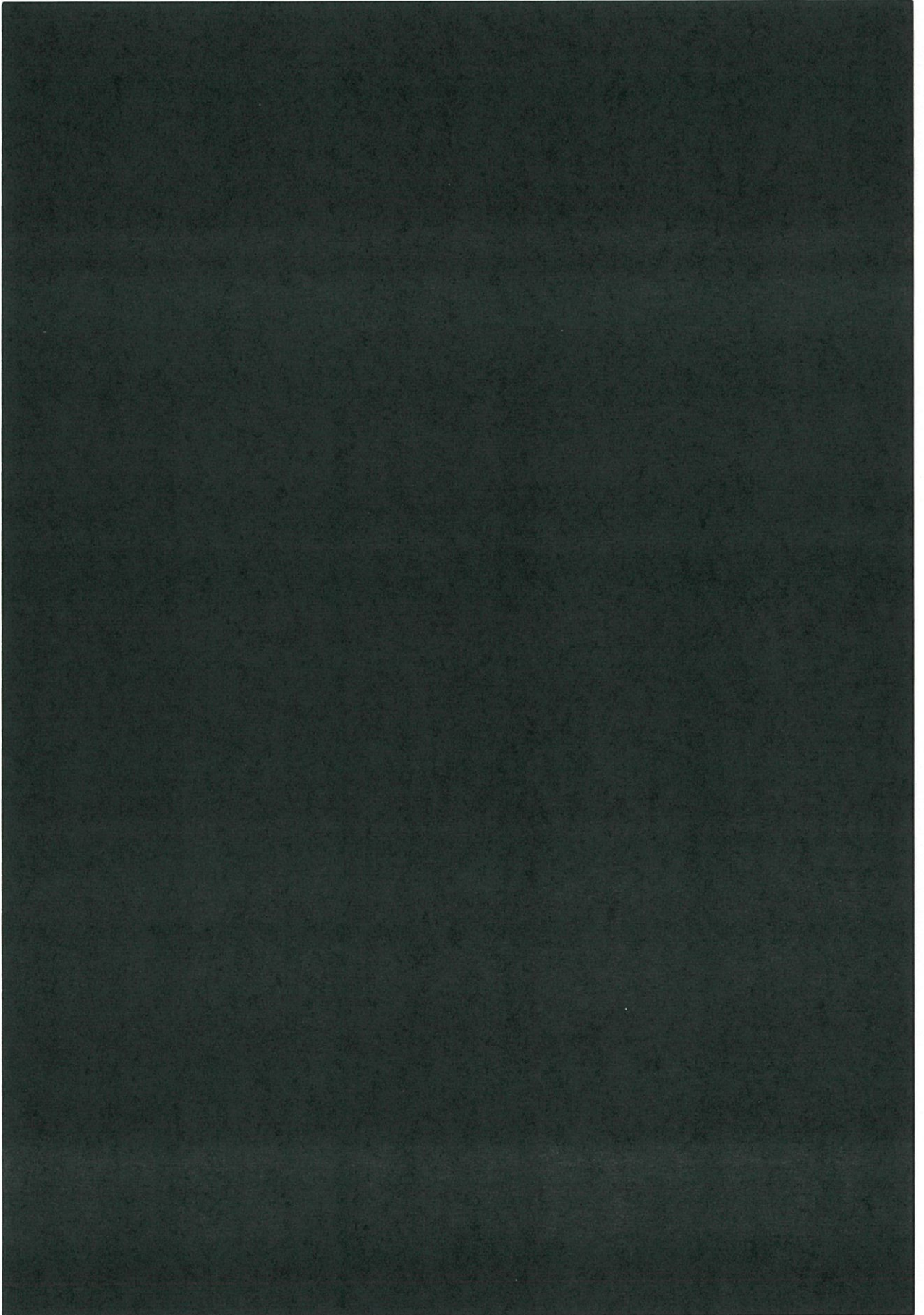
Term, abbreviation or acronym	Definition
10YMI	10 Year Major Inspection
ABS	Antilock Braking System
ADR	Australian Design Rules (as applied to vehicles)
AER	Australian Energy Regulator
AS	Australian Standard
AS1418.1	Australian Standard 1418.1 - 2002 Cranes, hoists and winches Part 1: General Requirements
AS1418.5	Australian Standard 1418.5 – 2013 Cranes, hoists and winches Part 5: Mobile Cranes
AS2550.1	Australian Standard 2550.1 - 2011 Cranes, hoists and winches – Safe Use Part 1: General Requirements
AS2550.5	Australian Standard 2550.5 - 20169 Cranes, hoists and winches – Safe Use Part 5: Mobile Cranes
Truck	The vehicle the CB is installed on for transport and powering the CB
CB	Crane Borer Plant
CB unit	Crane Borer fitted to its associated truck
COP	Code of Practice
COR	Chain of Responsibility
DWP	Design Working Period
EBS	Electronic Braking Systems
ESC	Electronic Stability Control
EQL	Energy Queensland Limited
FUPS	Front Underrun Protection System (heavy vehicles)
HVNL	Heavy Vehicle National Law
OEM	Original Equipment Manufacturer
PTO	Power Take-Off
RGVM	Regulated Gross Vehicle Mass
RPEQ	Registered Professional Engineer Queensland
SN	Serial Number

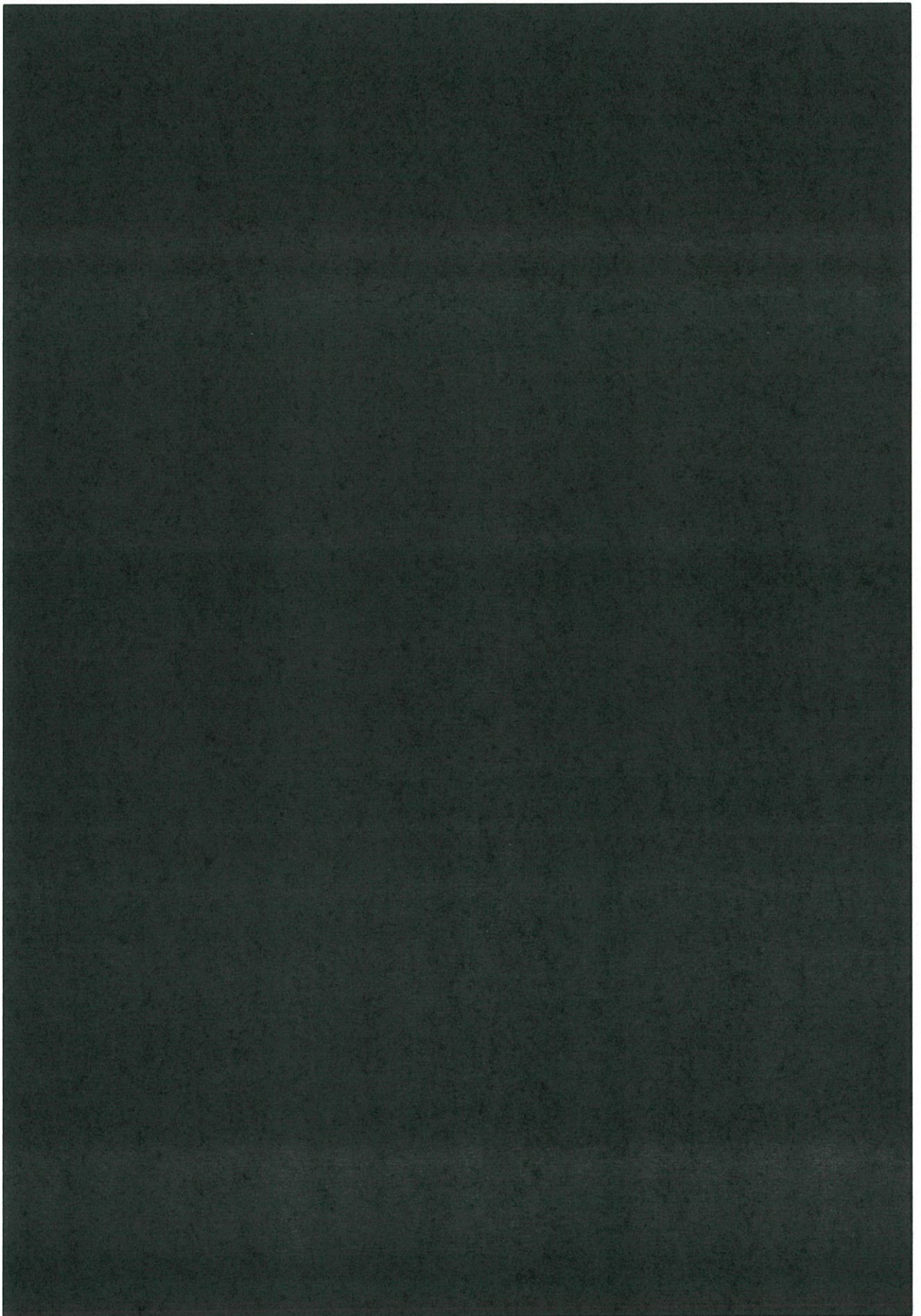
Table 5: Definitions, acronyms and abbreviations

