

EA02-025

FORD

10/27/03

BOOK 27 OF 61

PART 5 OF 5

BOX 23 OF 28



Control Laboratory

Reports 9900226

9900807

9901571

Figures 1 through 81

3713 7830

A



Central Laboratory

Report 9040225

Figure 1.: Switch A. Ad-received.

Magnification: -2.4X

A



Federal Laboratory

Report number

Figure 2: Switch A.

Face of cup.

Magnification: -6X

A



Central Laboratory

Report 0000226

Figure 3: Switch A. Filing end of barrel.

Magnification: ~6X

3713 7832



A

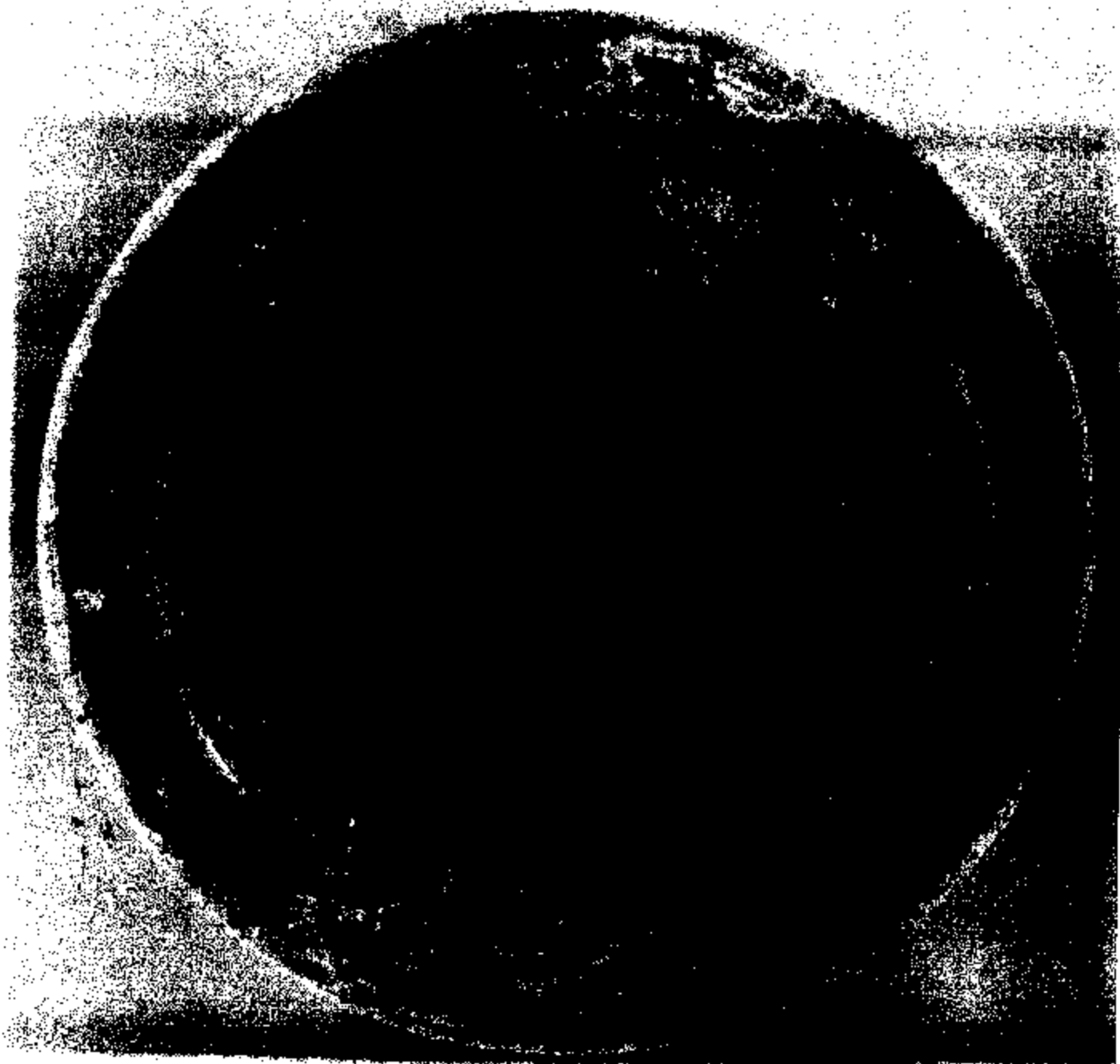


Central Laboratory

Report 800202

Figure 4: British A. Crimp ring removed.

Magnification: -2.7X



Central Laboratory

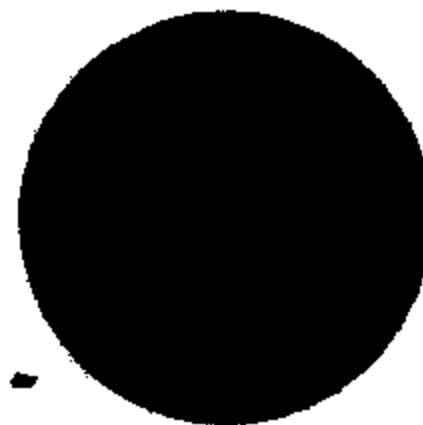
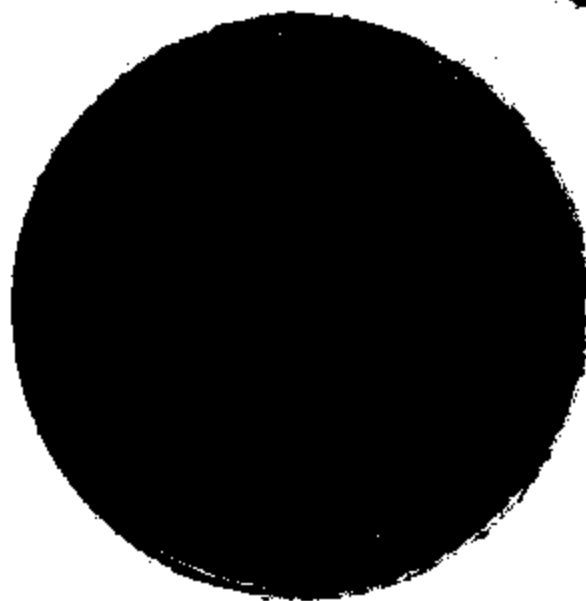
Report 8808228

Figure 5: Switch A.

Face of cup - crimp ring removed.

Magnification: -5X

A



A

3713 7835



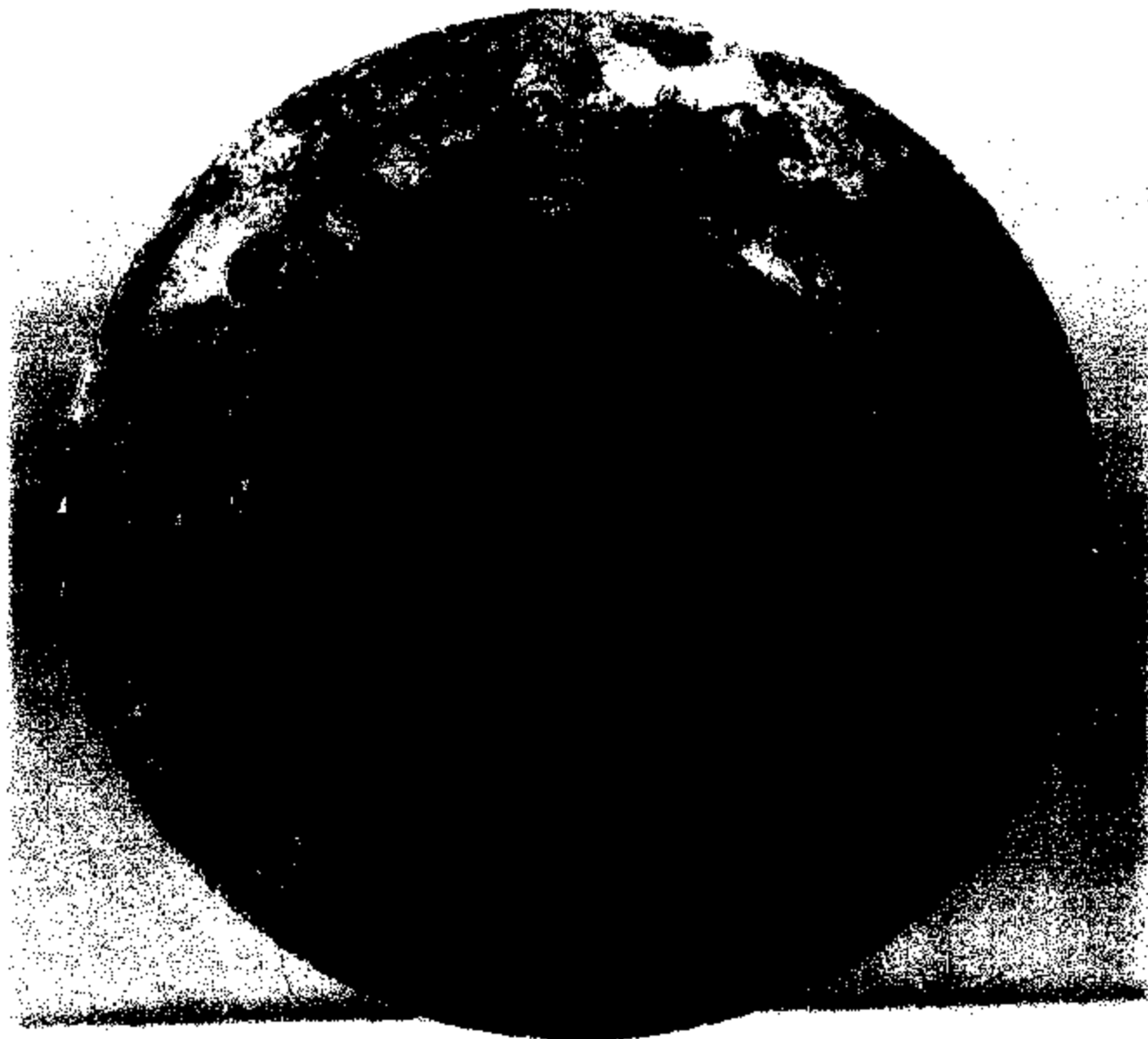
Central Laboratory

Report 9800226

Figure 6: Switch A.

Washer, converter, disc, and spacer.

Magnification: -3X

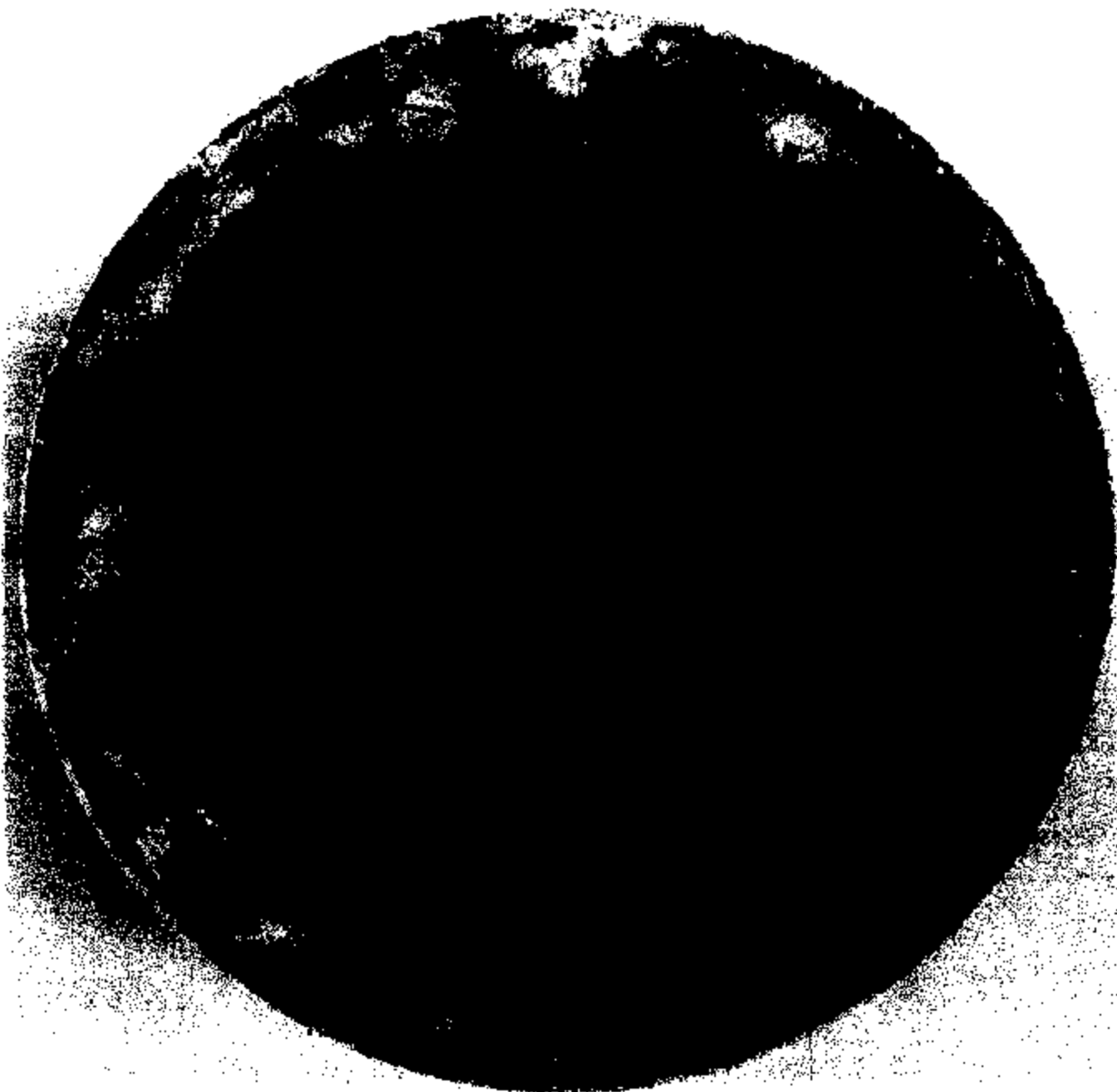


Central Laboratory

Report 9800228

Figure 8: Bulph A. Hexport cavity.

Magnification: -6.2X

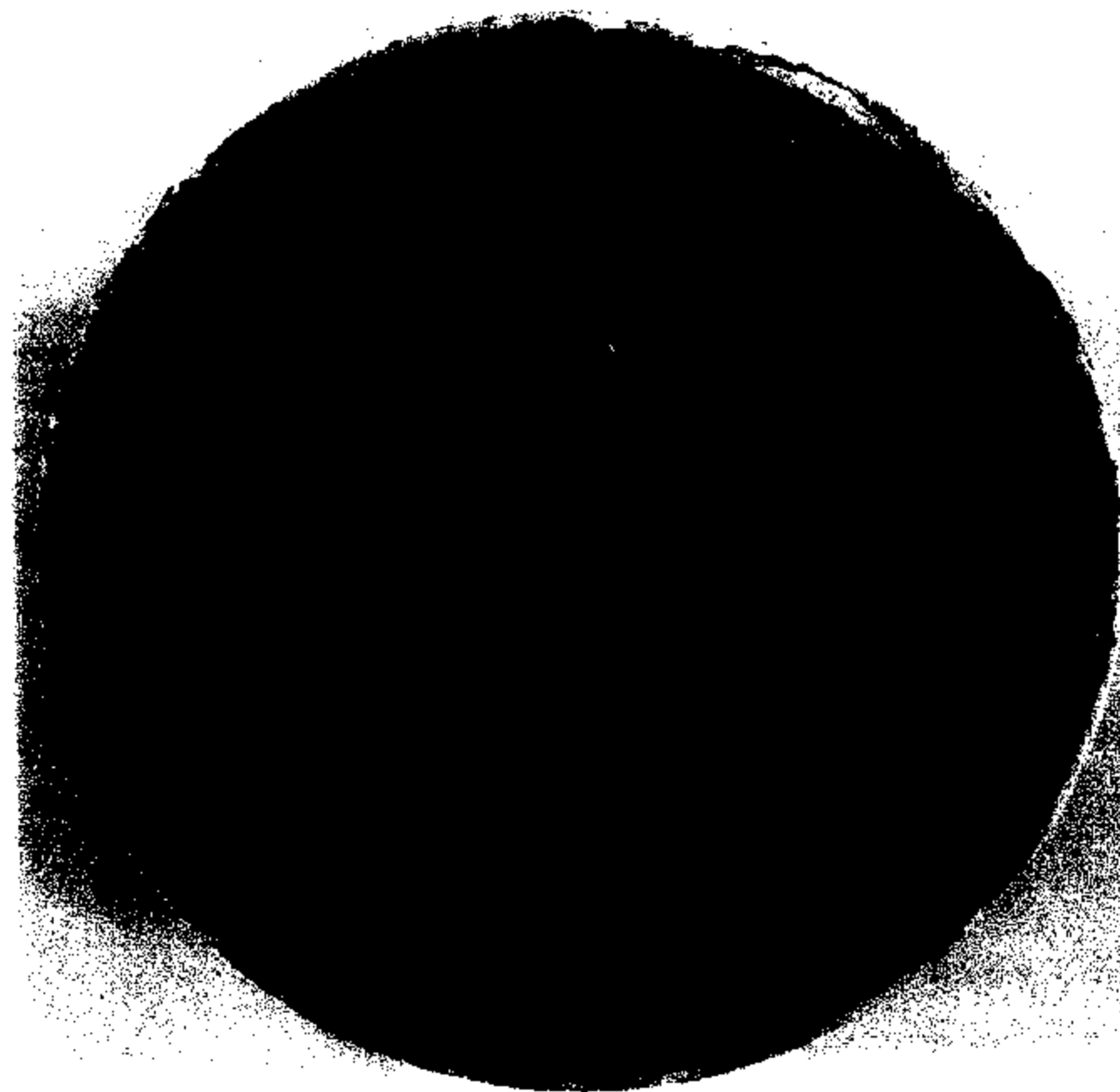


Central Laboratory

Report 8008226

Figure 9: Switch A. Washer and converter.

Magnification: -8.8X

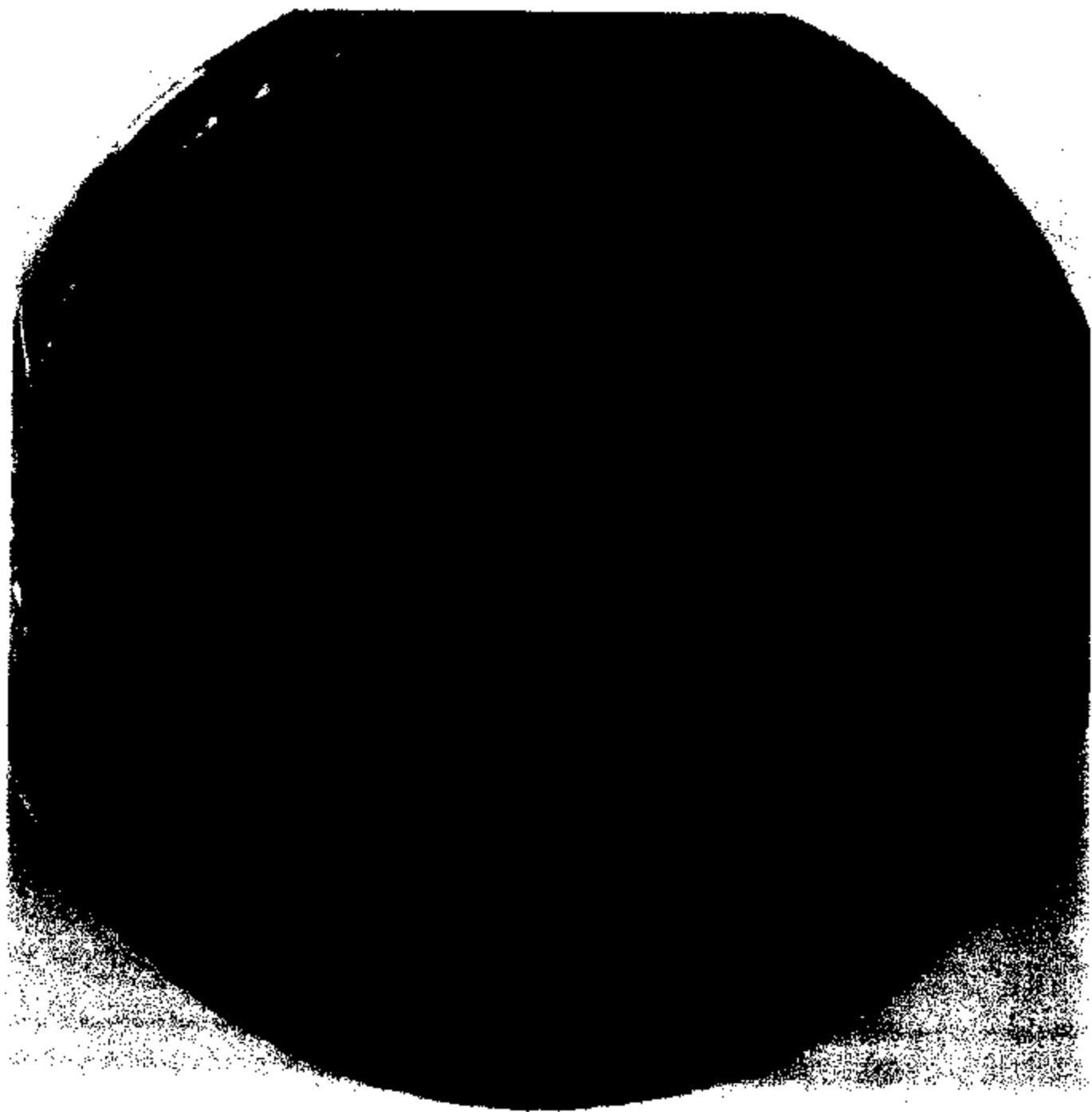


Central Laboratory

Report 8900228

Figure 10.: Switch A. Converter.

Magnification: -9.8X

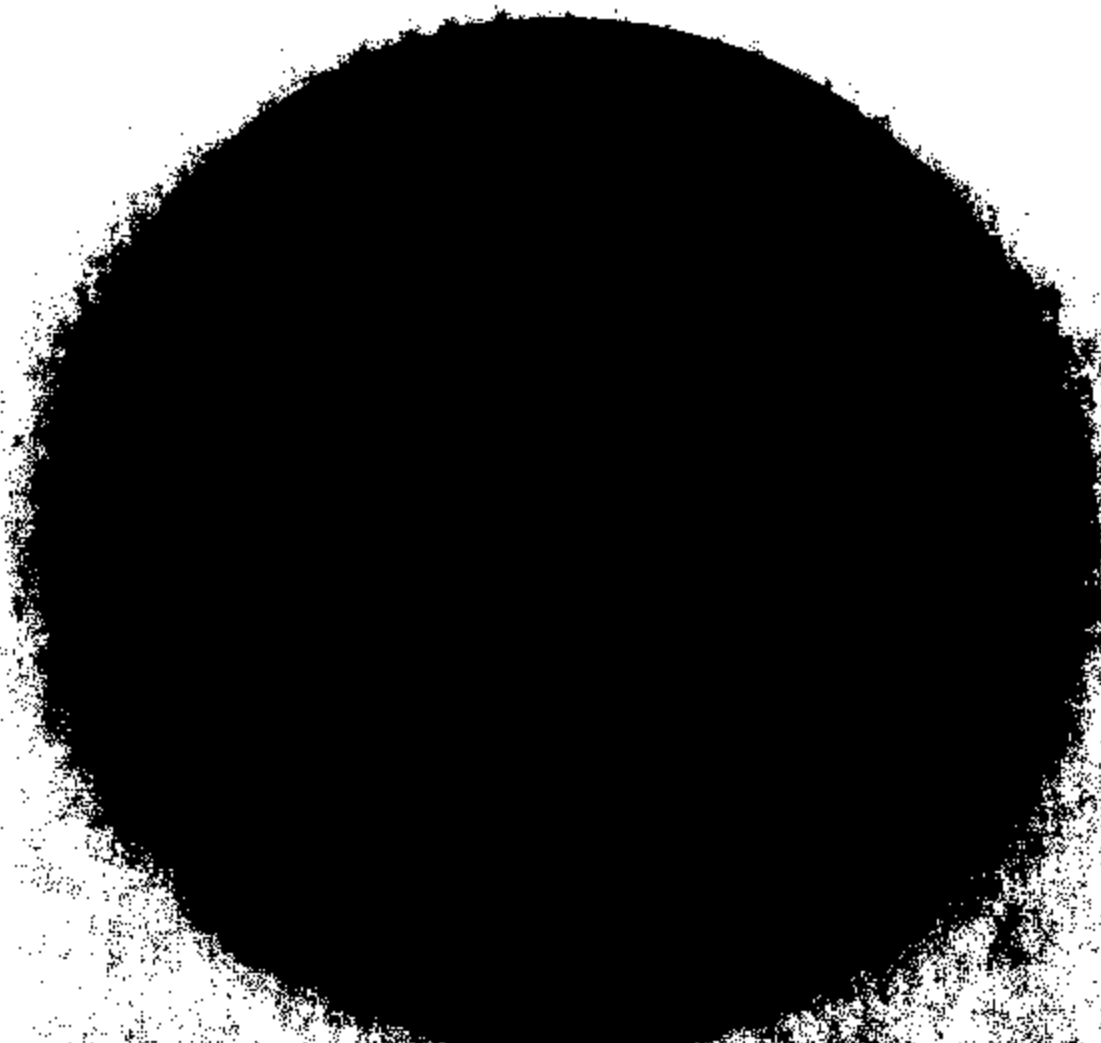


Central Laboratory

Report 0000228

Figure 11.: Switch A. Interior of cup.

Magnification: -8.7X



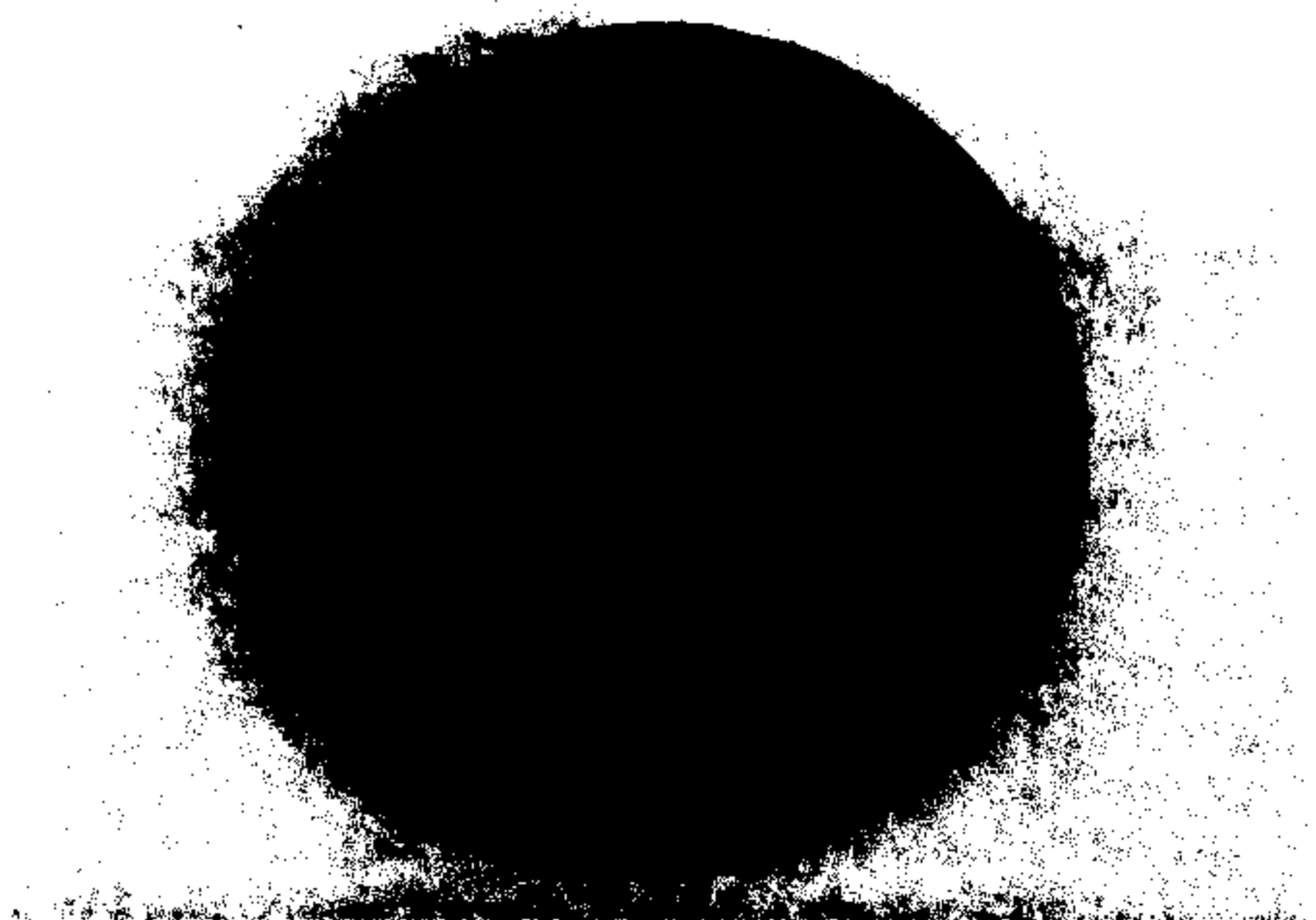
Central Laboratory

Report 8900226

Figure 12: Switch A.

