

EA02-025

**TEXAS INSTRUMENTS,
INC.'S 9/10/03
ATTACHMENT**

REQUEST NO. 7

BOX 8

PART A-U

PART T

~ 1-12-99
L. Cambra

Thermal Cycle Fluid Ingress Test

Purpose : To determine if fluid (water) will ingress into a sealed device after exposure to thermal cycling .

Test : Devices will undergo a 72hr thermal cycle with temperatures ranging from 125c to -40c . Each cycle will have a 4 hr soak at temp and a ½ hr . transition time between temperature excursions .

Post thermal cycling devices will be submitted to a soak of 125c and immersed into a cold water bath of 0c . A small percentage of salt will be added to the water for tracing purposes . Devices will be submerged to the top of the connector only and wires will remain exposed to the air . A 30 minute temperature soak and 5 minute immersion time will be considered 1 cycle . This will be repeated for 10 cycles and after all 10 cycles the device will be submitted to a high voltage current leak test from wire leads to ground . After a 24 hr set at room temperature .

Results : All ten samples passed current leak test at 1500 volts . No arcing or leakage to ground was observed .

Epstein, Sally

From: Warner, Pam [pwarn@email.mci.com]
Sent: Monday, April 12, 1999 2:09 PM
To: Beringhaus, Steven
Cc: McGuirk, Andy
Subject: Econoline fail



Ford_14_99presentation
ppt.ppt

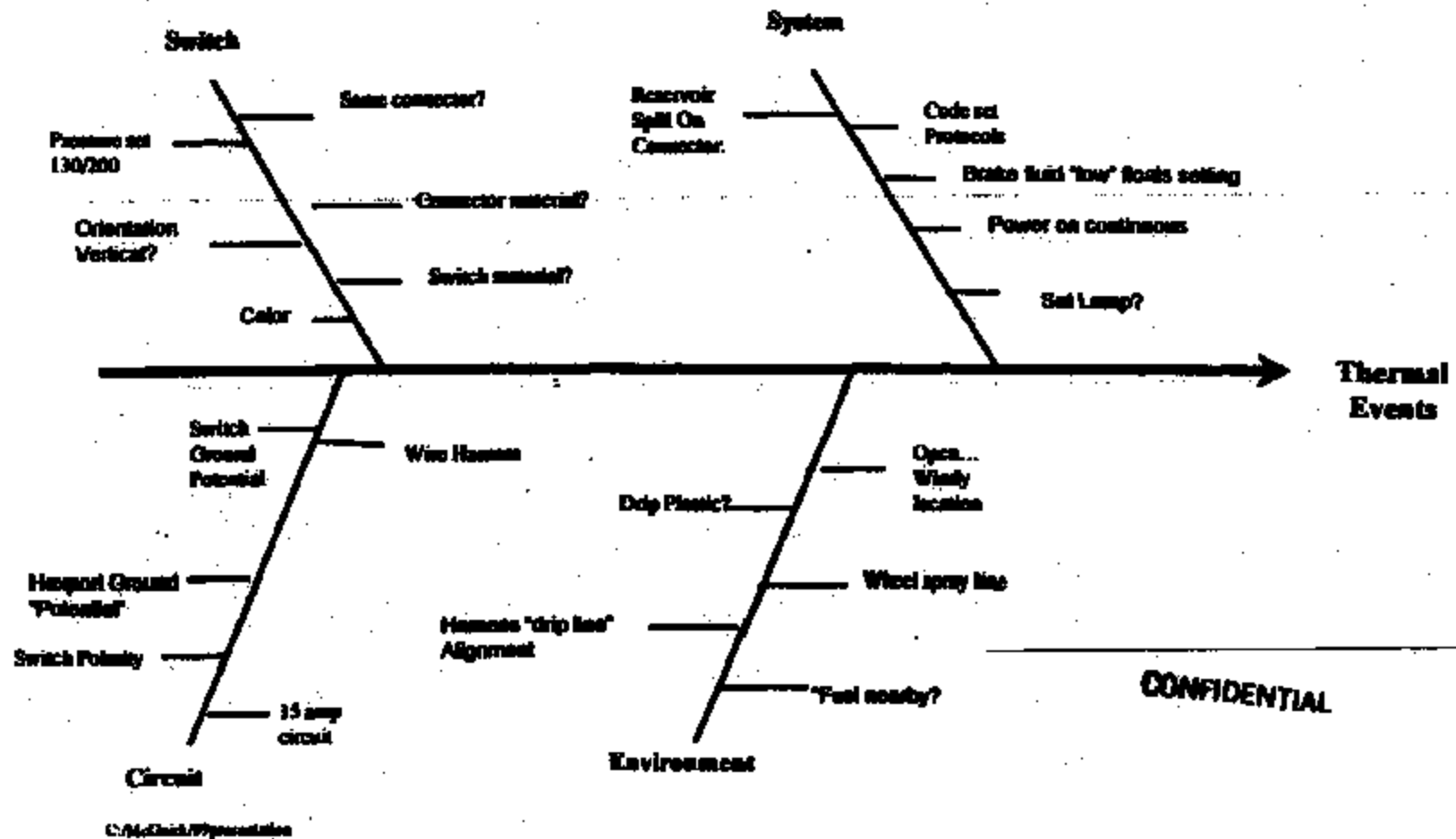
Steve

Andy McGuirk asked that I send this foil to you.

<<Ford4_14_99presentationppt.ppt>>

TI-NHTSA 013324

ECONOLINE VS. TOWN CAR P/S



TI-NHTSA 013325

Texas Instruments
Automotive Sensors & Controls

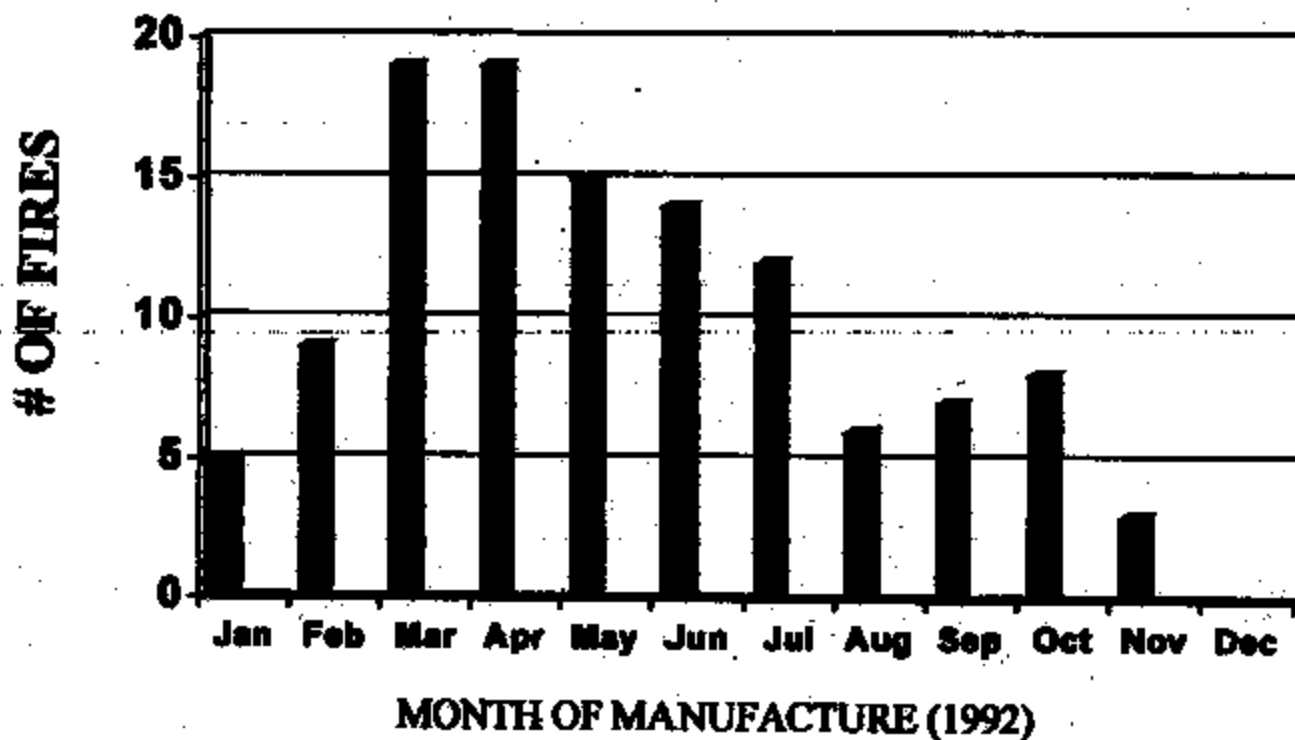
8D Report

Concern Title: 77 PS Thermal Events		Open Date: 3/9/99	
T.I. CAR Report Number: CAR 99-26		Updated: 3/15/99 <i>4/14/99</i>	
Status Date:	Vehicle: Lincoln	Part Name:	Electric Speed Control Deactivation Pressure Sw
	Model: Town Car	Part No:	77PS 12-1
	Plant: Various		
1. Team: S. Beringhaus B. Dugas A. Raham A. McGuirk C. Douglas G. Baker T. Rowland		2. Problem Description: Under hood car fires	
3. Containment Action(s): <i>CONSIDERING DISPOSING SPEED CONTROL SYSTEM</i> Under review, <i>LIMITATION OF THE CURRENT SYSTEM</i>		% Effectiveness:	Implementation Date:
4. Root Cause: See attachment 1, IS - IS NOT Table, F (Theories of 3/15/99) - Water enters pressure switch thru connector - Continuous power drives corrosion - Corrosion creates high resistance - Resistance creates local heating - Several exposures over time (?) - Local heating ignites pressure switch and connector plastic		<i>ALTERNATIVE CONSTRUCTION PRACTICES</i> % Contribution: Unknown	
5. Chosen Permanent Corrective Action: See attachment 2,3,4 Under Review: - Contain fire - Create ground fault protector - Improve connector seal - Eliminate constant power - Change P/S orientation - Provide power fuse / <i>POWER REDUCTION</i> - Modify plastic parameters		Verification: TBD by lab experiments	% Effectiveness: Unknown
6. Implemented Permanent Corrective Actions:		Implementation:	
7. Action(s) to Prevent Recurrence <i>ELIMINATE CONSTANT POWER, REMOVE POWER TO FUNCTION AREA SET LOW RESISTANCE "NORMAL" ELECTRICAL FUNCTION</i>		Implementation:	
8. Congratulate Team	Close Date:	Reported By:	A. McGuirk
		Dept. Name:	QRA Manager
		Telephone No.:	(505) 236-3000