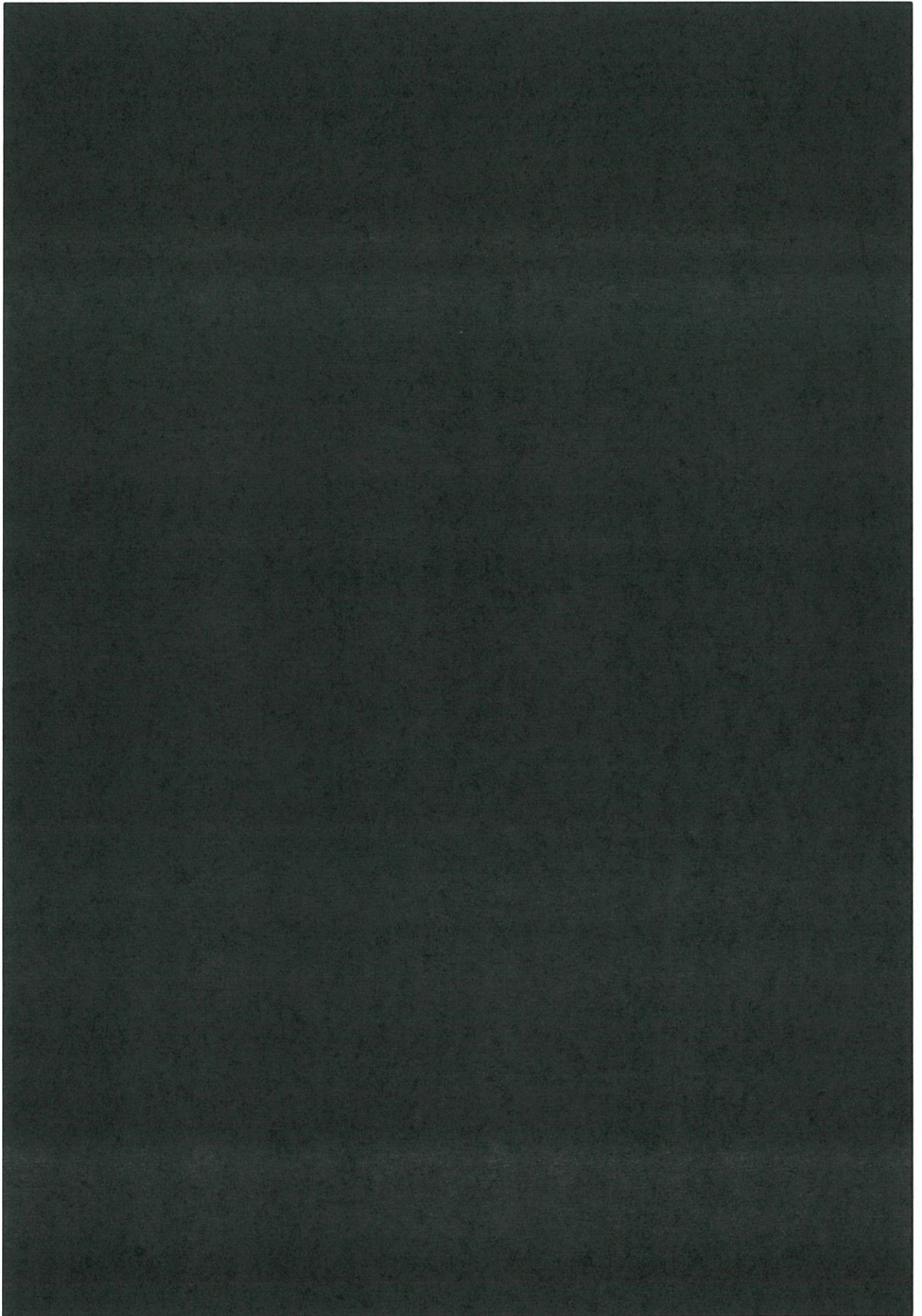
Appendix 2. OZZY Crane Borer

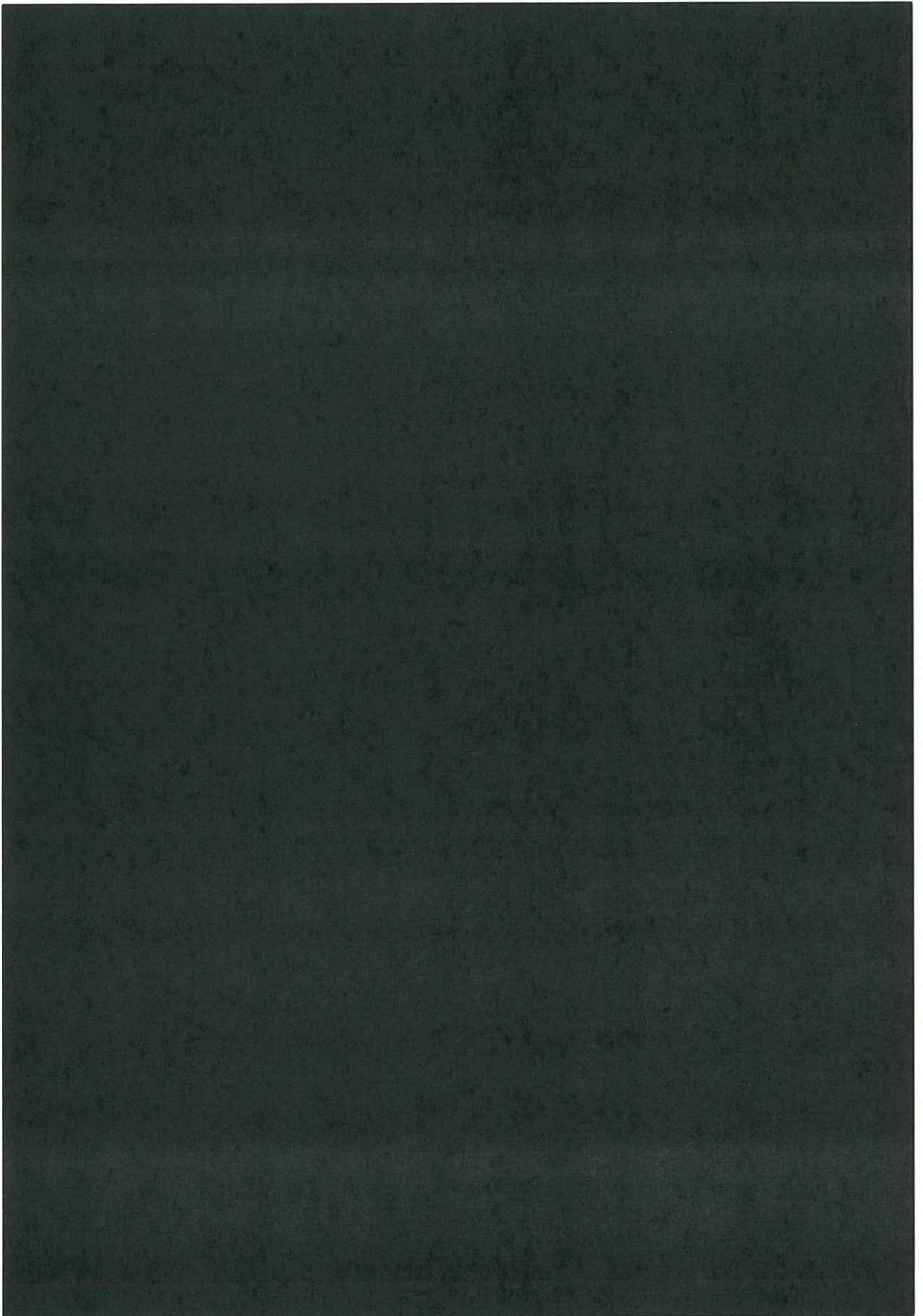


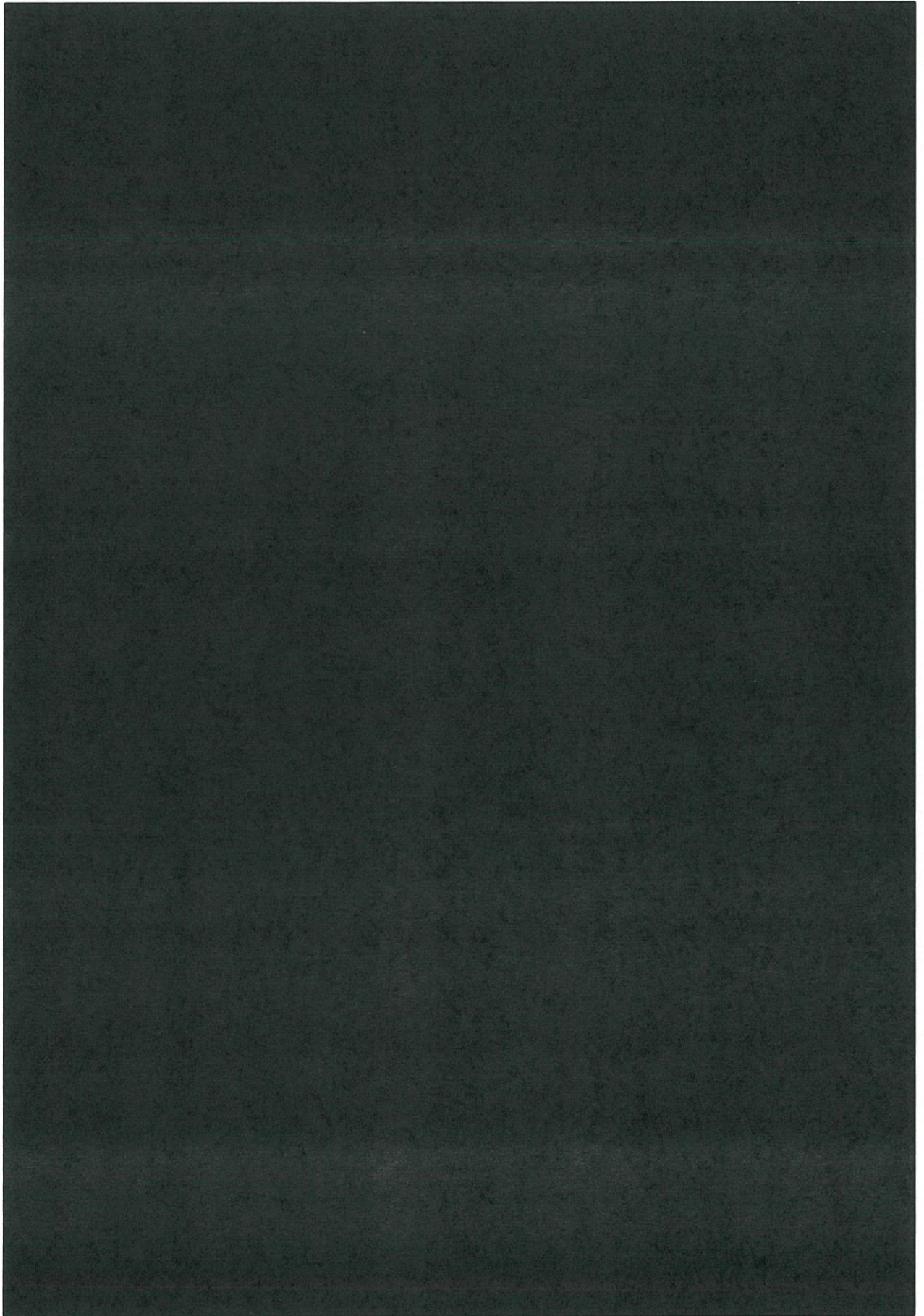


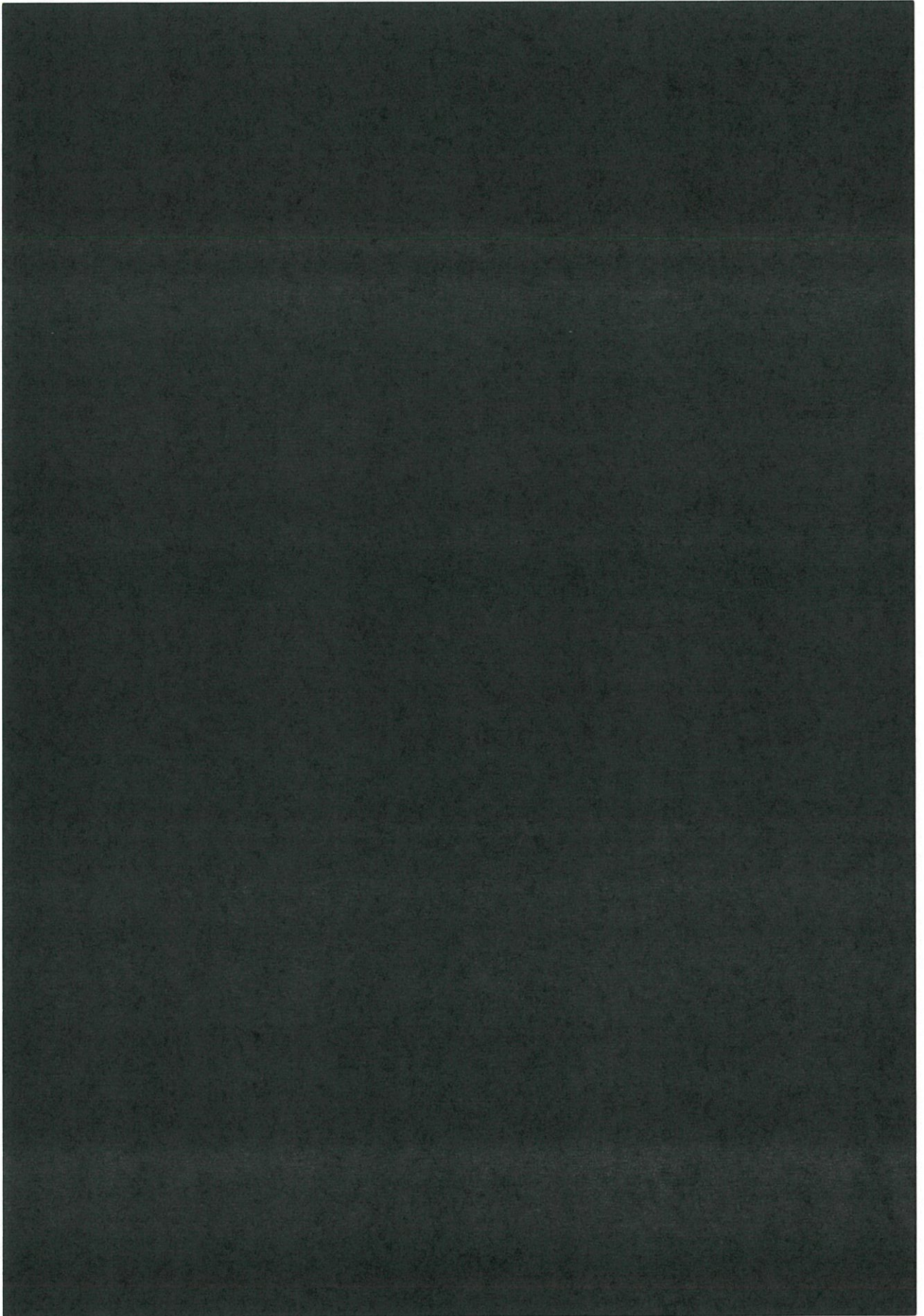