Diso - converter side.

Magnification: ~8X



A



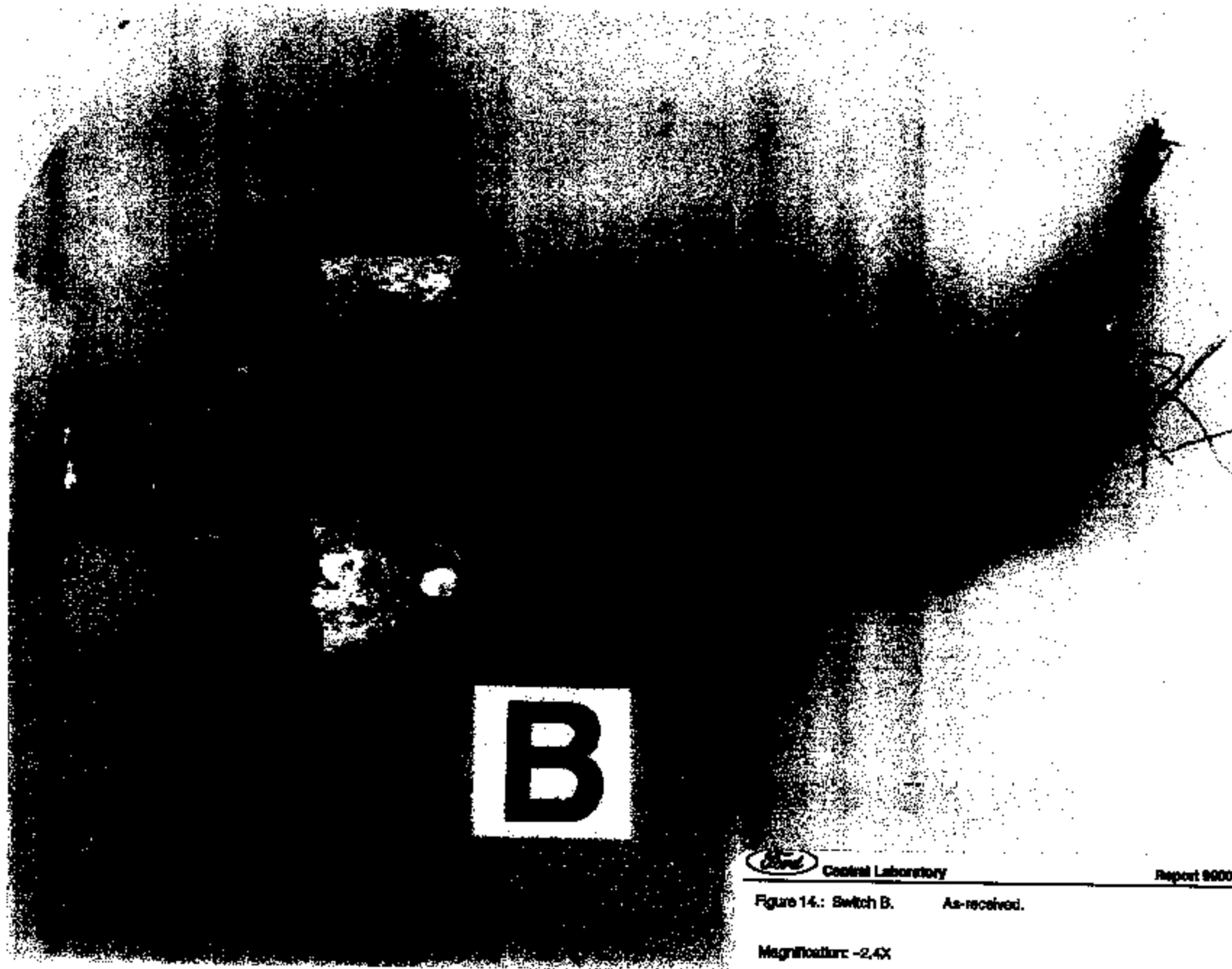
Central Laboratory

Report 8903228

Figure 13: Switch A.

Disc - opposite side.

Magnification: -8X



B



Central Laboratory

Report 8000238

Figure 14.: Switch B. As-received.

Magnification: ~2.4X

3713 7842

B



Central Laboratory

Report No. 3713

Figure 15: Switch B. Face of cup.

Magnification: -5.5X

B

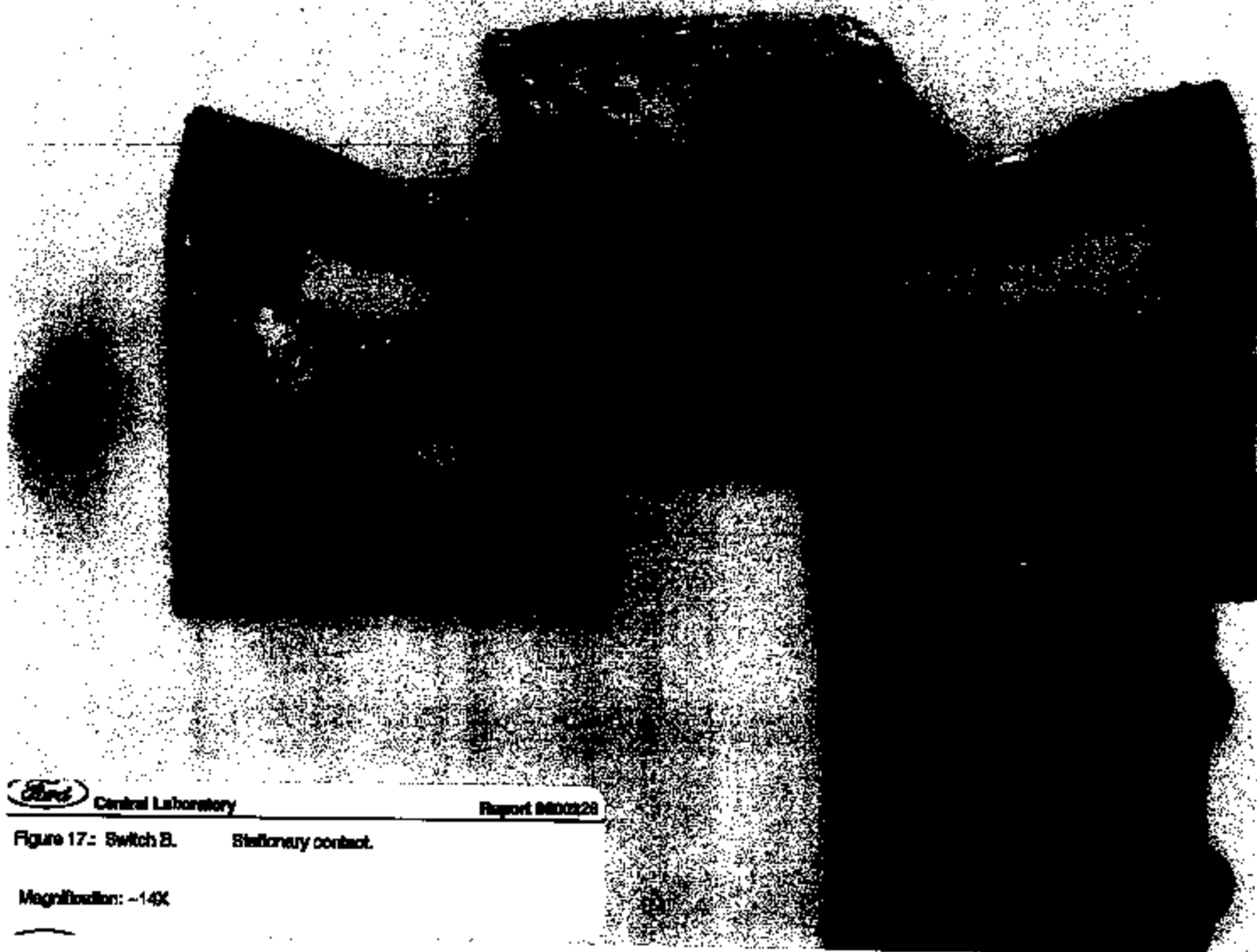


Central Laboratory

Report 9800228

Figure 18: Switch B. Fitting end of hexport.

Magnification: 5X



Central Laboratory

Report 9800228

Figure 17: Switch B. Stationary contact.

Magnification: -14X

C



Central Laboratory

Report 8901288

Figure 16: Switch O.

As-received.

Magnification: -2.5X

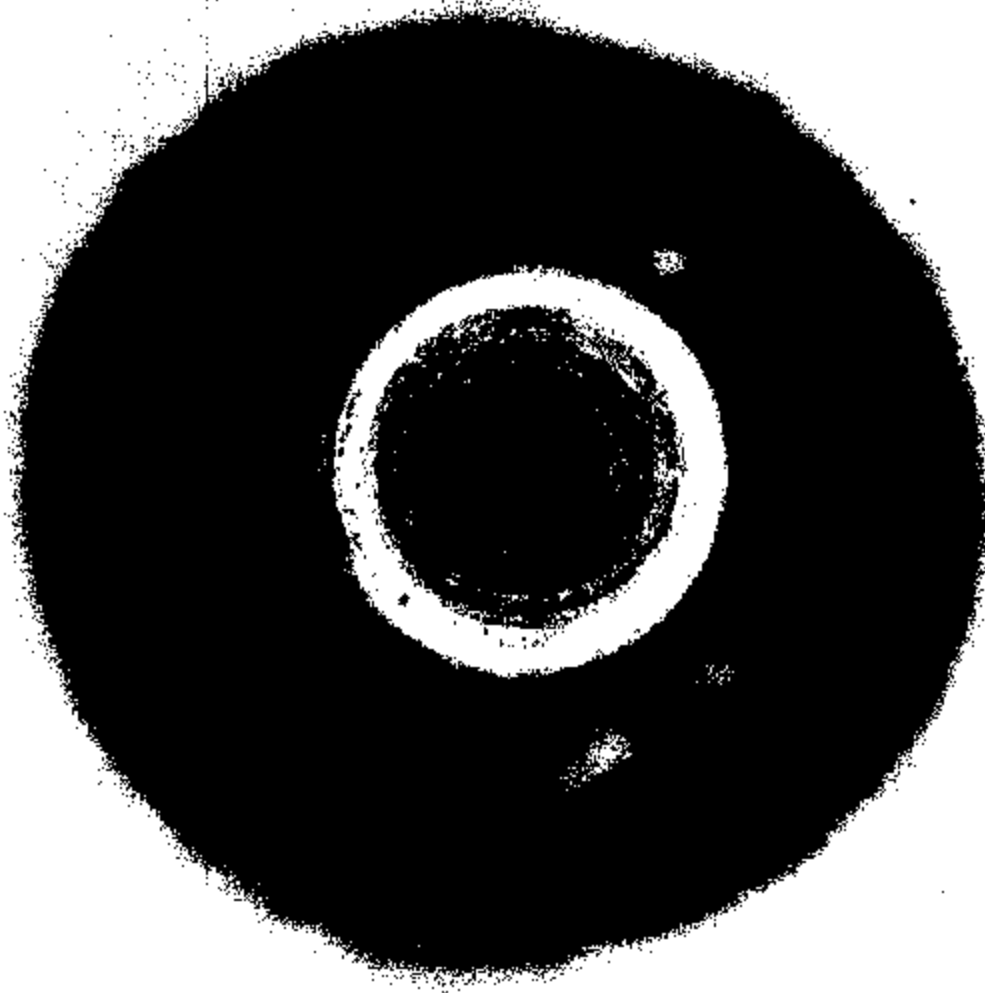


Central Laboratory

Report 9900228

Figure 19: Switch C. Face of cup.

Magnification: -5.5X



Central Laboratory

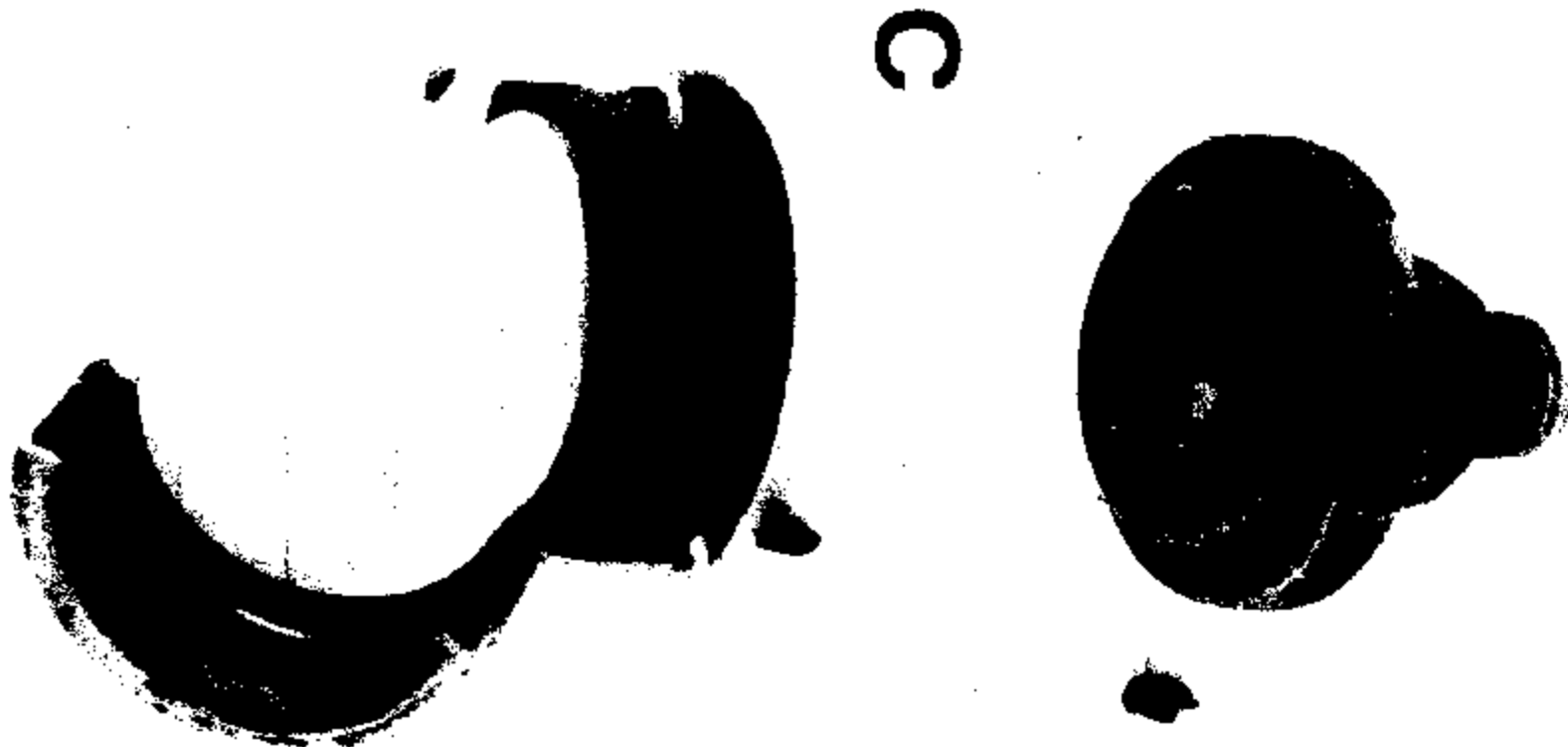
Report 9900226

Figure 20.: Switch C.

Fitting end of hasport.

Magnification: -6.9X

3713 7848

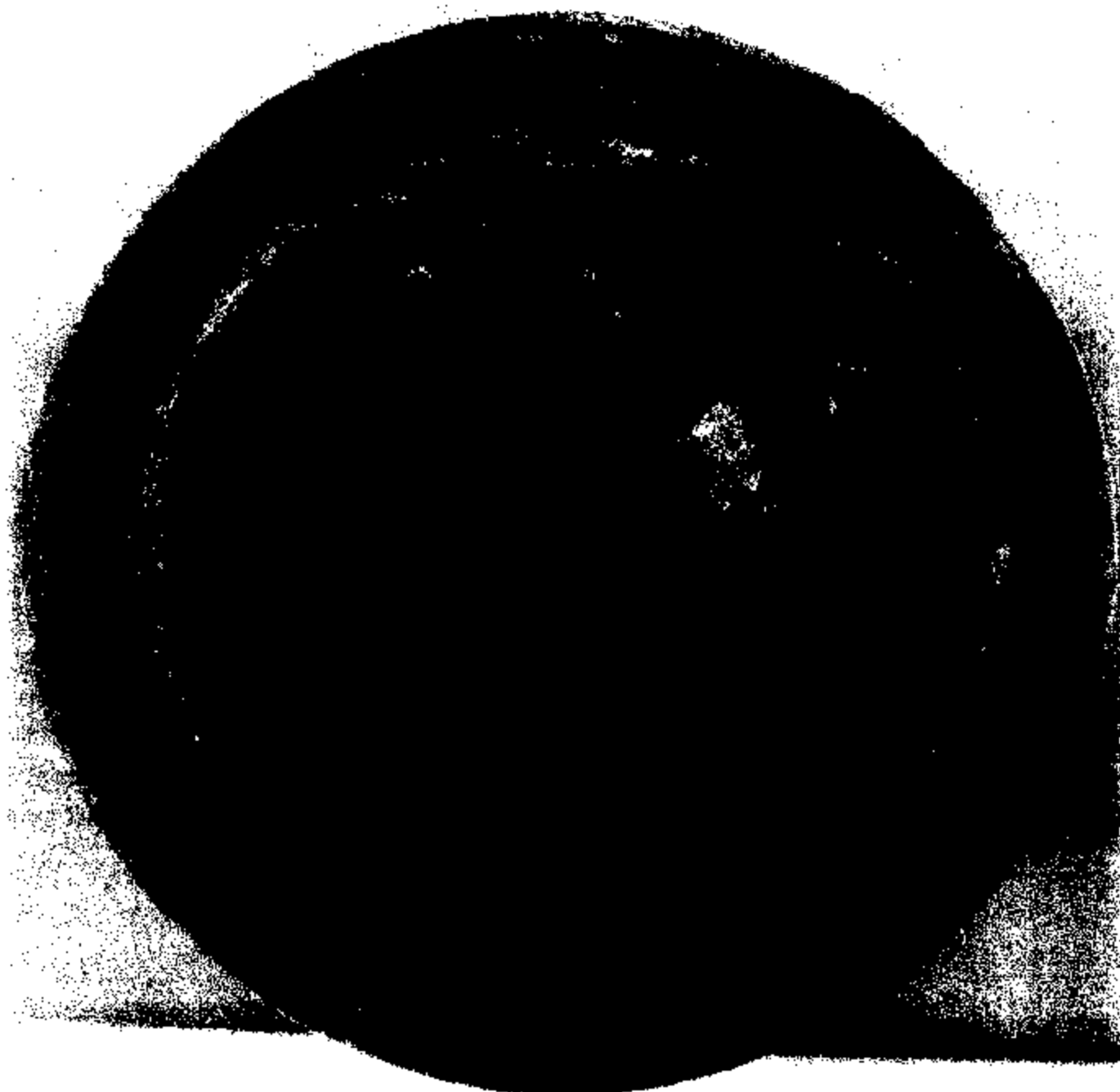


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Report 9800226

Figure 21: Switch C. Clamp ring removed.

Magnification: -2.2X



 Central Laboratory

Report 9800226

Figure 22: Switch C. Face of cup - crimp ring removed.

Magnification: -8.2X

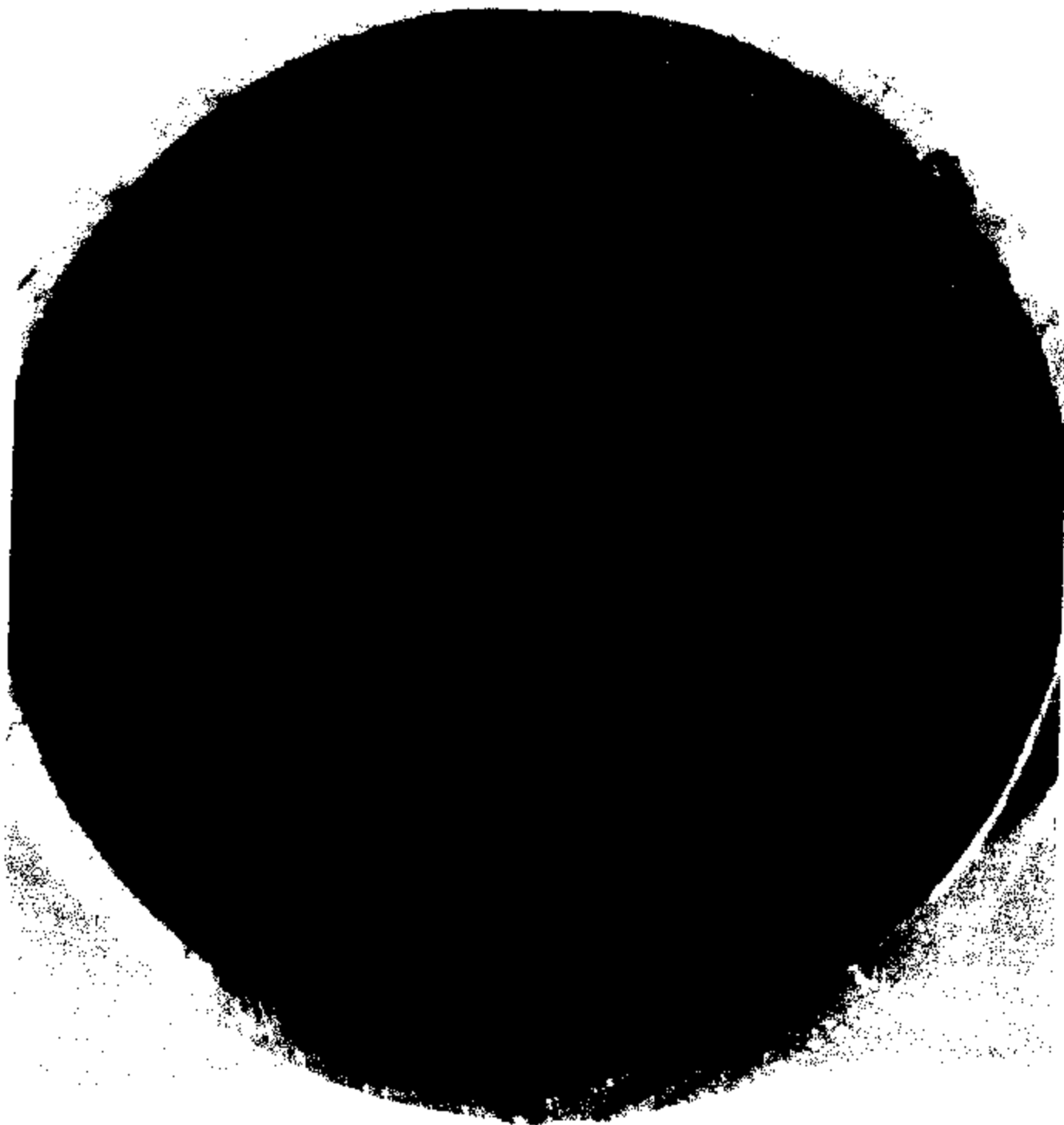


Central Laboratory

Report 090222

Figure 23: Switch C. Interior of cup, hexport, washer, and converter.

Magnification: ~3X

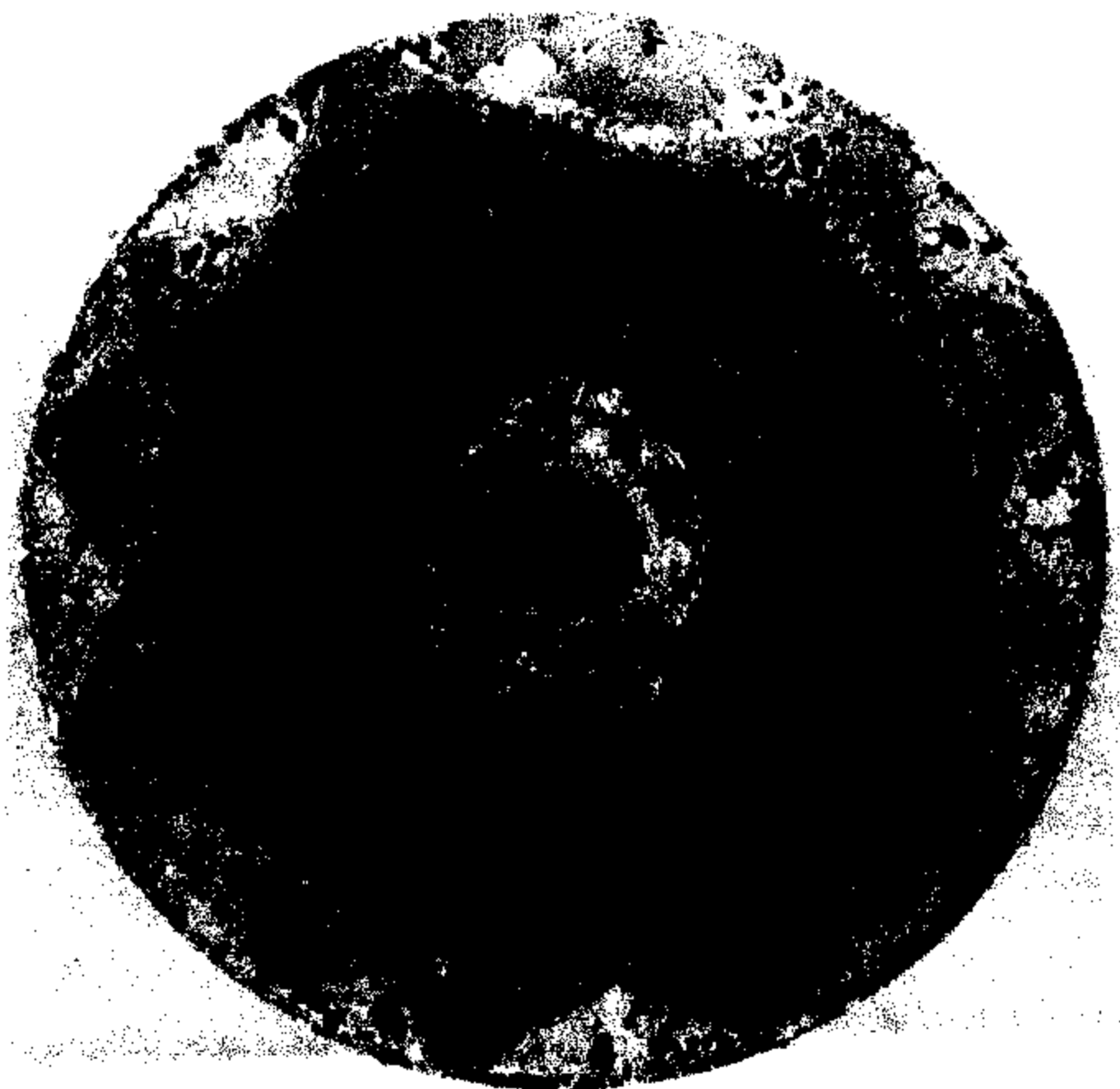


Central Laboratory

Report 980622s

Figure 24.: Switch C. Interior of cup.