TI-NHTSA 013326



FORD TOWN CAR ISSUES



NOTES: Ford data as of 4/14/99

1999 4 16 5:14:26 PM MVC-FD91

Digital Mavica images

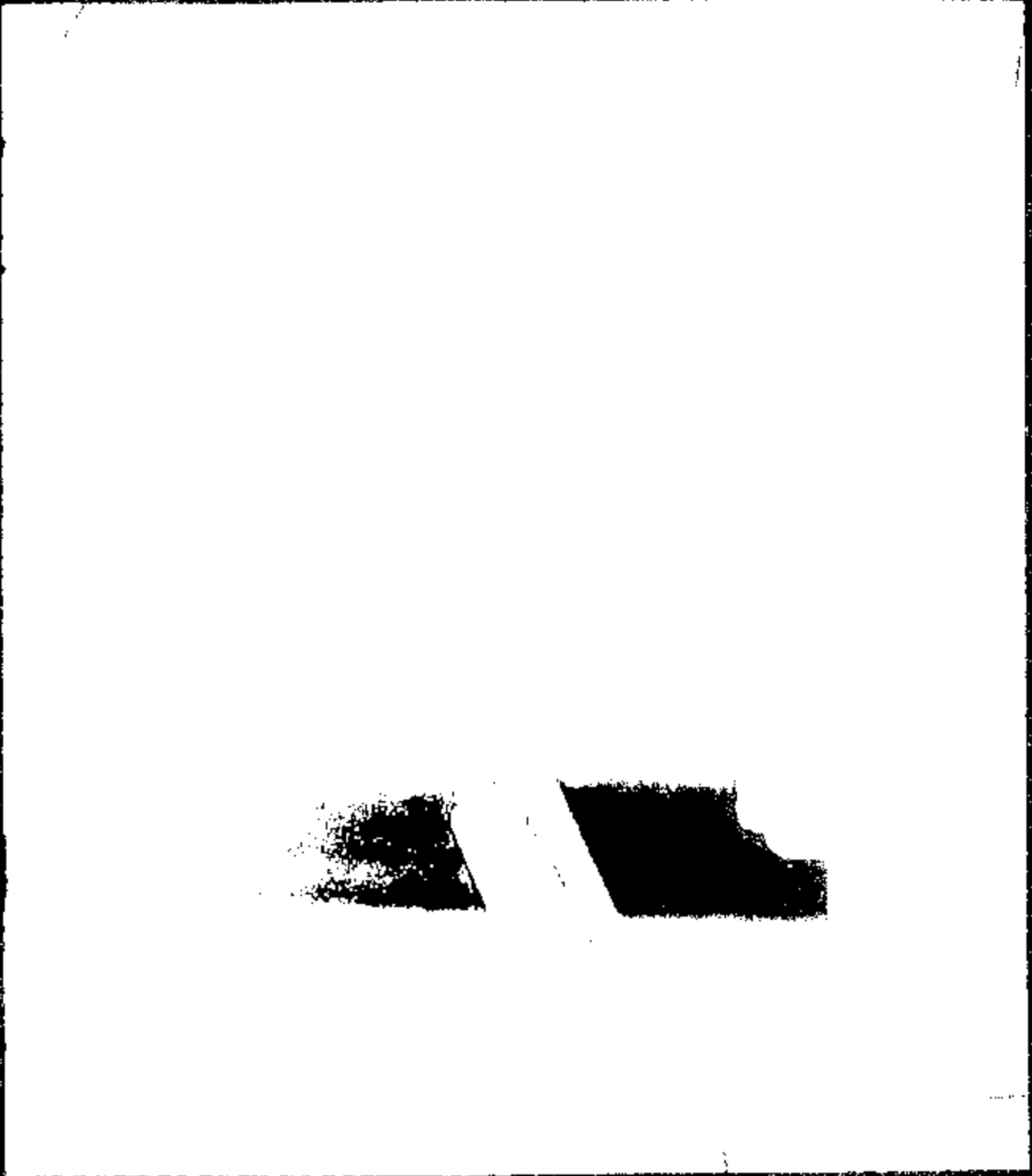
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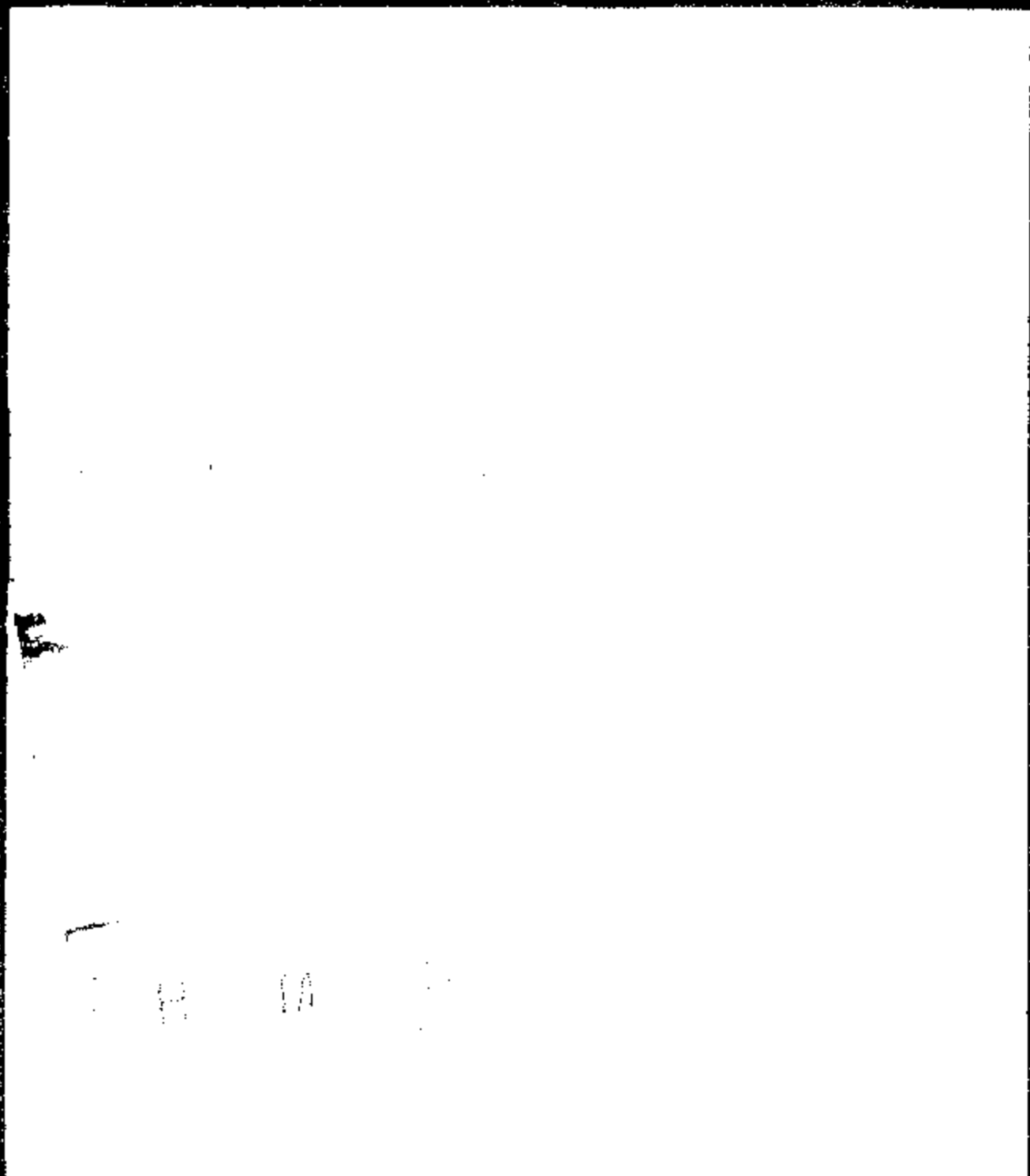
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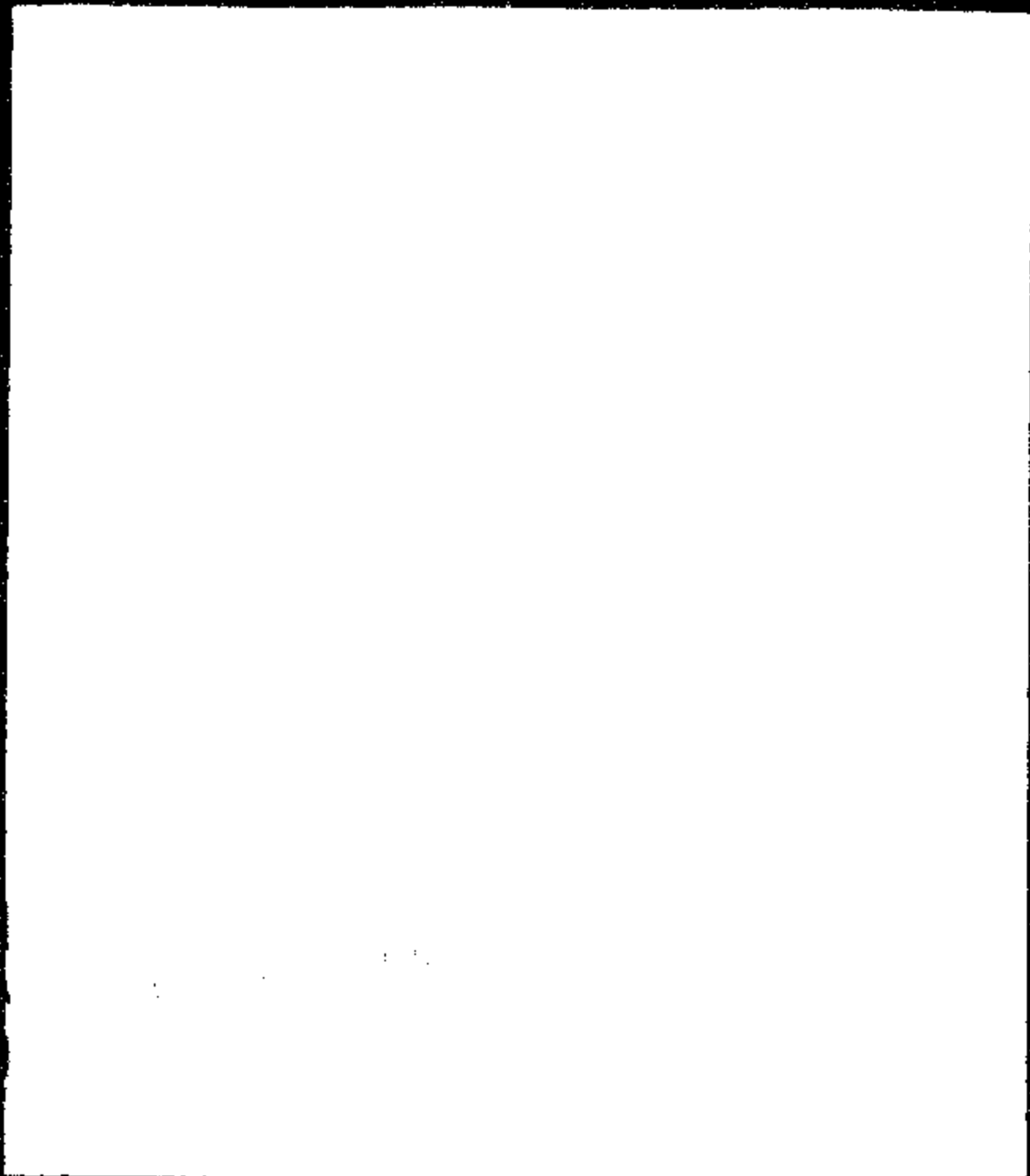