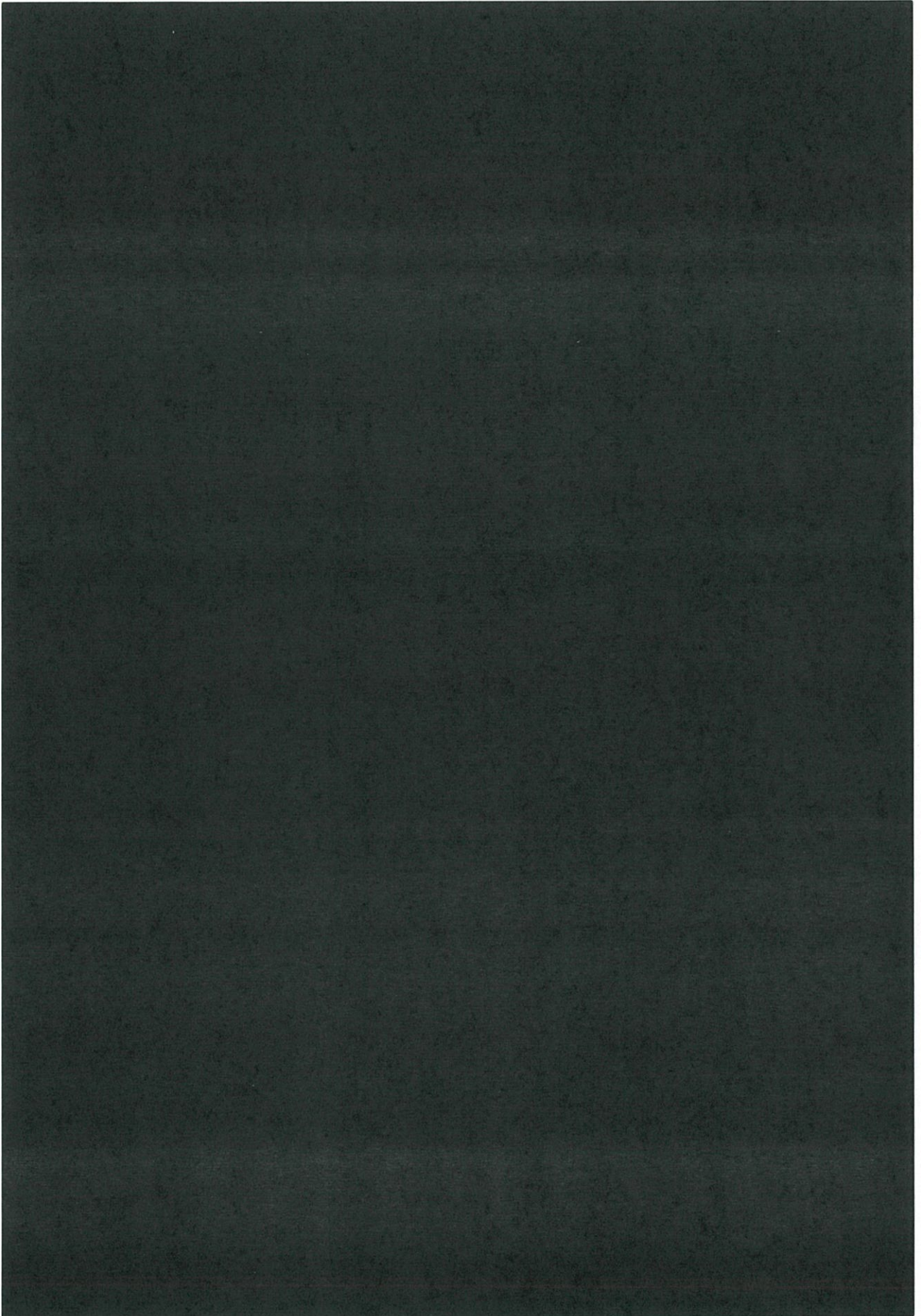


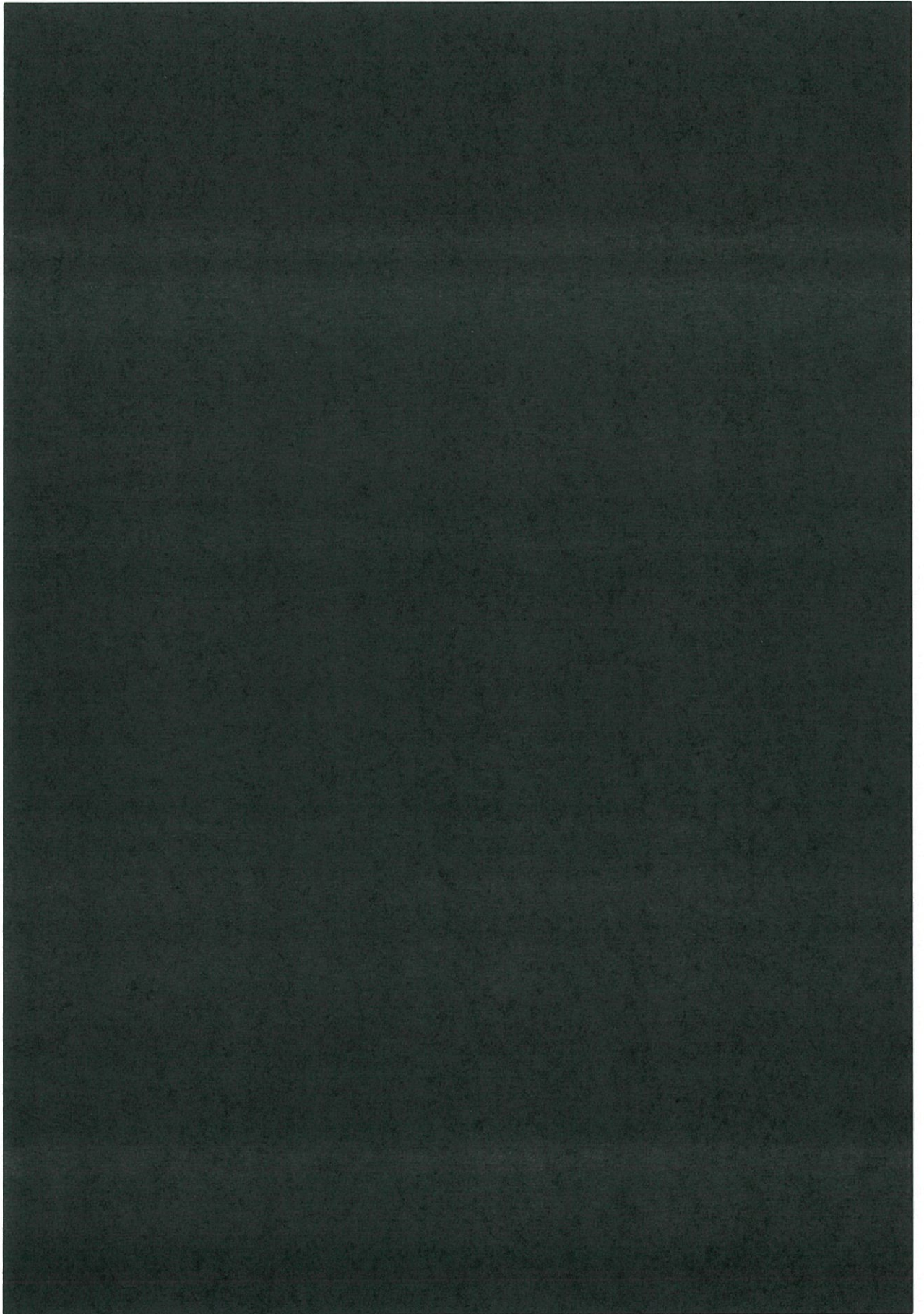


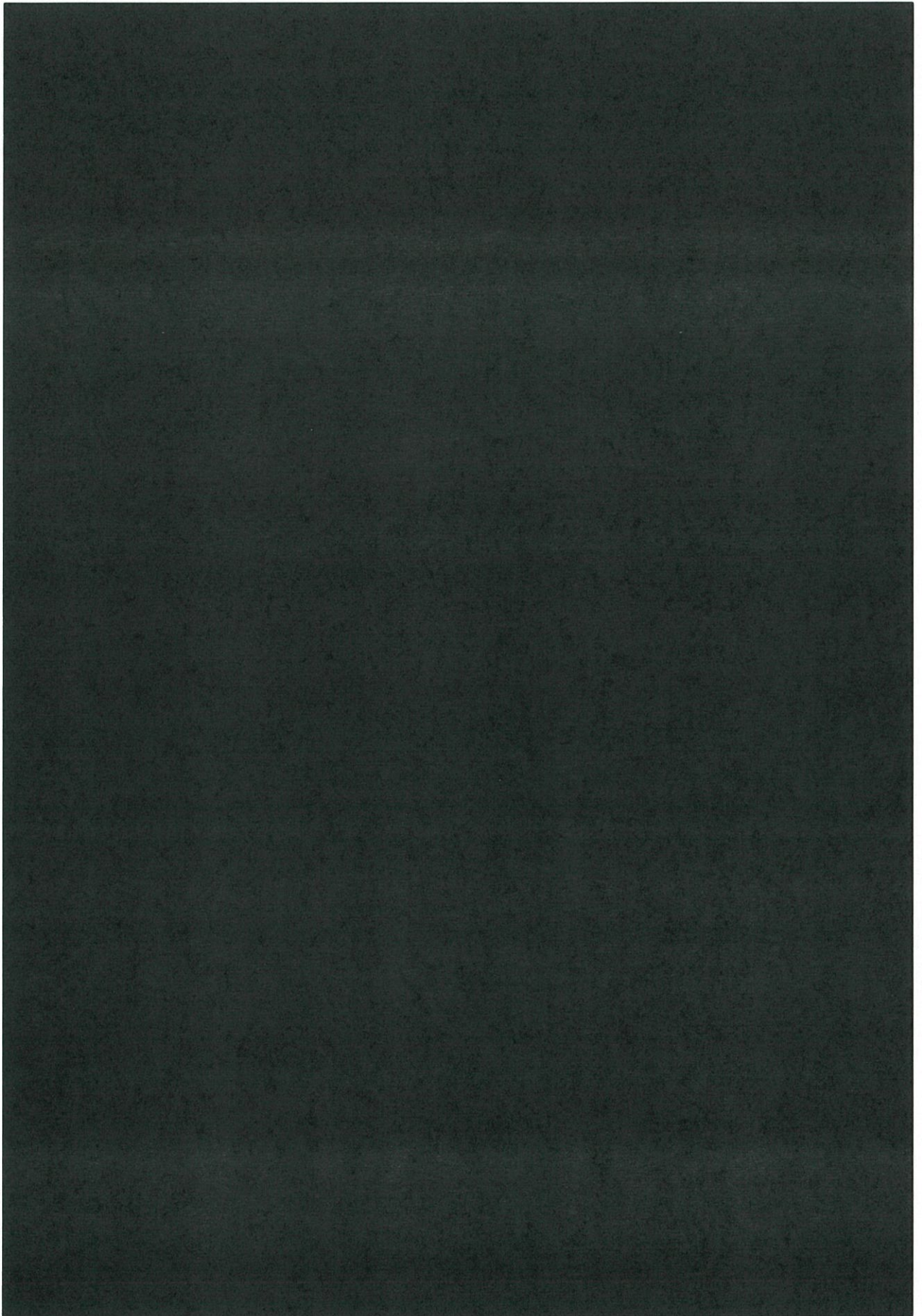


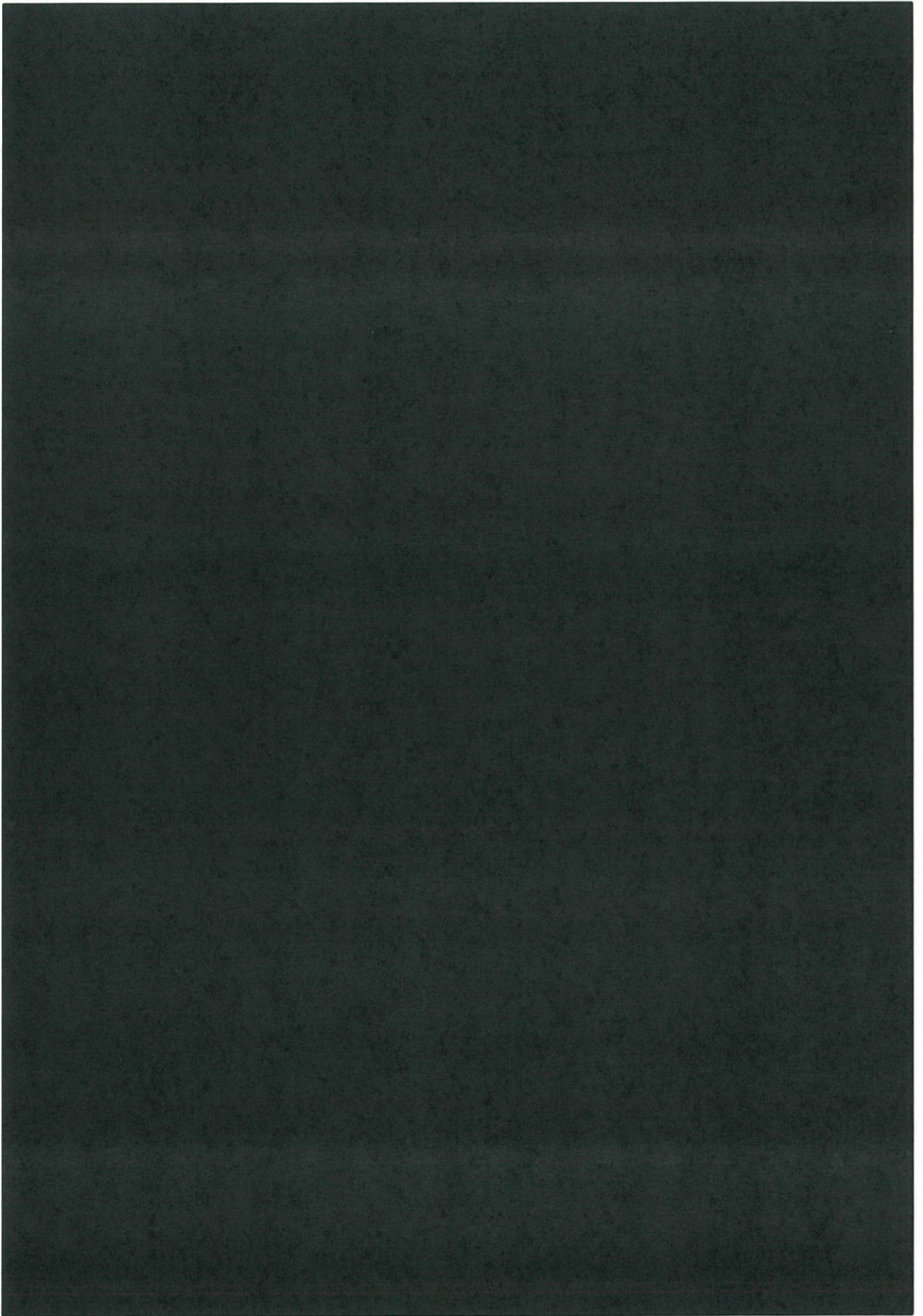