Magnification: -7X



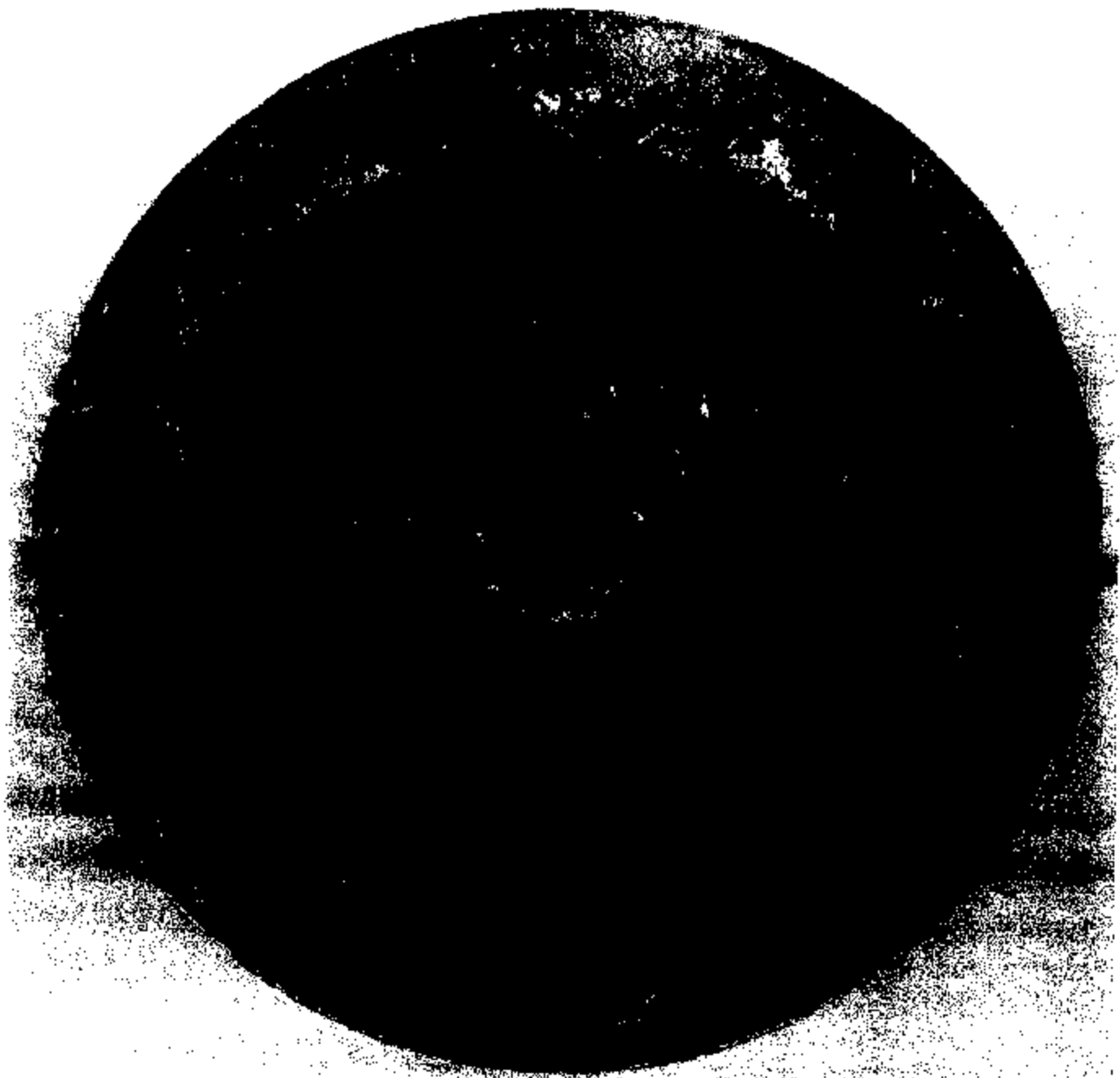
Central Laboratory

Report 9800228

Figure 25.: Switch C.

Hexport with remnants of Kapton seals in place.

Magnification: ~6.8X

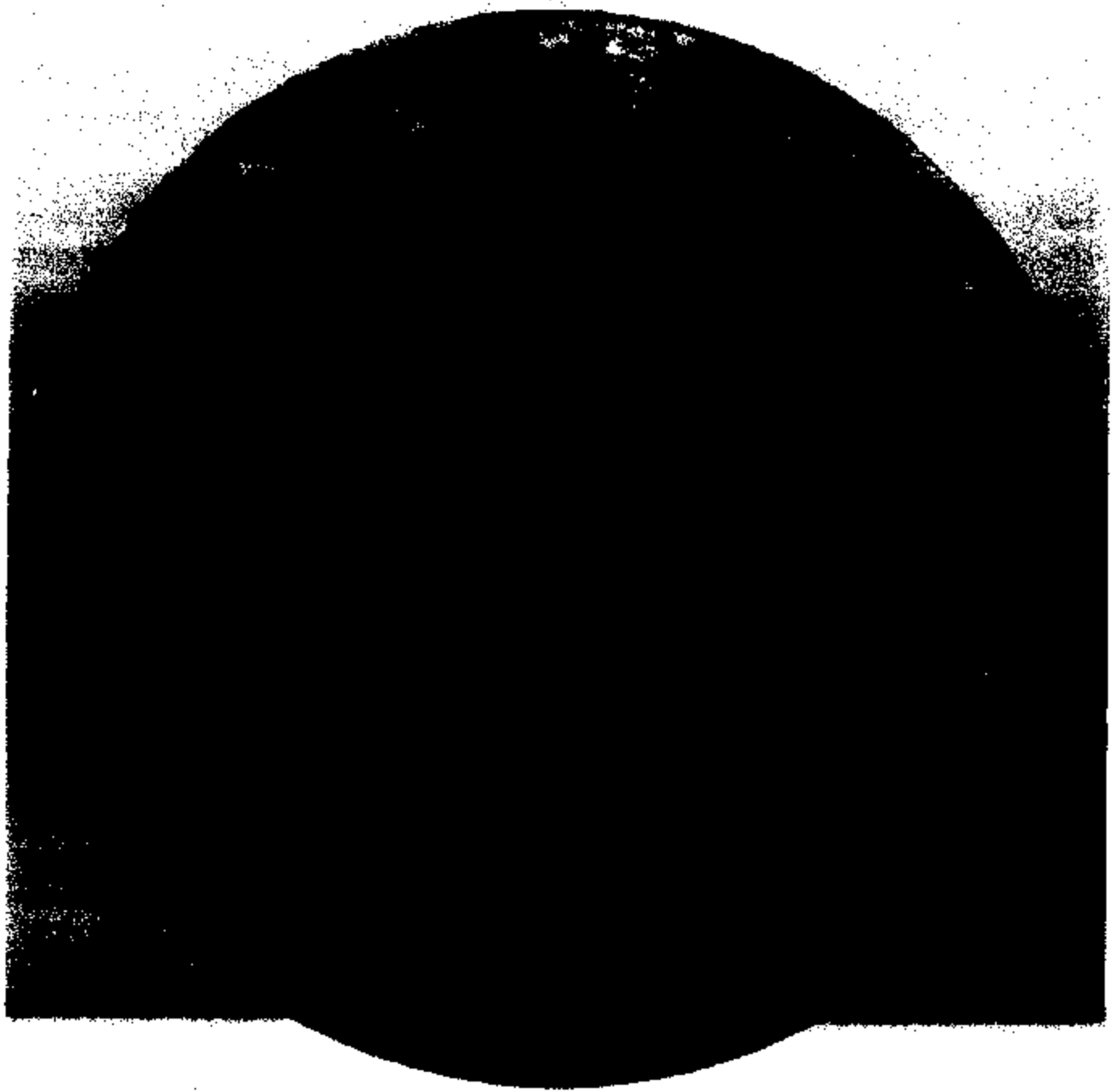


Central Laboratory

Report 8400228

Figure 26: Switch C. Washer and converter.

Magnification: ~6.7X

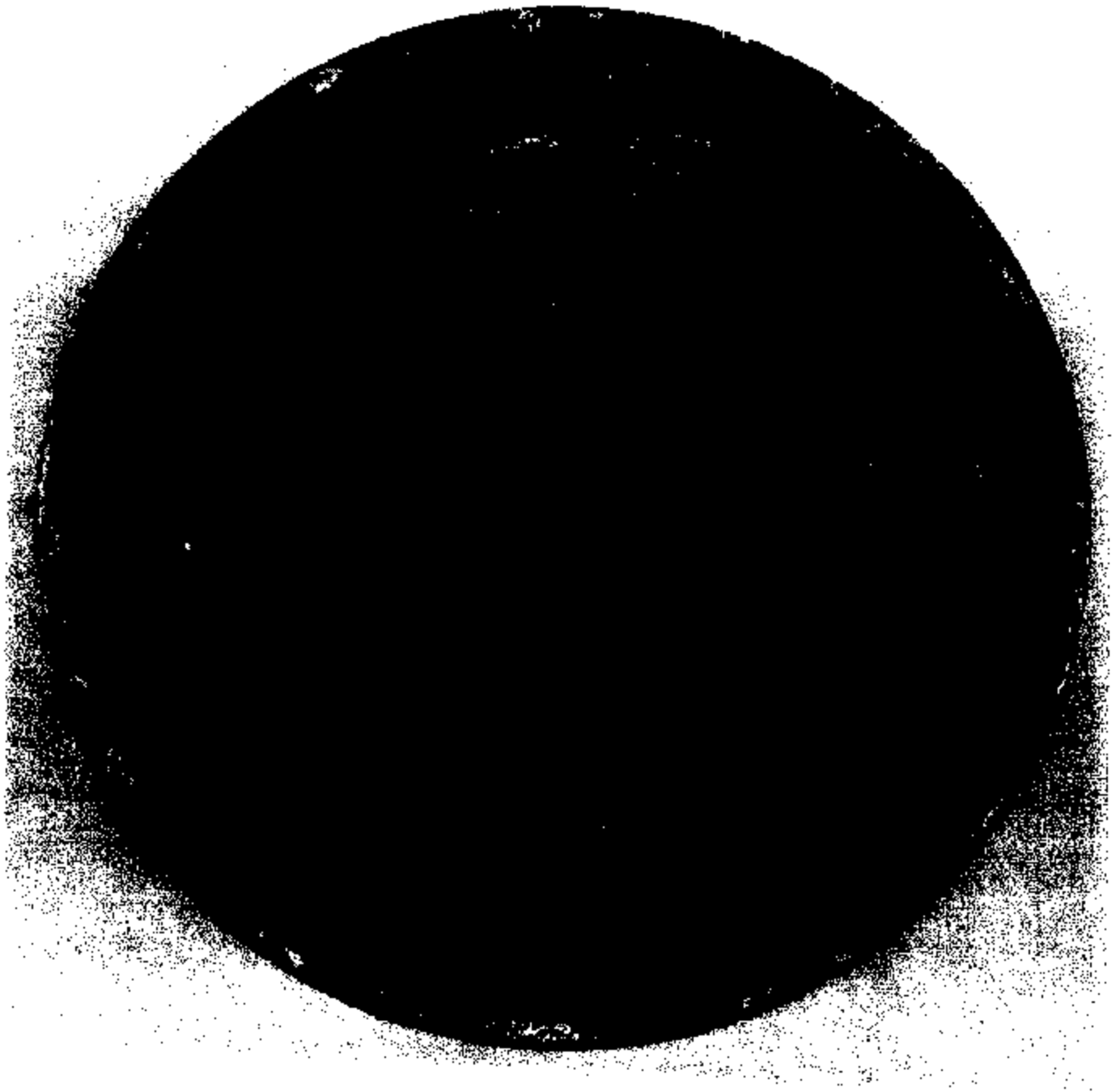


Central Laboratory

Report 9900225

Figure 27.: Switch C. Happort cavity.

Magnification: -8.0%



Central Laboratory

Report 9900225

Figure 28: Switch C. Converter and disc.

Magnification: ~2.5X



-8.5X

Figure 29: Switch C. Kapton seal - adjacent to converter.



-8.5X

Figure 30: Switch C. Kapton seal - opposite side.



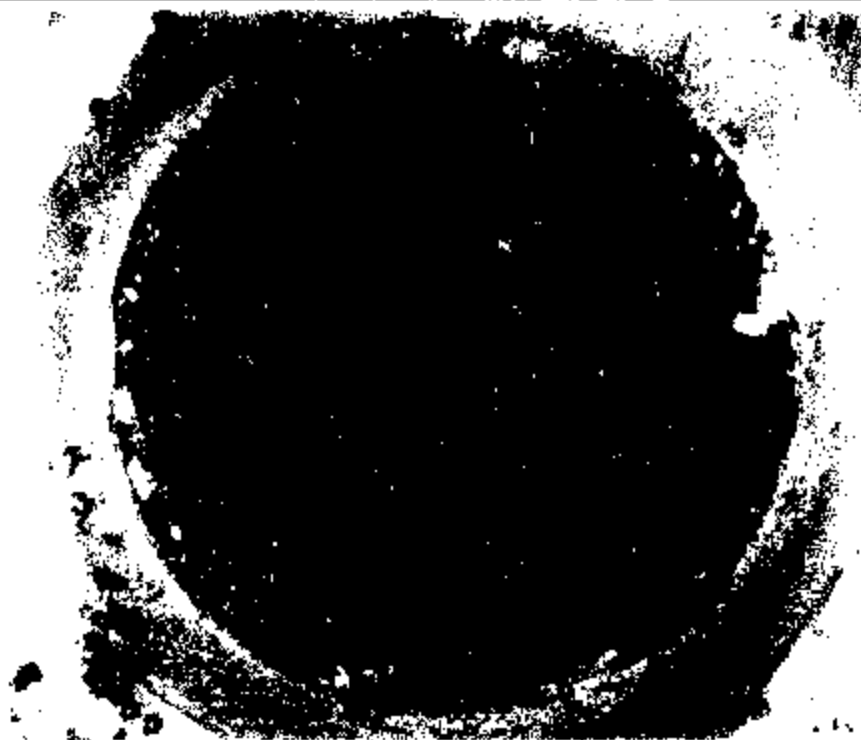
-8X

Figure 31: Switch C. Kapton seal - middle.



-10X

Figure 32: Switch C. Kapton seal - middle.



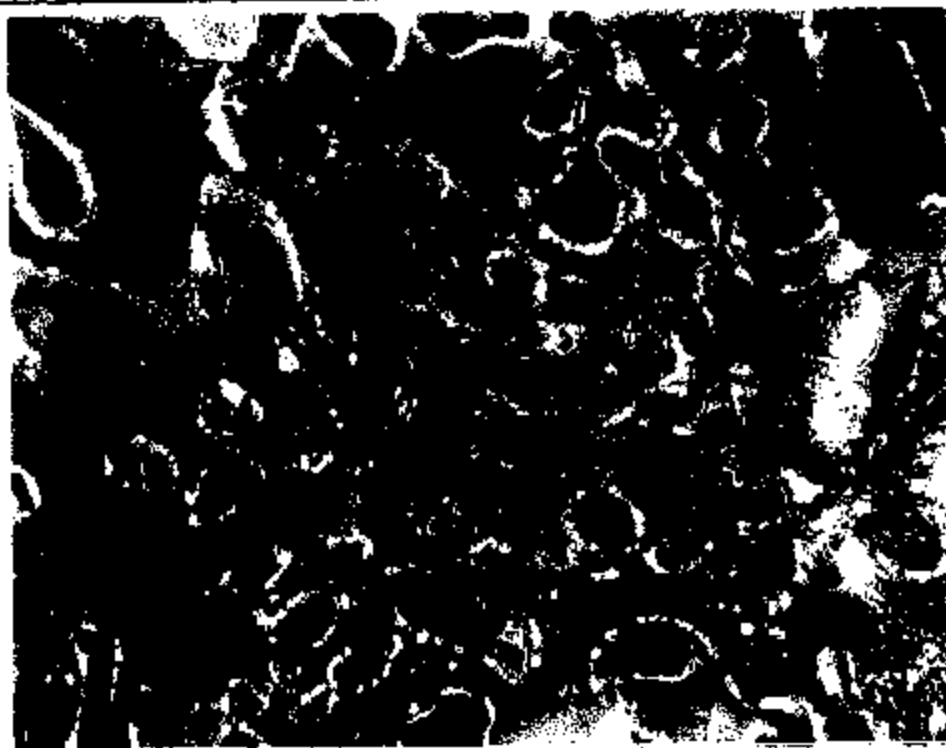
-8X

Figure 33: Switch C. Kapton seal - Adjacent to hexport.



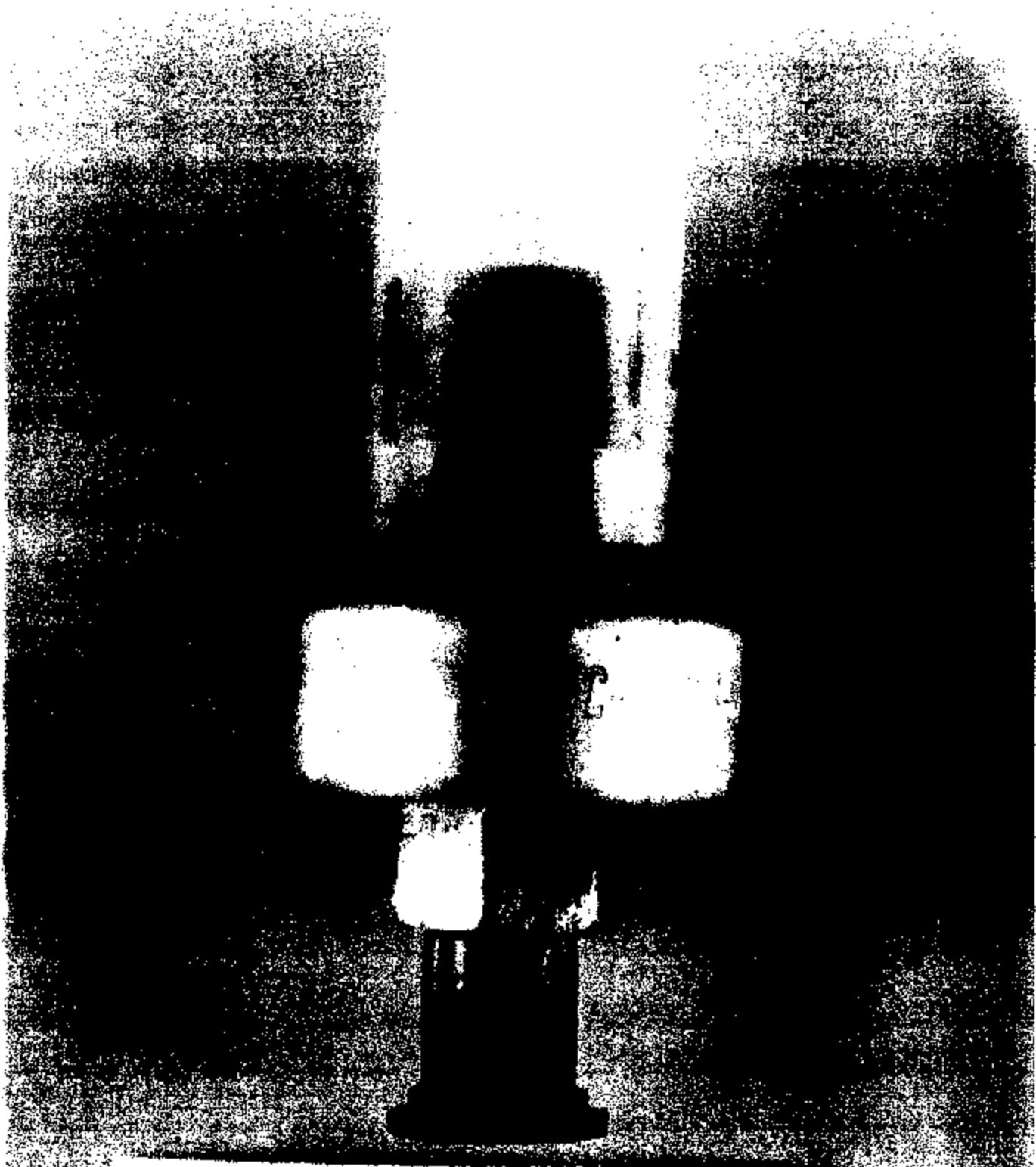
-8X

Figure 34: Switch C. Kapton seal - Adjacent to hexport - opposite side.



-13X

Figure 35: Switch C. Kapton seal - Adjacent to hexport - opposite side.



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Report 9000228

C

Figure 36: Switch D.

As-received.

Magnification: -2.7X



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Figure 97.: Switch D.

Fitting end of hexport.

Magnification: -9.8X



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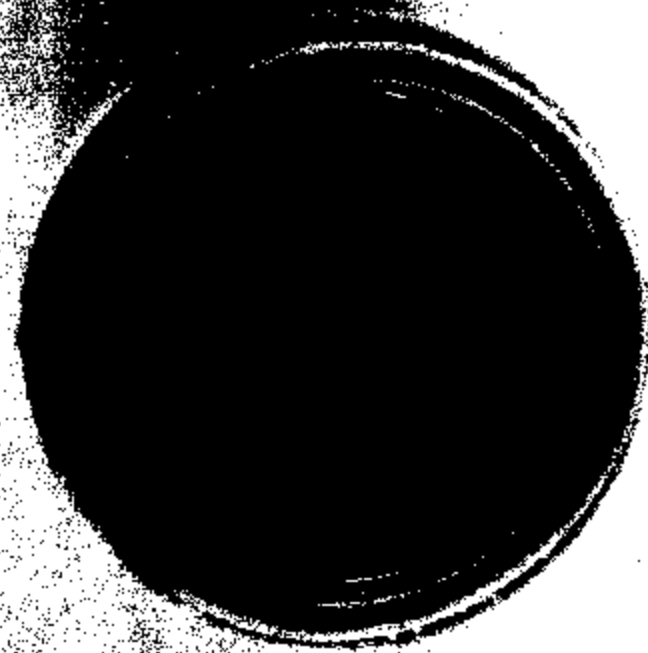
Report 8840222

Figure 36: Switch D. Terminal cavity.

Magnification: -8.5X

8713 7863

D



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Report 9900225

Figure 38: Switch D. Crimp ring removed.

Magnification: ~2.5X



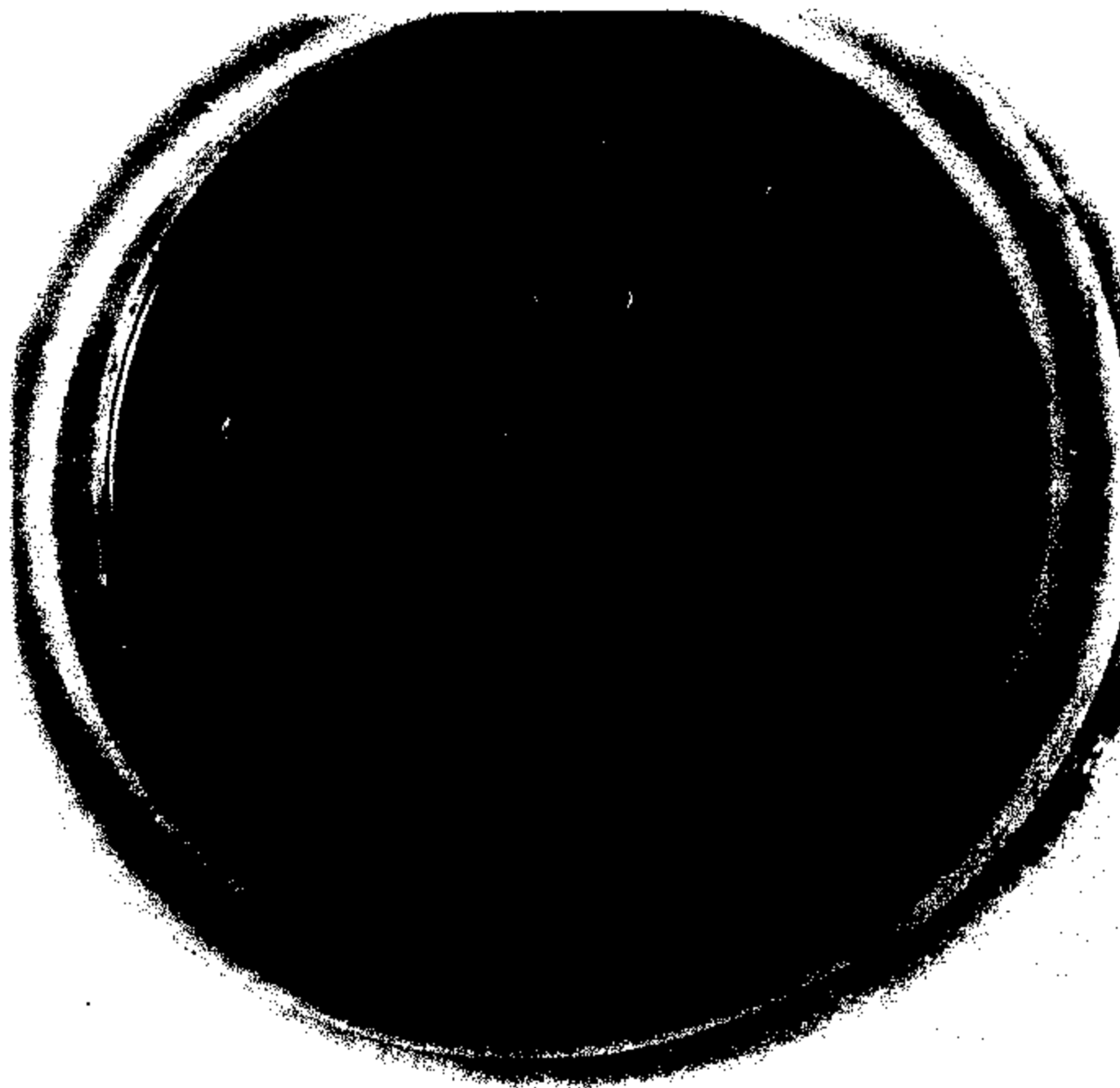
Central Laboratory

Report 9800228

Figure 40.: Switch D.

Face of cup.

Magnification: -6.4X



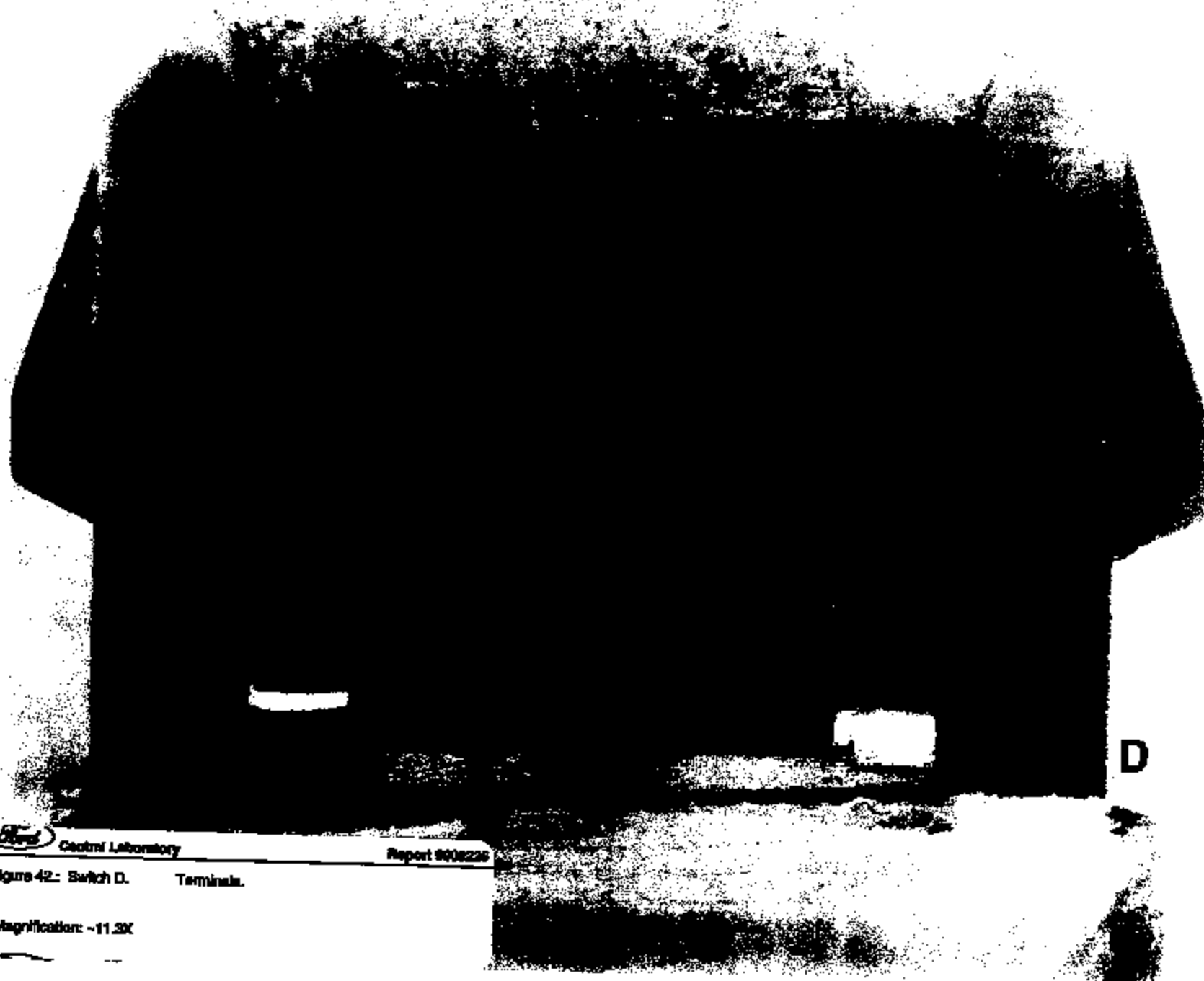
 Central Laboratory

Report 0000228

Figure 41.: Switch D. Switch cavity.