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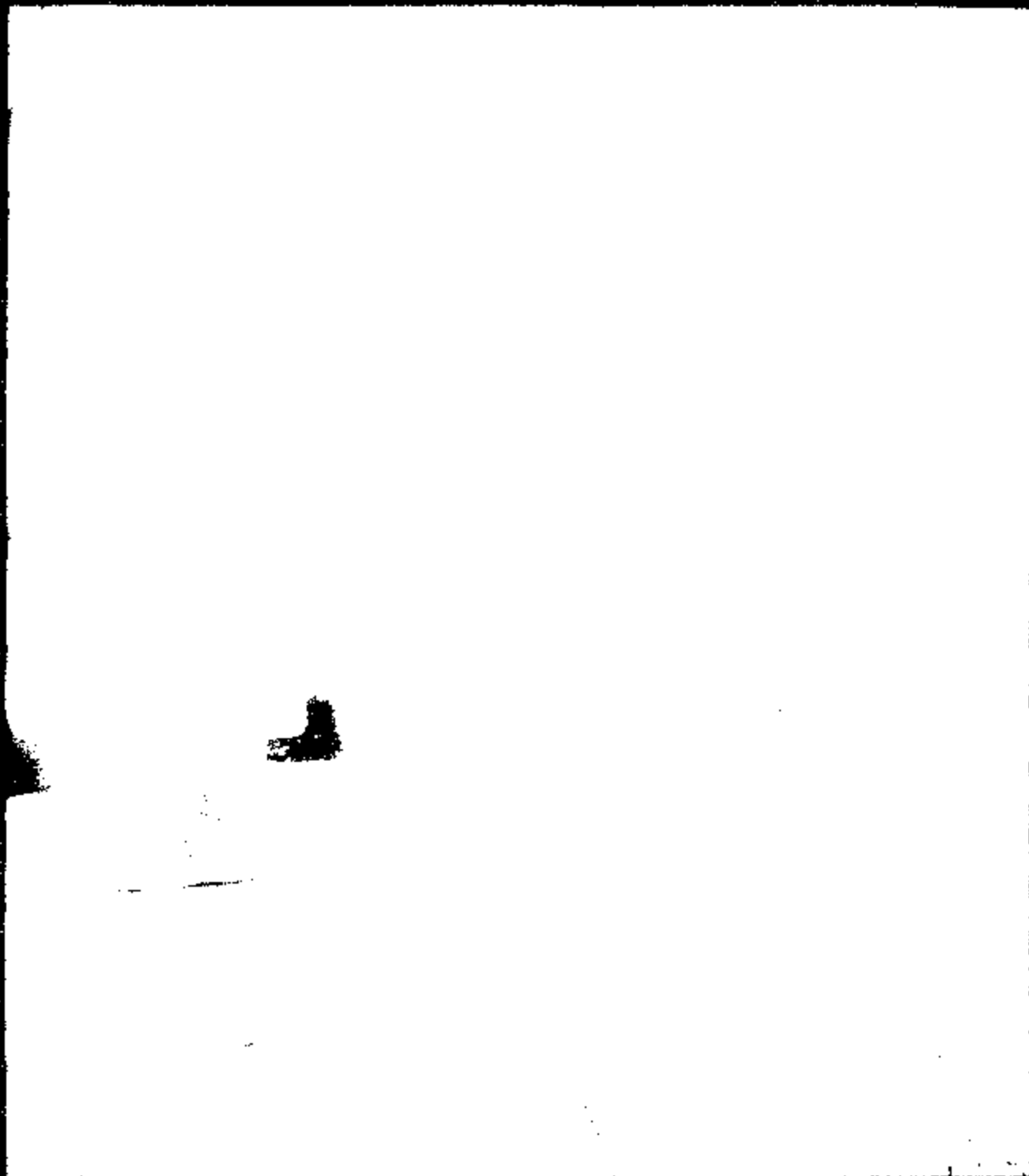
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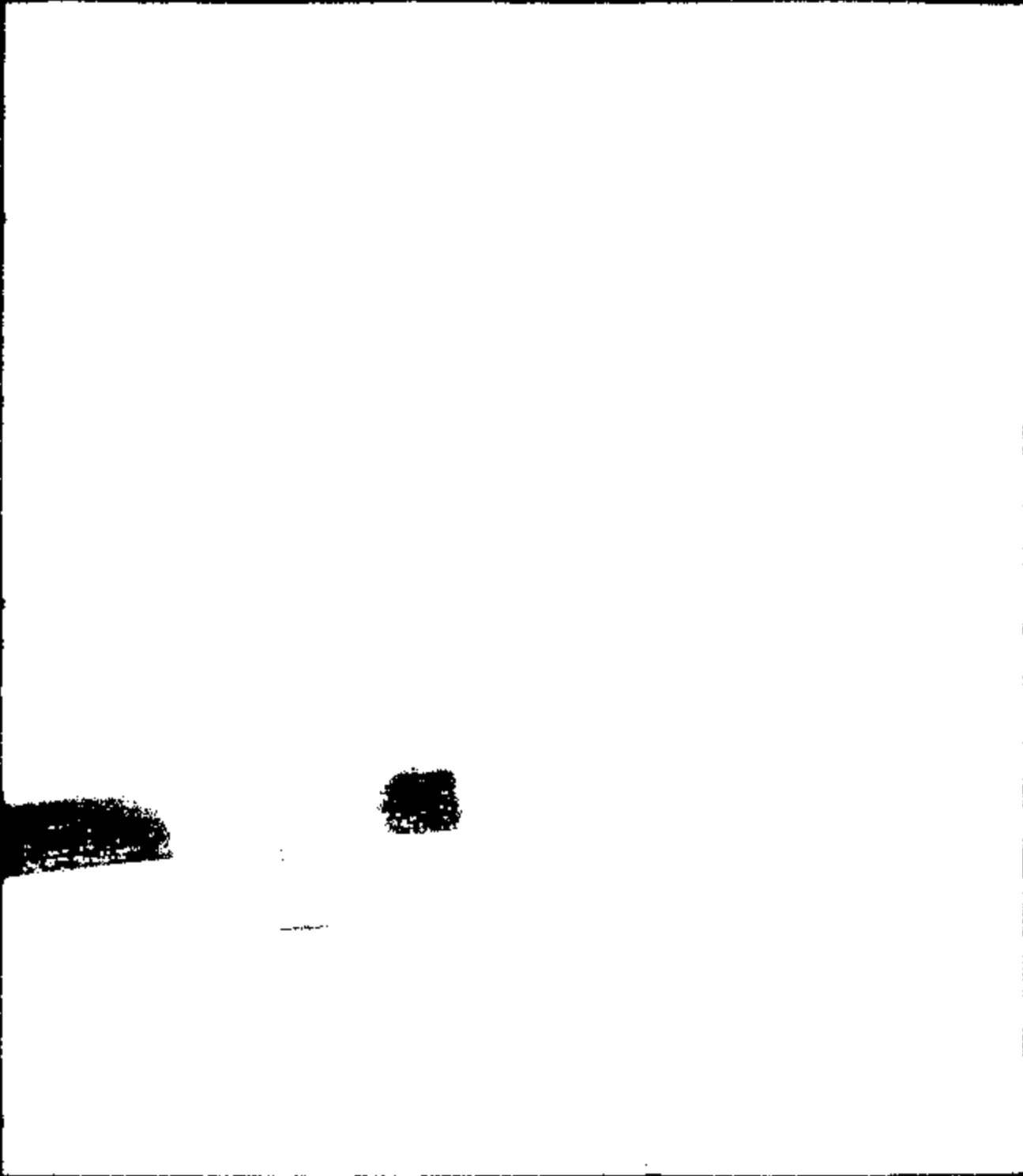
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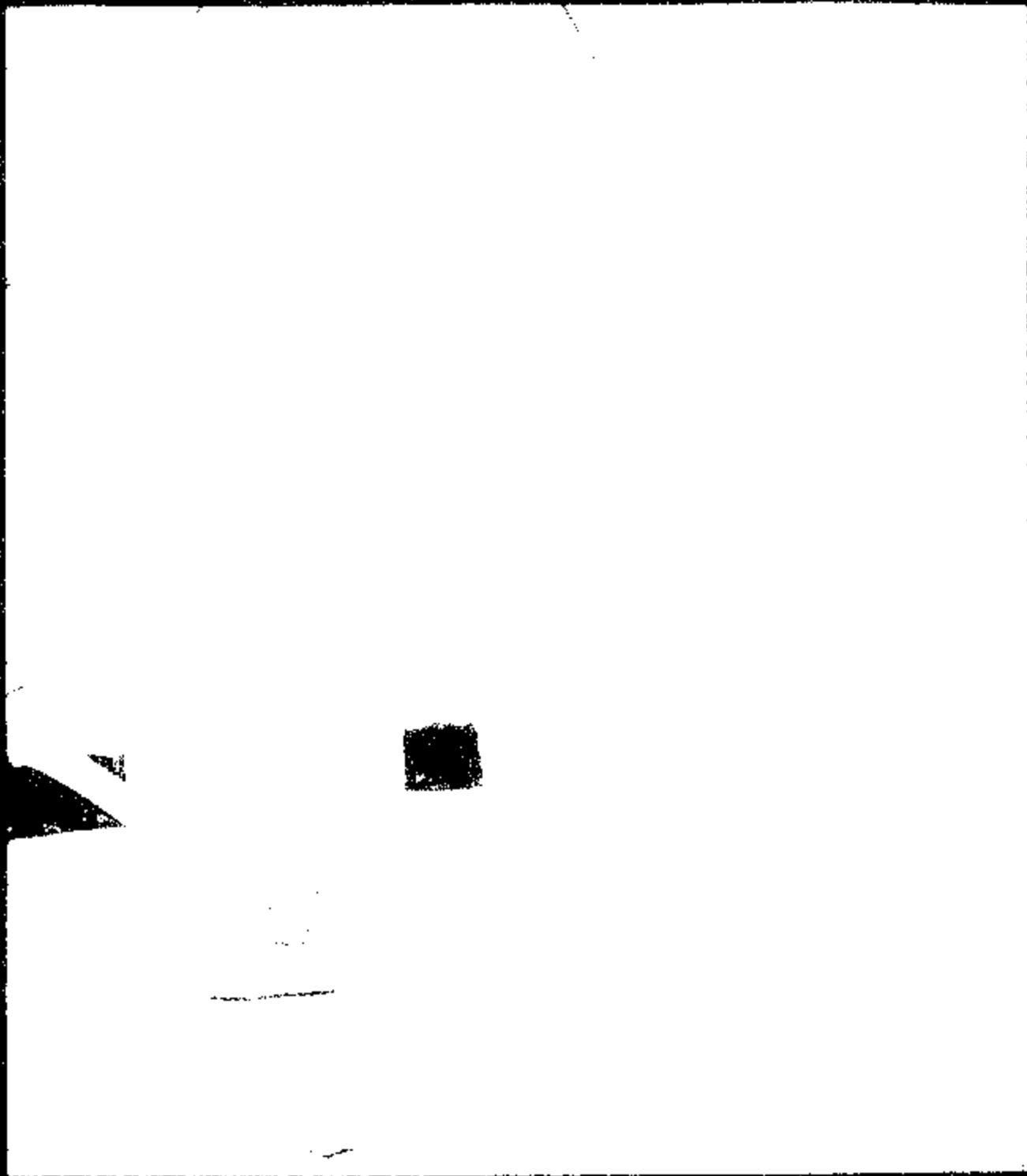
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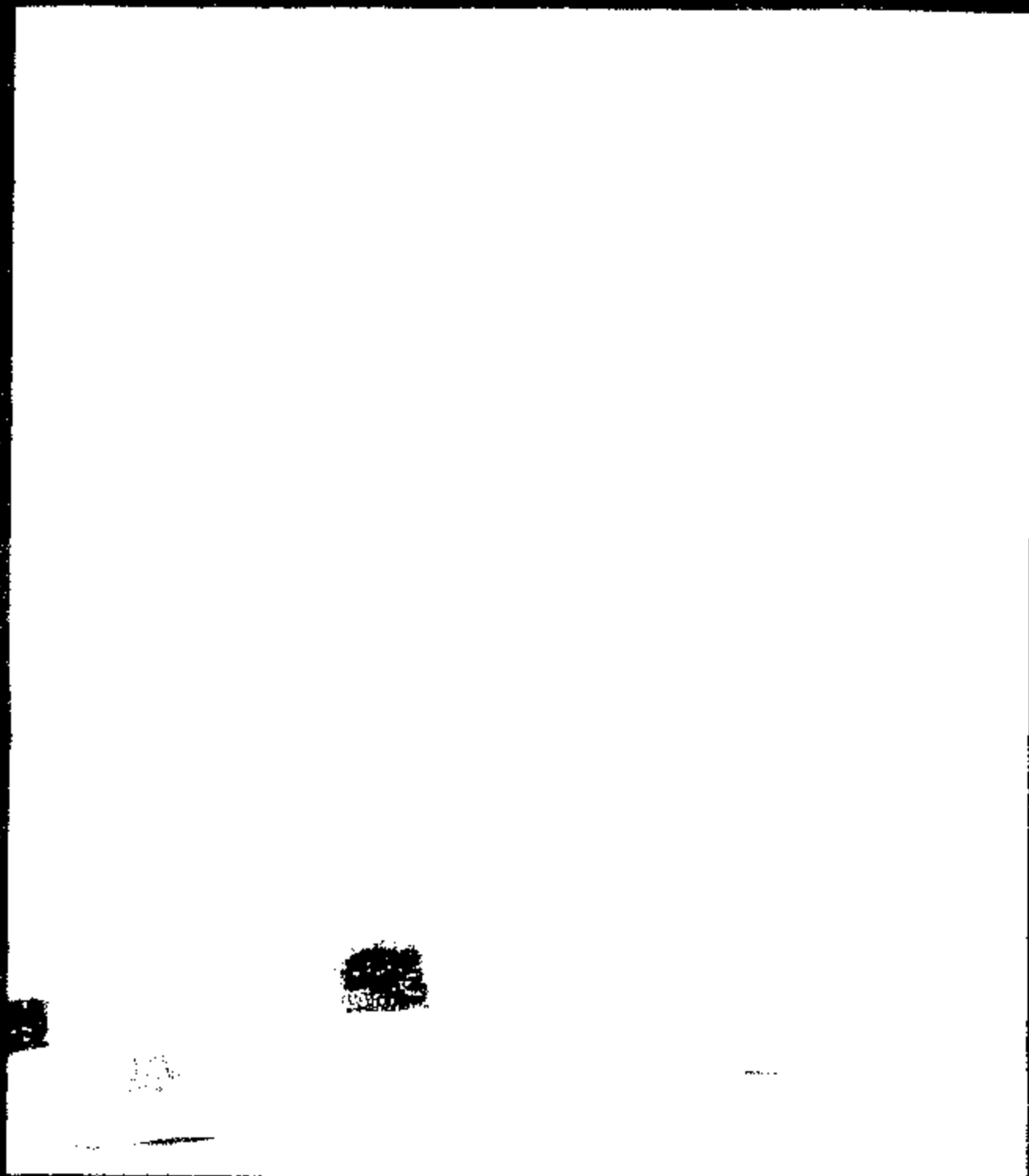
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TI-NHTSA 013334