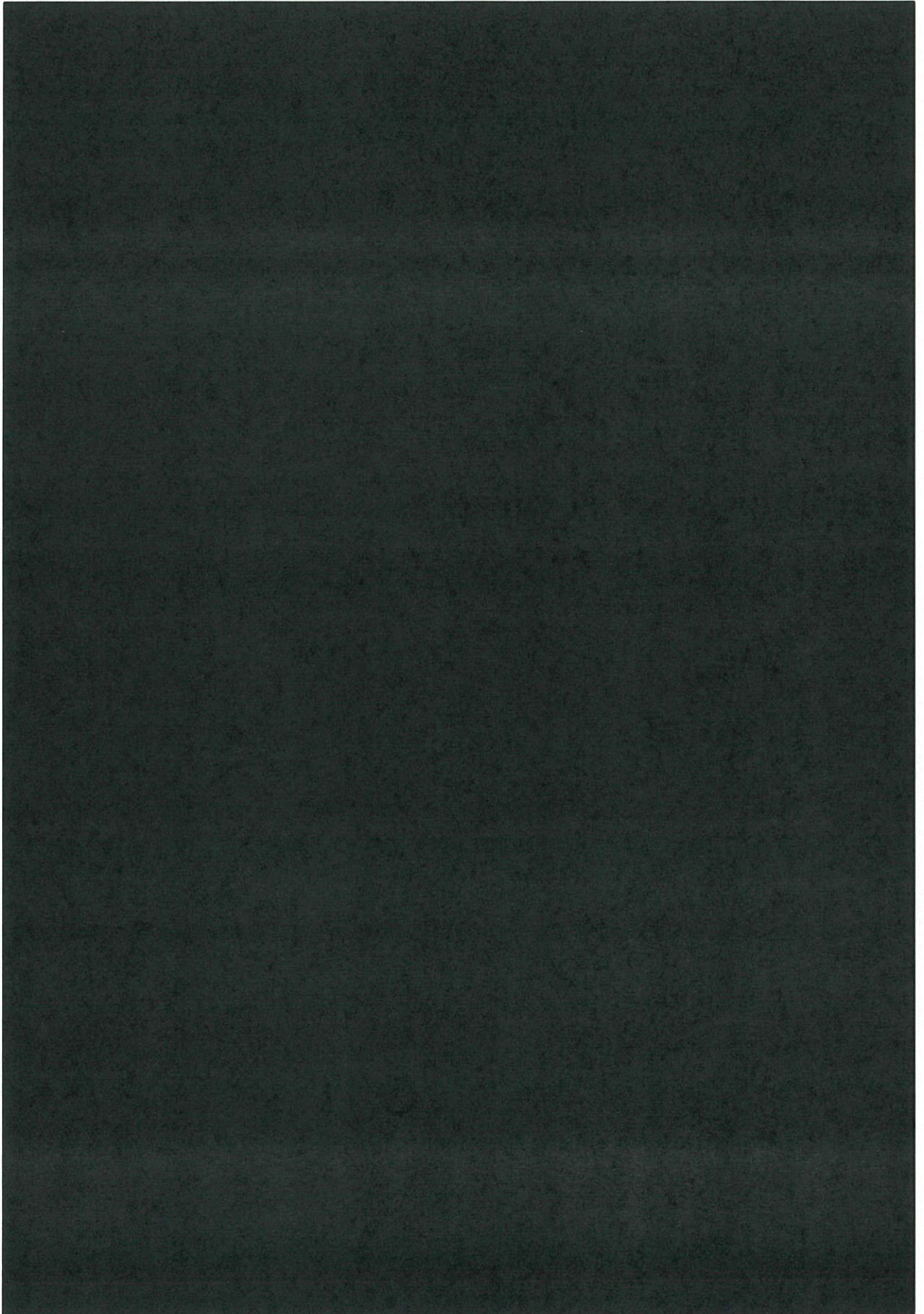


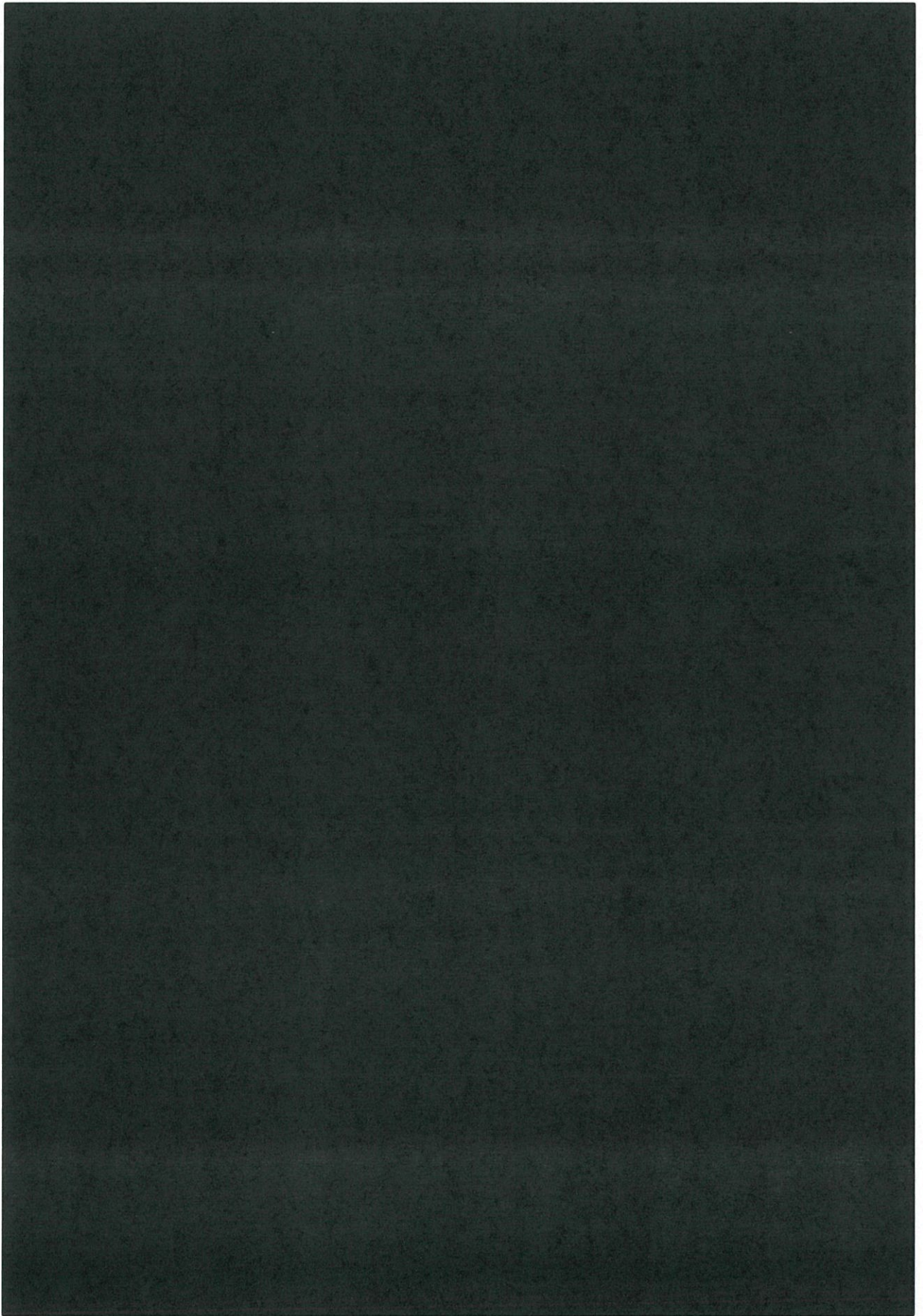


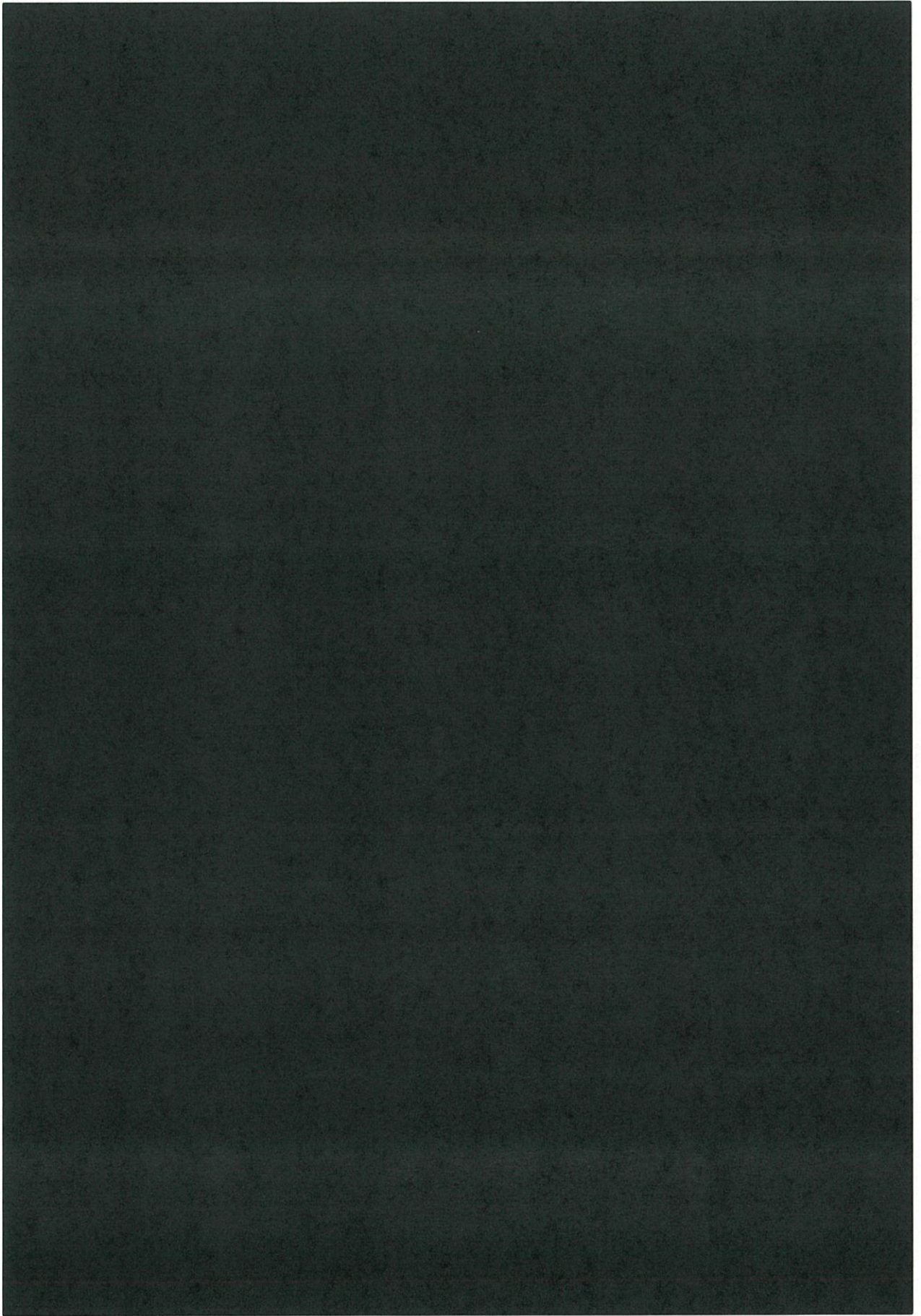


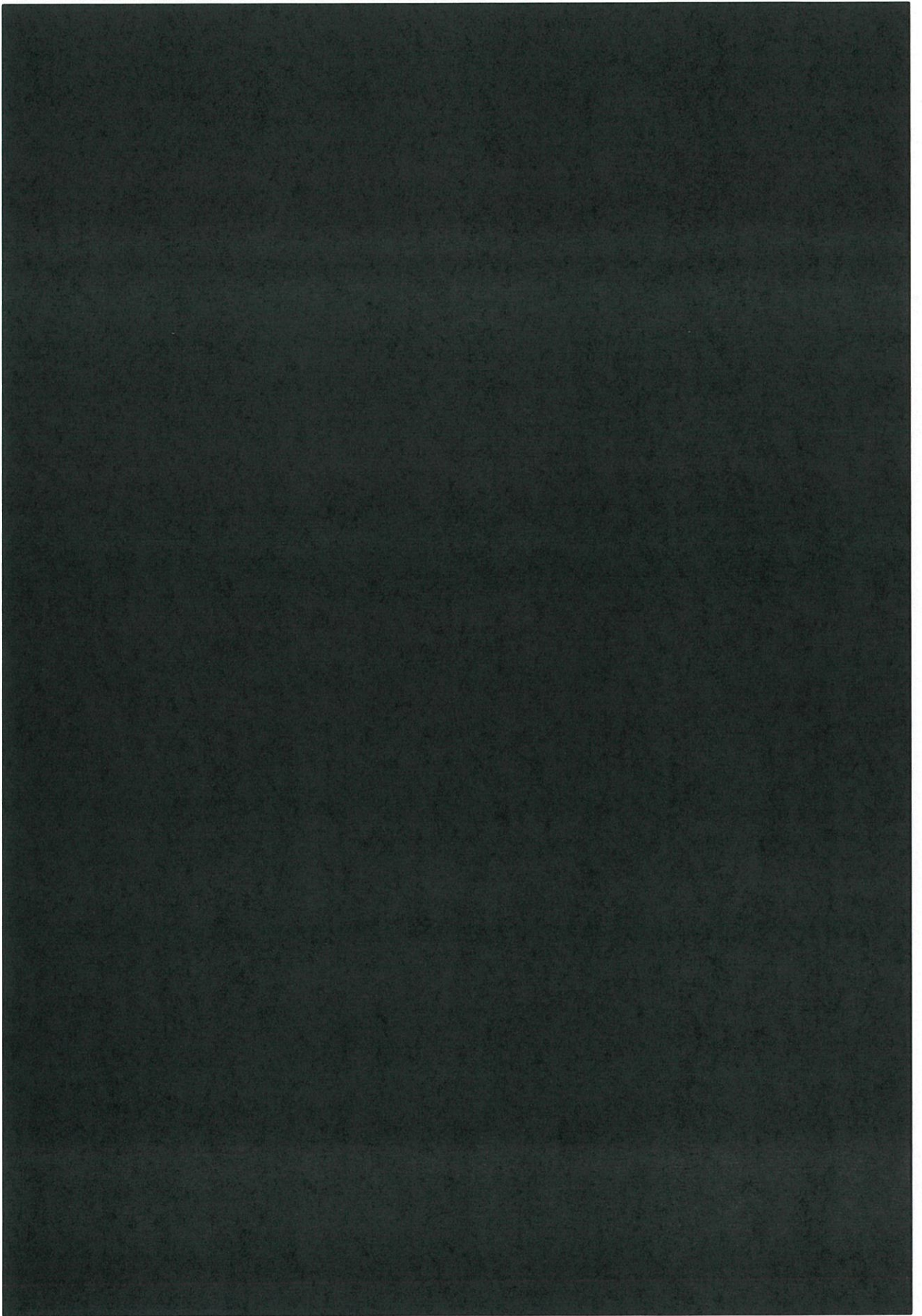


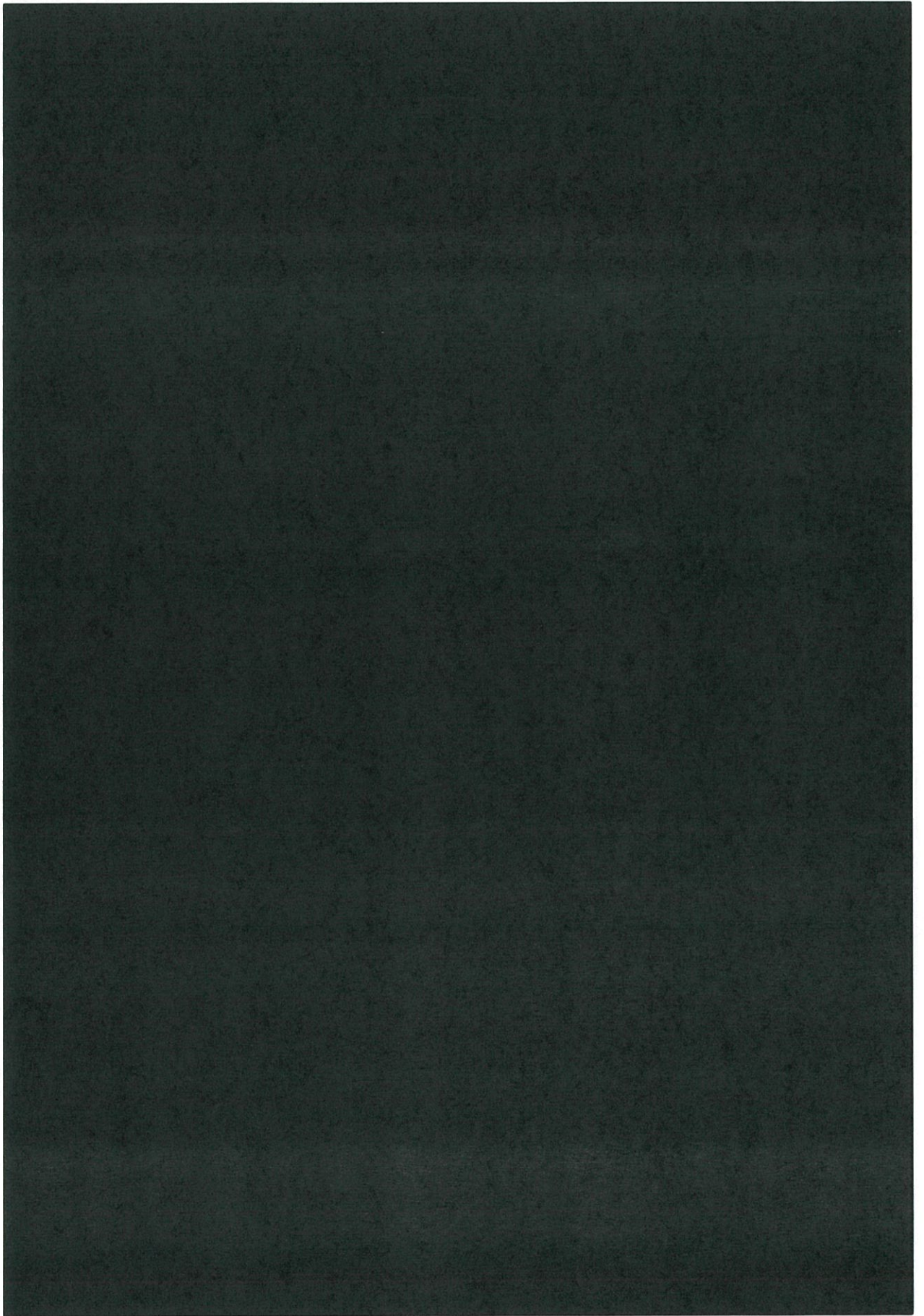