Magnification: ~7.5X





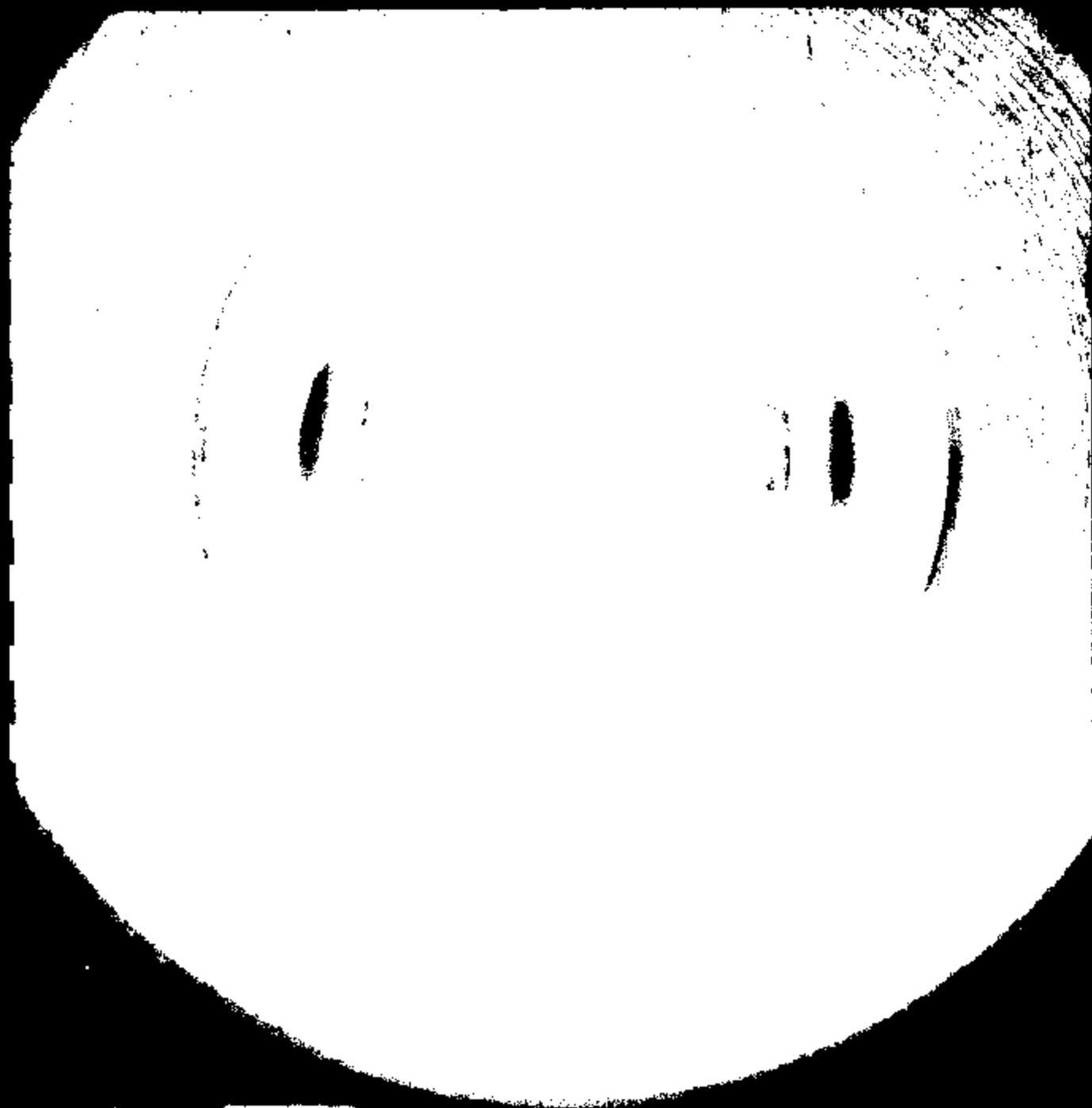
Central Laboratory

Report 9008226

Figure 42: Switch D. Terminals.

Magnification: ~11.3X

3713 7867



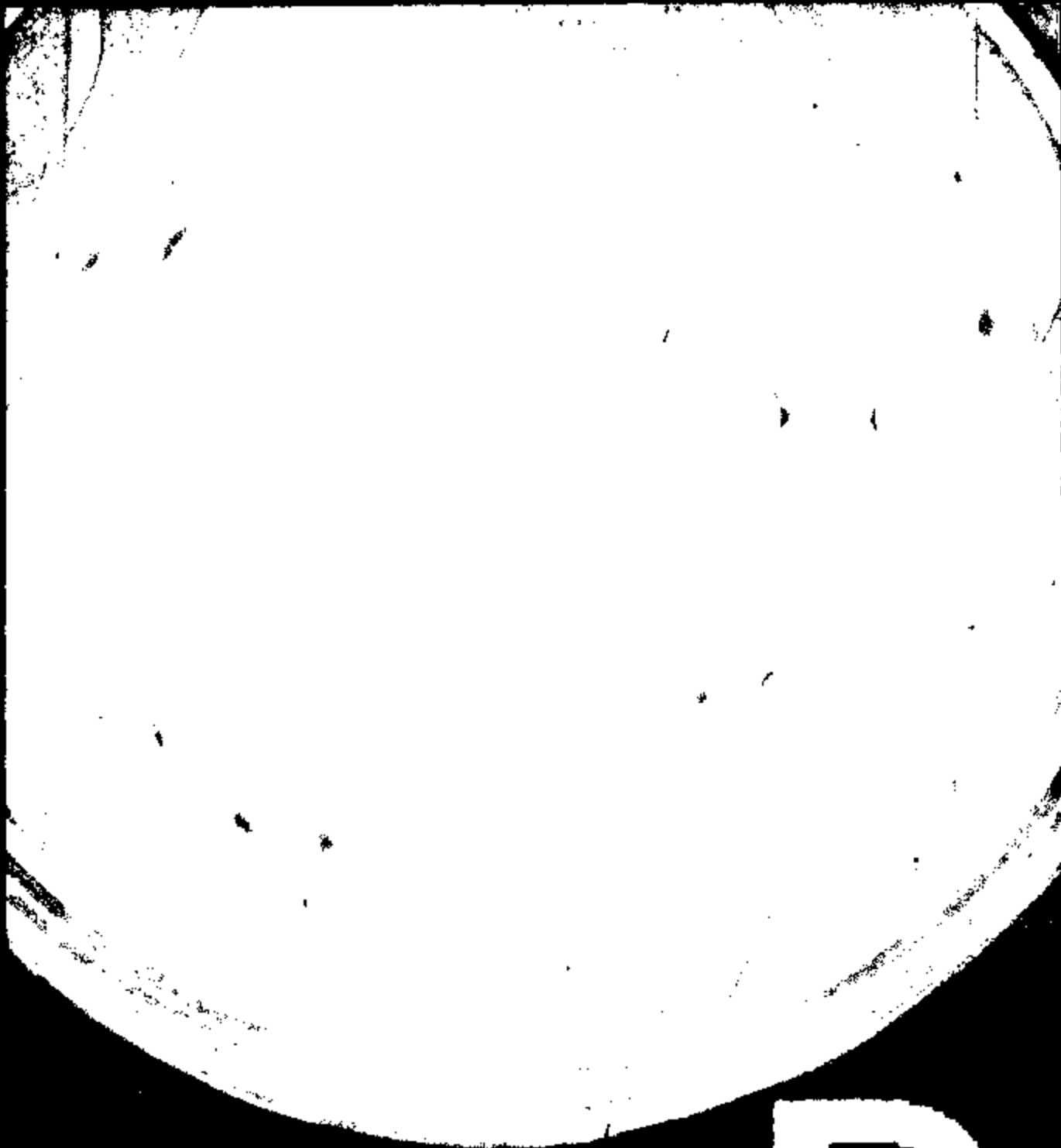
D

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Report 8900280

Figure 43: Switch D. Export cavity.

Magnification: -8.5X



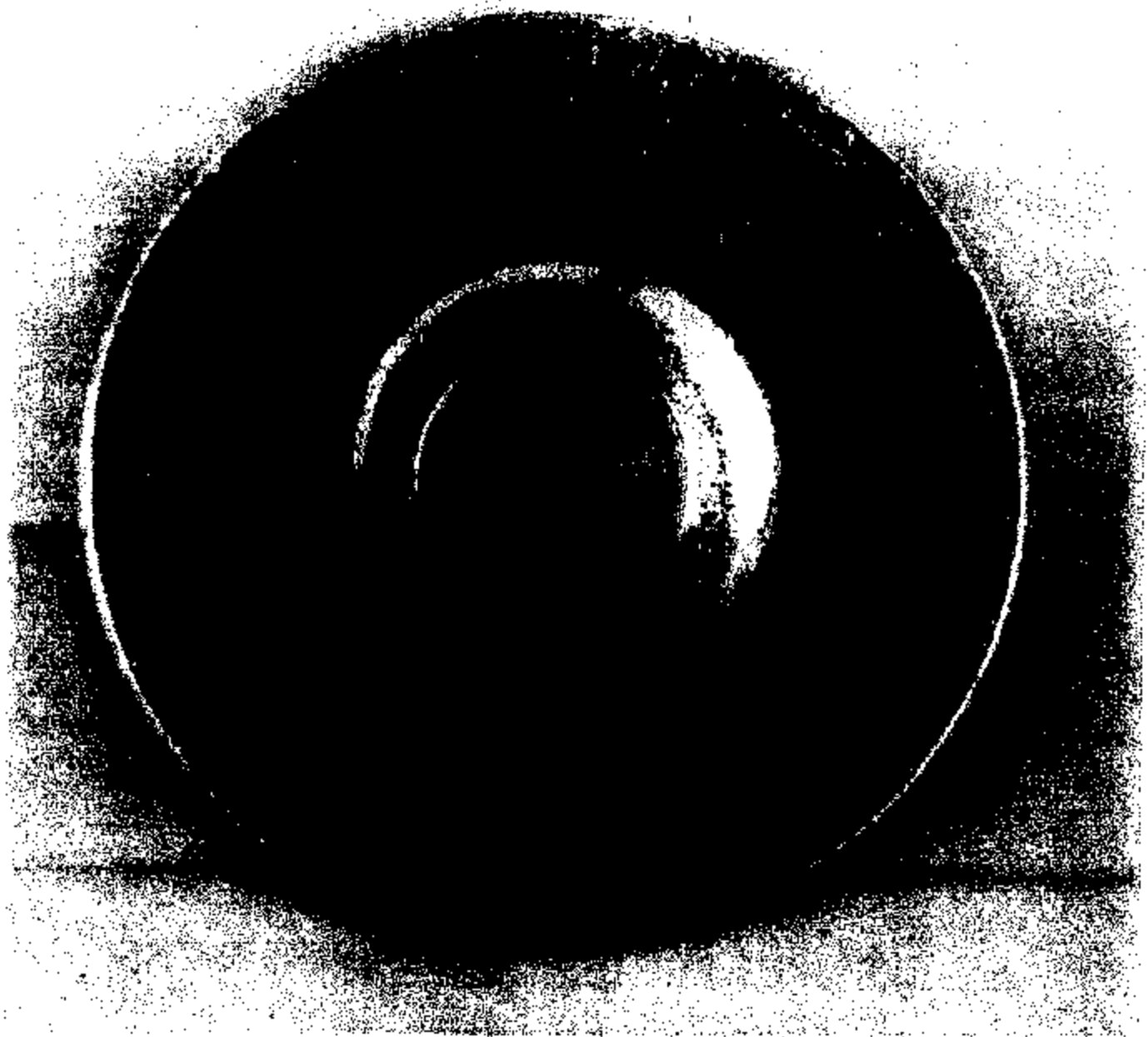
Central Laboratory

Report 89002255

Figure 44: Switch D. Kapton seals in place.

Magnification: -8.7X

D



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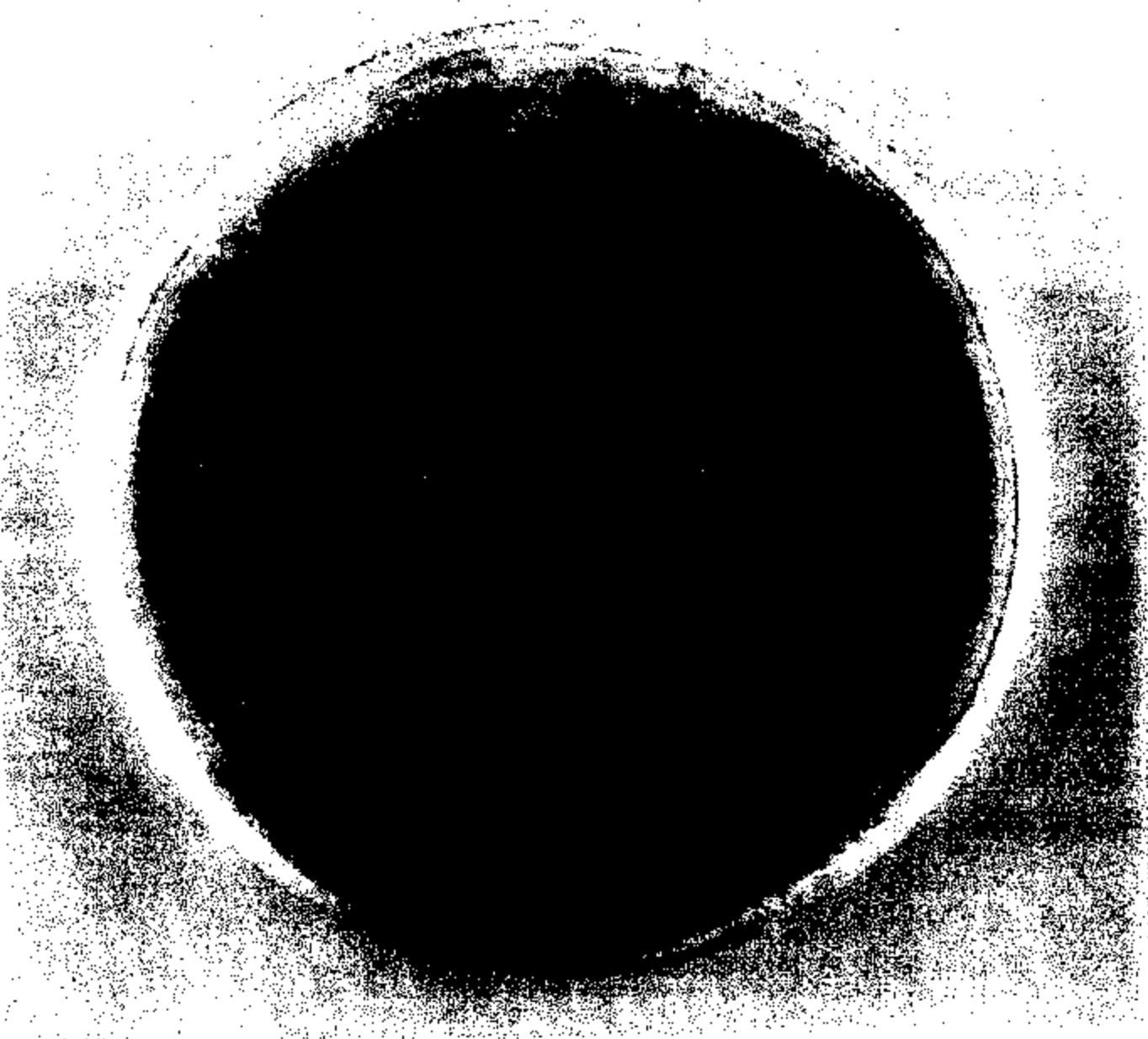
Report 040022m

Figure 48: Switch D.

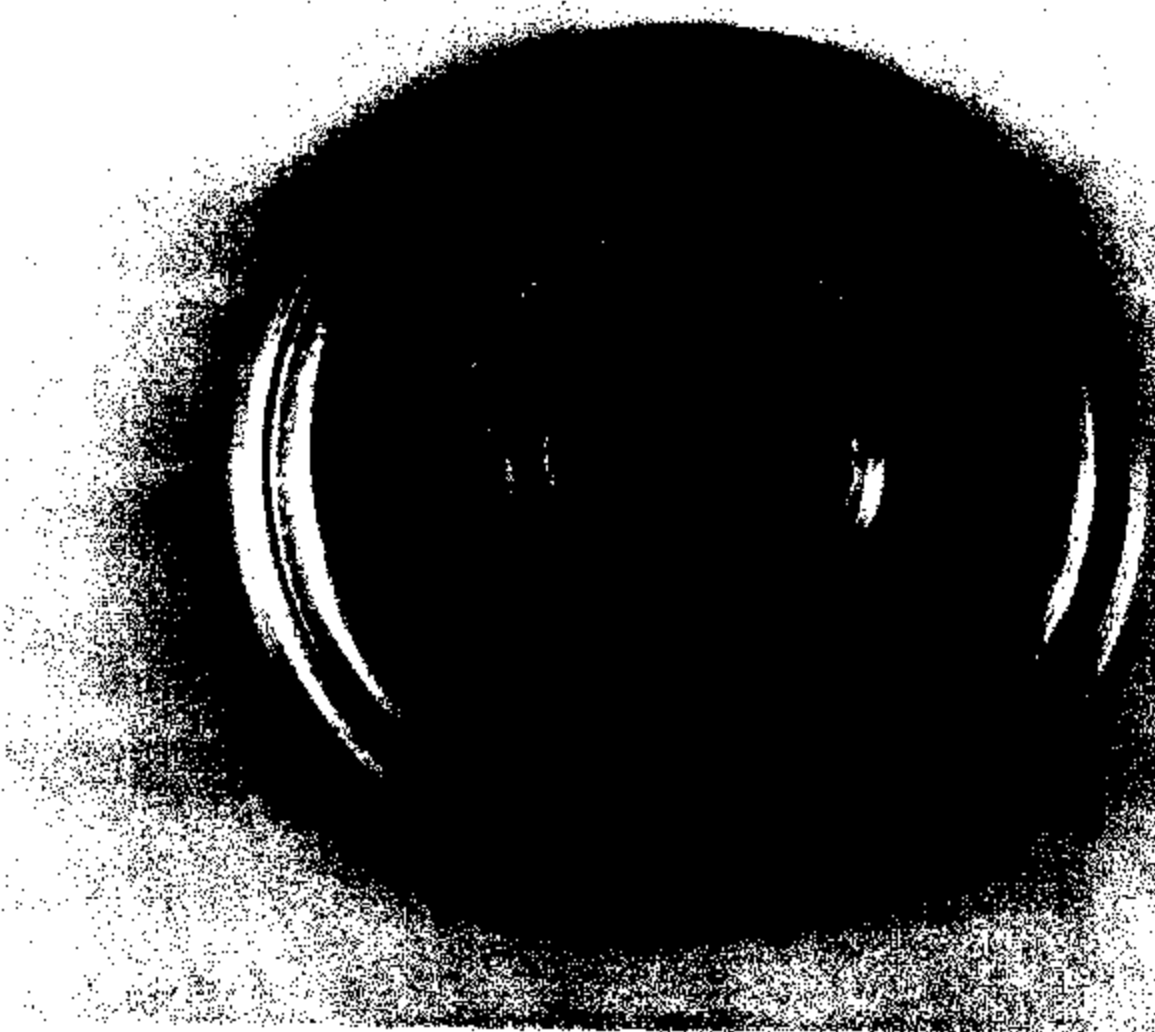
Washer - east side.

Magnification: -5.8X

3713 7870



D

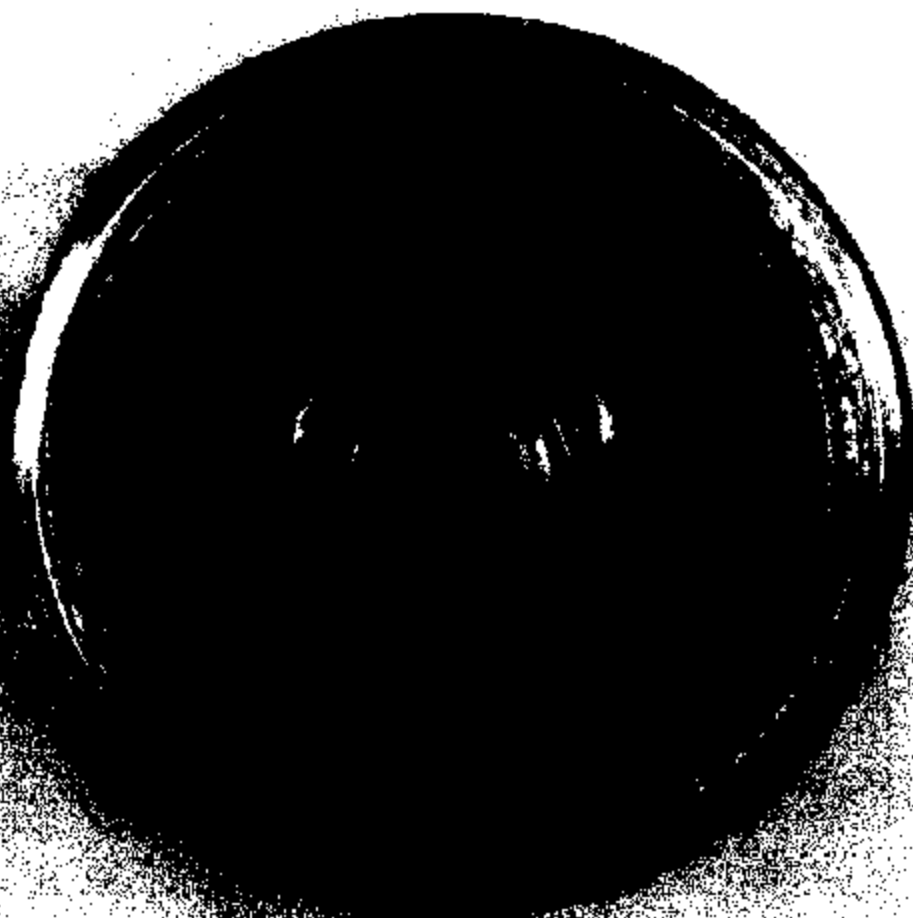


 Central Laboratory

Report 9800228

Figure 47.: Switch D. Converter - seal side.

Magnification: -6.8X



D

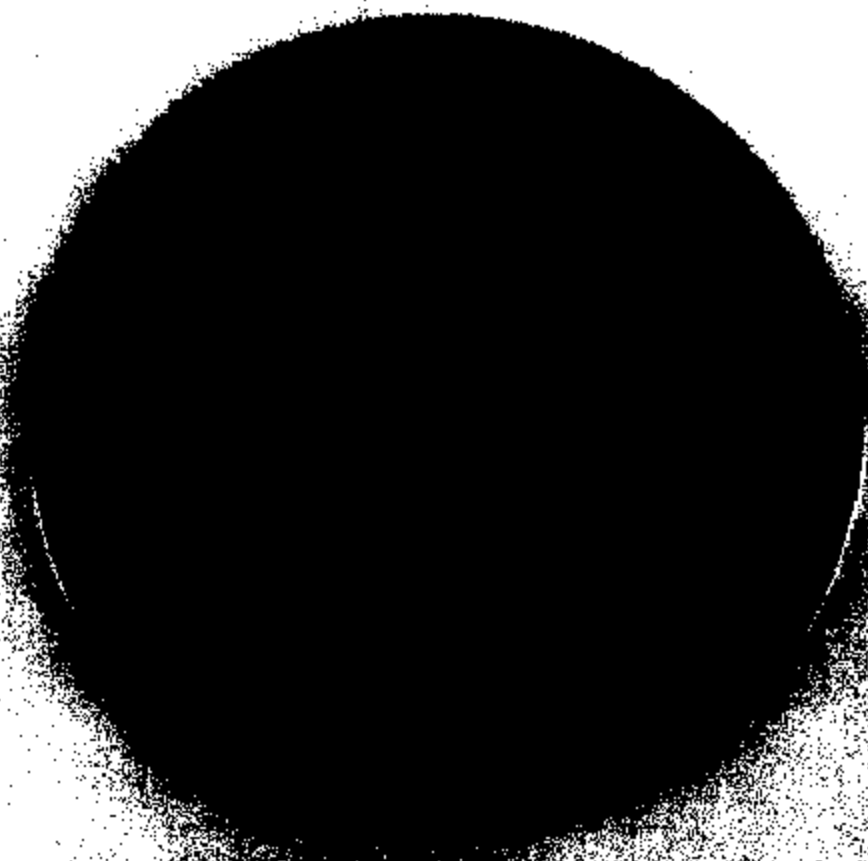


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Report 000028

Figure 48: Switch D. Converter - opposite side.

Magnification: -8.6X



D

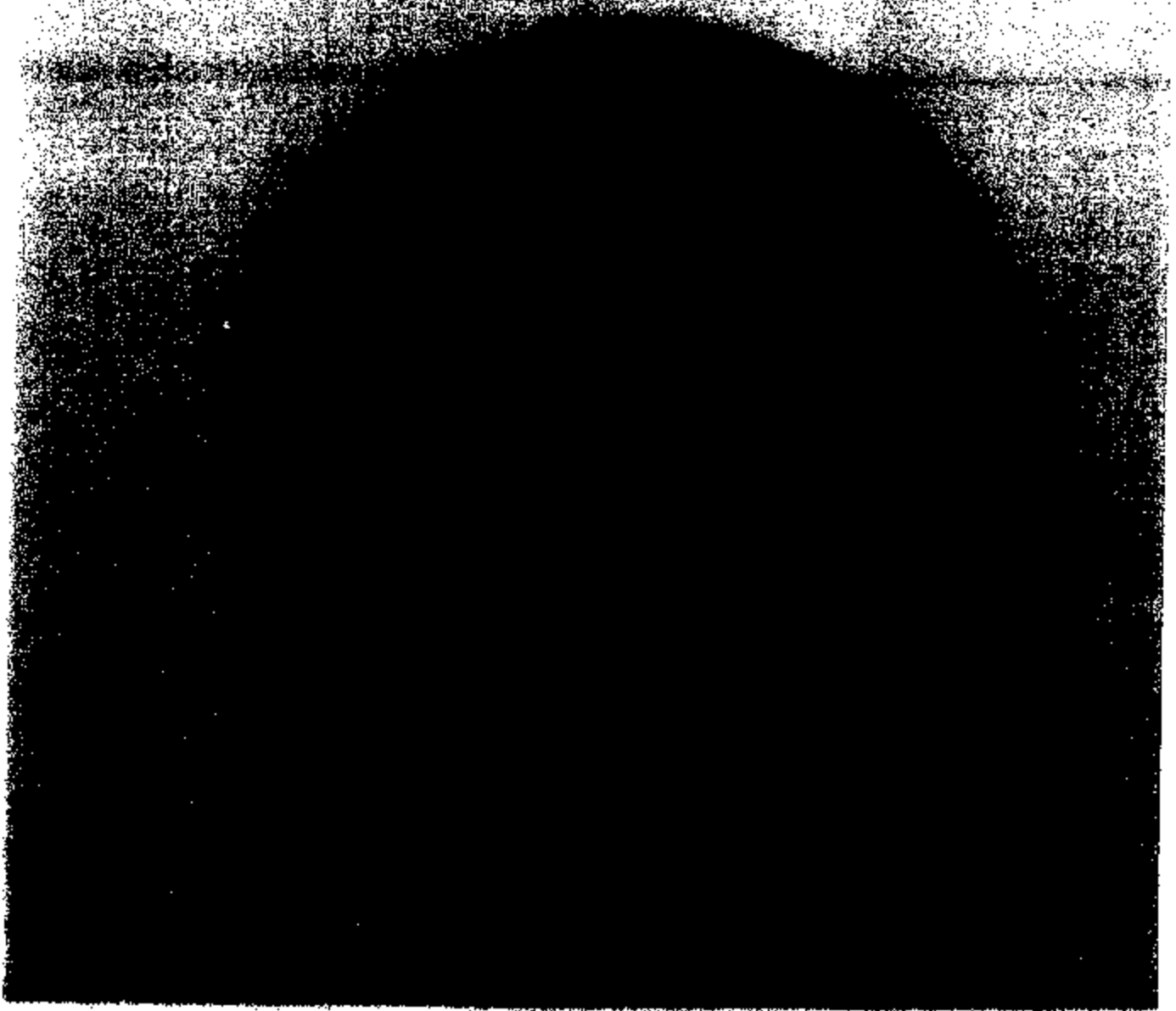


Central Laboratory

Report 9001234

Figure 49: Switch D. Dia - seal etc.