TI-NHTSA 013335



TI-NHTSA 013336

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Digital Mavica Images

3 mavica images

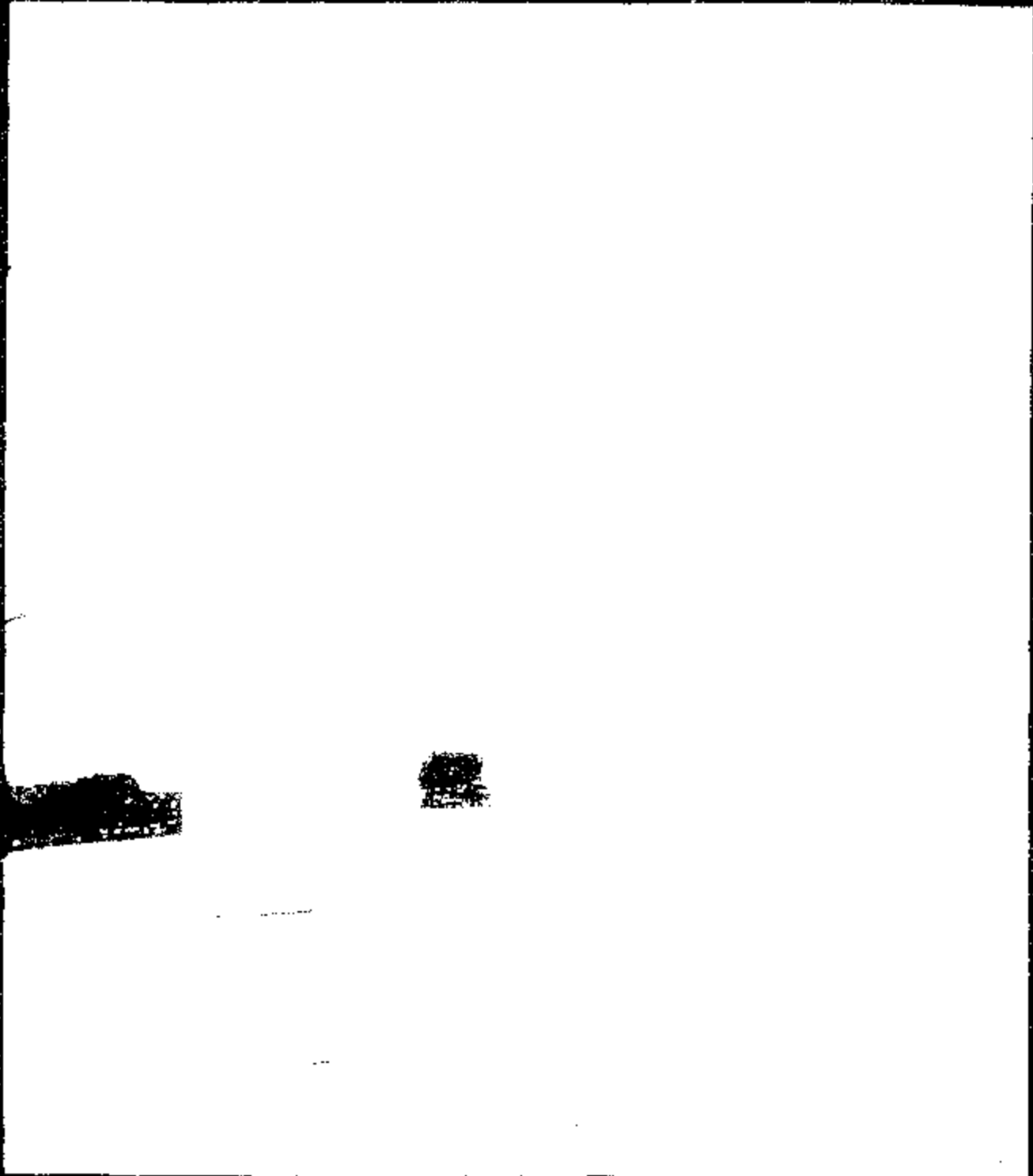
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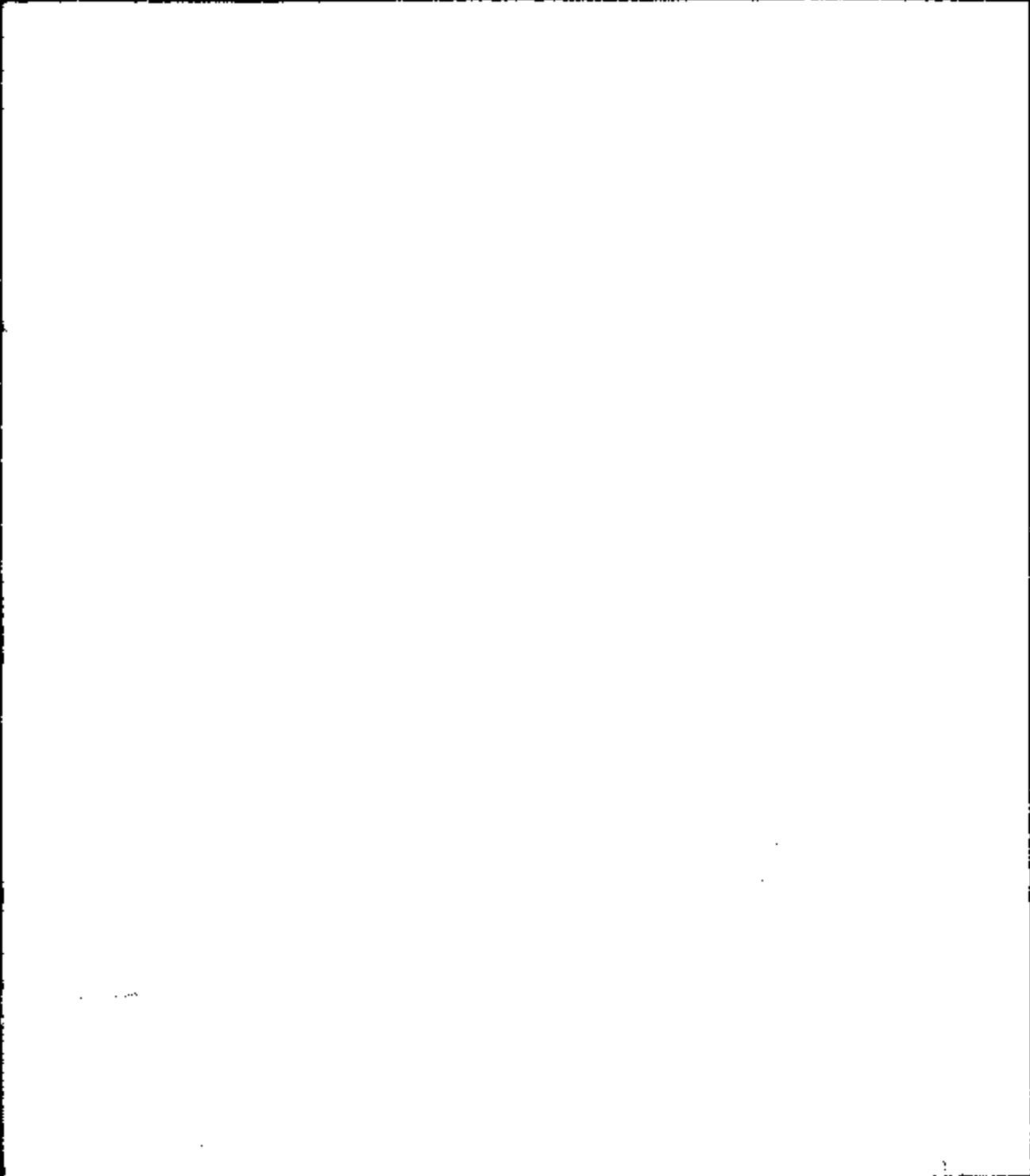
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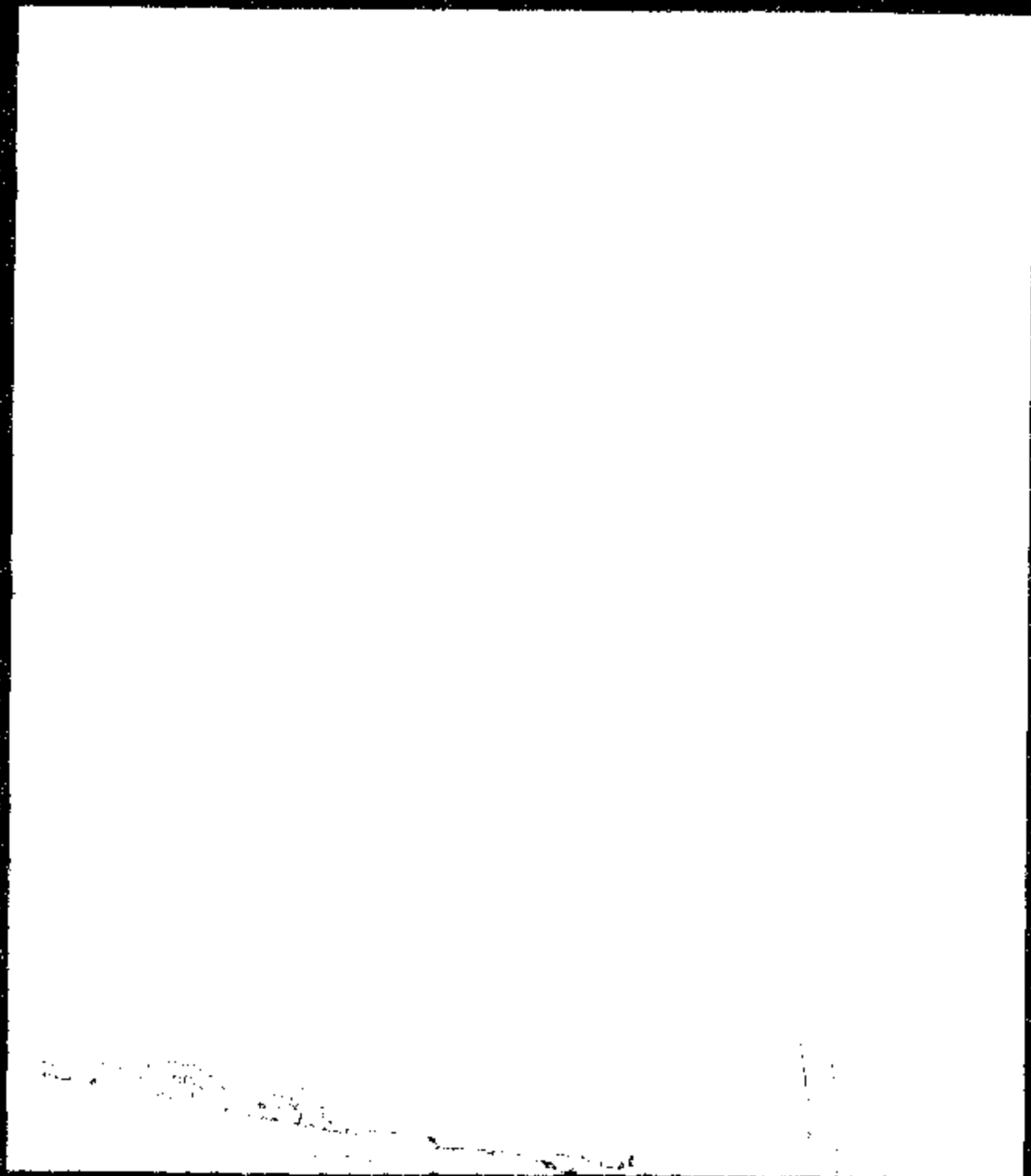
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TI-NHTSA 013339