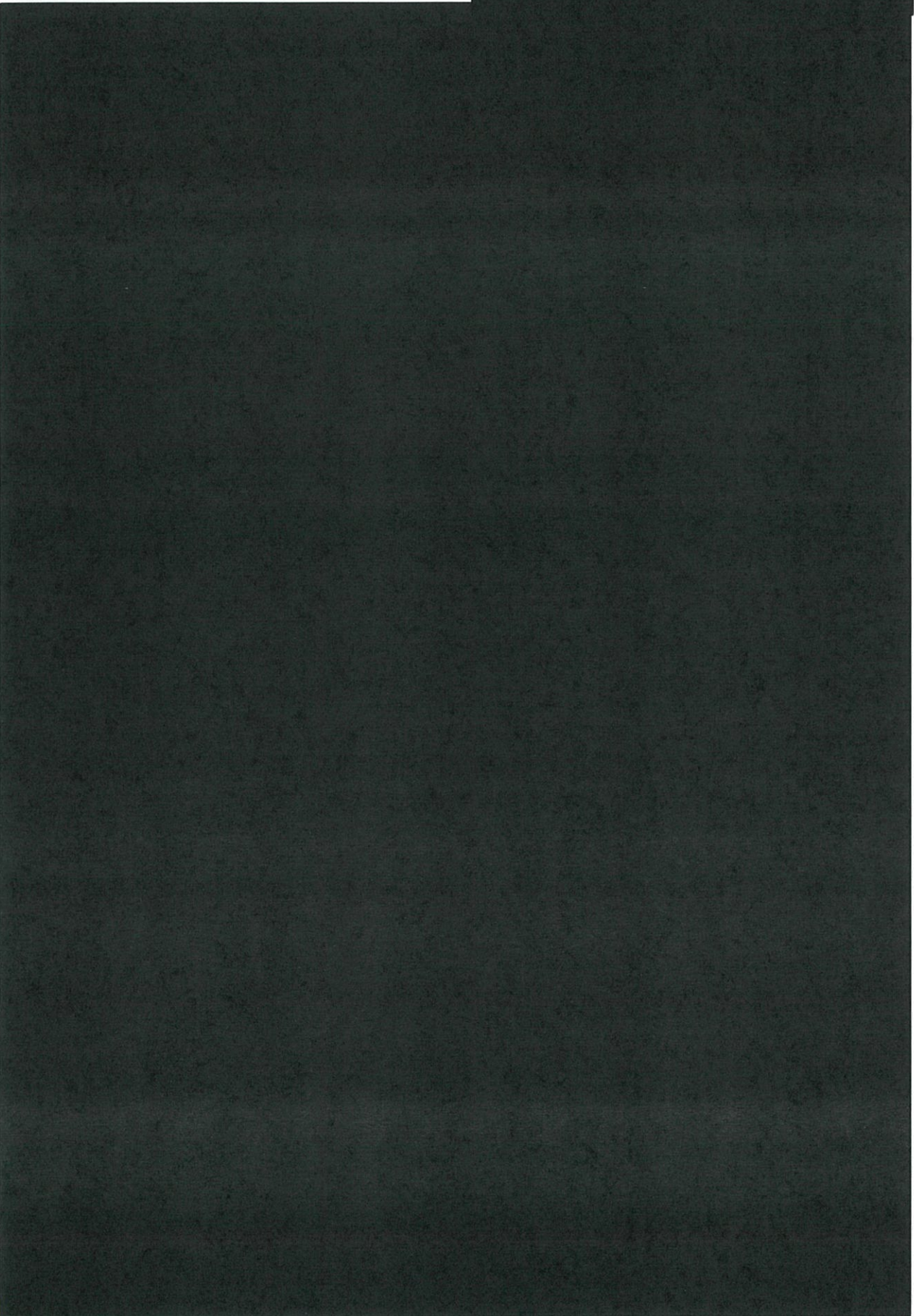


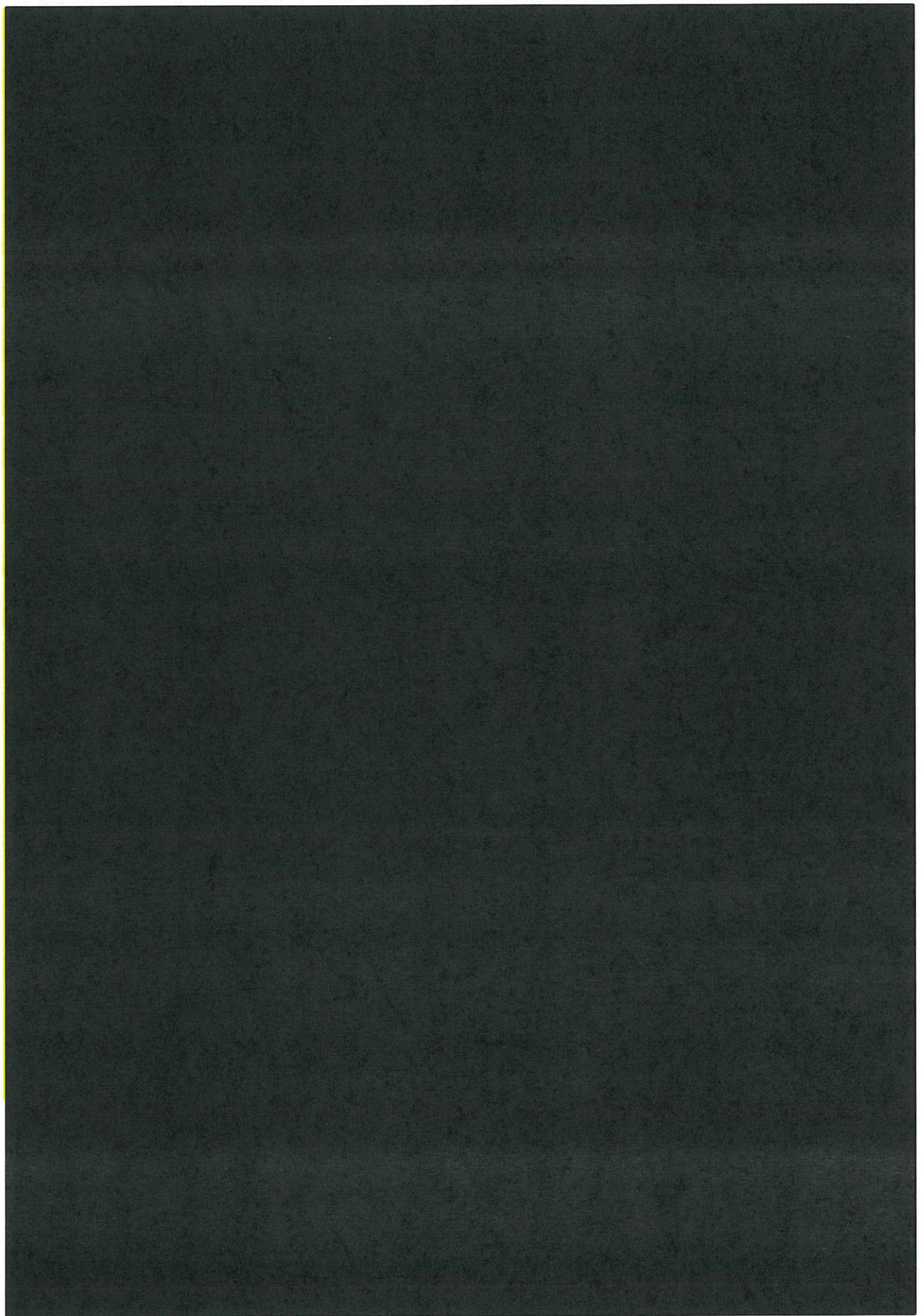


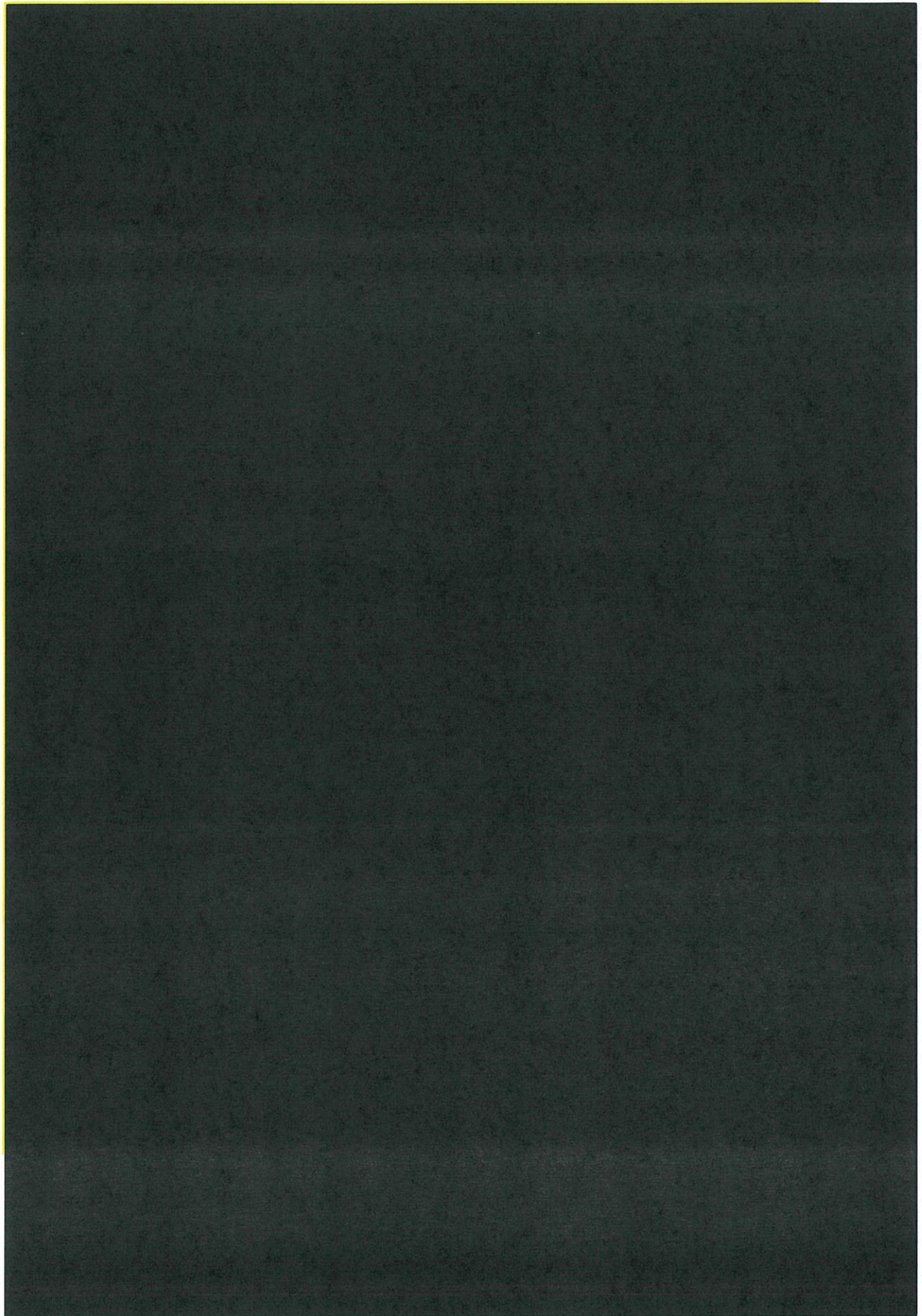


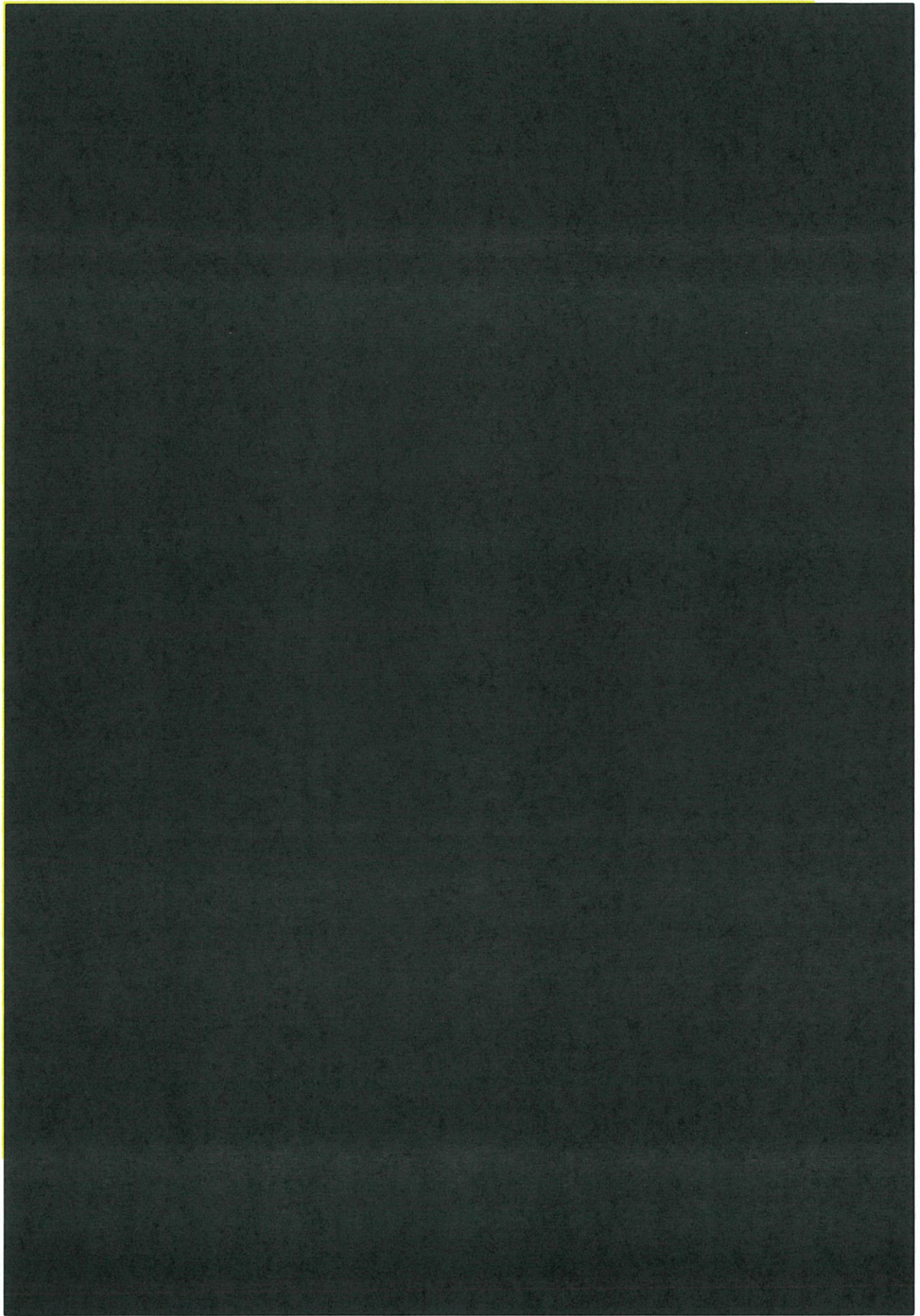