Magnification: -5.5X



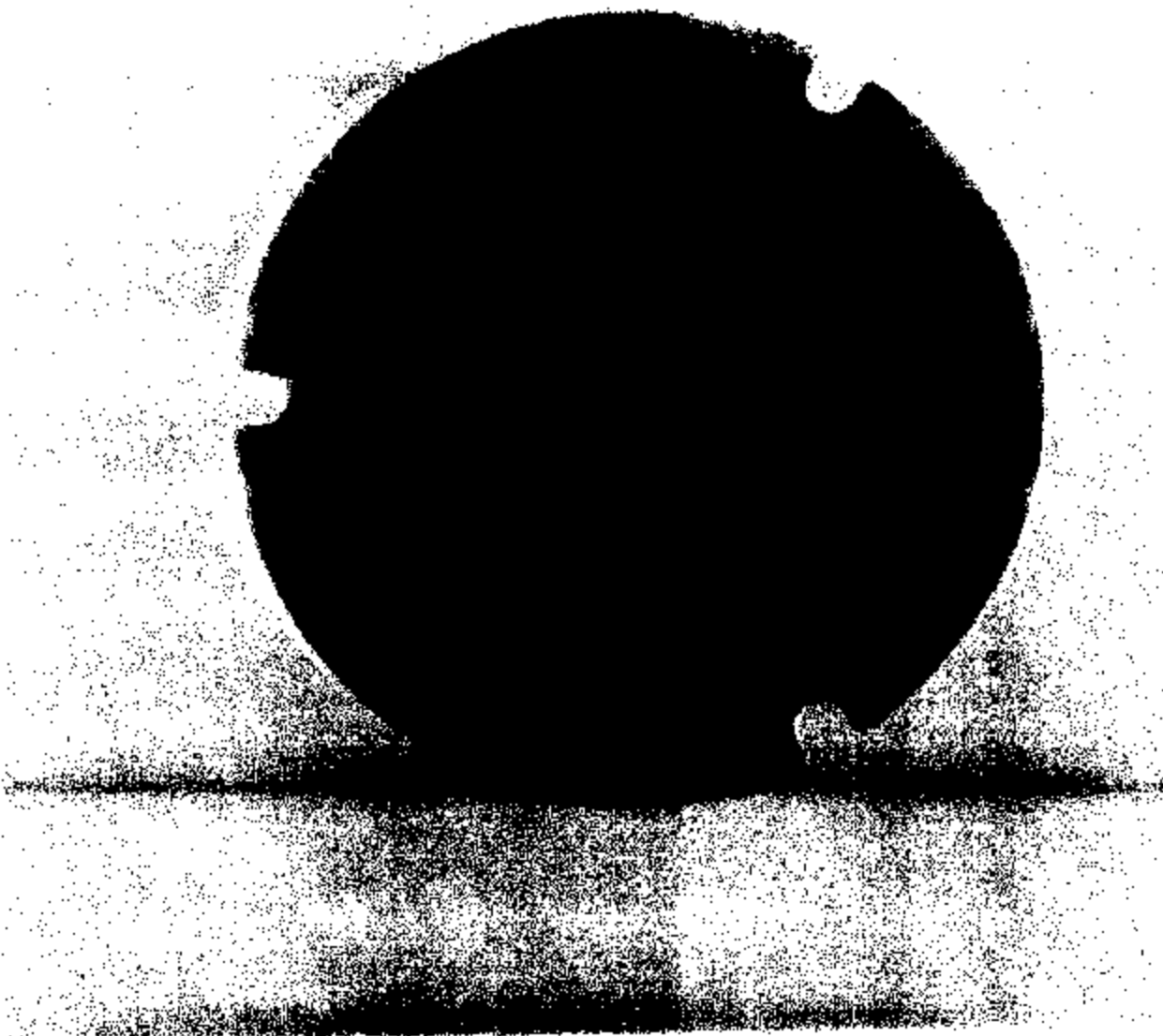
Central Laboratory

Report 88

Figure 50.: Switch D.

Disc - opposite side.

Magnification: -8.3X

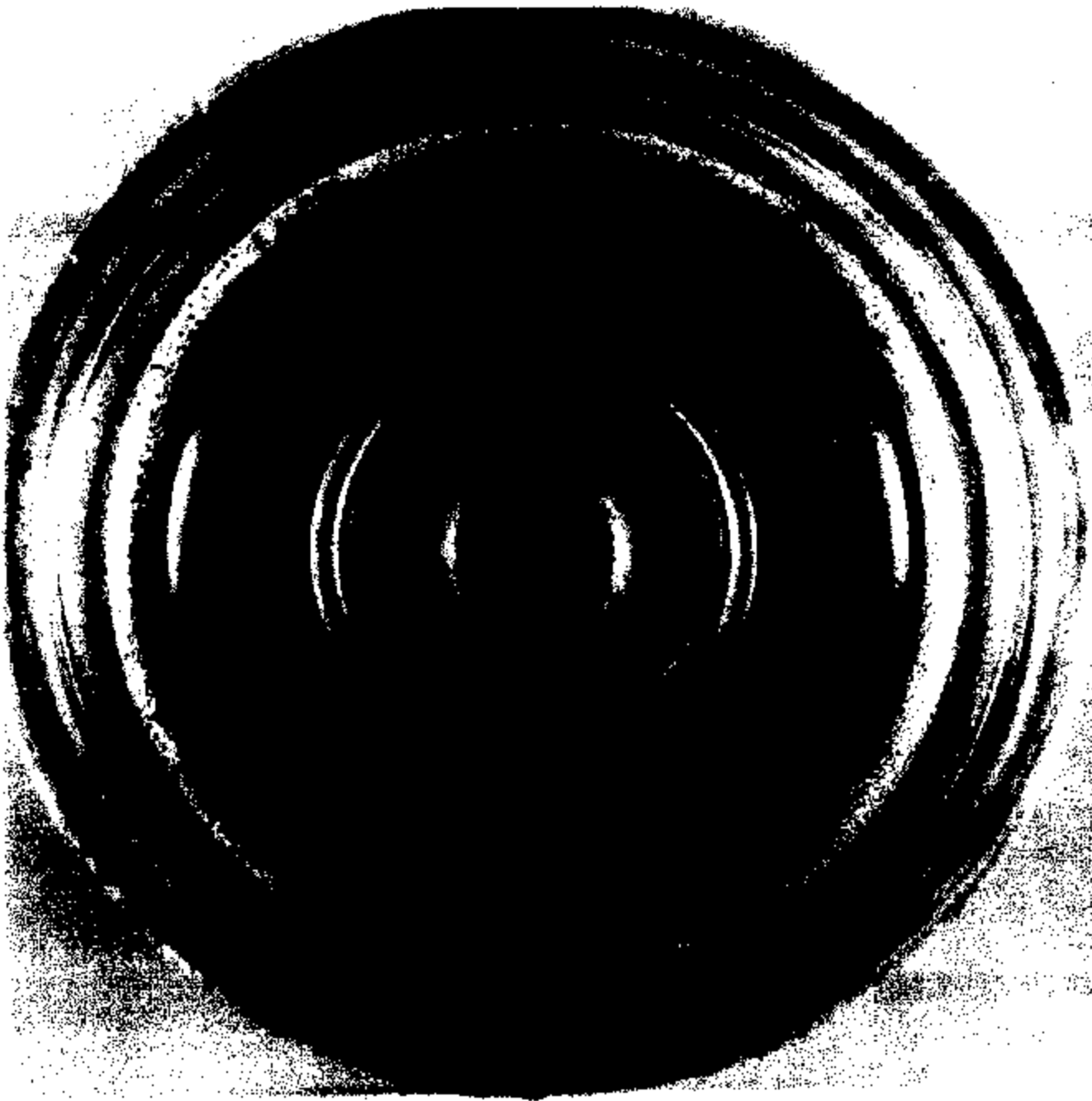


Central Laboratory

Report 8900225

Figure 51.: Switch D. Spacer.

Magnification: -6.5X



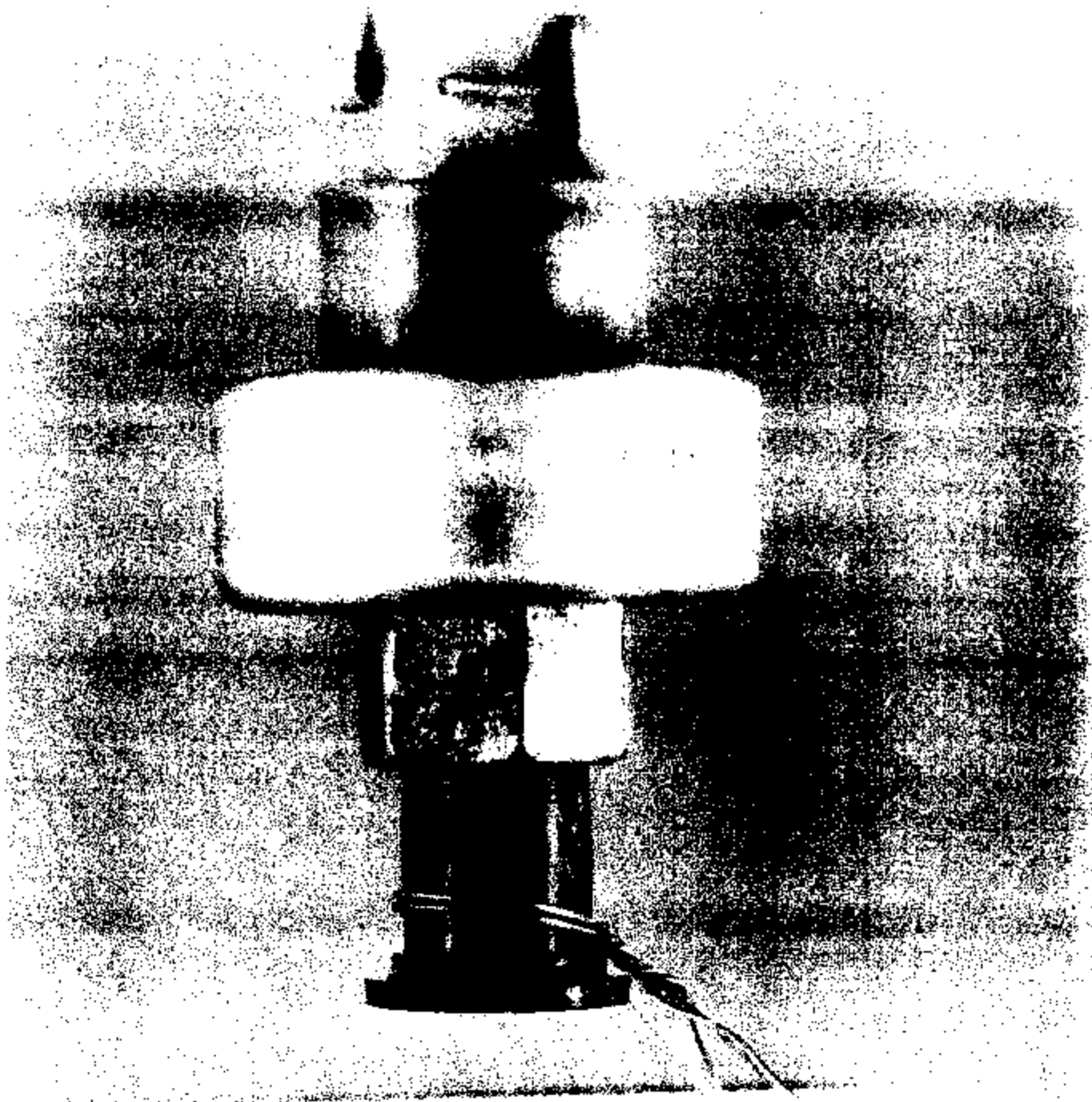
Central Laboratory

Report 6806236

Figure 52.: Switch D. Interior of cup.

Magnification: -8.2X

3713 7877



#11



Central Laboratory

Report 6800326

Figure 53.: Switch #11 (E). As-received.

Magnification: -3X



#11

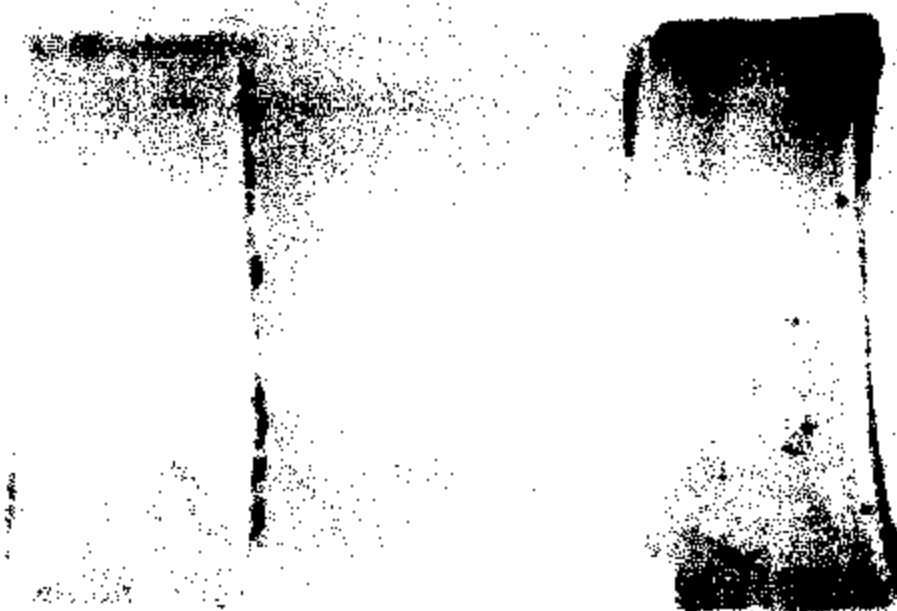
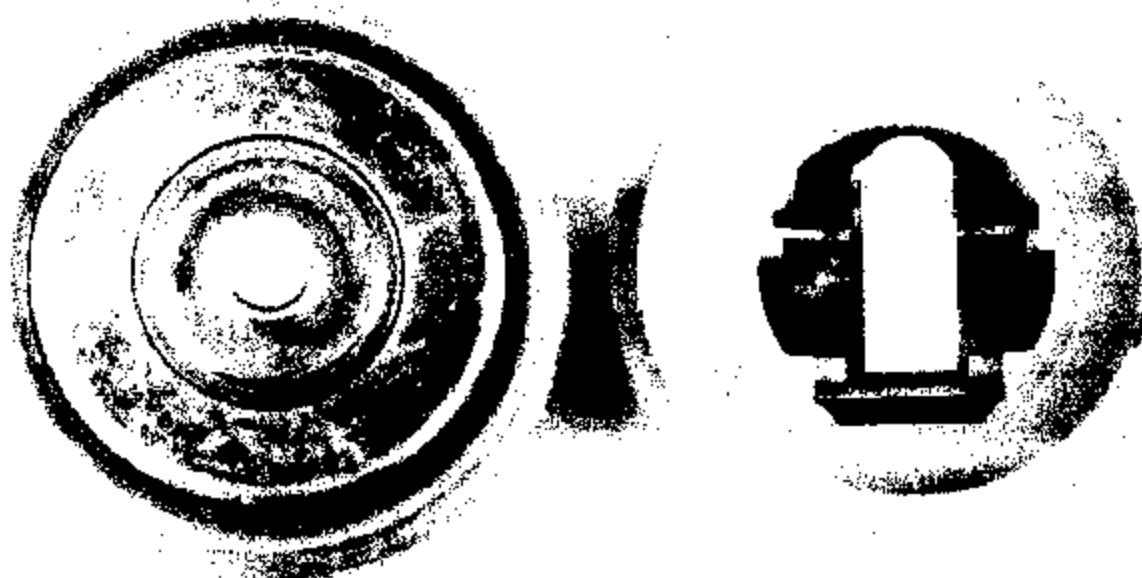


Central Laboratory

Report 880022s

Figure 64.: Switch #11 (E). Fitting end of hasport.

Magnification: ~9.5X



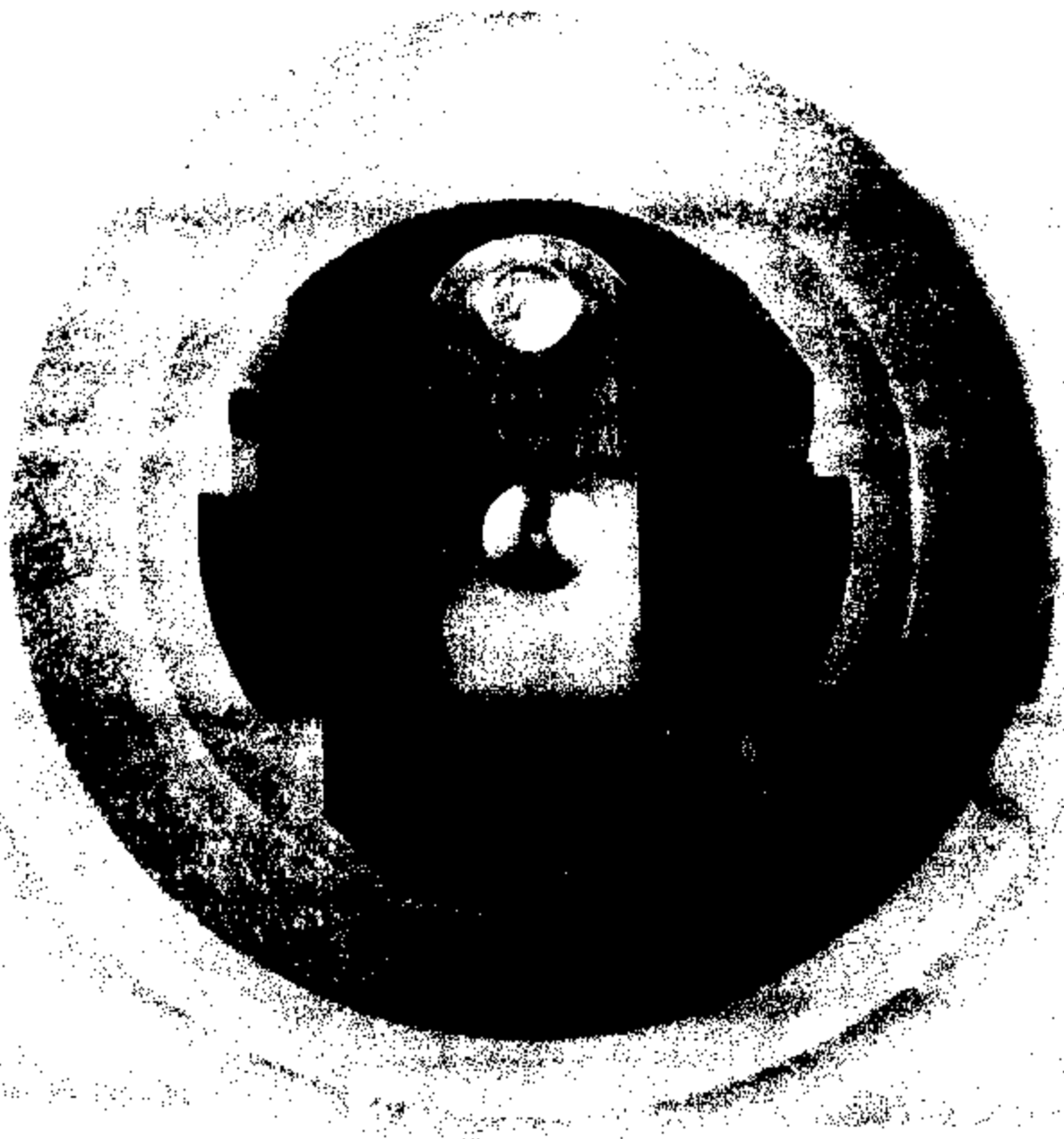
#

Ford Central Laboratory

Report 580000

Figure 35: Switch #11 (E). Crimp ring removed.

Magnification: -2.5X



11



Central Laboratory

Report 9800226

Figure 56: Switch #11 (E). Terminal cavity.

Magnification: -6X



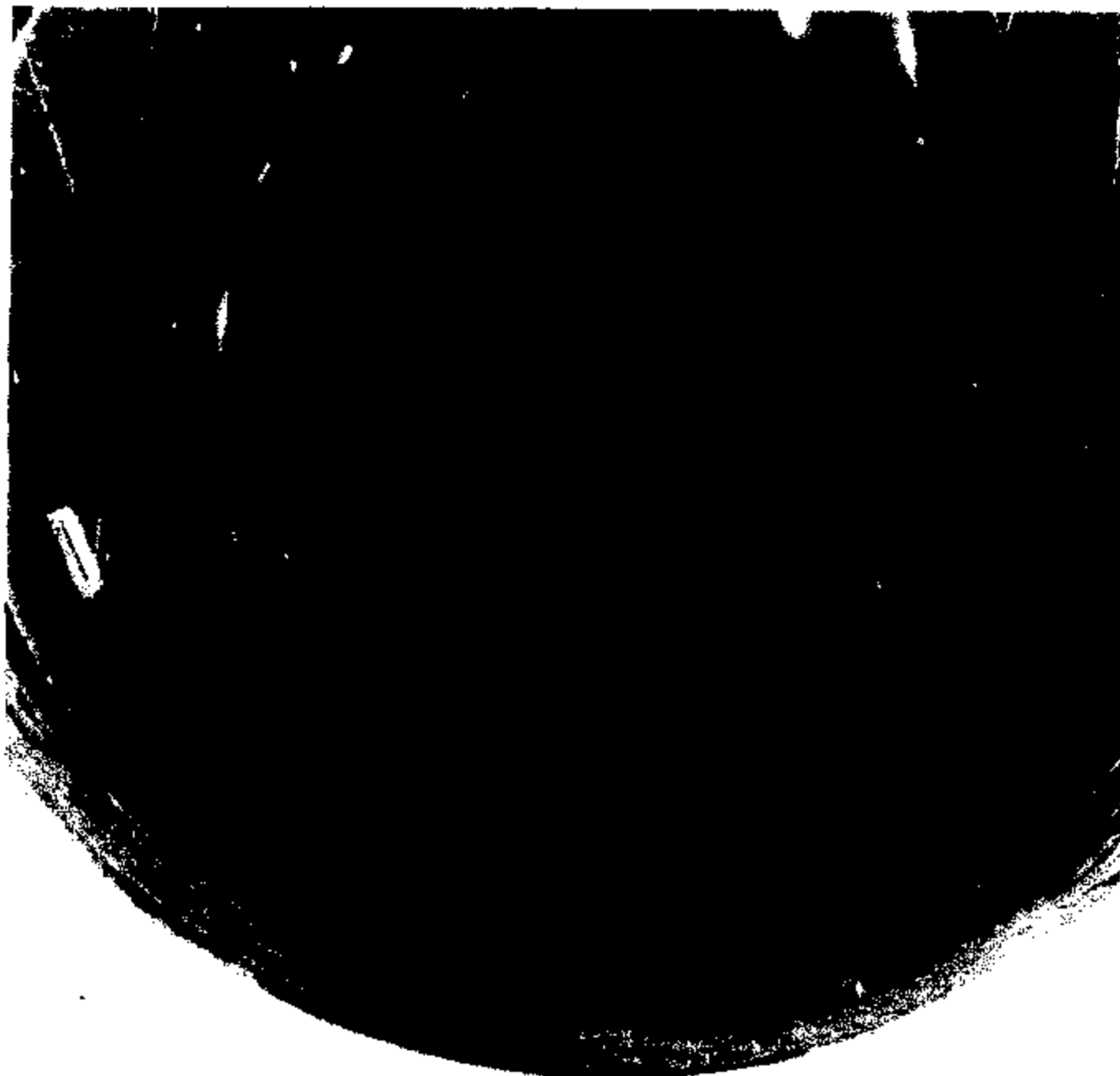
#11

 Central Laboratory

Report 000022

Figure 57: Switch #11 (E). Face of cup.

Magnification: ~5.7X



 Control Laboratory

Report 5088236

Figure 5B: Switch #11 (E). Kipion scale in photo.

Original Section: -0.25K



#11



Central Laboratory

Report #900221

Figure 58.: Switch #11 (E). Hexport cavity.

Magnification: -8.4X

3713 7884



#11

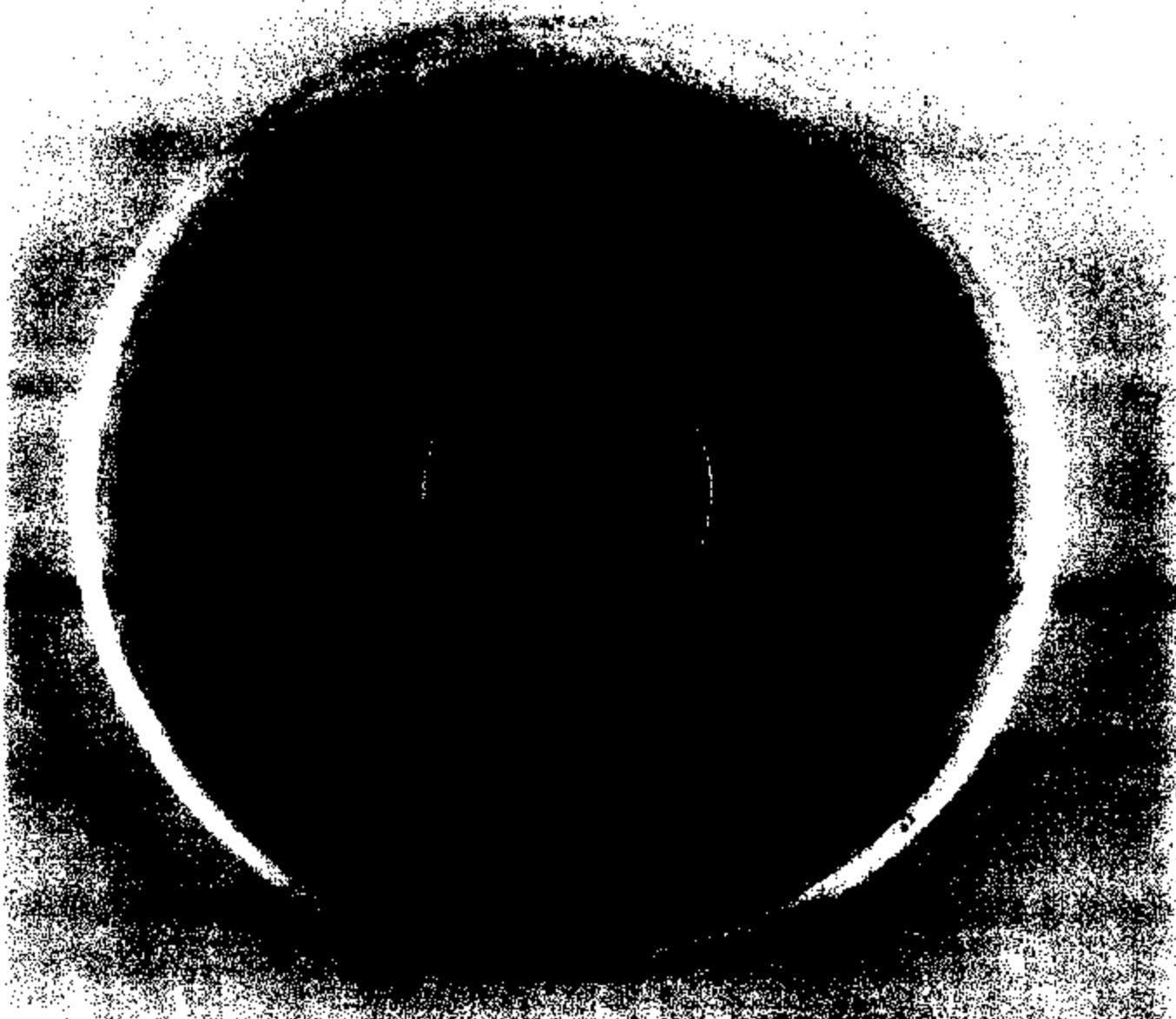


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Figure 60: Switch #11 (E). Washer - steel side.