TI-NHTSA 013340

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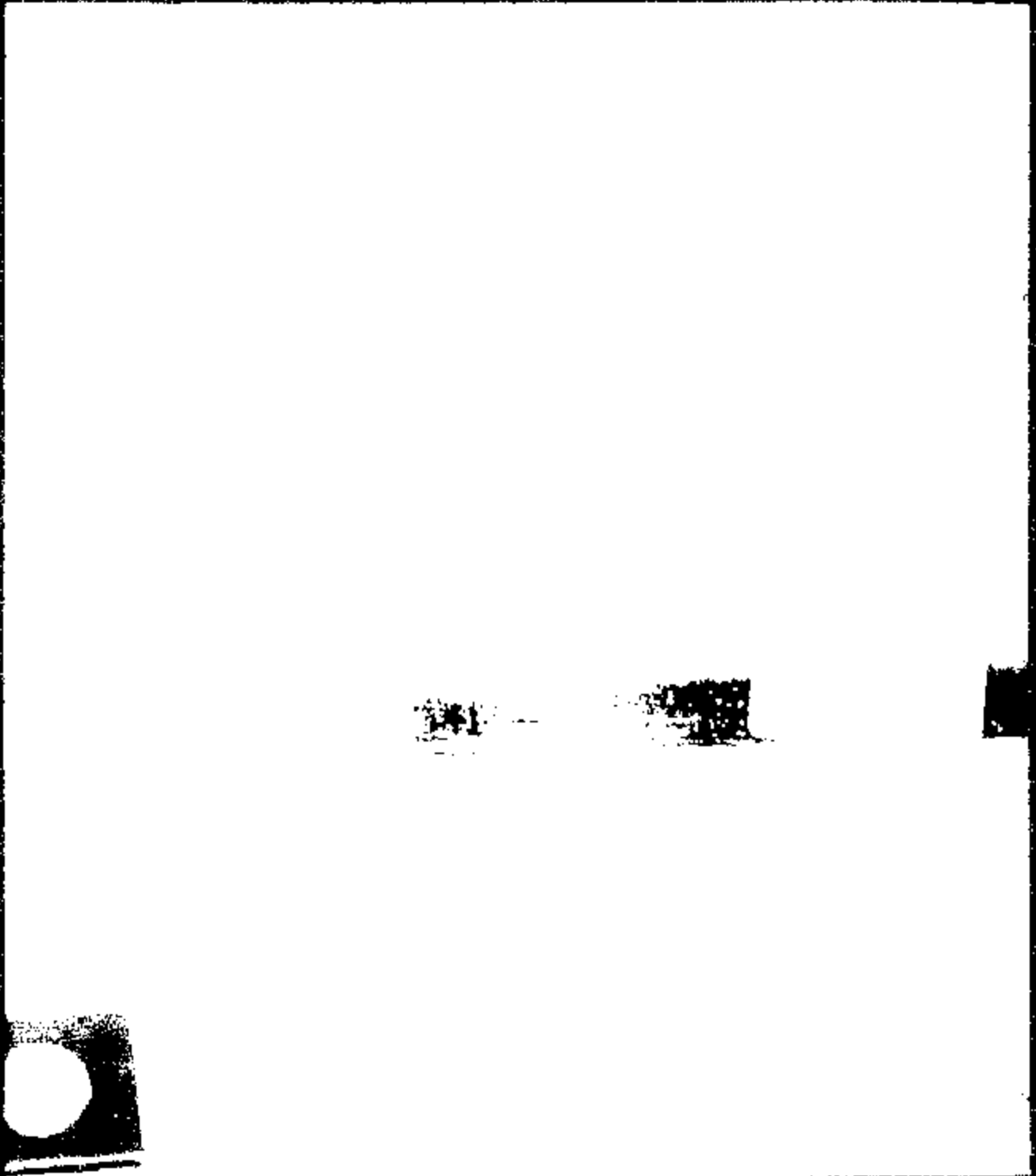
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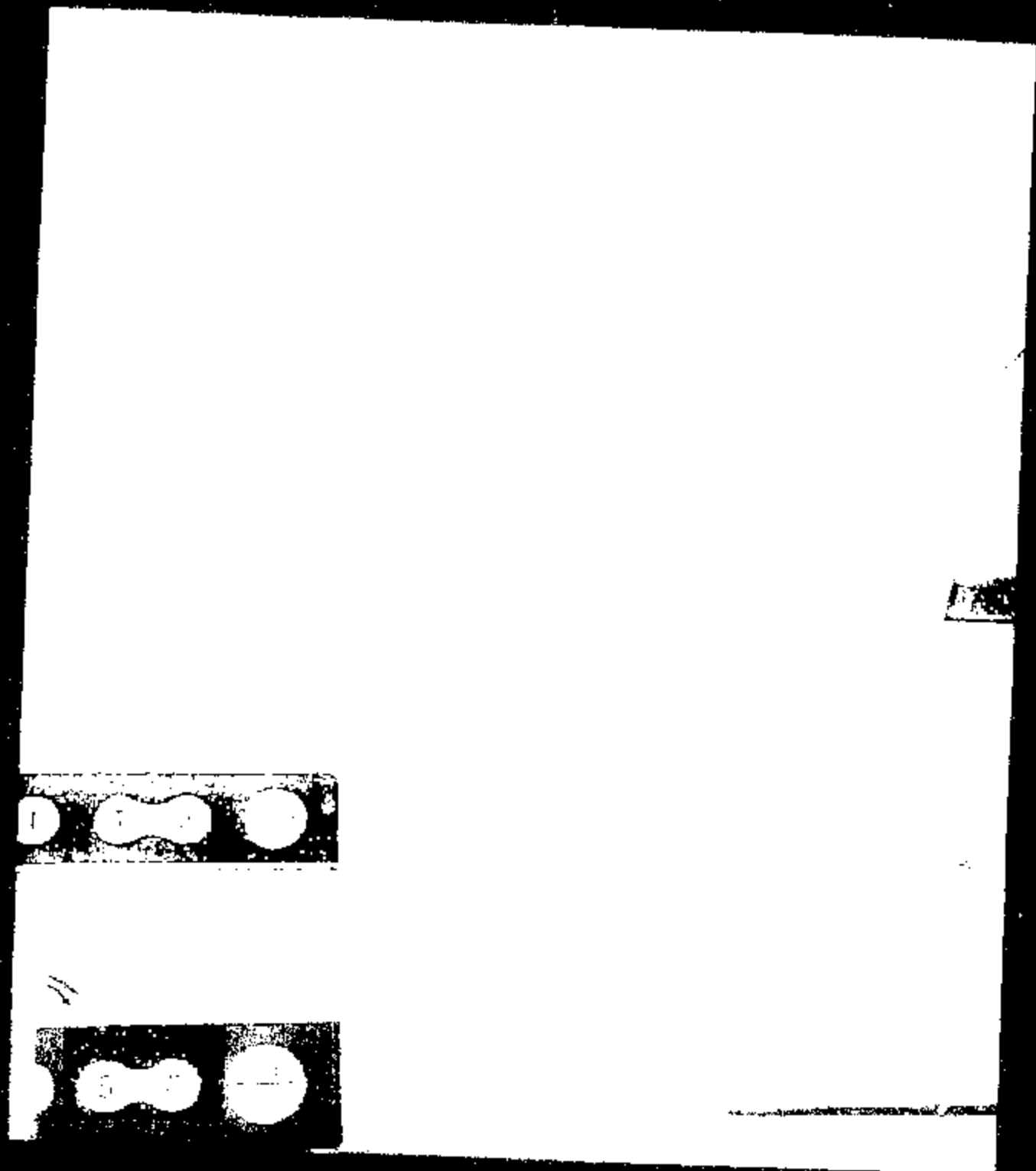
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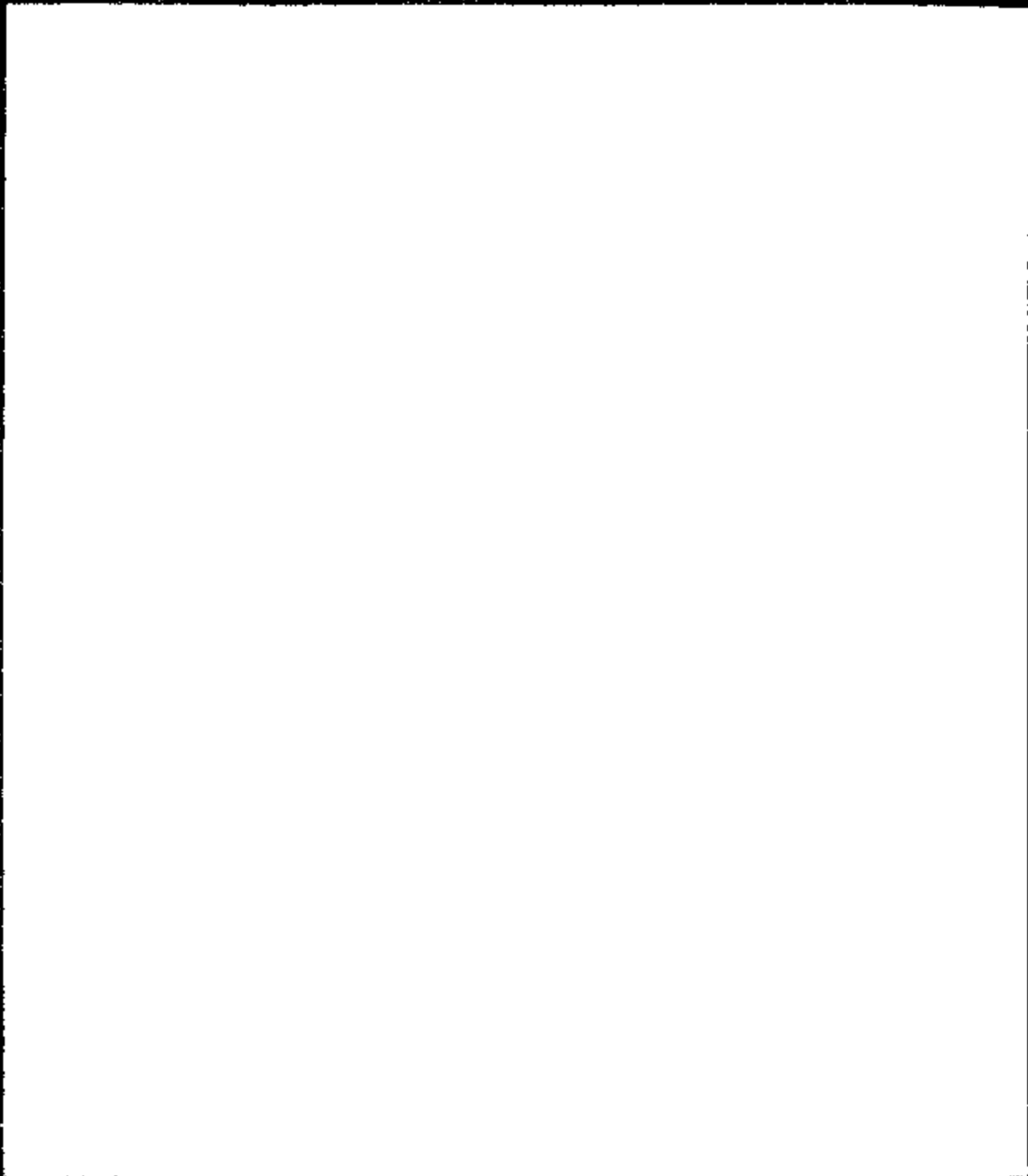
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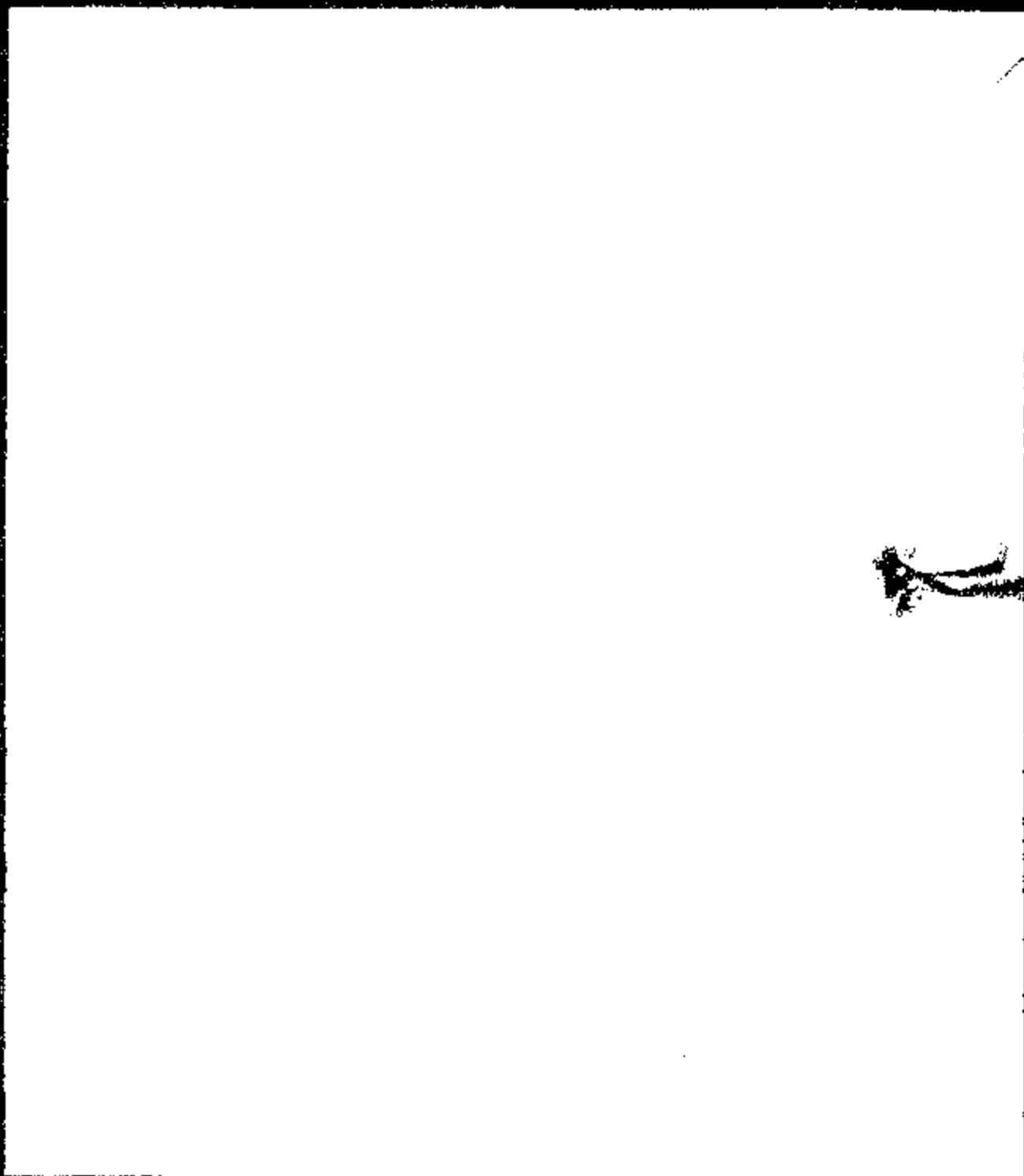
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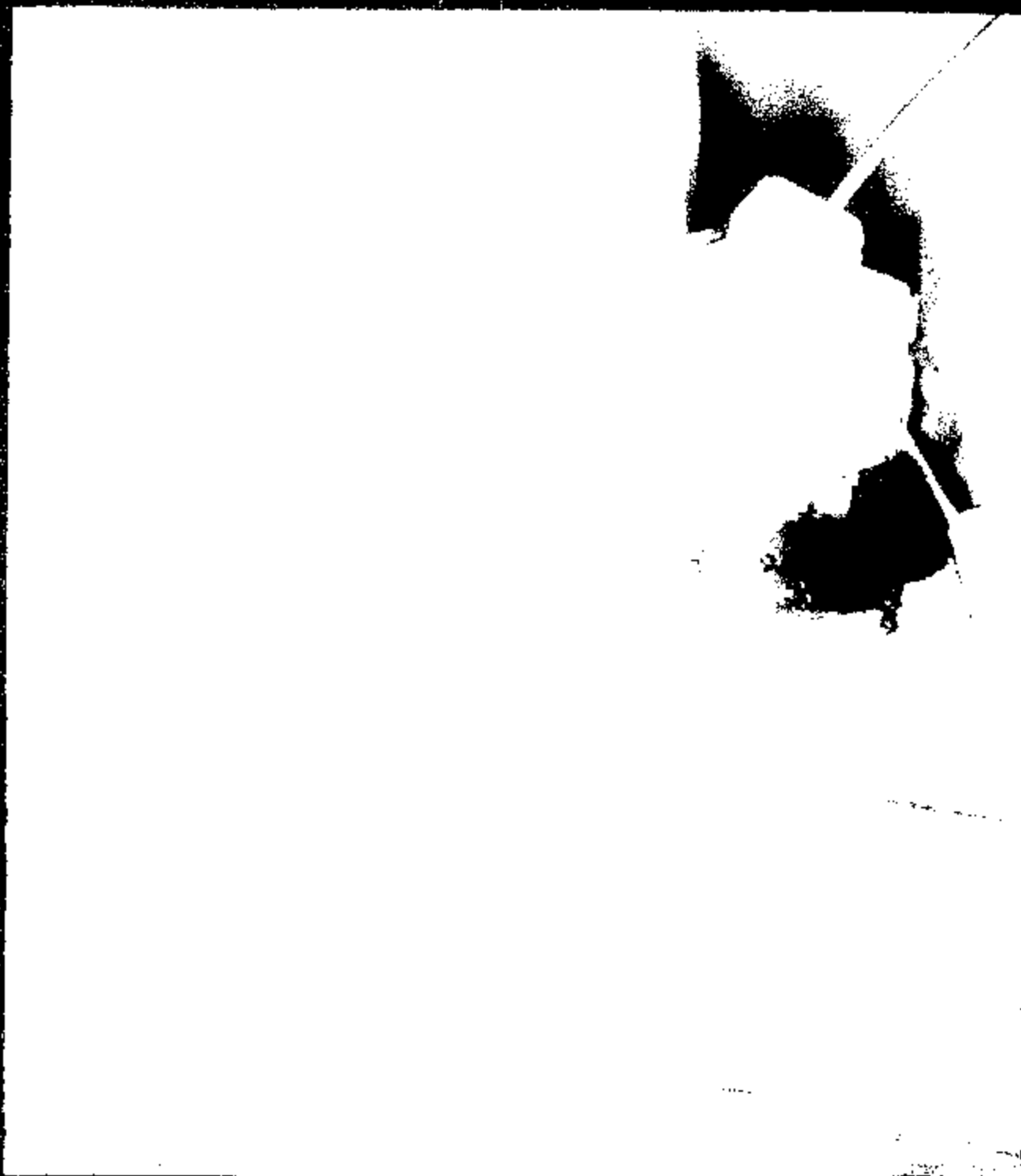
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TI-NHTSA 013344