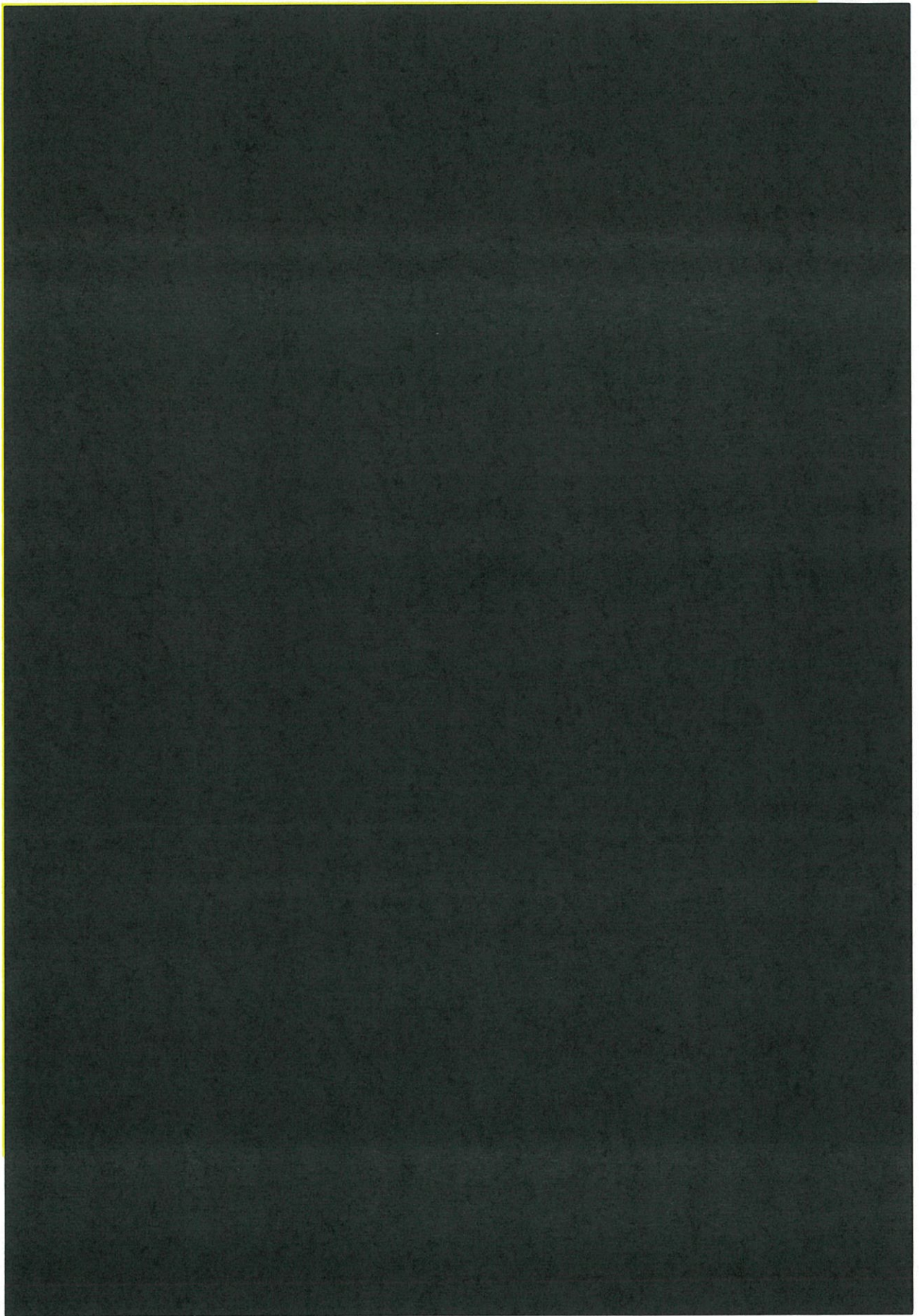
Appendix 3. OZZY Crane Borer

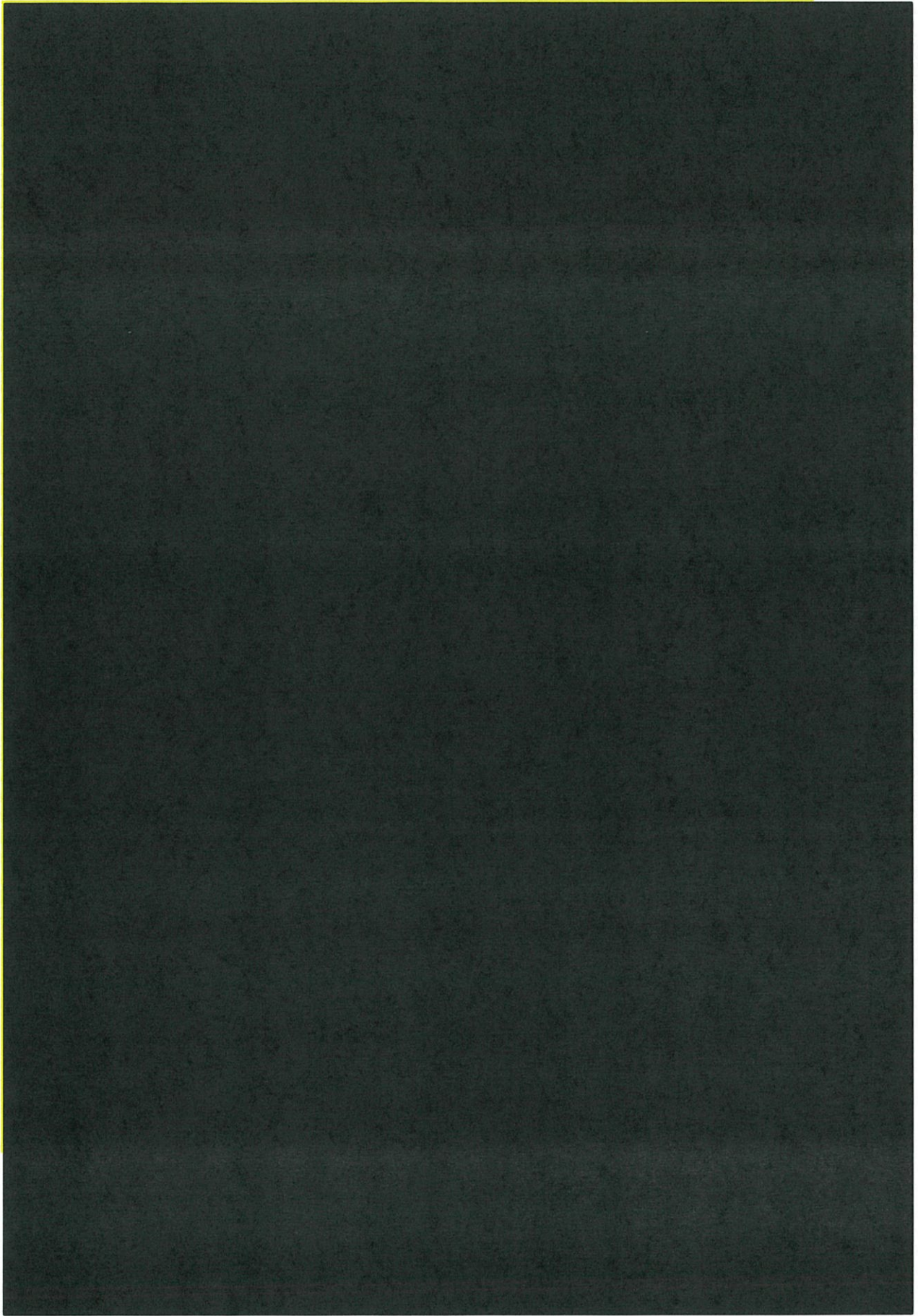


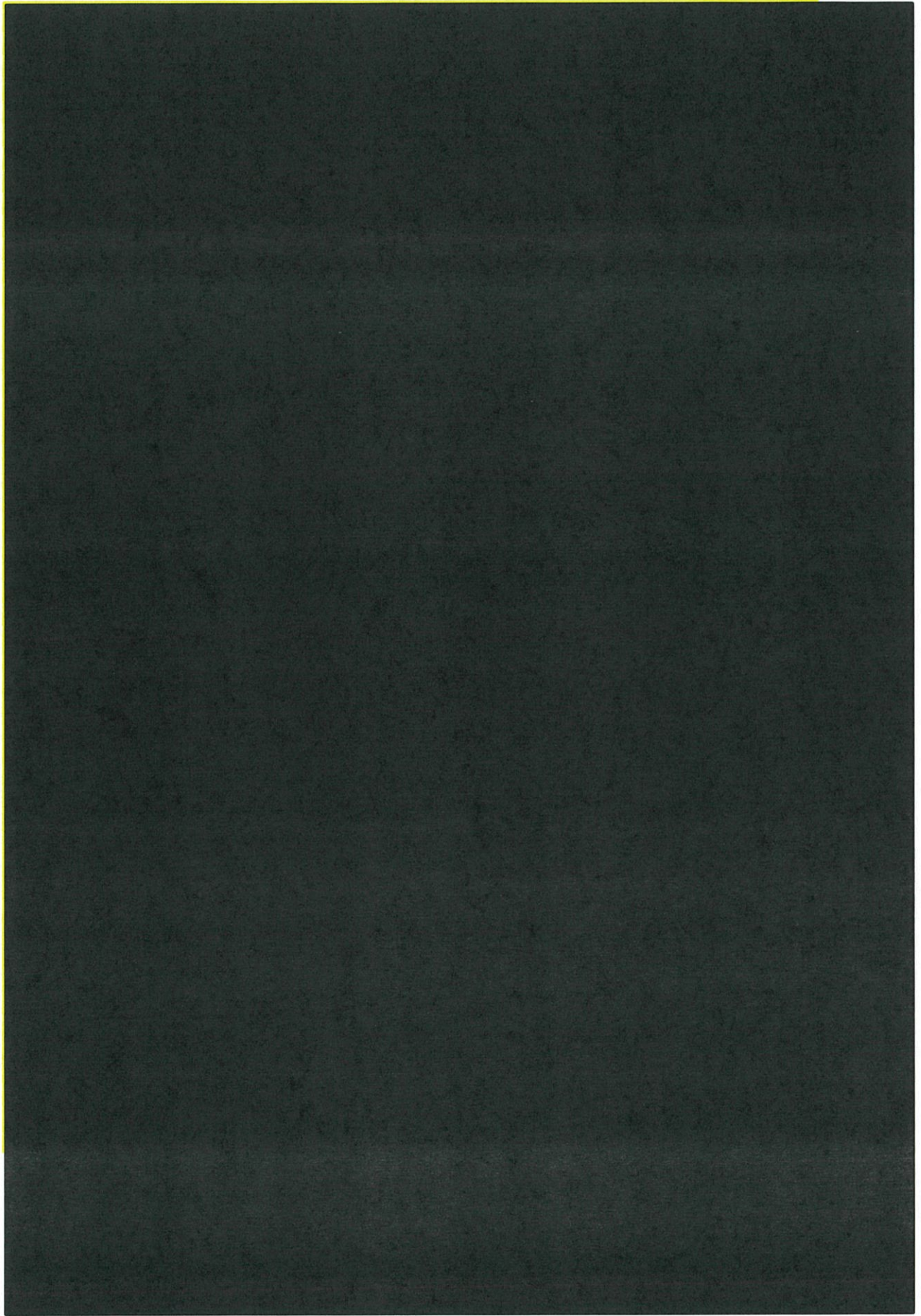


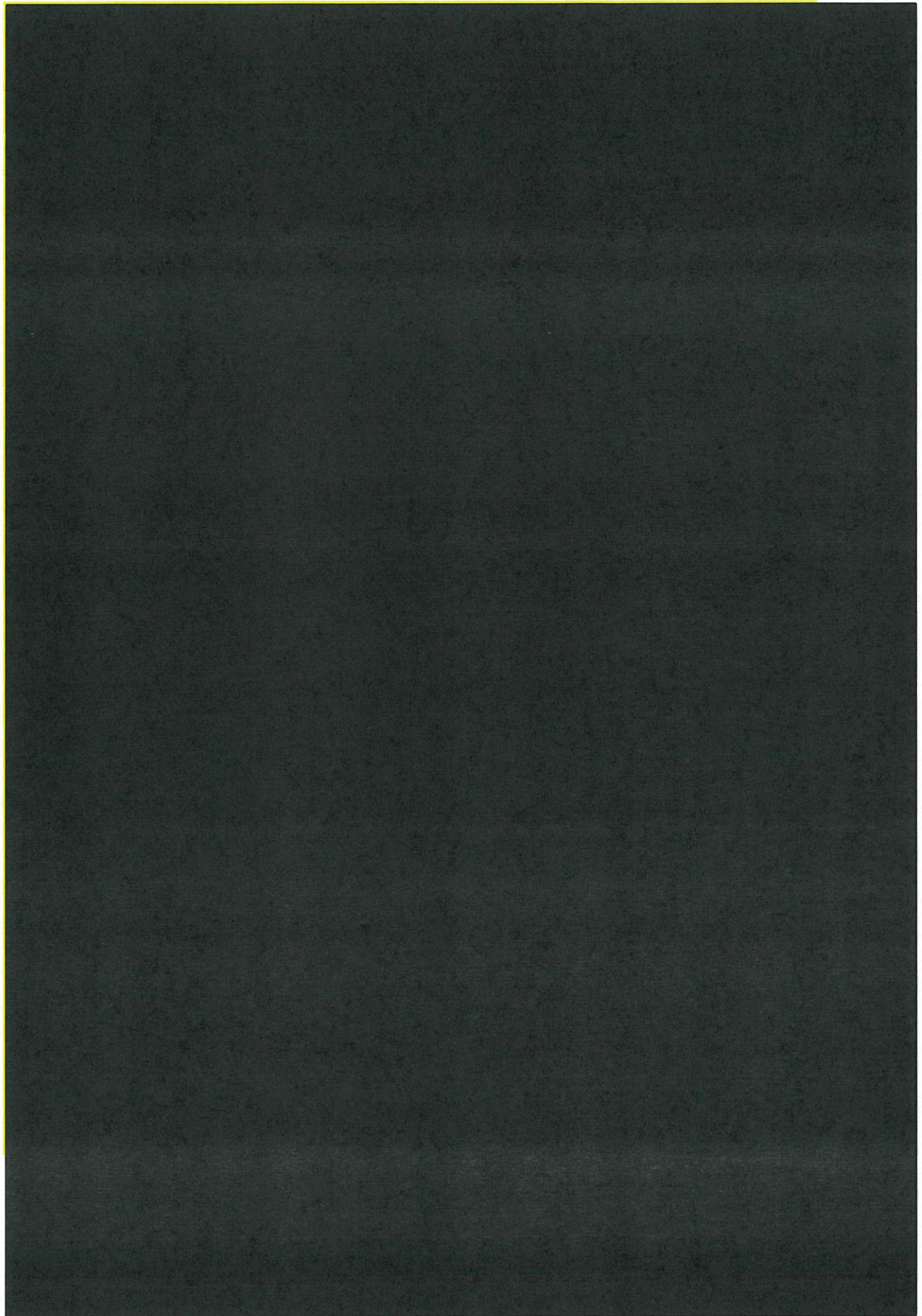