Magnification: -8.7X



#11

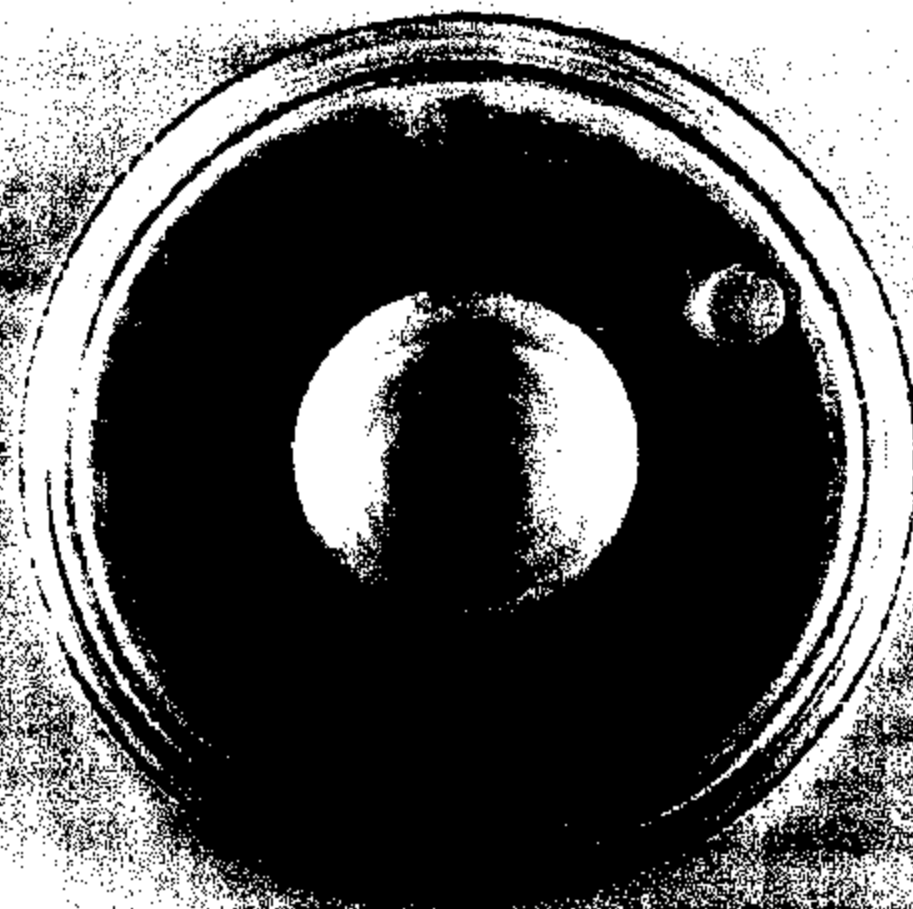


Central Laboratory

Report 0000226

Figure 61: Switch #11 (E). Washer - opposite side.

Magnification: -5.7X



#11



Central Laboratory

Report 9800228

Figure 62: Switch #11 (E). Converter - seal side.

Magnification: ~6.6X

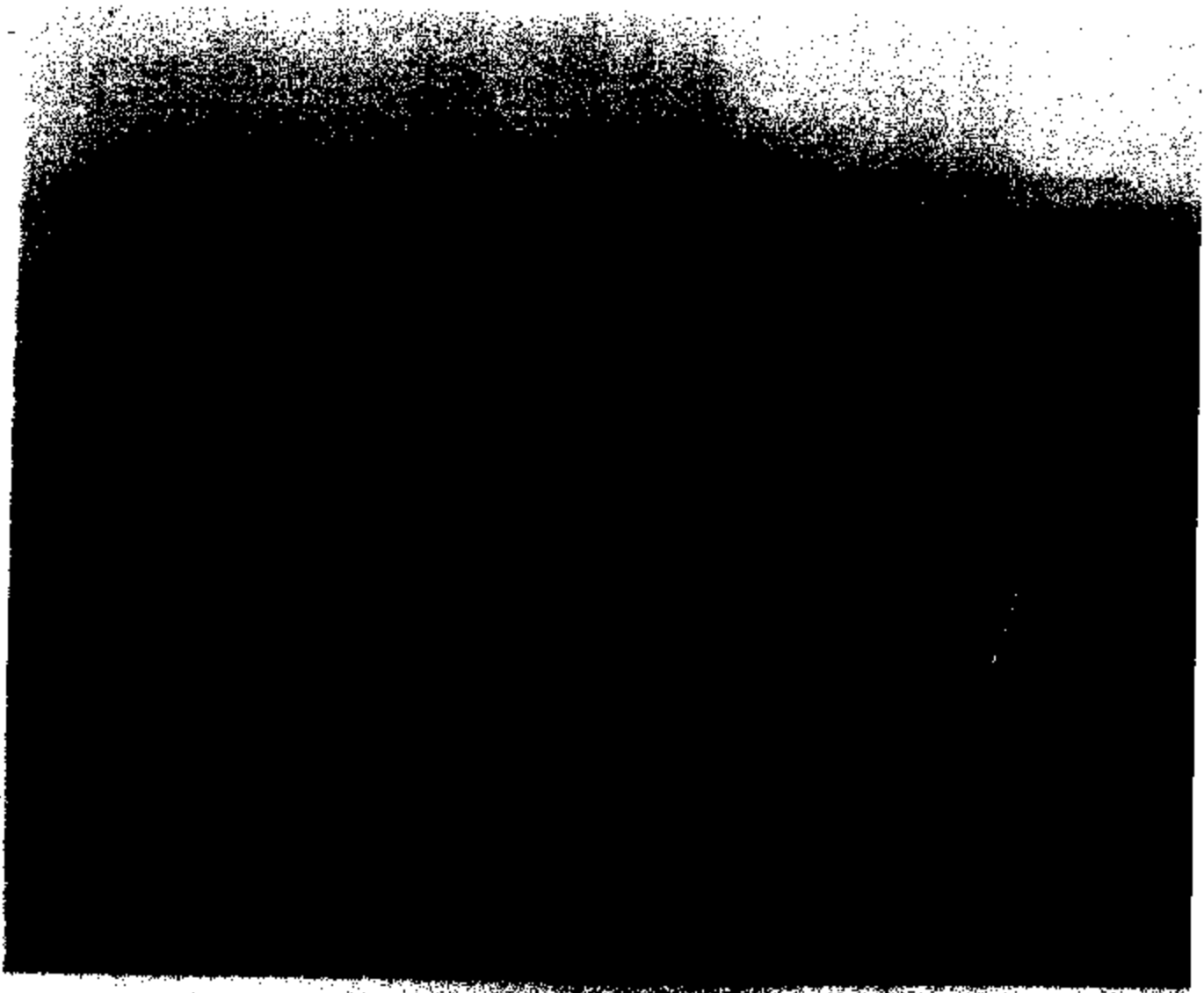


Central Laboratory

Report 984

Figure 63: Switch #11 (E). Disc - converter side.

Magnification: ~8.4X



#11



Federal Bureau of Investigation
Laboratory

Report 884

Figure 84: Switch #11 (E). Disc - opposite side.

Magnification: -6.4X

#11



Central Laboratory

Report 9900226

Figure 65: Switch #11 (E). Spacer.

Magnification: -8.1X



#11



Central Laboratory

Report 9000228

Figure 06: Switch #11 (E). Interior of cup.

Magnification: ~6.2X

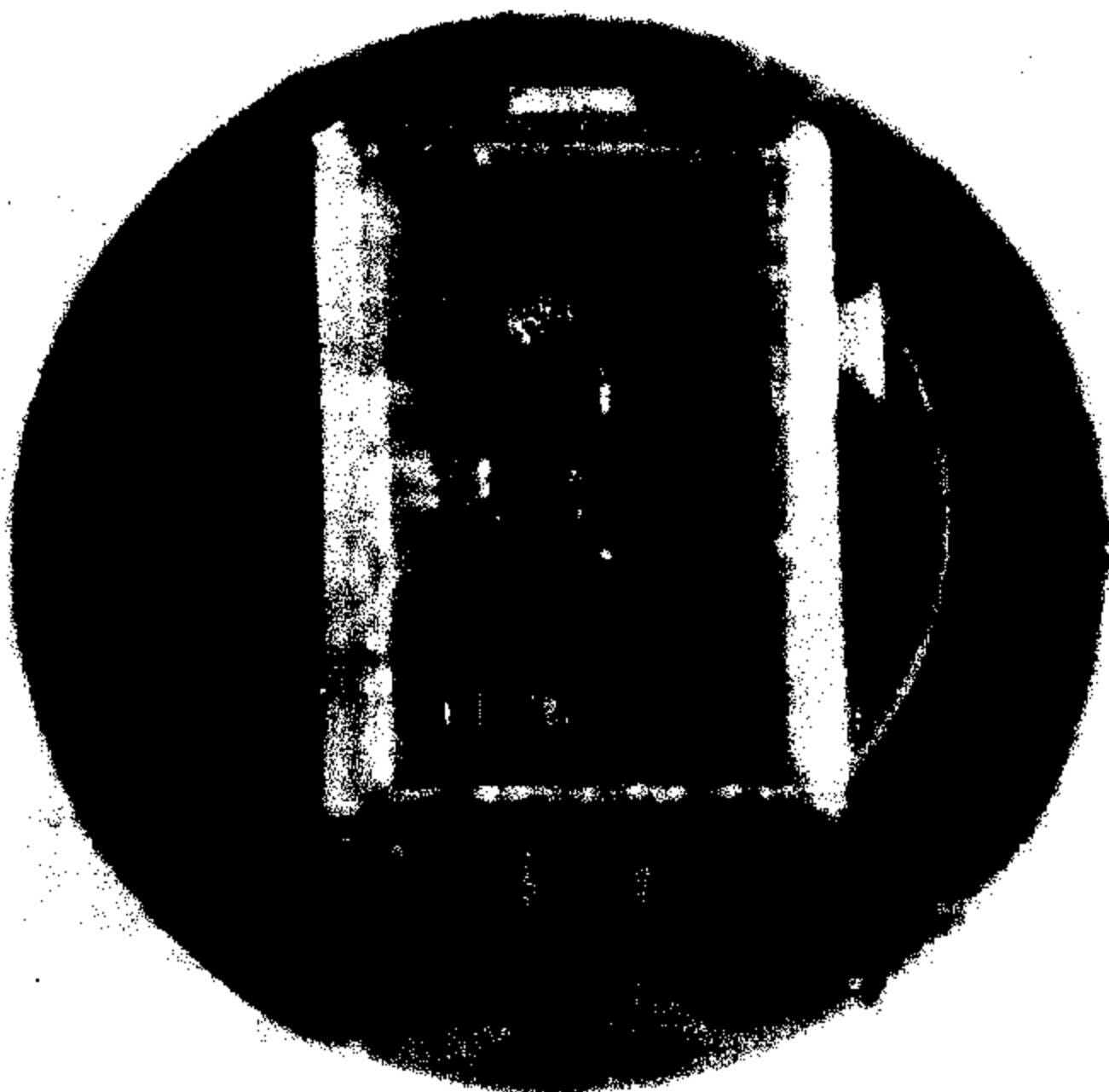


Central Laboratory

Report 680028

Figure 67: Switch F, As-received.

Magnification: -8.5X



 Central Laboratory

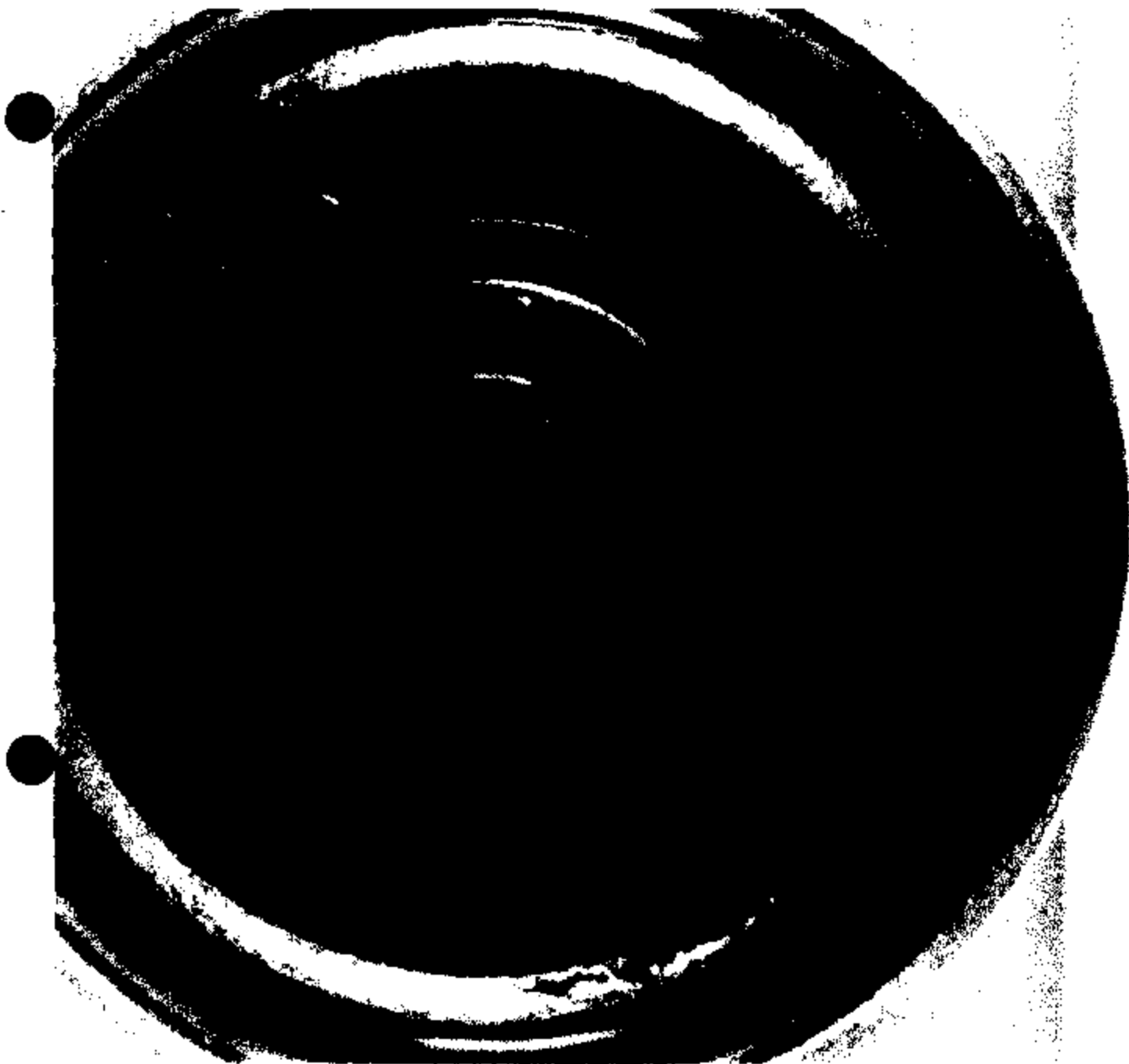
Report 0000226

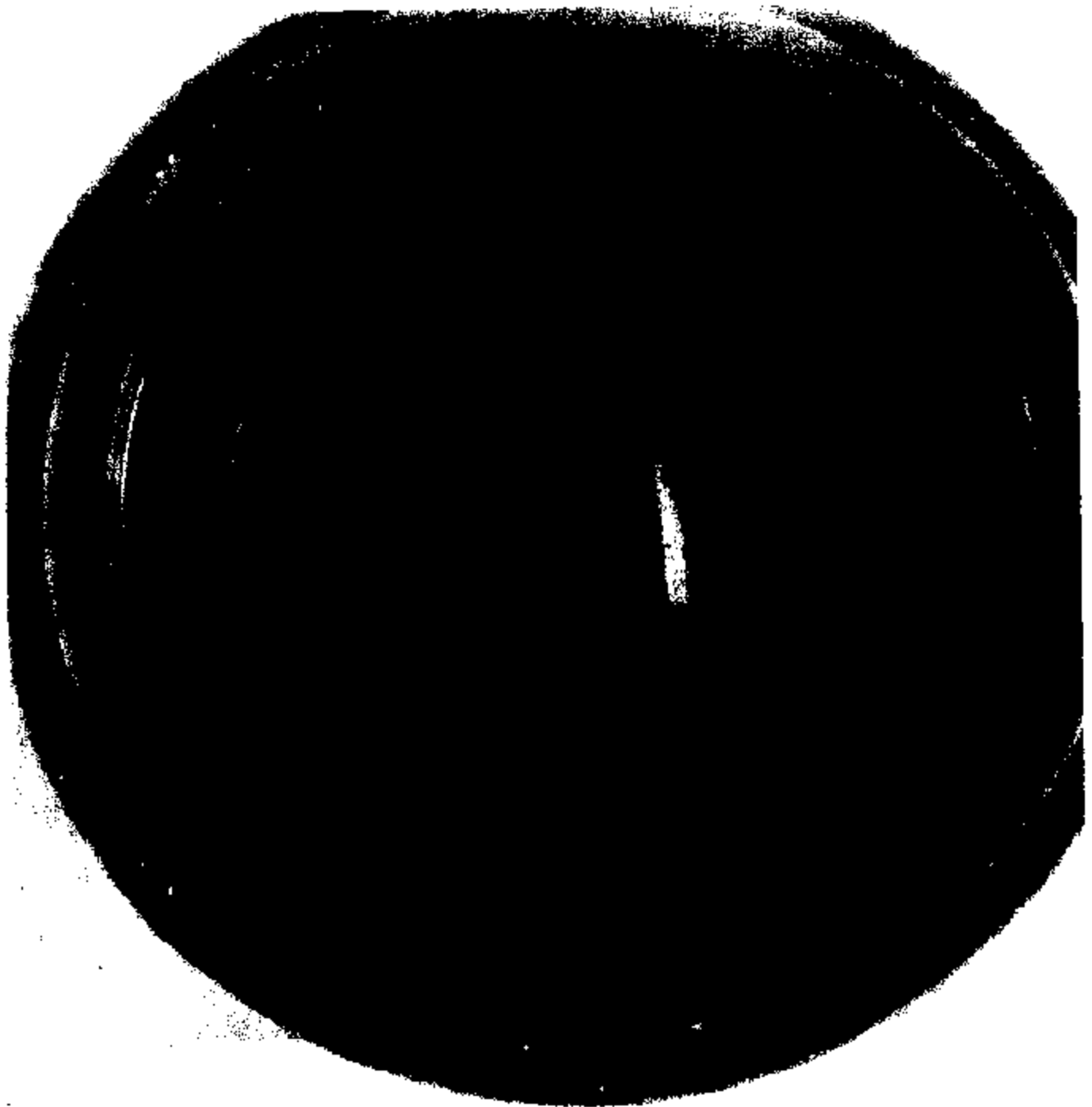
Figure 88: Switch F. Terminal cavity.

Magnification: ~7.5X

3

3713 7894





 FBI Laboratory

Report 0000220

Figure 71.: Switch F. Switch cavity.

Magnification: ~7.5X

3713 7896



F



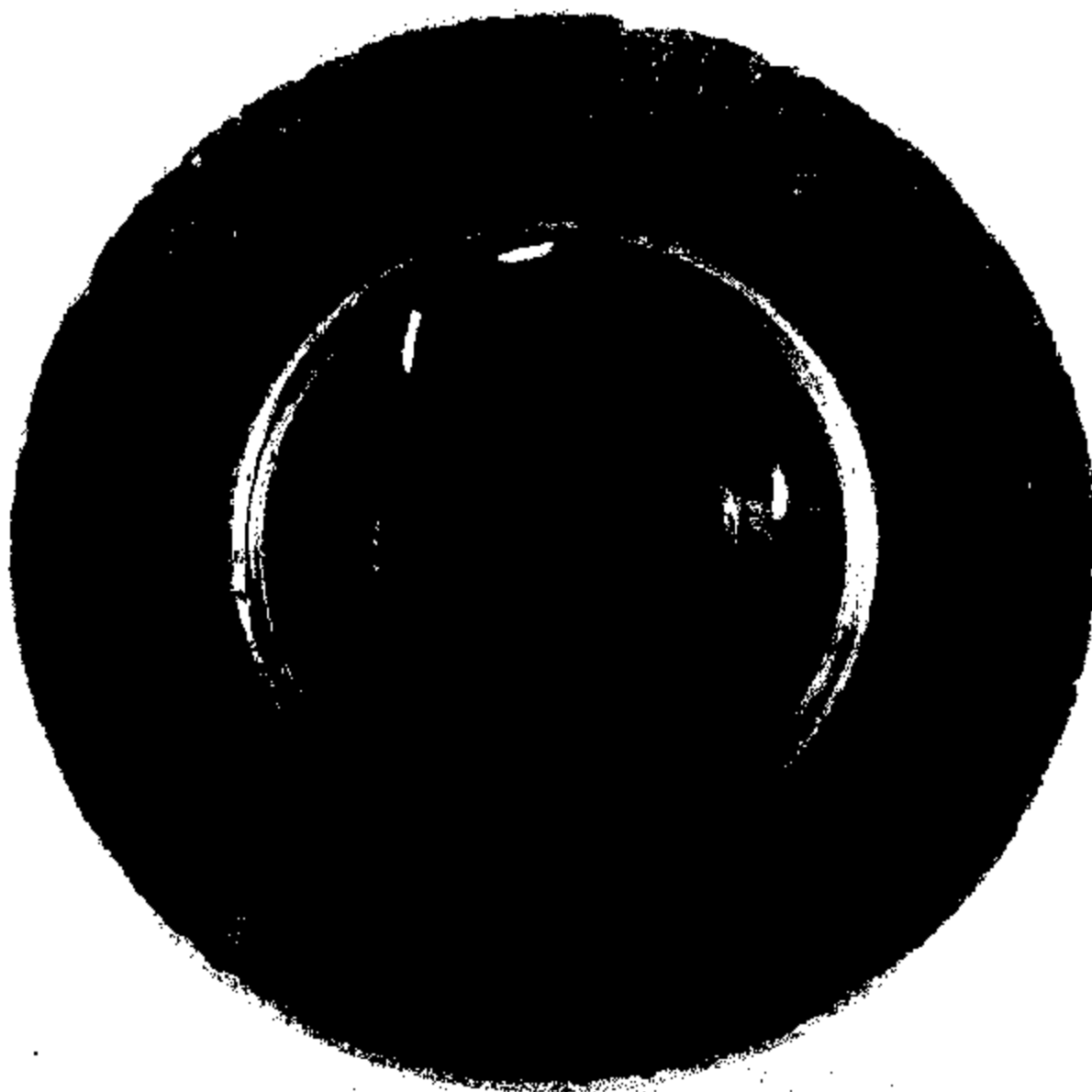
Central Laboratory

Report 9000228

Figure 72.: Switch F. Kapton seals in place.

Magnification: -7.5X

3713 7897



F



Central Laboratory

Report 8800226

Figure 73: Switch F. Export cavity.

Magnification: ~6.1X



F



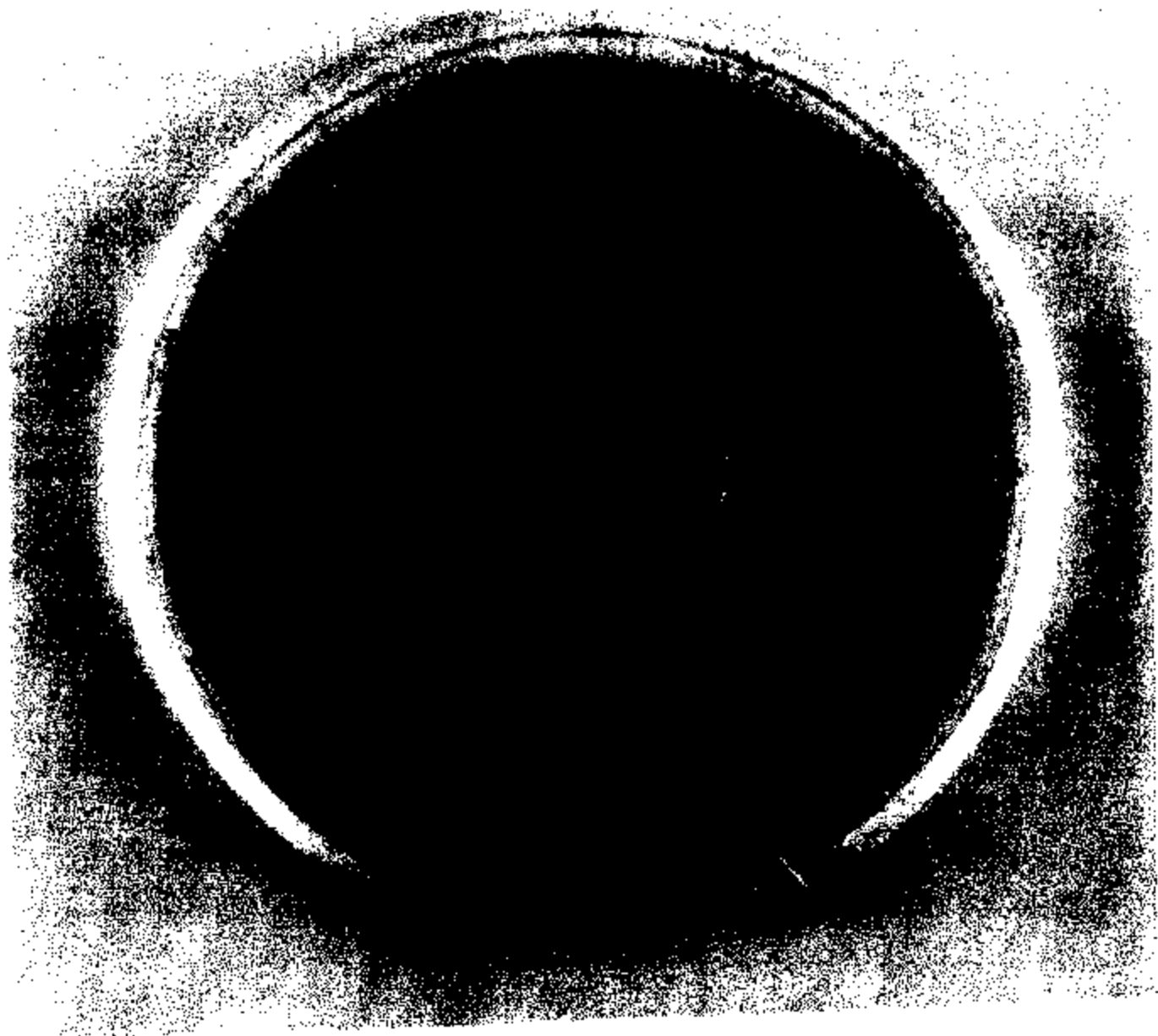
Central Laboratory

Report 0001220

Figure 74: Switch F.

Weather - cool side.

Magnification: -5.7X



F



Central Laboratory

Report 1.0000220

Figure 75.: Switch F. Water - opposite side.

Magnification: ~5.7X



F



Central Laboratory

Report 9800325

Figure 76: Switch F. Converter - seal side.