TI-NHTSA 013345



TI-NHTSA 013346

1999 5 4 11:01:09 AM MVC-FD91

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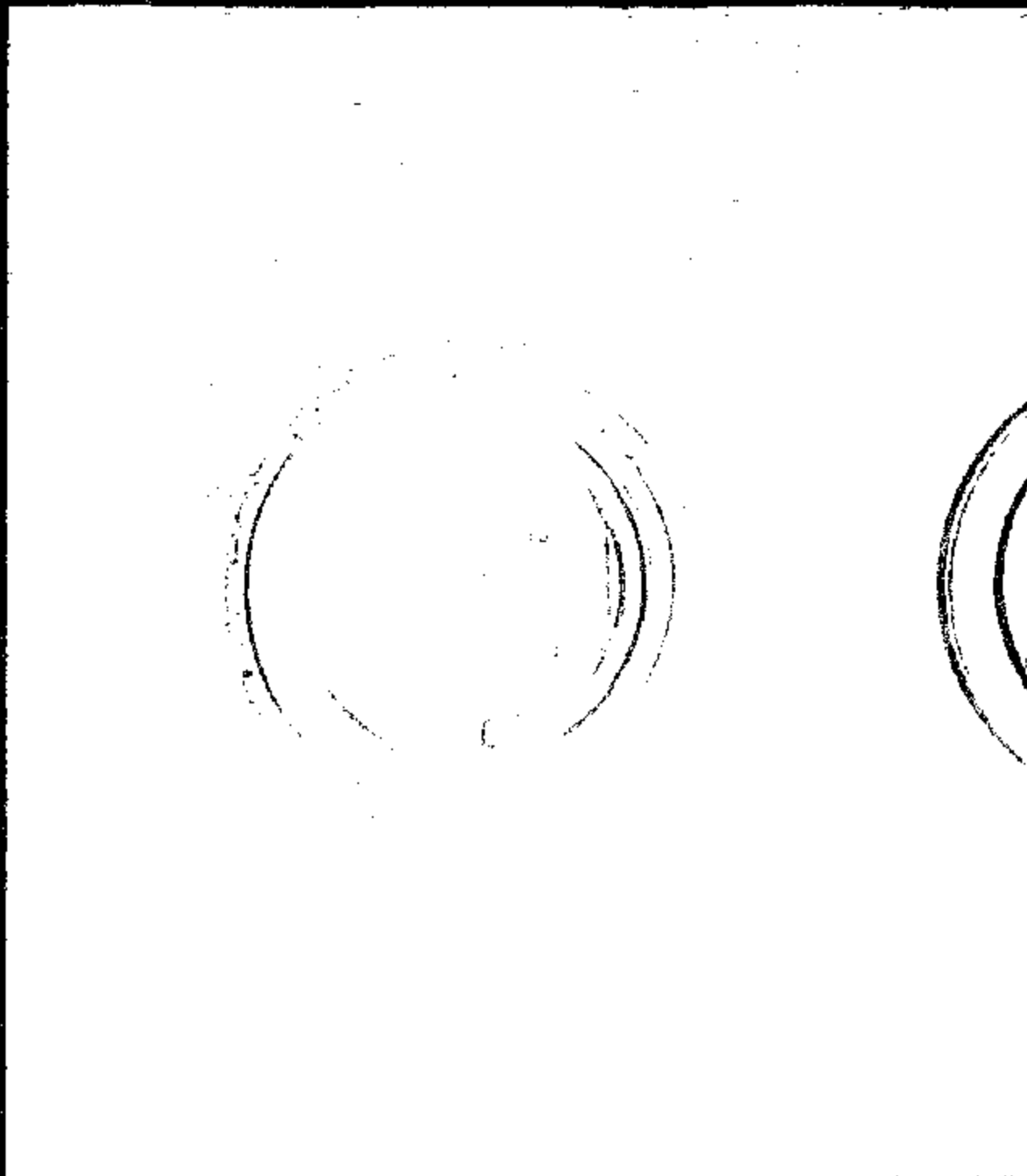
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TI-NHT8A 013347



TI-NHTSA 013348



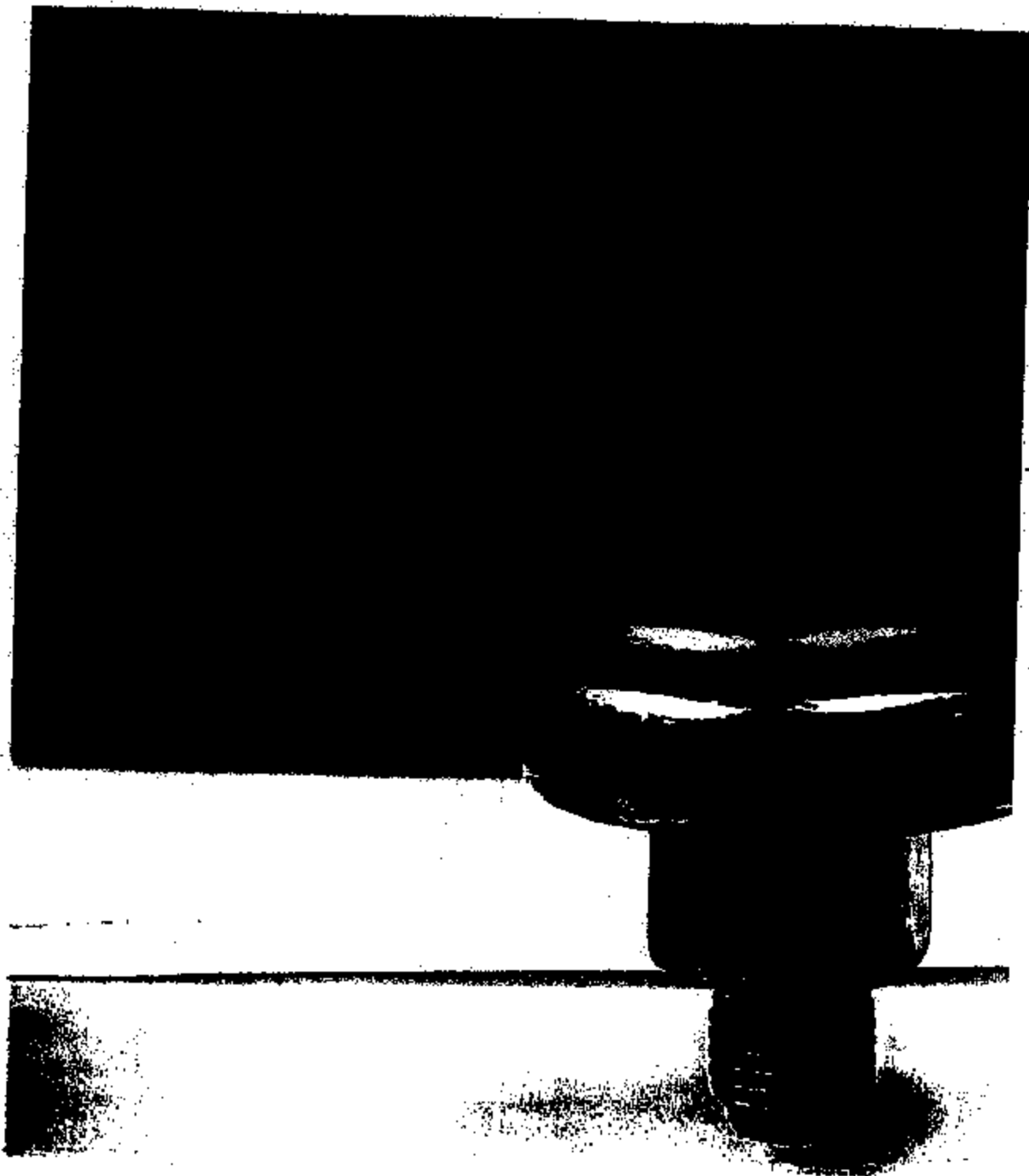
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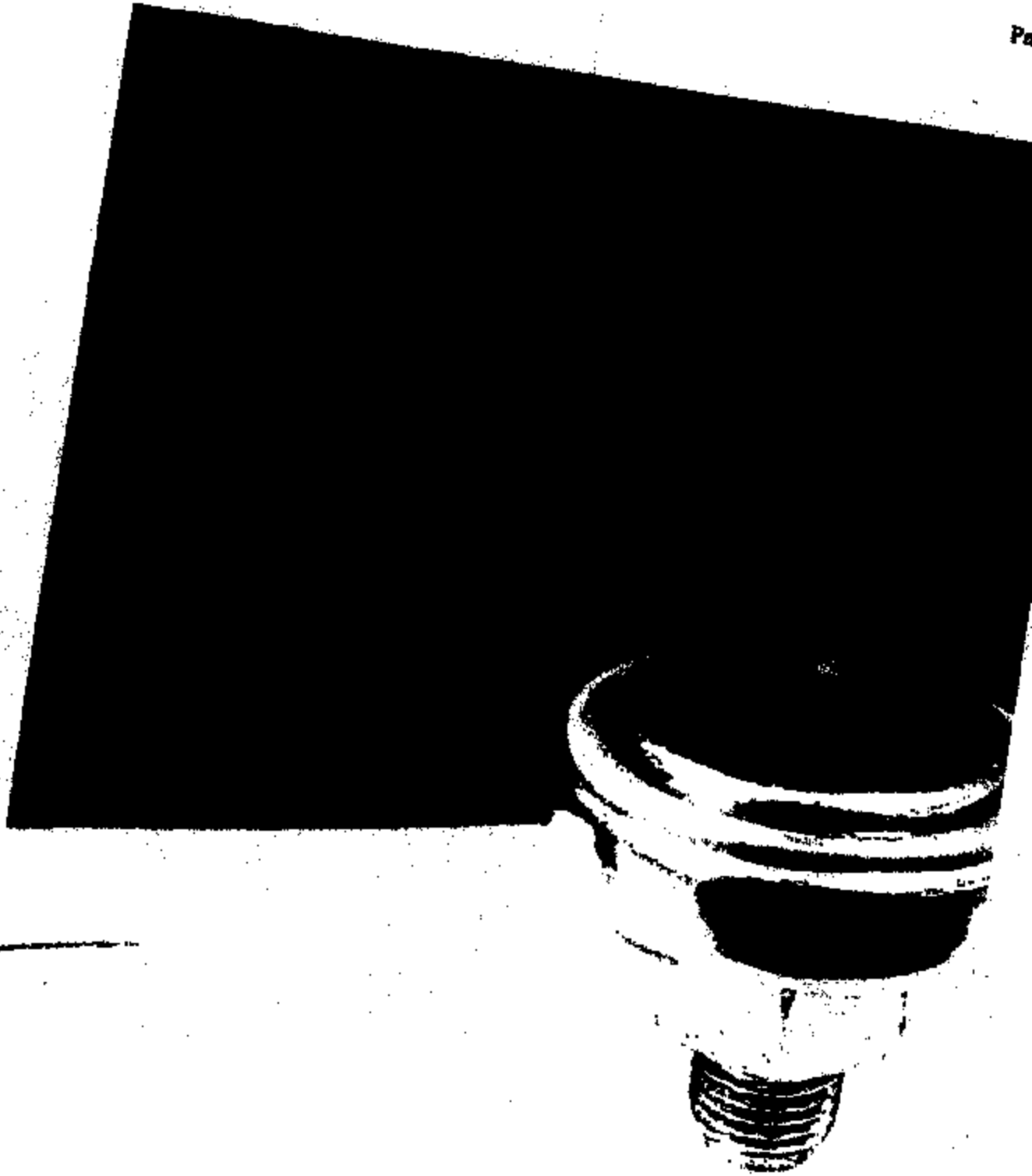
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TI-NHTSA 013351