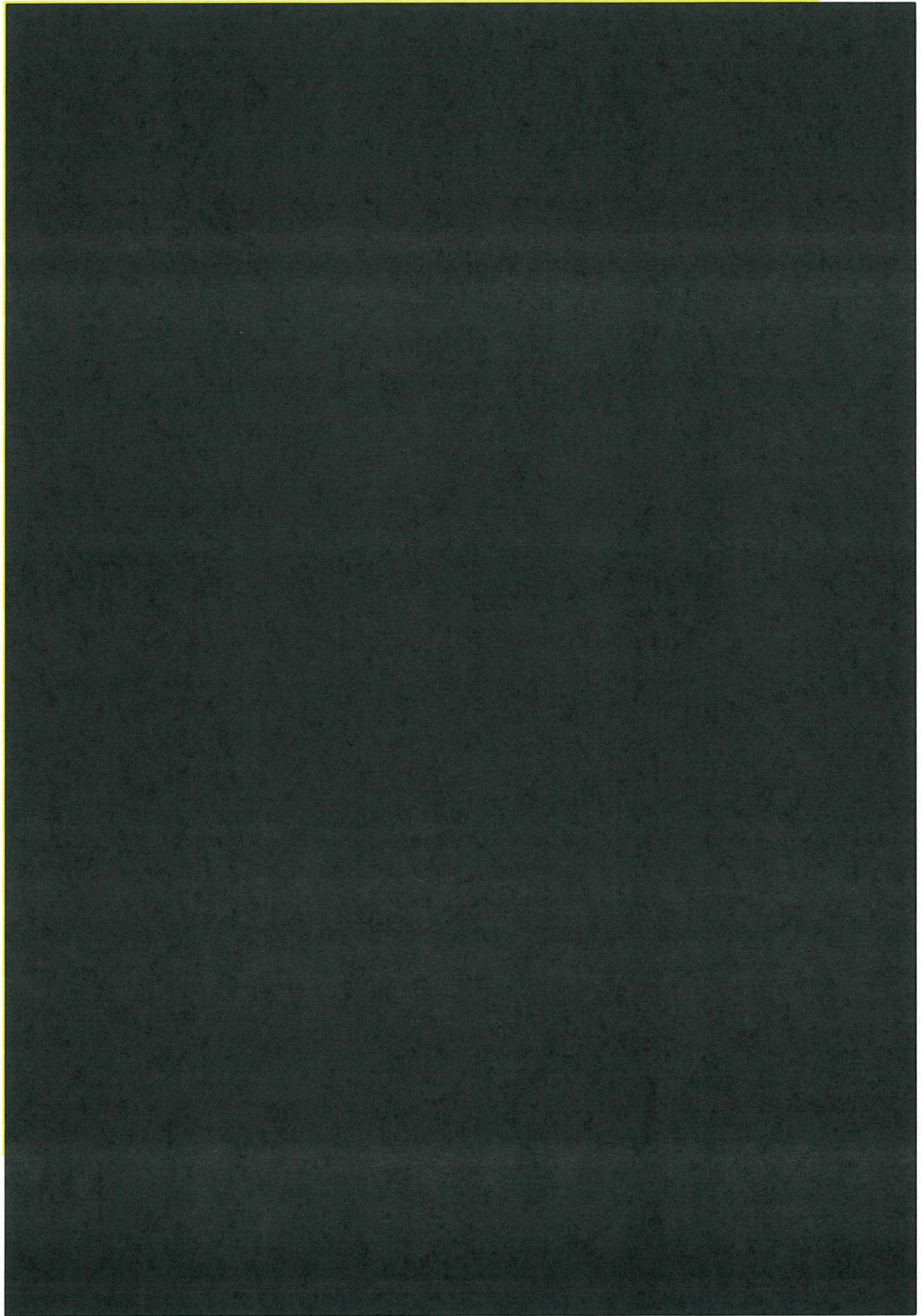


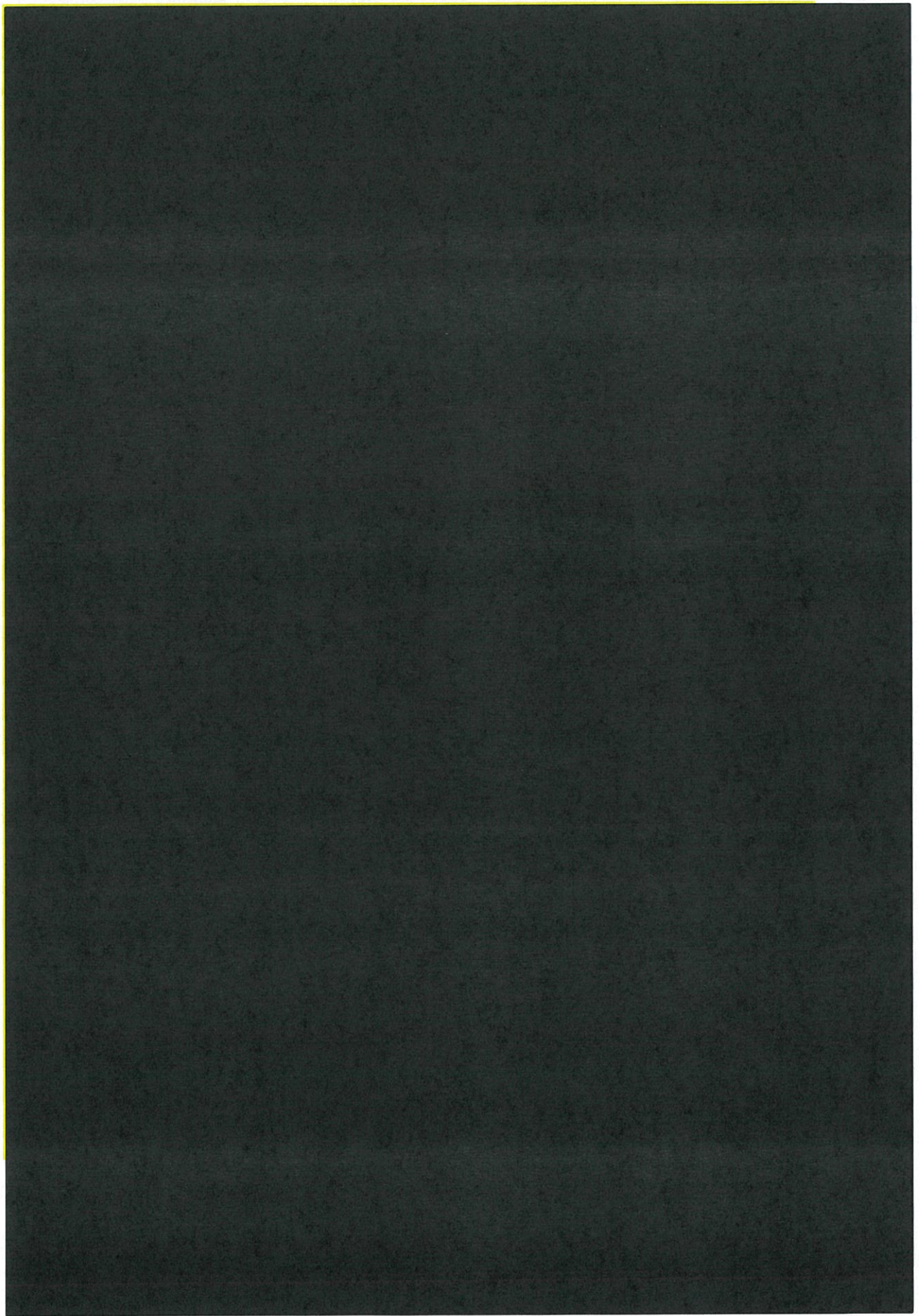


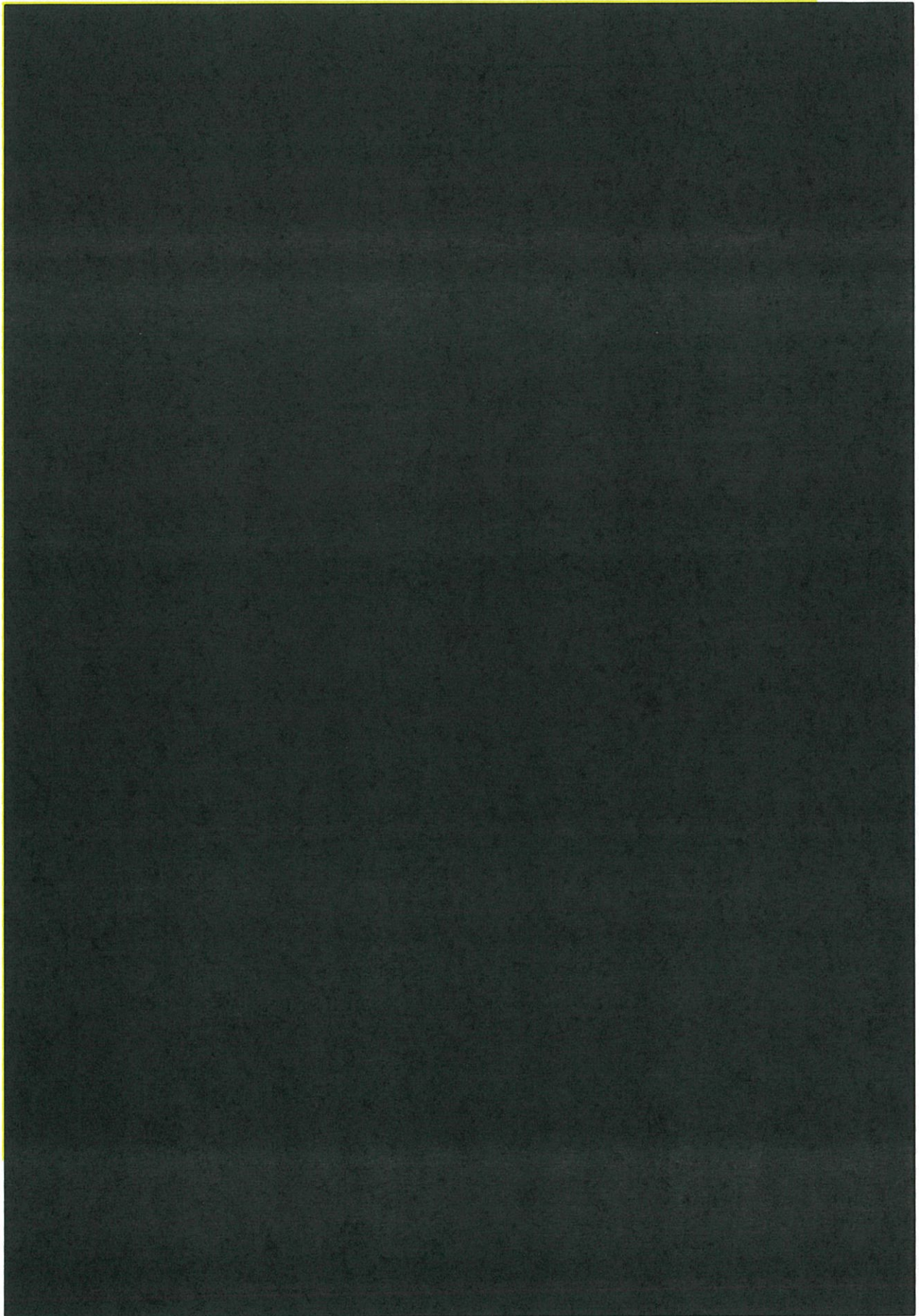


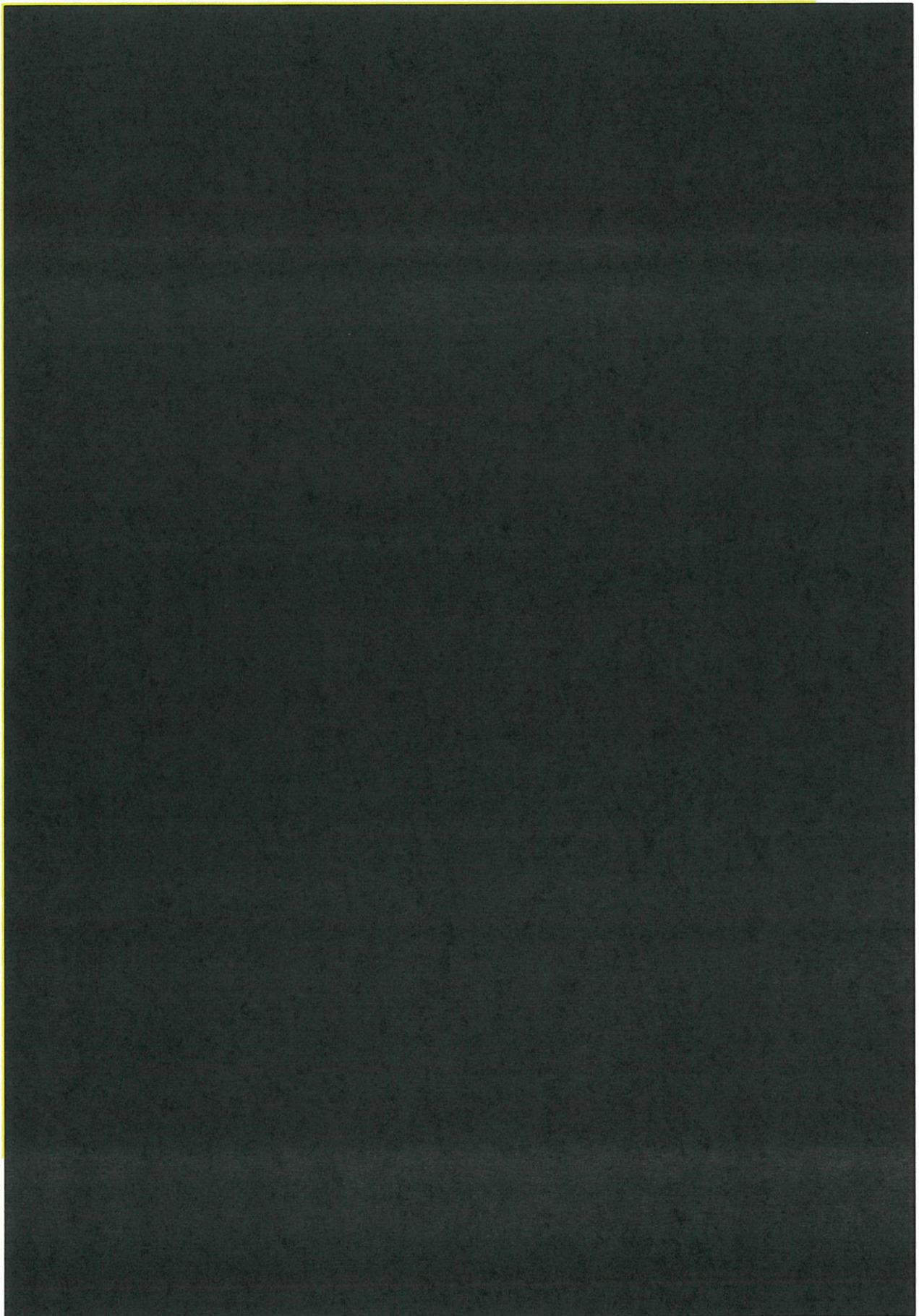


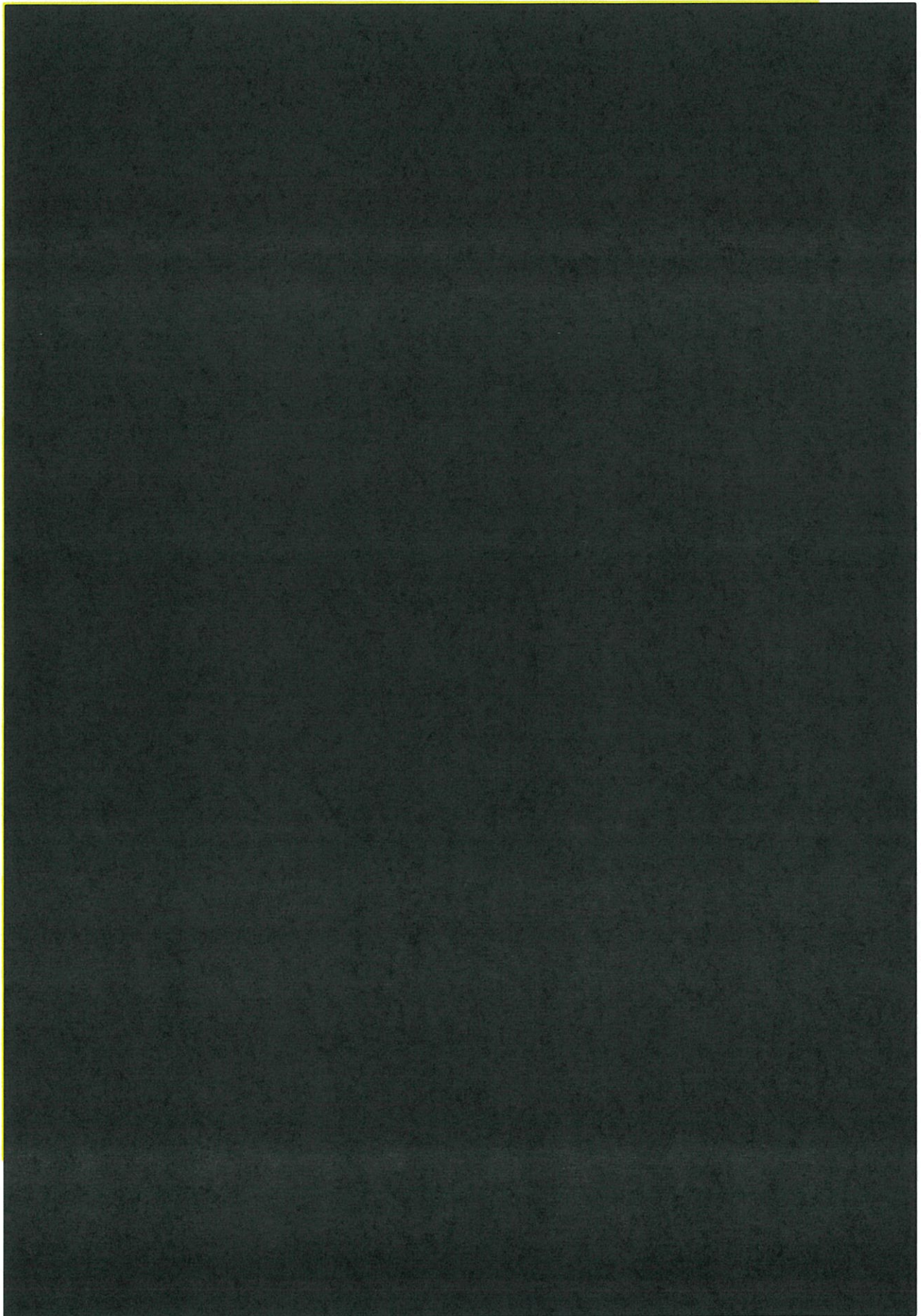