Magnification: -7X



F



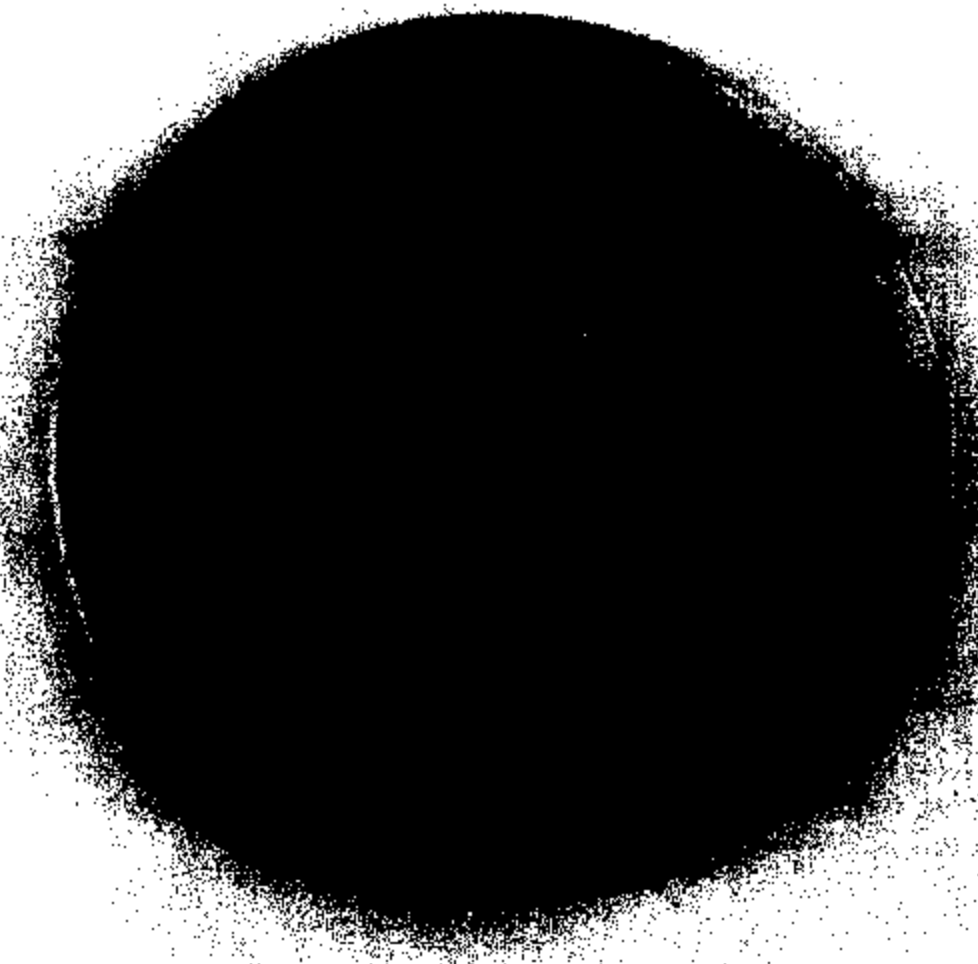
Central Laboratory

Report 9800228

Figure 77: Switch F. Converter - opposite side.

Magnification: -7X

3713 7802



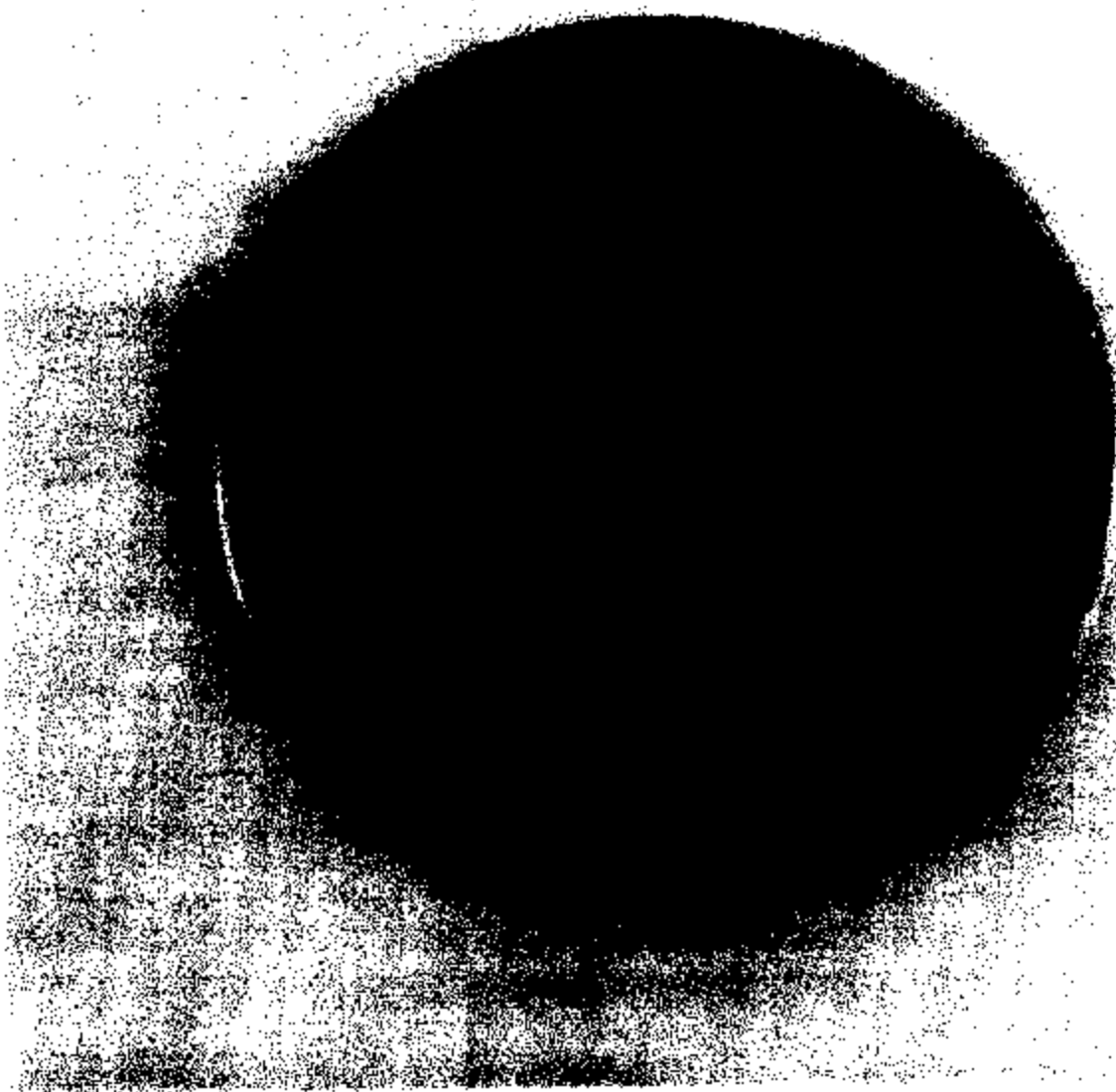
Central Laboratory

Report 9900220

Figure 78.: Switch F.

Die - converter side.

Magnification: ~0.9X

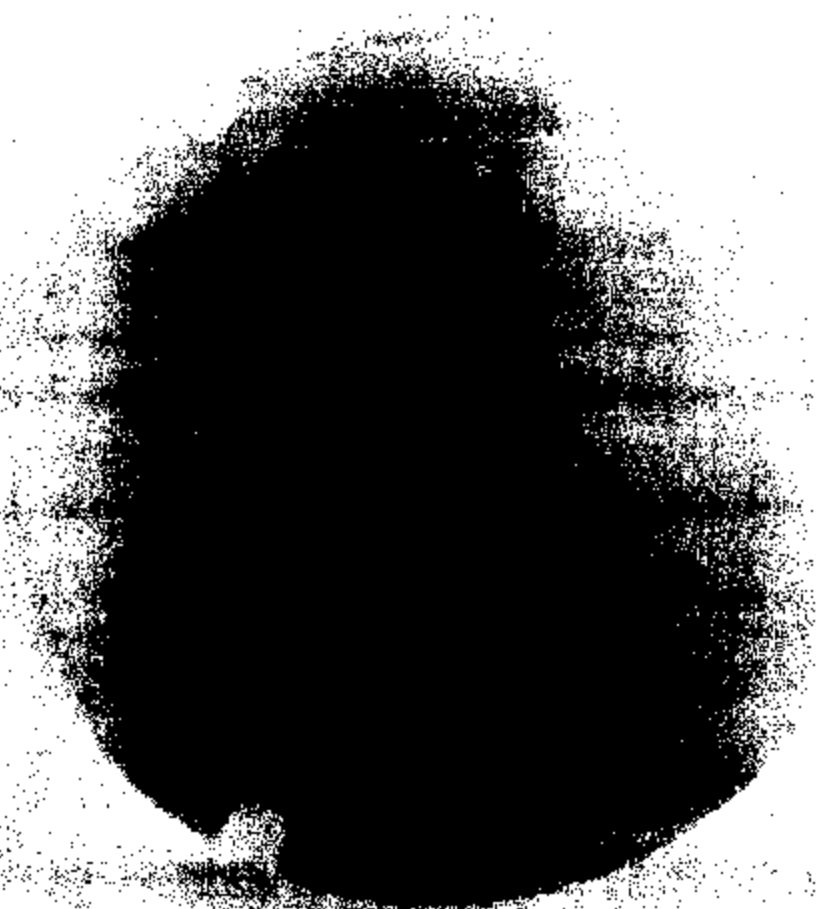


Central Laboratory

Report 0000220

Figure 79.: Switch F. Dio - opposite side.

Magnification: -6.9X



F

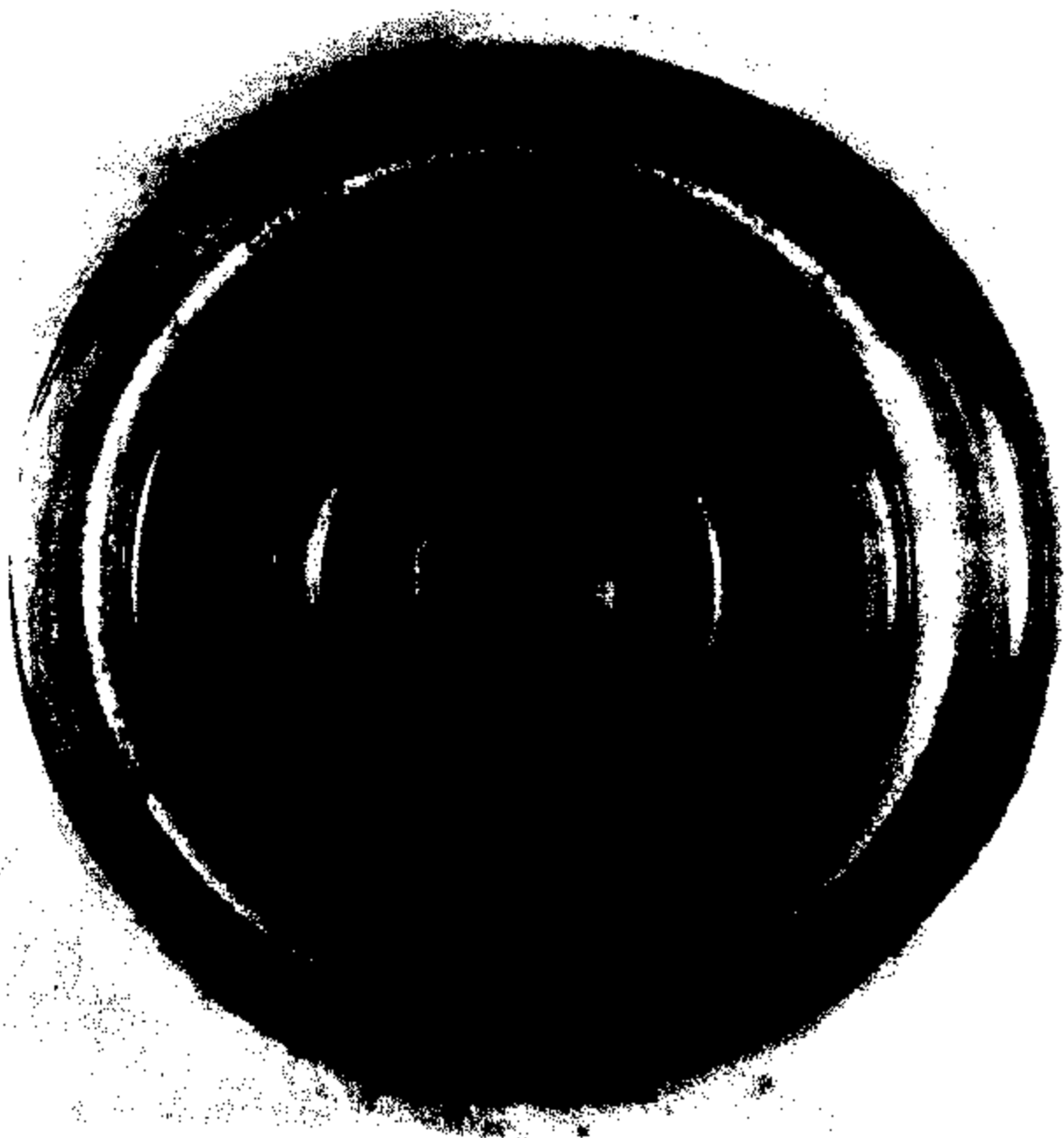


Central Laboratory

Report 9800330

Figure 80.: Switch F. Spacer.

Magnification: -8.8X



F



Central Laboratory

Report 8900220

Figure 21.: Switch F. Interior of cup.

Magnification: -6.1X



Central Laboratory

Reports 9900226
9900607
9901571

Figures 82 through 219

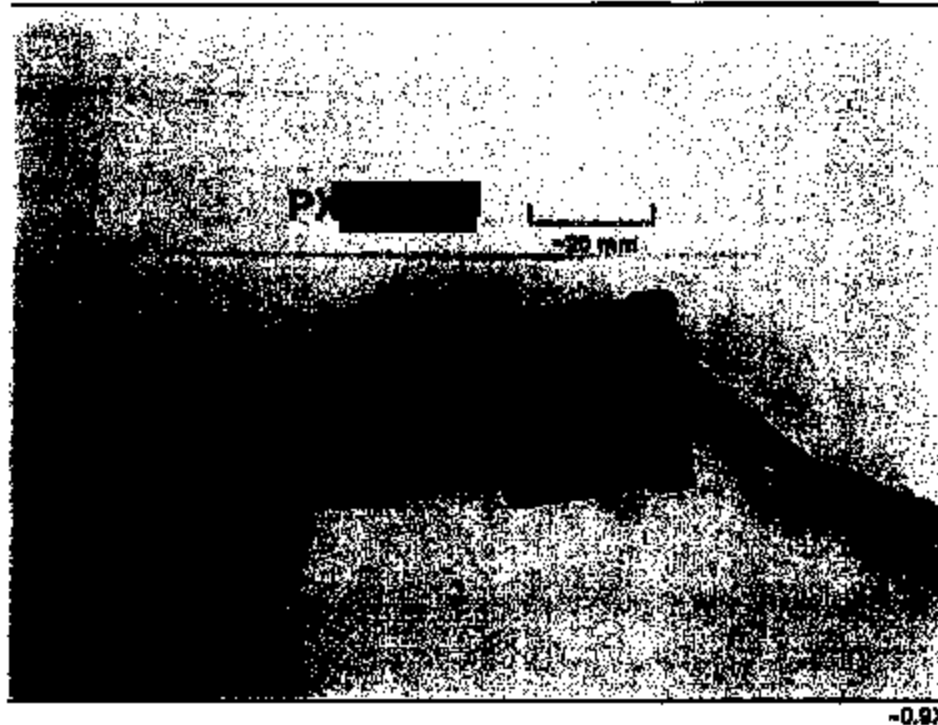


Figure 82: PX [redacted] switch as-received. Note that connector is not fully engaged.

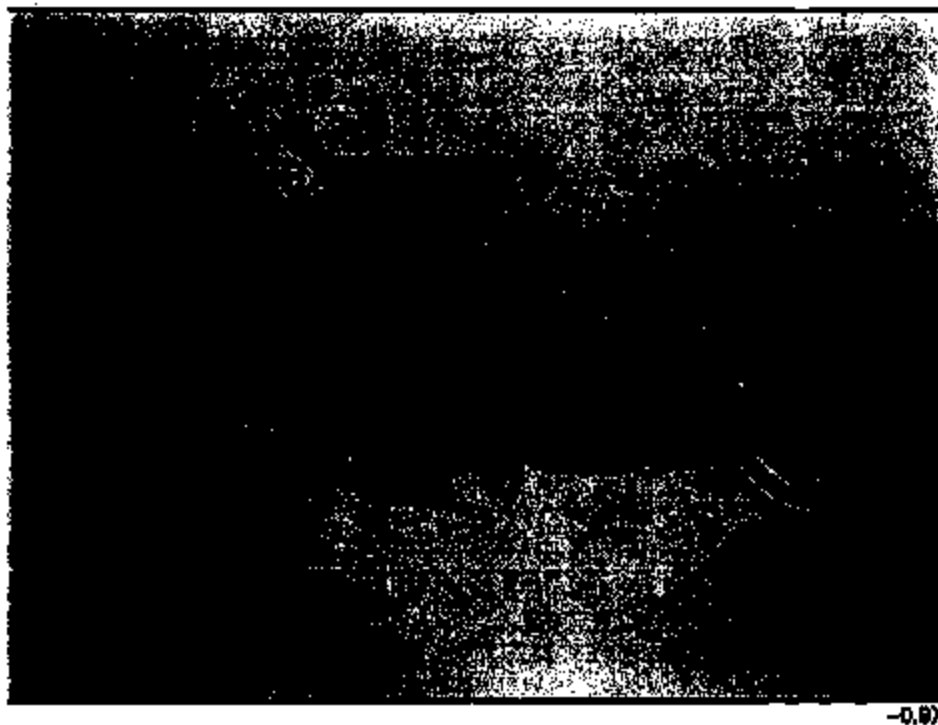
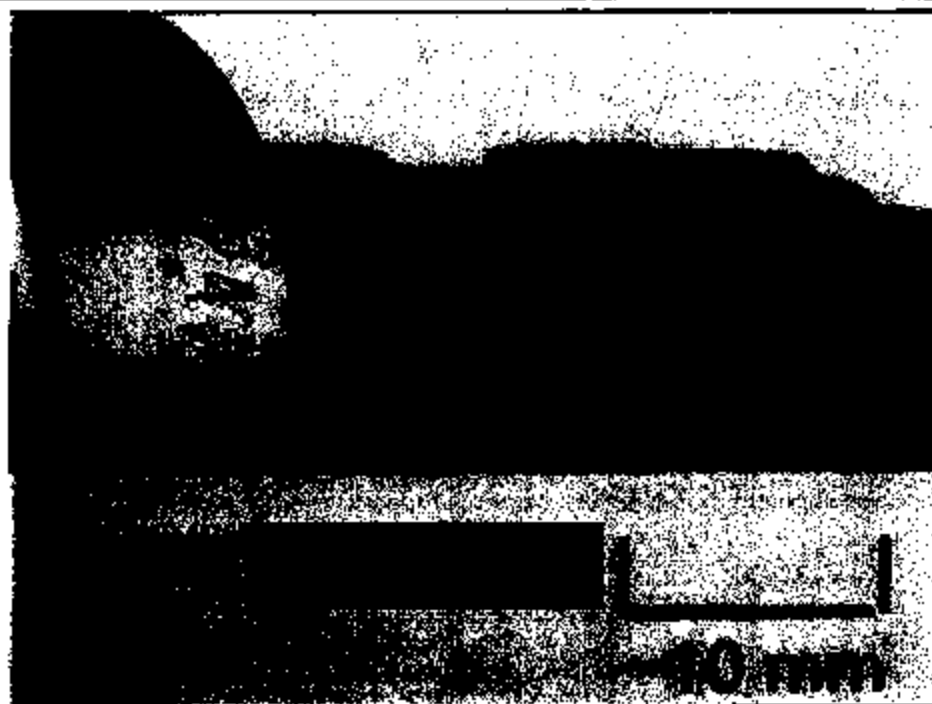
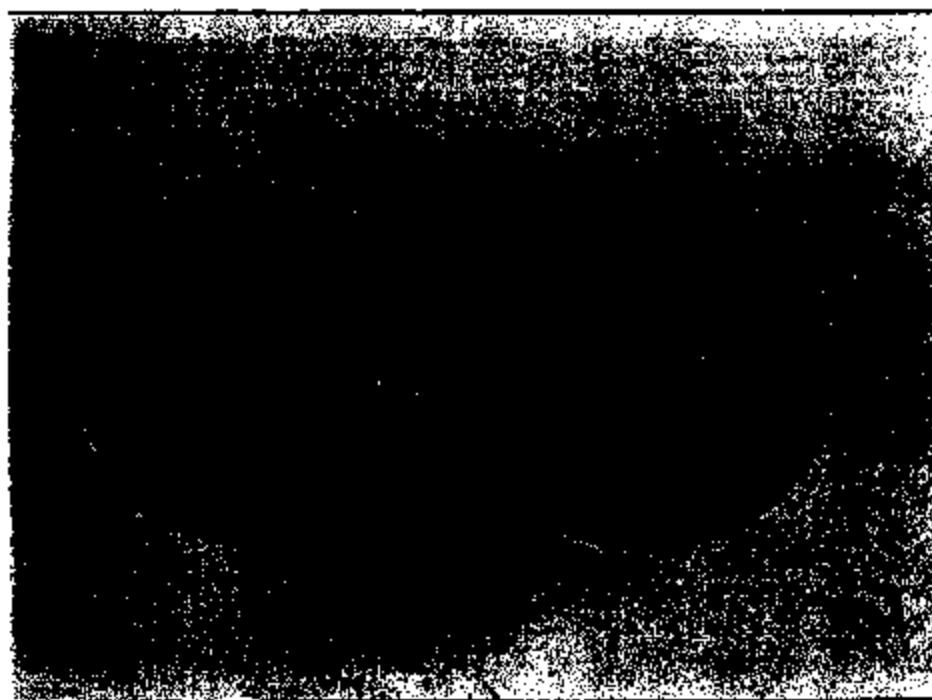


Figure 83: PX [redacted] Switch as-received



-3.8X

Figure 84: PX [redacted] Showing tab not fully engaged.



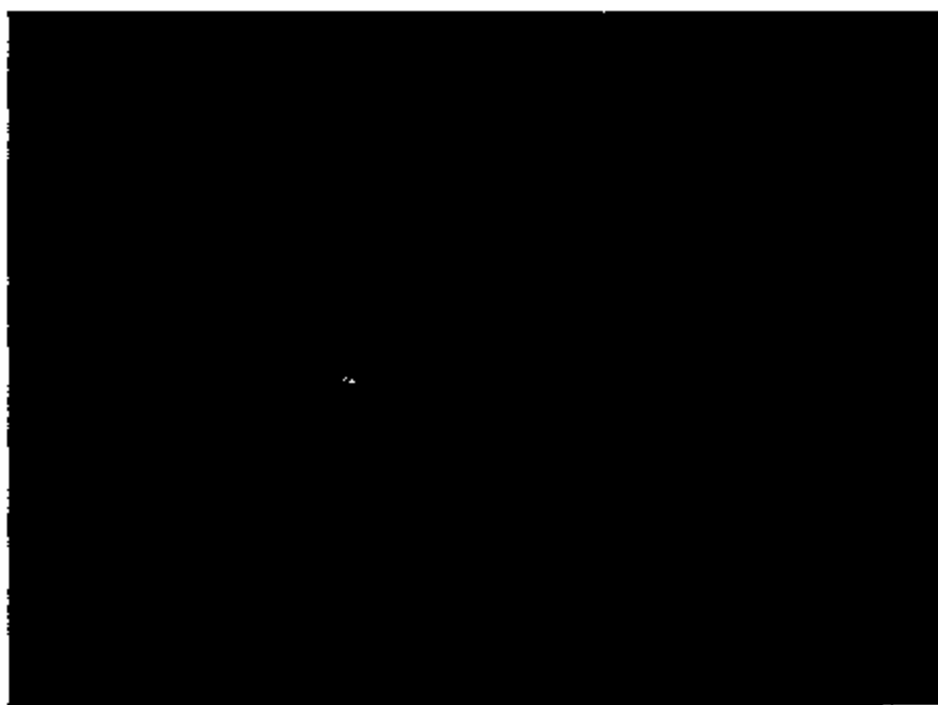
-1.7X

Figure 85: PX [redacted] Showing face of cup and switch cavity after crimp removed.



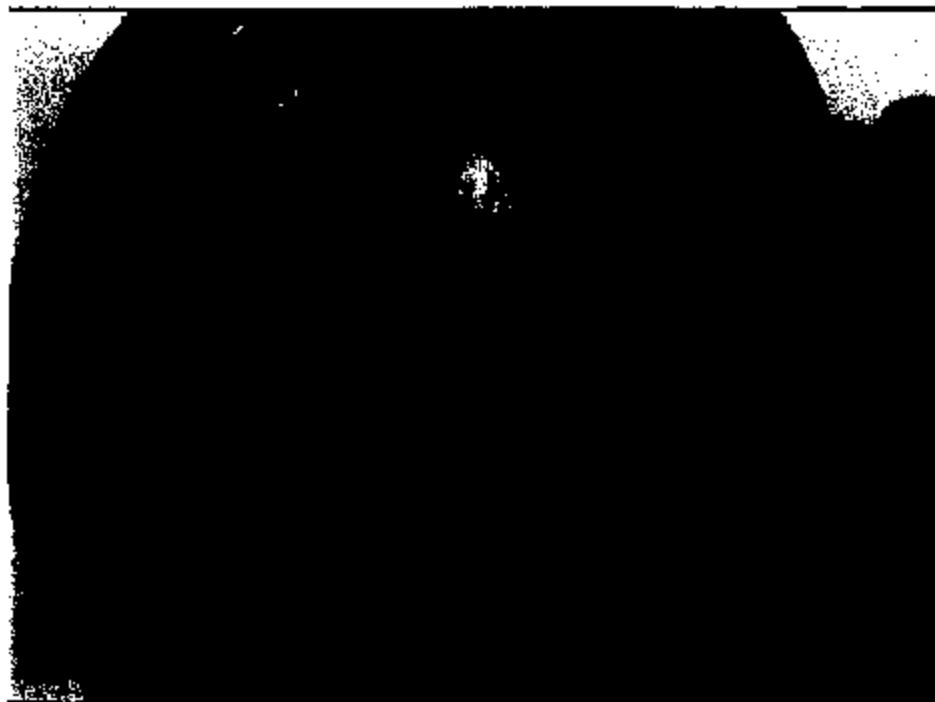
~3X

Figure 86: PX [redacted] Showing face of cup.



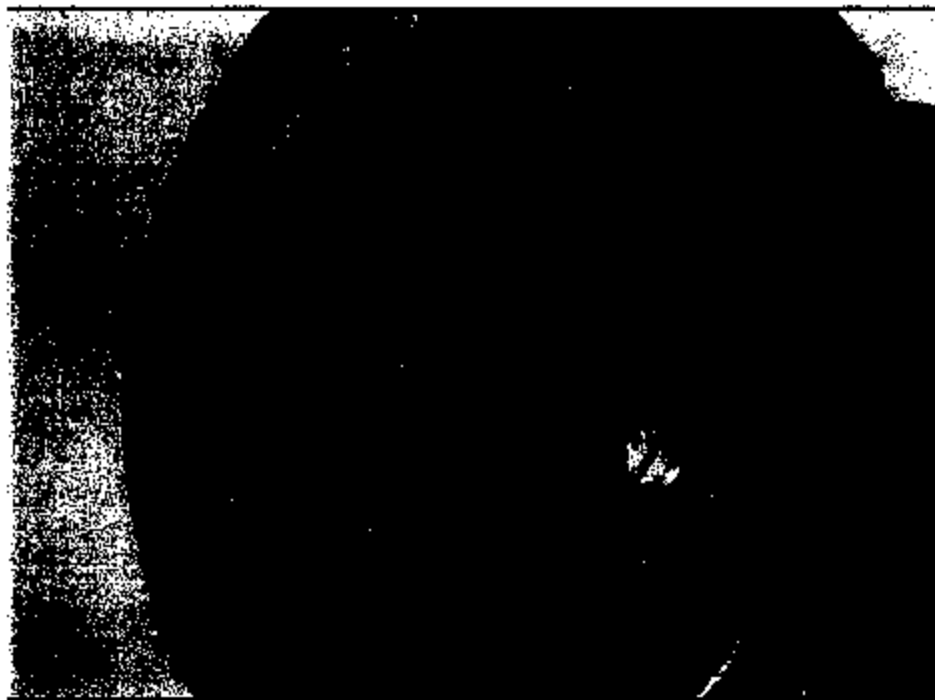
~3.2X

Figure 87: PX [redacted] Showing corrosion on surface of cup under o-ring ring.