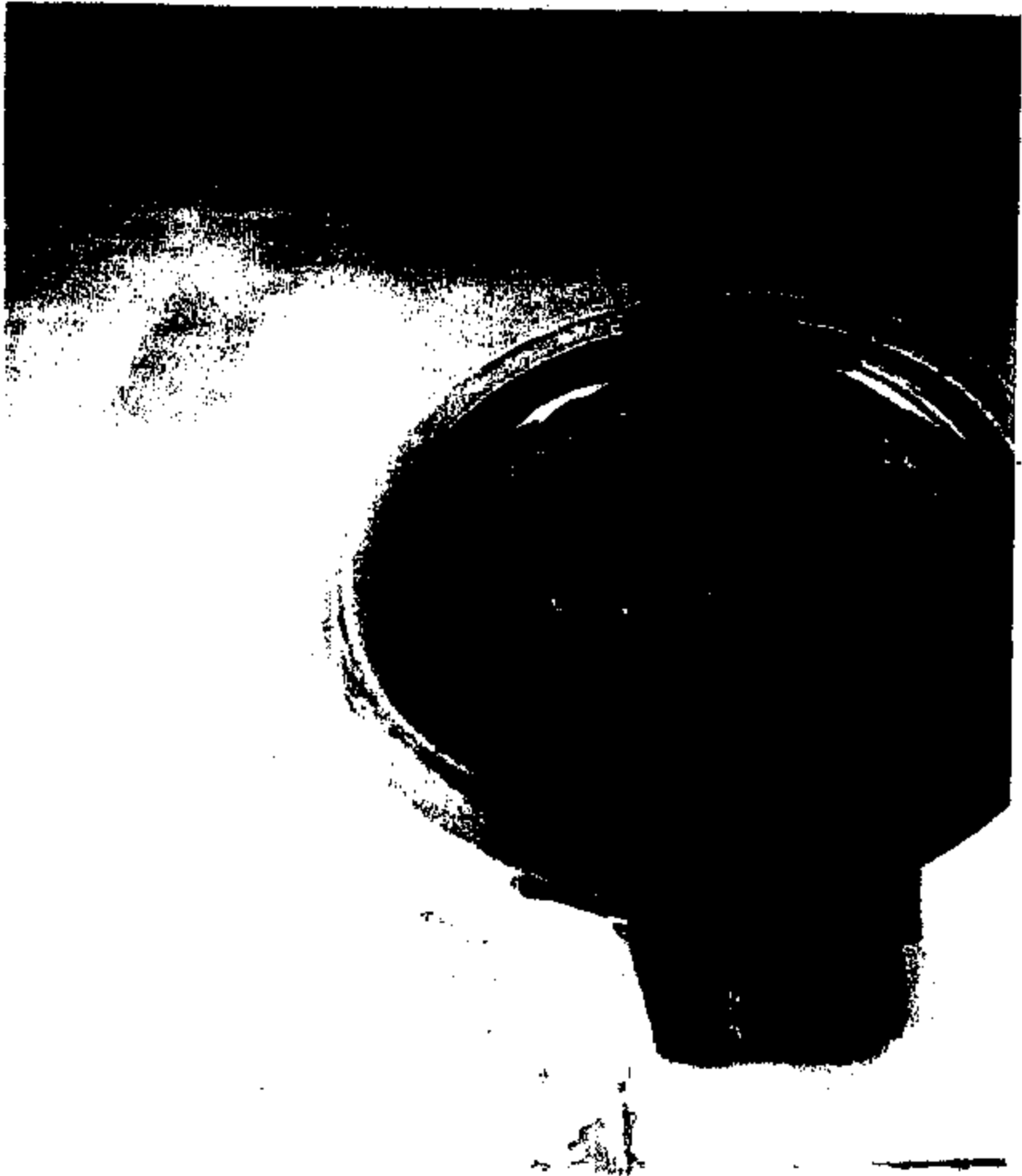


TI-NHTSA 013362



file://P:ADisc 34\MYC-180X.JPG

T1-NHT8A 013353



TI-NHTSA 013354

Epstein, Sally

From: McGuirk, Andy [a-mcguirk@email.mcti.com]
Sent: Monday, April 19, 1999 3:19 PM
To: Demers, Richard
Cc: Watt, Jim; Sundaram, Sundar
Subject: RE: IMPULSE TEST DATA FOR IP2 TEST

the answer will be a 'qualified' yes to both questions.....i do not know if you/i need characteristic sheets. i want all 77 ps impulse test 'history' with focus on the line 400k and 500k cycle test at room temp (the so called rapid cycler that all qc used to run in qc loading samples etc) with focus on after test for 'no oil leakers after cycles' for production pilots and runs that were ultimately built into product and shipped...

start the data summary with most recent history first

a

AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
34 FOREST ST M/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-3745
MOBILE: (508) 208-6119
PAGE: (800) 467-3700 PIN 604-2044

From: Demers, Richard
Sent: Monday, April 19, 1999 11:48 AM
To: McGuirk, Andy
Subject: IMPULSE TEST DATA FOR IP2 TEST

ANDY,

JIM WATT STOPPED ME THIS MORNING IN BLDG. 12 HE WAS TELLING THAT YOU WERE AGAIN LOOKING FOR SOME DATA FROM THE LINE, IN THE FORM OF CHARACTERISTIC SHEETS.

HE SAID HE THOUGHT YOU MAY BE LOOKING FOR STUFF FROM THE EARLY 90's 1991 etc. IS THIS CORRECT?

THE DATA I SUPPLIED YOU WITH LATE LAST YEAR WAS FROM 1998 .

IN ANY CASE, UNLESS YOU WANT STUFF YTD. I WOULD NEED TO RETRIEVE IT FROM DATA STORAGE.

PLEASE ADVISE , THANKS & REGARDS, RICK

Rick Demers
Texas Instruments, Inc.
34 Forest Street Attleboro, Ma, 02703
tel # 508-236-2588 (fax) 508-236-2430

TI-NHTSA 013355



UNRESOLVED ISSUES/ACTIONS

ISSUES

ACTIONS

Connector seal changes '92/'93/'94 *N/A*
 Ford wording of notification to NHTSA
 Ford "belief" of leakers at P/S - *Q2 P3 UNTR*
 - Windstar

Ford c/o Andy McGuirk
 Andy McGuirk
 Andy McGuirk

Difference between Town Car / Econoline

Ford

Desire for "long life" switch

Resolve leakers belief Andy McGuirk / Design
 Design

DOE resolution...SNAP/quiet

High temp / fire retard plastic switch *N/A*

Zytel test setup at design

Ford use of constant power at future *NEW CONNECTOR JUMPER*

Andy McGuirk / Russ Baumann

Litigation strategy *NEW ARCHITECTURE*

Russ Baumann

60% of 286 K = 172 K RES P/S TI

DUPont KAPTON CHANGE HISTORY - TI

HILTI CHANGE HISTORY - Ford c/o Andy

OTHER BRAKE APPLICATIONS - Δ - CATALYTIC / MANAG

DUPont BRAKE TEST - OXALIC ACID

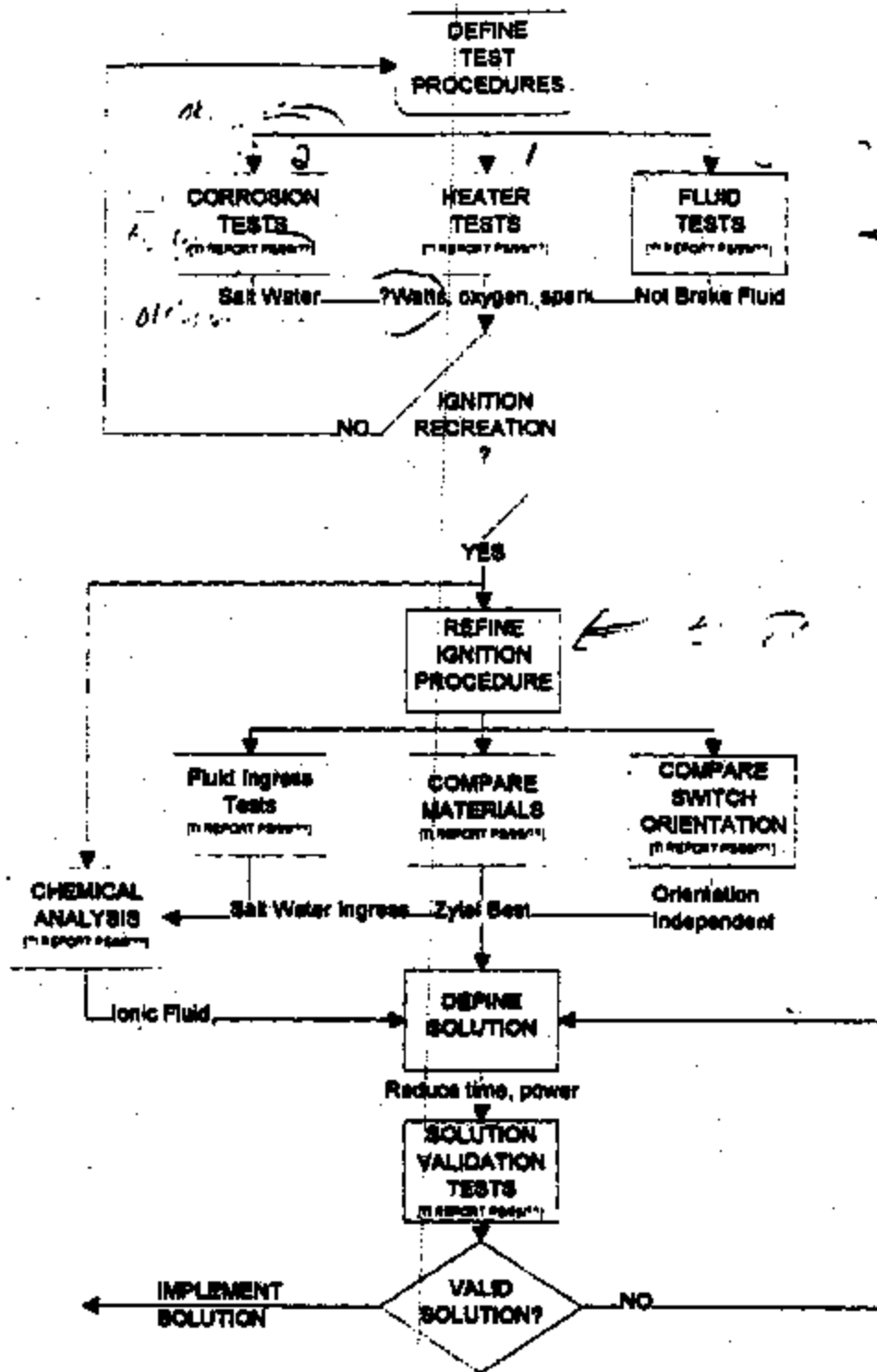
WIND TUNNEL BRAKE FLUID RESERVOIR NOTATIONS - 1205?

Summary of 4/21/99

- TI TO ACCESS P/S RECORDS
- FIND TO UNDERSTAND ECONOMIC/INDUSTRIAL OPERATION NOTIFICATION PROCEDURES
- FIND TO UNDERSTAND SUPPLY CHAIN ITEMS
 - MULTIPLE MANUFACTURING CONSTRUCTION SUPPLIERS
 - THER-DISE PROCESS
 - BODY/ASSEMBLY PROCESS
- TS TO COMPLETE DRUG TESTING PROGRAM

att C

176

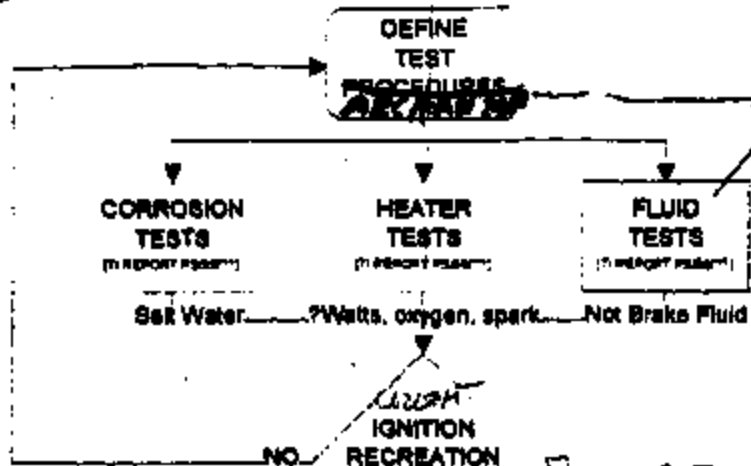


PPAPs

Establish Switch metb spec

Book #1 / 19d

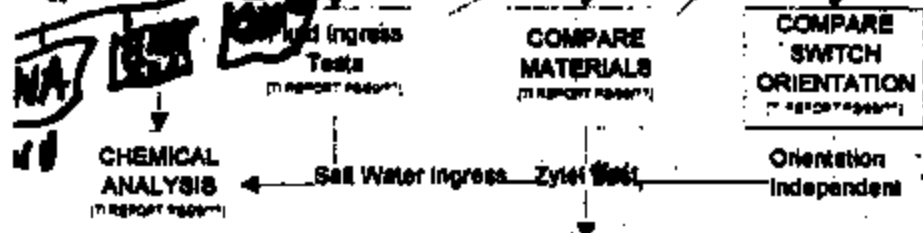
C17th



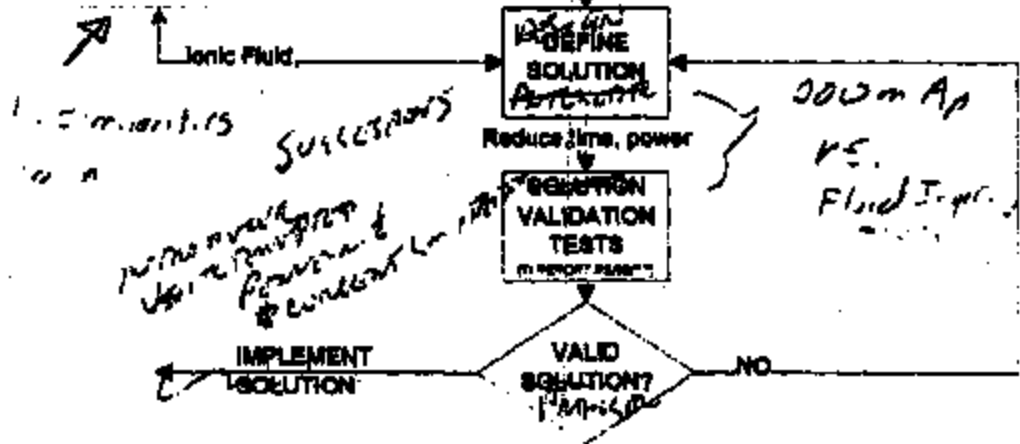
Evaluate switches
SREA
phys. Param: 1.820202
Karnon Series
prc chn hts

interrupted
ABS
Traction control
the shield chip & aging
uply chn

plastic shop



Compare Orientation
Essential
DOE



Successors
Reduce time, power
no more
use power & constant

DOE on Ap
vs.
Fluid Ingr.