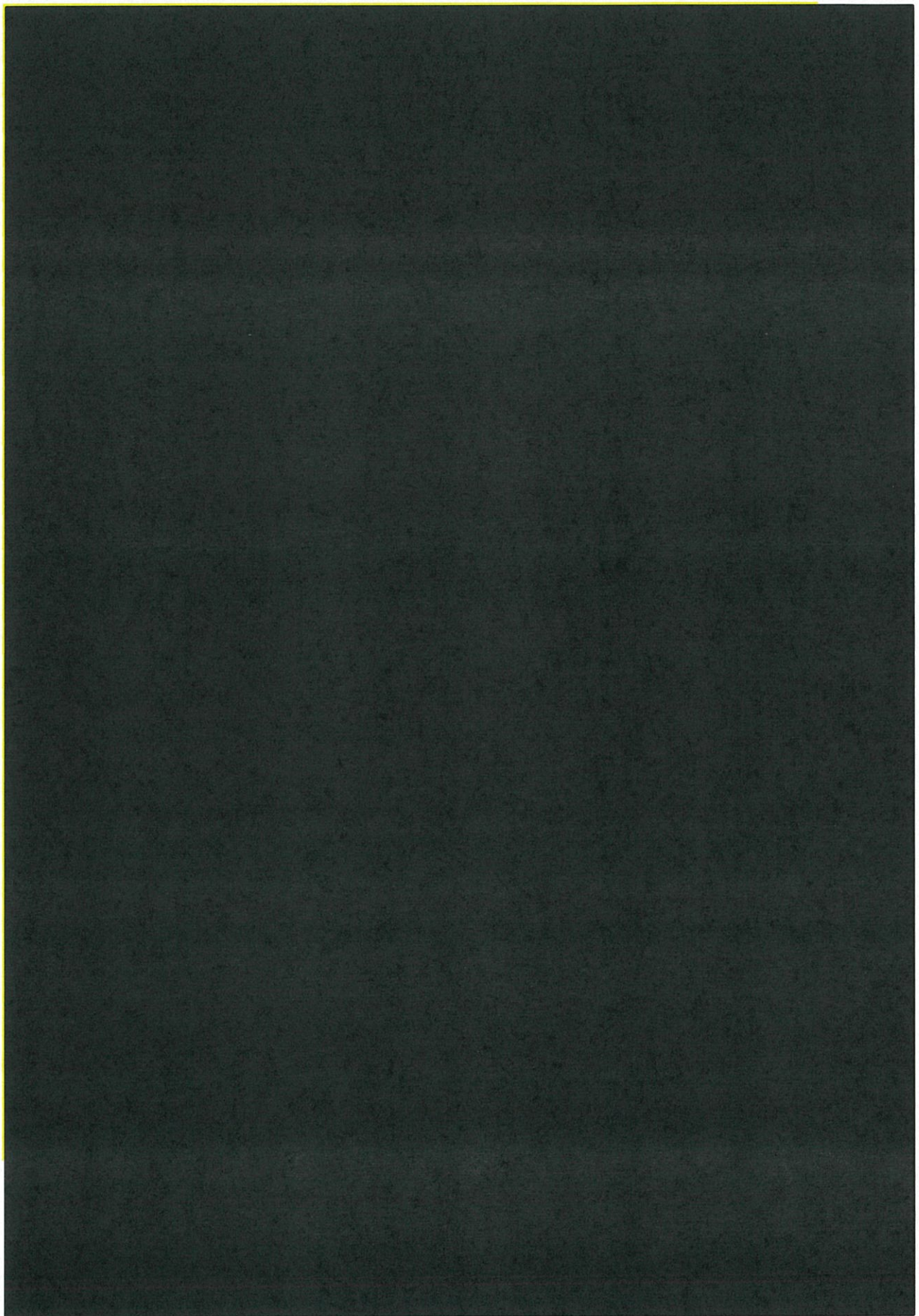


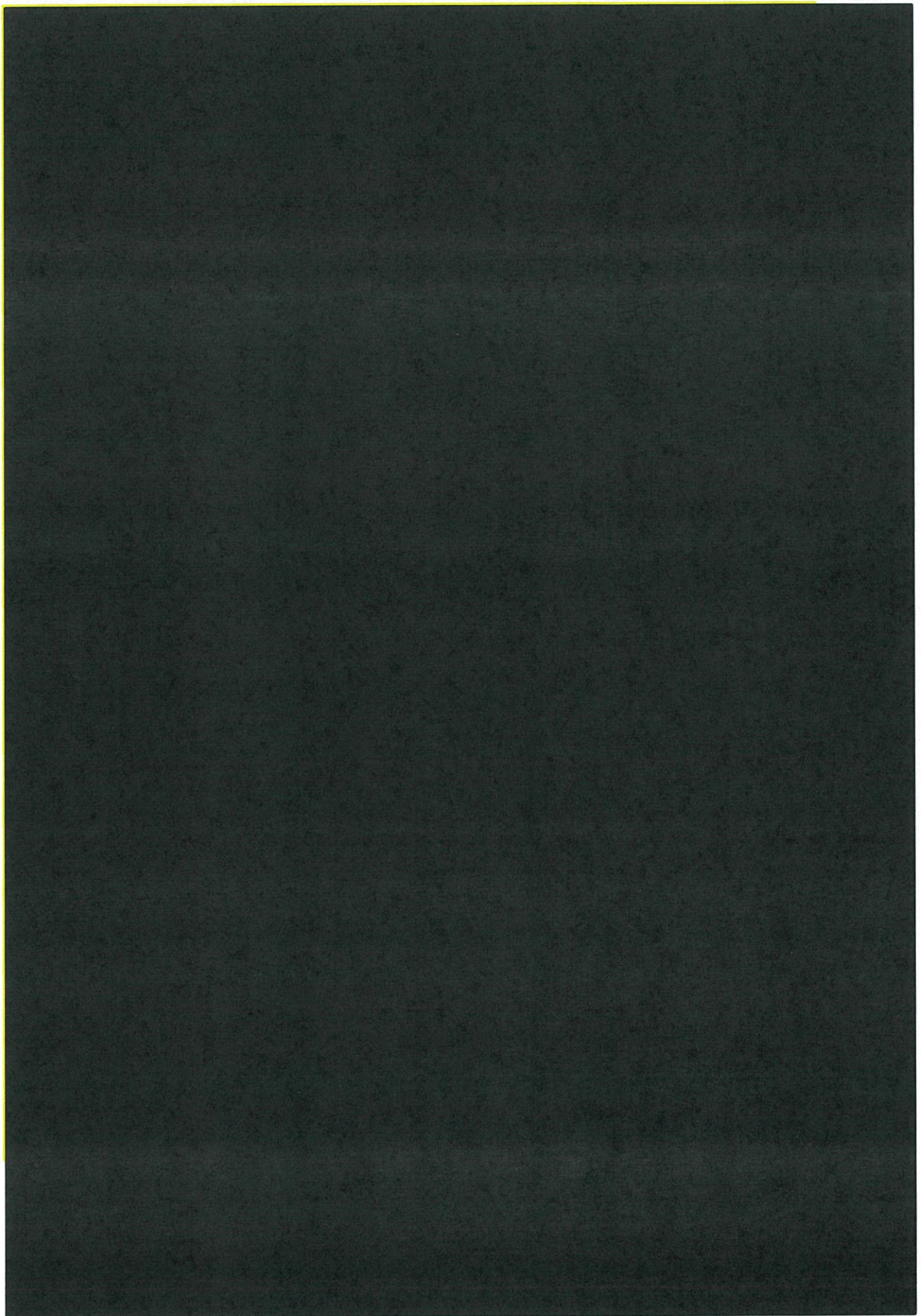


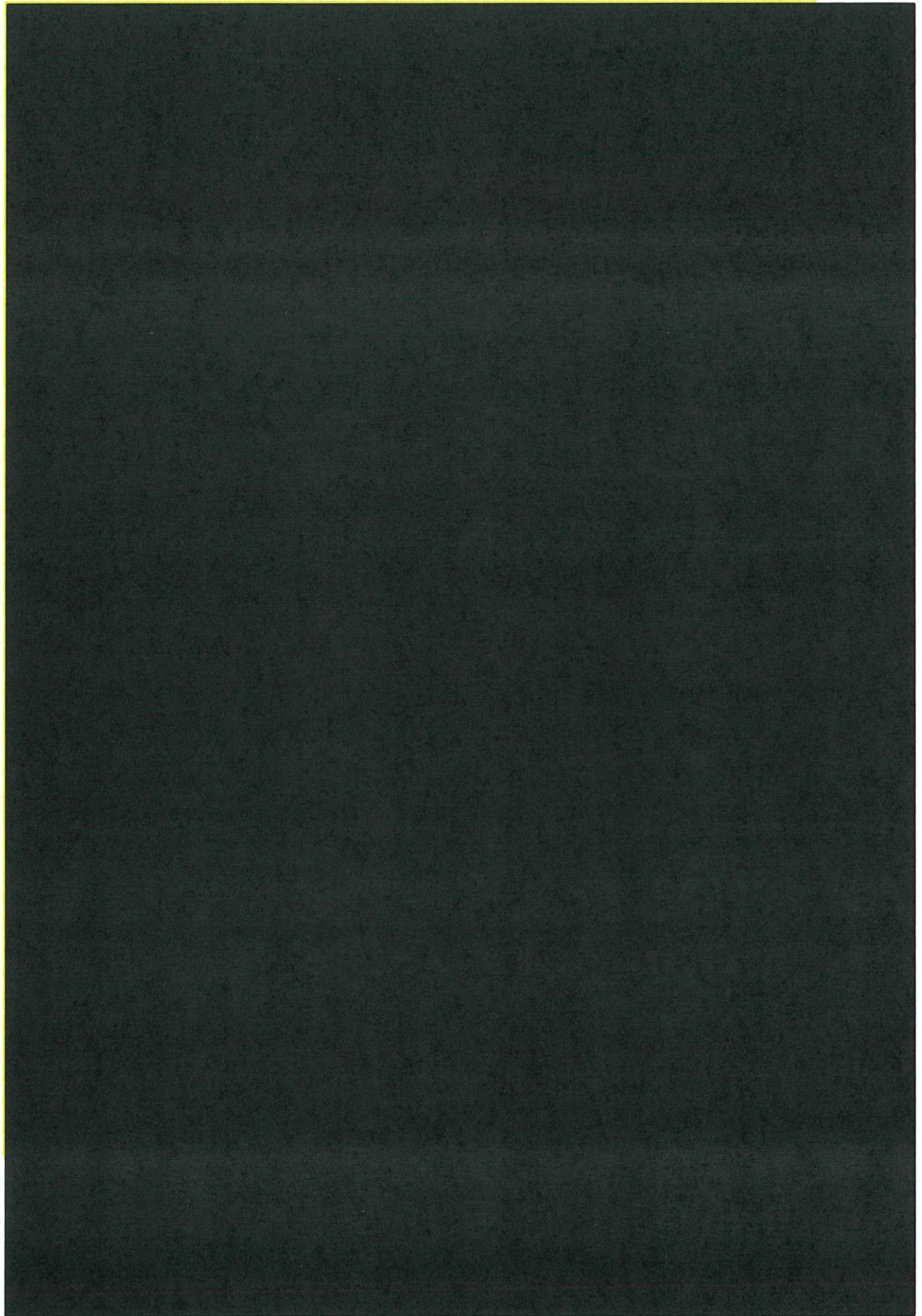












Appendix 4. Proline Crane Borer