Be →

Ford Central Labs Control

Saintest

Colloidal → Switch

Be deposit

spread

Bryan

Switch

four Laroush

✓

(7) switch

3 FIVE

Samples

(4)

Cadaveris Ford

switches

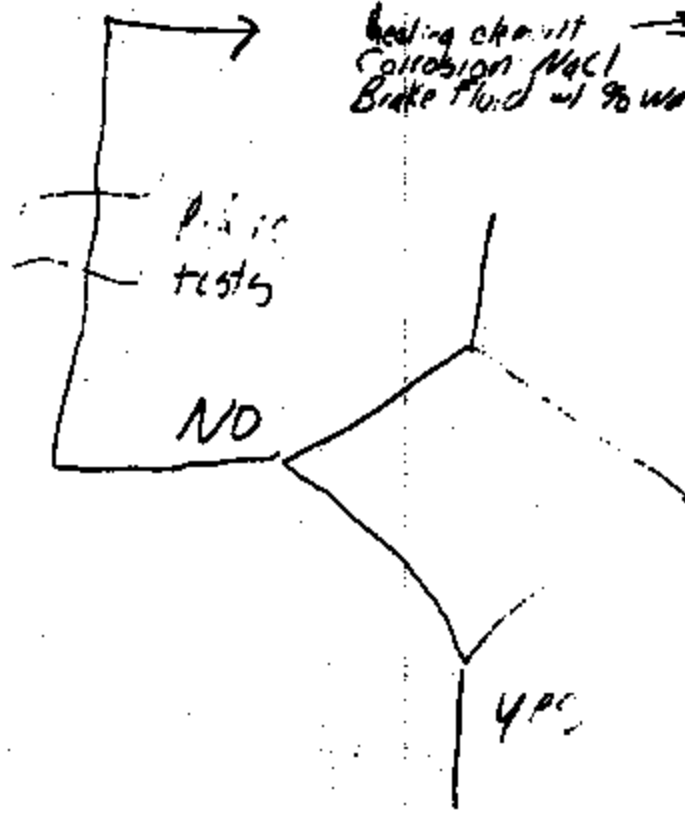
20-147
100-147
200-147

22-147
23-147
24-147



Objective → Can we recreate the Ignition

feeding circuit → short to ground
Corrosion NaCl
Brake fluid w/ 90 water



22-141 24 MONTHS
22-142 180 MONTHS
22-144 360 MONTHS
22-141 24 MONTHS
22-142 180 MONTHS
22-144 360 MONTHS

$$V = IR$$

$$R = \frac{V}{I} \quad \frac{1.4}{4}$$

~~R~~ VI

A no.

A1
Analysis

Ford Central

4/22/04

22.141
22.142
22.143
22.144
22.145

- Deposits not necessary for ignition? ^{compare} to 4 samples
[finds point to ?]
- Brake fluid samples w/ % water
- Is 300mAmp different to 15 Amp slow process
and what are they
- Comparison Memphis to 15 Amp
- share findings w/ Ford Central
- share samples w/ "

Currey, Pat

From: Mulligan, Sean [smulligan@email.mc.ti.com]
Sent: Thursday, April 22, 1999 10:38 AM
To: McGuirk, Andy
Subject: RE: Corrosion analysis

Copper, Iron, and Chromium only. Beryllium can not be detected (as I understand).

All the best,

Sean P. Mulligan

Phone (508) 236-2535
Fax (508) 236-3586

From: McGuirk, Andy
Sent: Thursday, April 22, 1999 11:27 AM
To: Mulligan, Sean
Subject: RE: Corrosion analysis

COPPER?

BEUC?

A
AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
34 FOREST ST M/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-3745
MOBILE: (508) 208-6119
PAGE: (800) 467-3700 PIN 604-2044

From: Mulligan, Sean
Sent: Thursday, April 22, 1999 11:07 AM
To: Hopkins, AL; McGuirk, Andy
Cc: Dague, Bryan; Beringhouse, Steven
Subject: RE: Corrosion analysis

Andy,
we've analyzed old brake fluid for water content and metal content. We have those results. No other testing of brake fluid in the works.

All the best,

Sean P. Mulligan

Phone (508) 236-2535
Fax (508) 236-3586

From: McGuirk, Andy
Sent: Thursday, April 22, 1999 10:57 AM
To: Mulligan, Sean; Hopkins, AL
Cc: Dague, Bryan; Beringhouse, Steven
Subject: RE: Corrosion analysis

1

TI-NHTSA 013365

HAVE WE ANALYZED JUST 'OLD' FORD BRAKE FLUID TOO AS
A 'BASELINE'?

A
AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
34 FOREST ST M/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-3745
MOBILE: (508) 208-6119
PAGE: (800) 467-3700 FIM 604-2044

From: Hopkins, AL
Sent: Thursday, April 22, 1999 10:44 AM
To: Mulligan, Sean
Cc: Dague, Bryan; Beringhouse, Steven;
McGuirk, Andy
Subject: RE: Corrosion analysis

I have quite a bit of data now. Let's get
together to review it and see exactly what you need.

Al

From: Mulligan, Sean
Sent: Thursday, April 22, 1999 10:00 AM
To: Hopkins, AL
Subject: Corrosion analysis

Hi Al,
We are feeling increased pressure to produce
reports on the 7799 issue. The corrosion analyses are needed. It will take
some time to incorporate your findings into the reports. Can you expedite
the analyses?

All the best,

Sean P. Mulligan

Phone (508) 236-2535
Fax (508) 236-3586

Test/sample	Test Results/Conclusions	Chem Lab Results
Heater Tests	Power, oxygen and spark needed.	None in process
Ignition recreation 0% H ₂ O in brake fluid 4% H ₂ O in brake fluid 8% H ₂ O in brake fluid 16% H ₂ O in brake fluid 75% H ₂ O in brake fluid	Brake fluid with H ₂ O will not ignite in test setup.	None in process. Identify chemical makeup of corrosion. Quantify corrosion as a function of % H ₂ O in brake fluid. Identify deposits. Quantify deposits as a function of % H ₂ O in brake fluid.
Brake fluid analysis Used brake fluid. Master cylinder Caliper New brake fluid.		Cu = 416 (ug/ml), Fe = 5.8 (ug/ml), Cr = 0.08 (ug/ml), 1.1 %H ₂ O. Cu = 582 (ug/ml), Fe = 6.5 (ug/ml), Cr = 1.9 (ug/ml), 1.1 %H ₂ O. Cu = <0.01 (ug/ml), Fe = 0.82 (ug/ml), Cr = <.01 (ug/ml), 0.3 %H ₂ O.
Corrosion Tests 5% salt in H ₂ O	Resistive heating element possible. Heating element is not across switch terminals but from terminal to ground.	None in process
Fluid Ingress Tests (3) hour tests 5% NaCl in tap water tap water rain water (24) hour tests used brake fluid used brake fluid w/ 5% H ₂ O new brake fluid new brake fluid w/ 5% H ₂ O	ignition. Large hotspot current low hotspot current low hotspot current low hotspot current low hotspot current low hotspot current	Cu deposits. Cu deposits. Cu deposits. Cu deposits. -No corrosion. Black soot deposit composition Cu deposits. -No corrosion. Black soot deposit composition Cu deposits. -No corrosion. Black soot deposit composition Cu deposits. -No corrosion. Black soot deposit composition
Virgin Switch Analysis (4) 2-1 switches		Cu content.

Black = Complete

Red = Incomplete

Blue = Not in Process

Test/sample	Test Results/Conclusions	Chem Lab Results
Material Comparison Cellnex 4300 Cellnex 3318 Noryl Zylel	Zylel performed best. All will burn in 15 amp circuit.	None in Process
Switch Orientation Vertical Horizontal Rotational	Orientation independent.	None in Process
Delay Circuit Tests (48) hour worst case scenario Impending burn Maximum power	Corrosion rate drastically reduced. Power not enough to nucleate an ignition.	Cannot differentiate between 15 Amp corrosion and 200mAmp corrosion (It looks similar but at 200mAmps, the arm is intact after (48) hours whereas the contact arm is dissolved in 45 minutes to 15 Amp test).
71 Memphis Findings		Phosphorus, Potassium and Sulfur present. LoI
Ford Central Findings Memphis A B C D E F		

Black = Complete

Red = Incomplete

Blue = Not in Process

Test/sample	Test Results/Conclusions	Chem Lab Results
Heater Tests	Power, oxygen and spark needed.	None in process
Ignition recreation 0% H ₂ O in brake fluid 4% H ₂ O in brake fluid 8% H ₂ O in brake fluid 10% H ₂ O in brake fluid 75% H ₂ O in brake fluid	Brake fluid with H ₂ O will not ignite in test setup.	None in process Identify chemical makeup of corrosion. Quantify corrosion as a function of % H ₂ O in brake fluid. Identify deposits. Quantify deposits as a function of % H ₂ O in brake fluid.
Brake fluid analysis Used brake fluid. Master cylinder Caliper New brake fluid.		Cu = 415 (ug/ml), Fe = 5.6 (ug/ml), Cr = 0.08 (ug/ml), 1.1 %H ₂ O. Cu = 592 (ug/ml), Fe = 5.5 (ug/ml), Cr = 1.9 (ug/ml), 1.1 %H ₂ O. Cu = <0.01 (ug/ml), Fe = 0.82 (ug/ml), Cr = <.01 (ug/ml), 0.3 %H ₂ O.
Corrosion Tests 5% salt in H ₂ O	Resistive heating element possible. Heating element is not across switch terminals but from terminal to ground.	None in process
Fluid Ingress Tests (3) hour tests 5% NaCl in tap water tap water rain water (24) hour tests used brake fluid used brake fluid w/ 5% H ₂ O new brake fluid new brake fluid w/ 5% H ₂ O	ignition. Large hexport current low hexport current low hexport current low hexport current low hexport current low hexport current	Cu deposits. Cu deposits. Cu deposits. Cu deposits. -No corrosion. Black soot deposit composition Cu deposits. -No corrosion. Black soot deposit composition Cu deposits. -No corrosion. Black soot deposit composition Cu deposits. -No corrosion. Black soot deposit composition
Virgin Switch Analysis (4) 2-1 switches		Cu content.

Black = Complete

Red = Incomplete

Blue = Not in Process

Test/sample	Test Results/Conclusions	Chem Lab Results
Material Comparison Celanex 4300 Celanex 3318 Noryl Zytel	Zytel performed best. All will burn in 15 amp circuit.	None in Process
Switch Orientation Vertical Horizontal Rotational	Orientation Independent.	None in Process
Relay Circuit Tests (48) hour worst case scenario impending burn Maximum power	Corrosion rate drastically reduced. Power not enough to recede an ignition.	Cannot differentiate between 15 Amp corrosion and 200mAmp corrosion (It looks similar but at 200mAmps, the arm is intact after (48) hours whereas the contact arm is dissolved in 45 minutes in 15 Amp test).
TI Memphis Findings		Phosphorus, Potassium and Sulfur present. Lot
Ford Central Findings Memphis		

15
15
16

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Lonik TETM
OLD BATTLE C
146 154
Black = Complete

Red = Incomplete

Blue = Not in Process

Currey, Pat

From: McGuirk, Andy [a-mcguirk@smail.mc.ti.com]
Sent: Sunday, April 25, 1999 11:45 AM
To: Mulligan, Sean
Subject: FW: TESTLOG.xls

Importance: High



fyi

call me if questions.....508 208 6119

also, copy daque and beringhouse and warner on your reply

A
AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
34 FOREST ST N/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-3745
MOBILE: (508) 208-6119
PAGE: (800) 467-3700 PIN 604-2044

From: Daque, Bryan
Sent: Tuesday, March 16, 1999 5:37 PM
To: Warner, Pam; Rahman, Aziz
Cc: McGuirk, Andy; Beringhouse, Steven
Subject: RE: TESTLOG.xls

<<TESTLOG 3-17>>

Andy,

Check it out to make sure the words are right and I did not miss anything.

See you at 7:00.

Bry

From: Rahman, Aziz
Sent: Wednesday, March 10, 1999 8:03 AM
To: Warner, Pam
Cc: McGuirk, Andy; Daque, Bryan; Beringhouse, Steven
Subject: TESTLOG.xls

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<<File: TESTLOG.xls>>

Pam,

For Andy's trip today.

Regards
Aziz.

Brake Pressure Switch Test Log, Updated 3/10/00

Category	Test	Location	Test Procedures	Results Update
Lab Simulation	1	TI	Vehicle Levels of 'new' Brake Fluid, Master Switch (14000 psi max nominal, hazard occurred) Water Cont. 0%, 4%, 6%, 10%, 75%	2800 hours, Current drops in the 4.5m to 5m, range Field has deteriorated
Diagnosis Wear	2	TI	Vehicle Levels of 'new' Brake Fluid, Water, (1 Amp) through switch terminals	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	3	AVT	'new' Brake Fluid in Switch, 2M VOC in one terminal, Hazard Occurred	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	4	AVT	'new' Brake Fluid in Switch, 2M VOC in one terminal, Hazard Occurred, Ambient at 150 C	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	5	AVT	'new' Brake Fluid in Switch, 2M VOC in one terminal, Hazard Occurred	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	6a	AVT	'new' Brake Fluid in Switch system, 2M VOC in one terminal, Hazard Occurred	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	6b	TI	Part Number elements into Switch, 1/2" x 1/2" x 1/2", include terminal Weld 1/2" x 1/2" x 1/2" Use 'new' brake fluid with metal shavings No water that remains	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	6c	TI	Create heater by covering spring arm with water system, 140 between spring and hazard	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	6d	TI	Remove wiring lead to understand connectivity, correct path	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	7	TI	2-1400 mag pressure points at 120C per ES	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	8	TI	2-1400 mag pressure points at 120C ambient Field returns from dealer lab, analysis	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	9	TI	Vehicle Levels of Brake Fluid, Water, Hazard Occurred	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time
Diagnosis Wear	10	TI	Vehicle Levels of Brake Fluid, Water, Hazard Occurred	2800 hours, Current drops in the 4.5m to 5m, range No significant temperature rise with 1000 hour lamp-on time

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