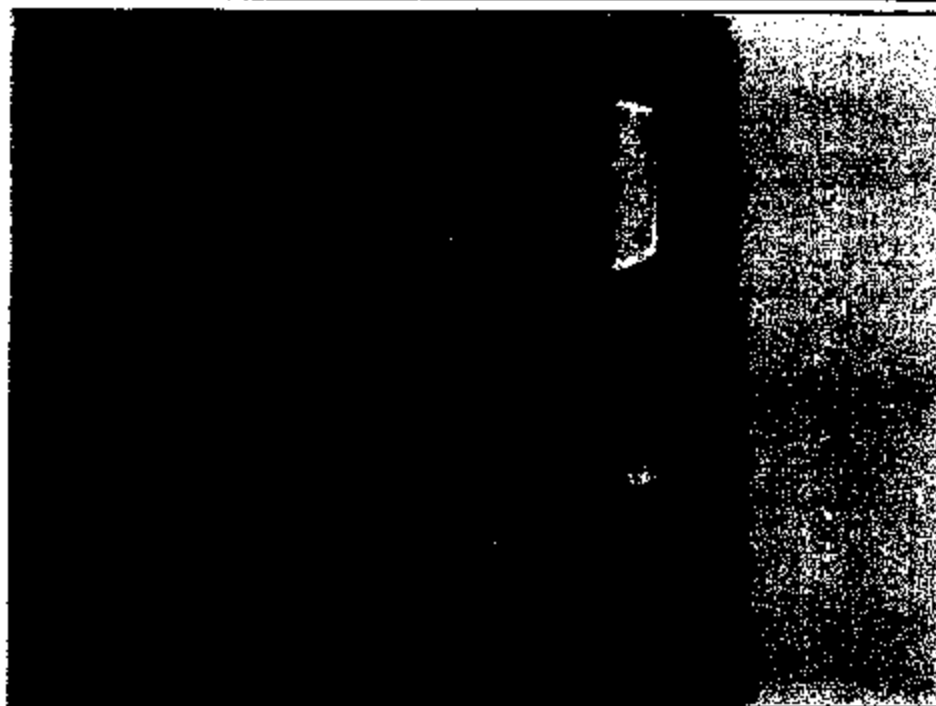
-5X

Figure 88: PX [redacted] Showing corrosion product in switch cavity.



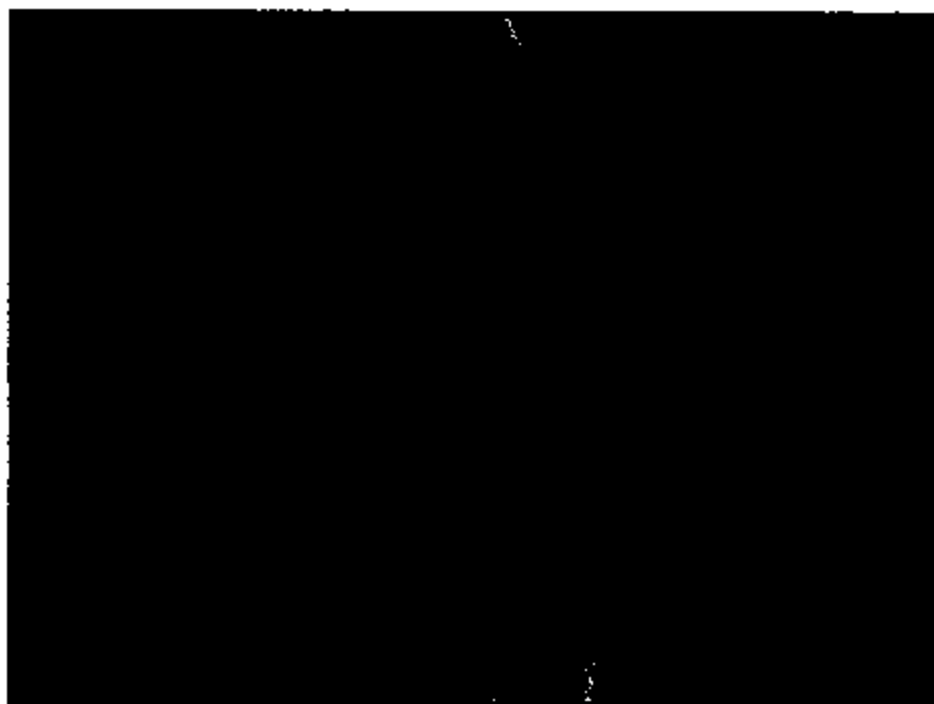
-5X

Figure 89: PX [redacted] Showing corrosion product in switch cavity.



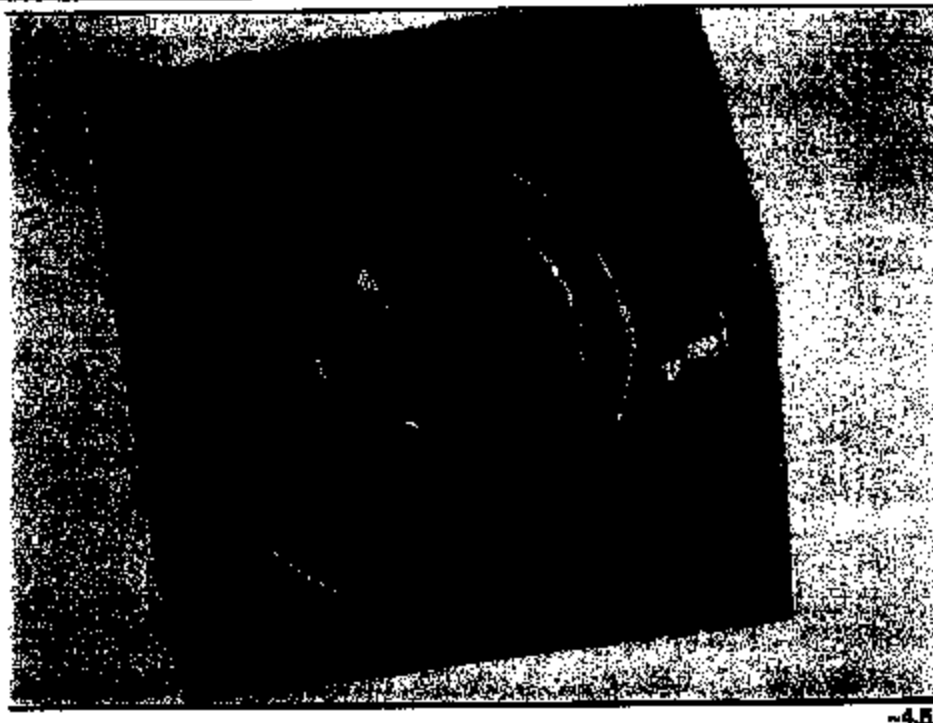
-B4X

Figure 90: PX [redacted] Showing tarnish on terminals.



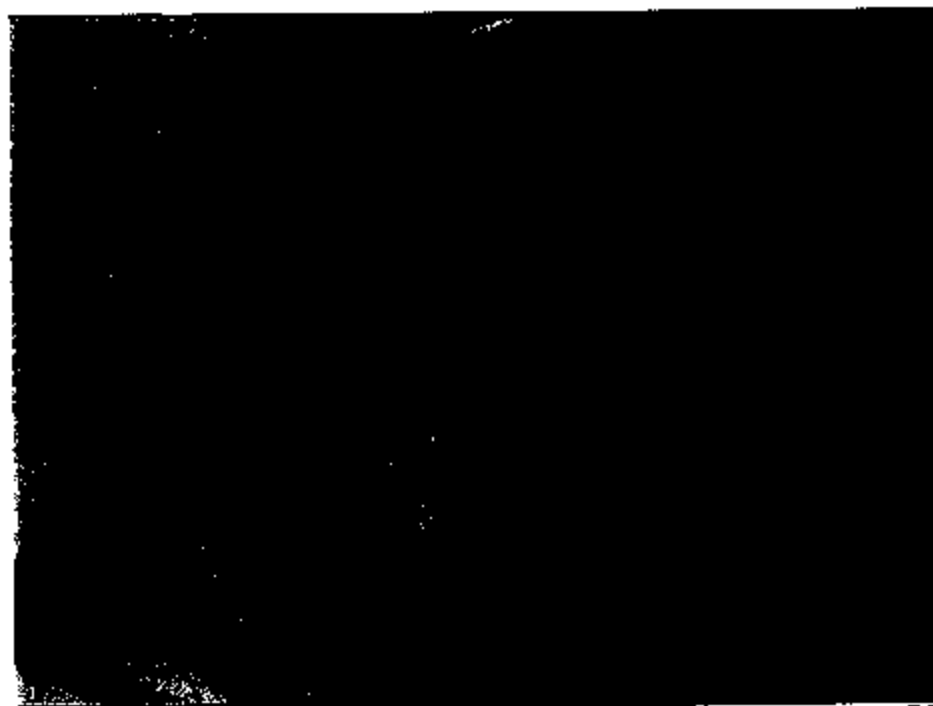
-7X

Figure 91: P2 [redacted] Showing corrosion under environmental seal.



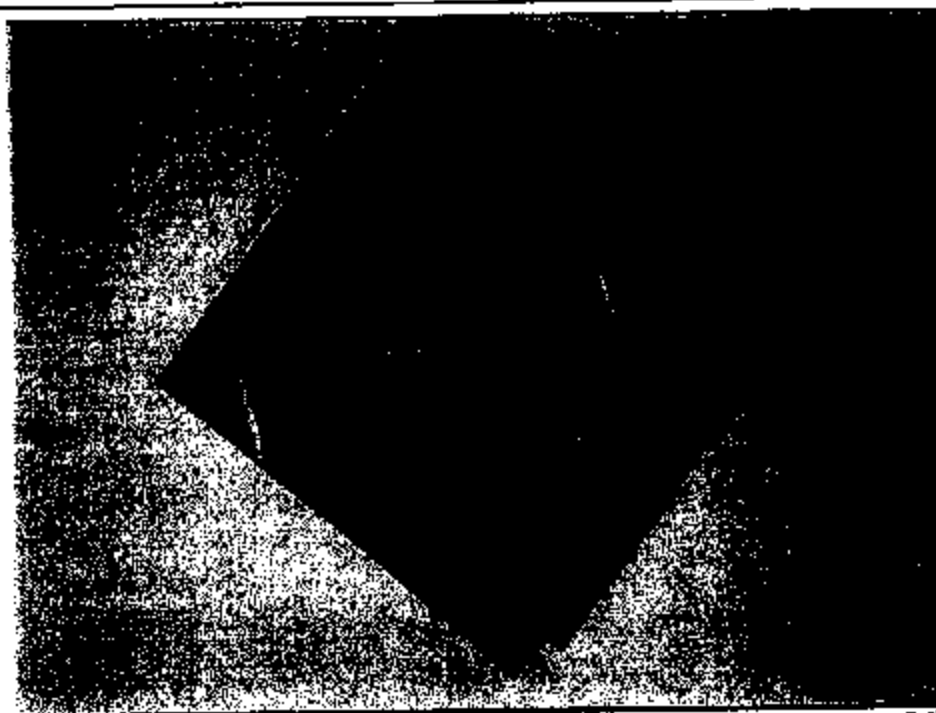
~4.5X

Figure 82: P2 [redacted] Showing Kapton seal adjacent to hexport. Arrow points to tear in Teflon.



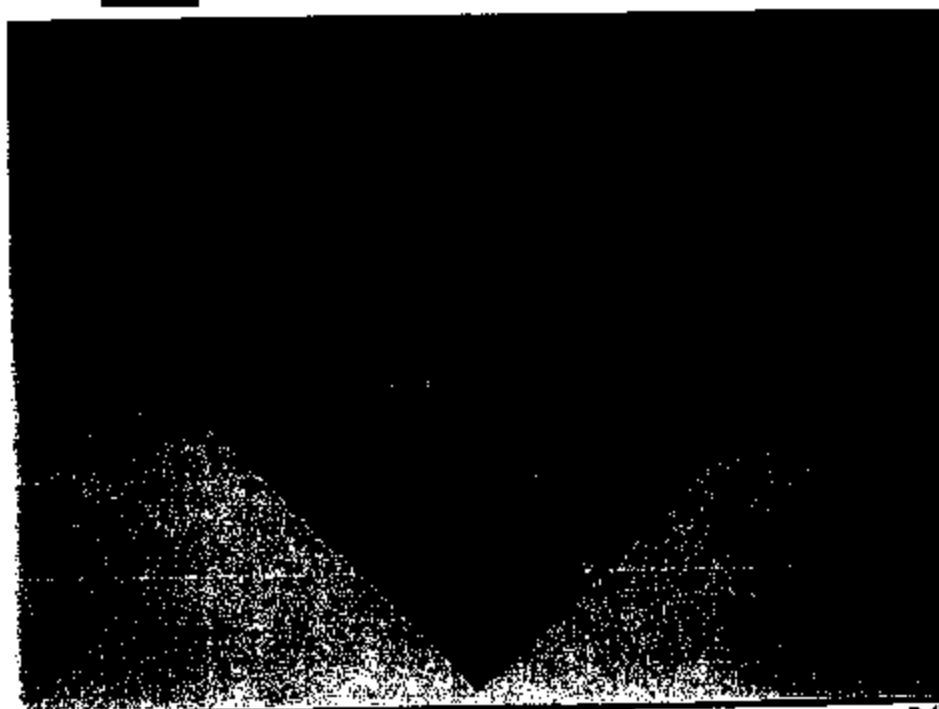
~7.3X

Figure 83: P2 [redacted] Showing close up of tear shown in Figure 82.



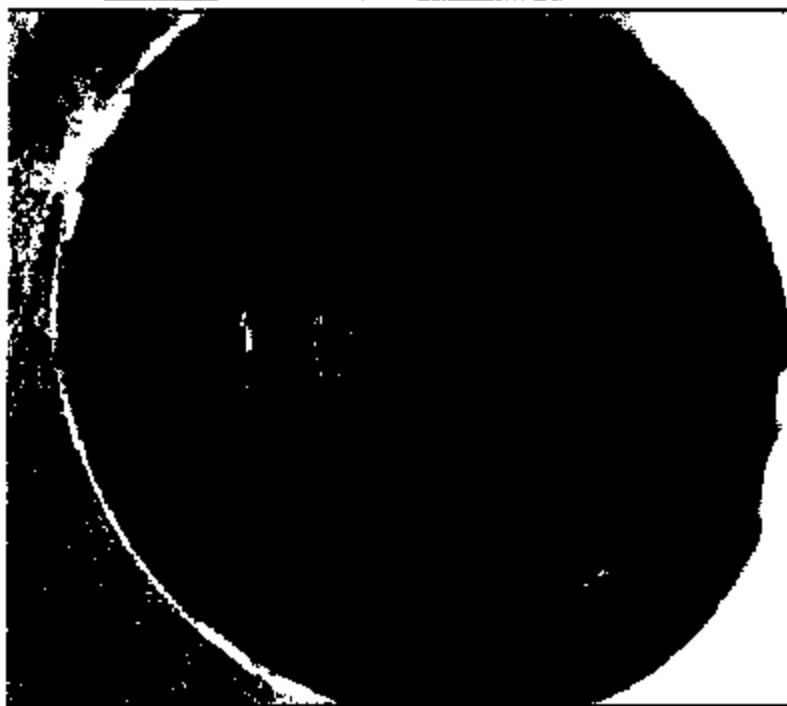
~3.4X

Figure 94: P7 [redacted] Showing middle Kapton seal.



~3.4X

Figure 95: P7 [redacted] Showing Kapton seal adjacent washer/converter.



-7.3X

Figure 98: PX  Showing black residue in hexport cavity.

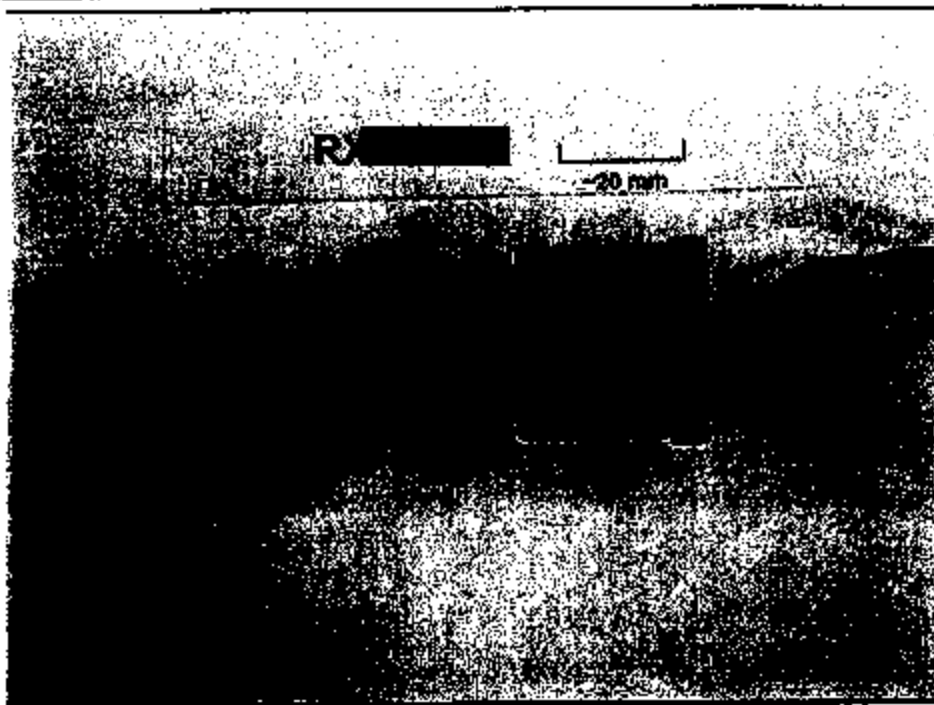


-4.4X

Figure 99: PX  Fluoroscopic image showing engagement of terminals.

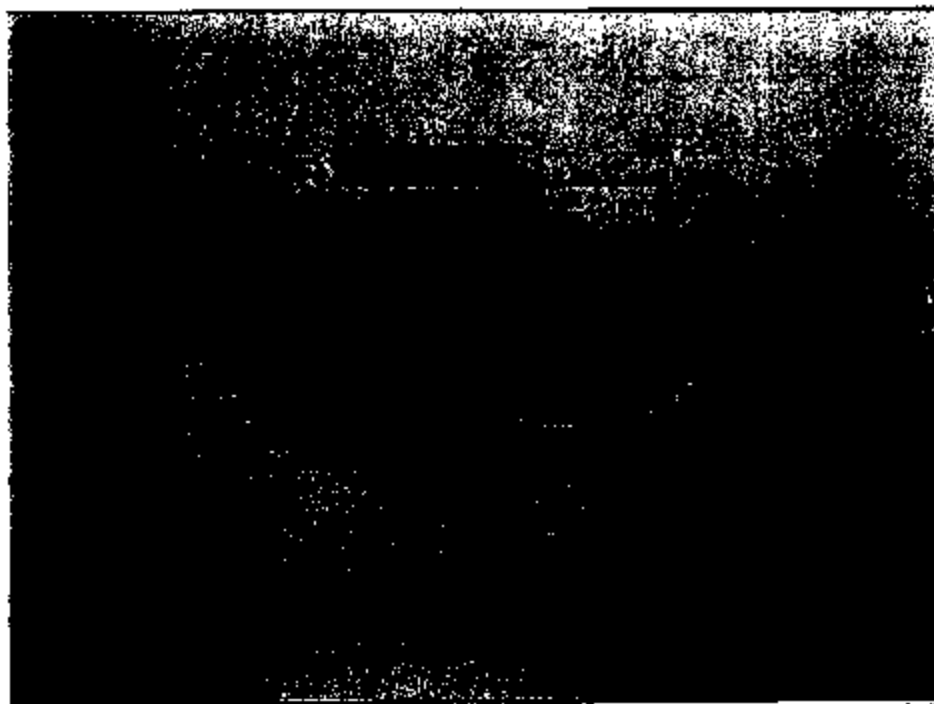


Figure 100: PX [REDACTED] Fluorescopic image showing engagement of switch base and seal in connector.



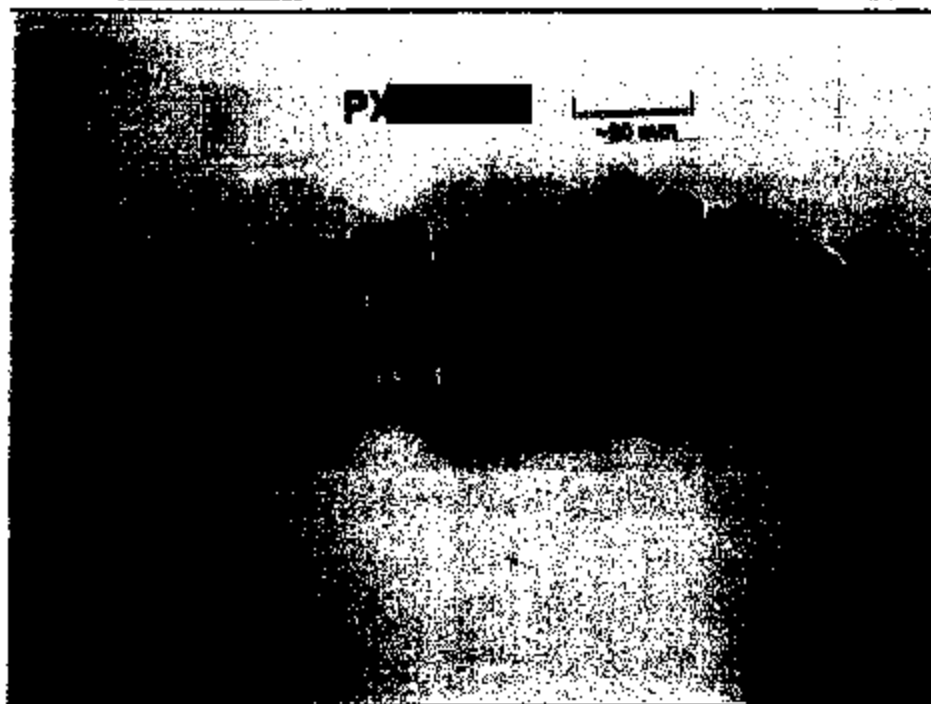
-8.5X

Figure 101: R Showing switch as-received. Note that connector is fully engaged.



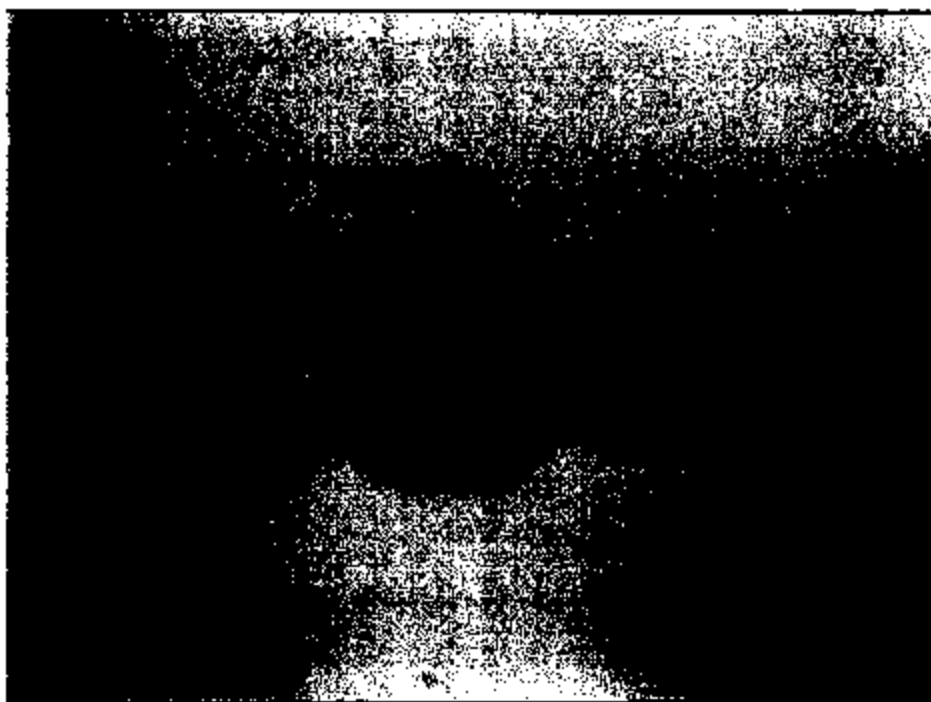
-8.5X

Figure 102: R Showing switch as-received.



~0.8X

Figure 103: PX [redacted] Showing switch as-received. Note that connector is not fully engaged.



~0.9X

Figure 104: PX163312. Showing switch as-received.

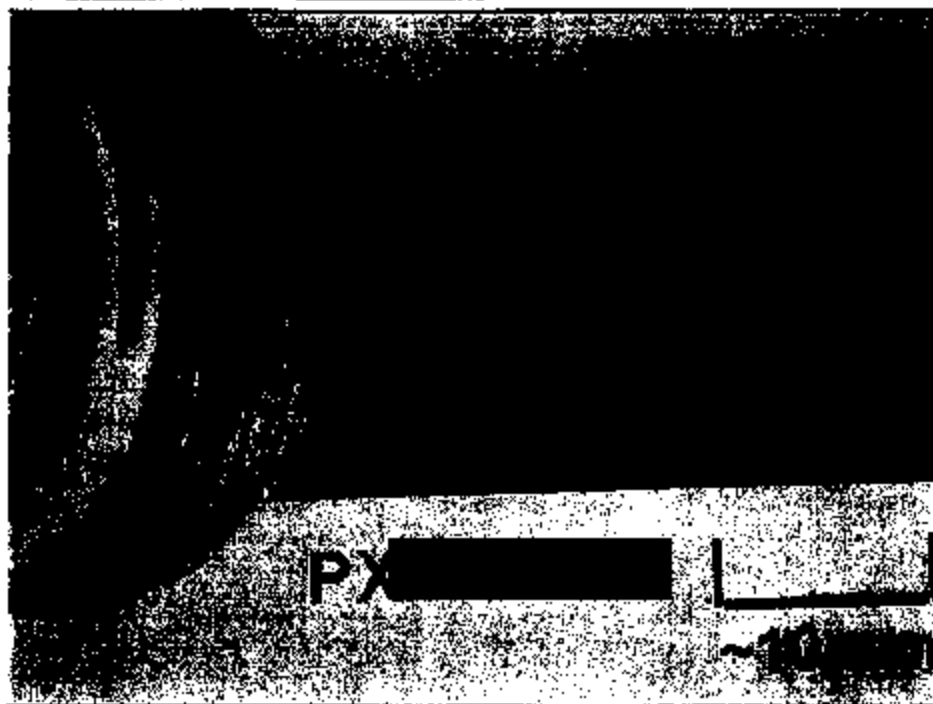


Figure 105: P[REDACTED] Showing tab not fully engaged.

-3X

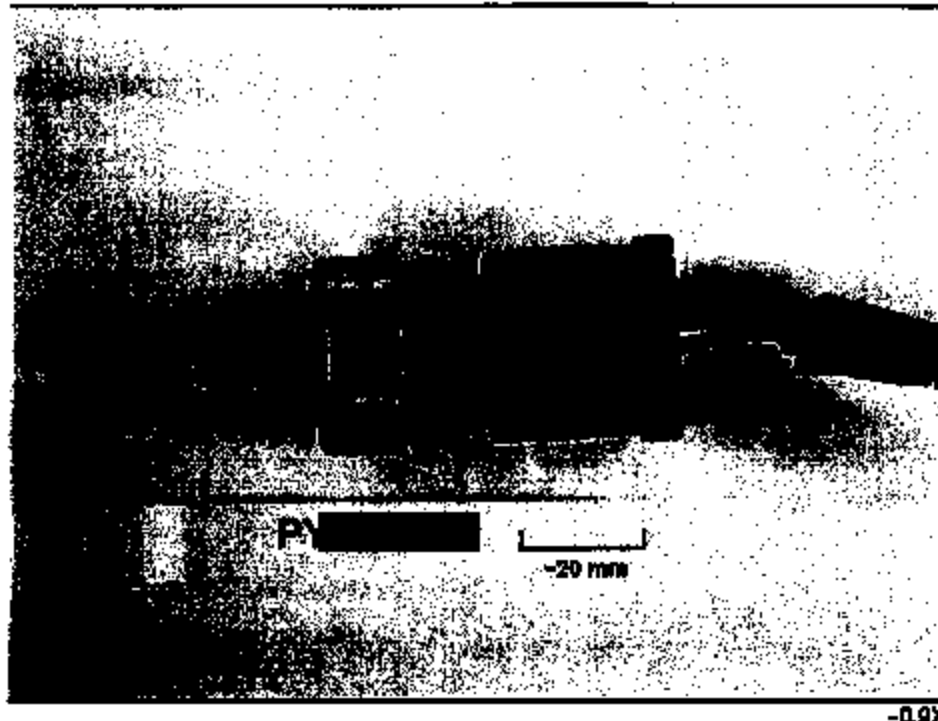


Figure 108: P [redacted] Showing switch as-received. Note that connector is fully engaged.



Figure 107: P [redacted] Showing switch as-received.

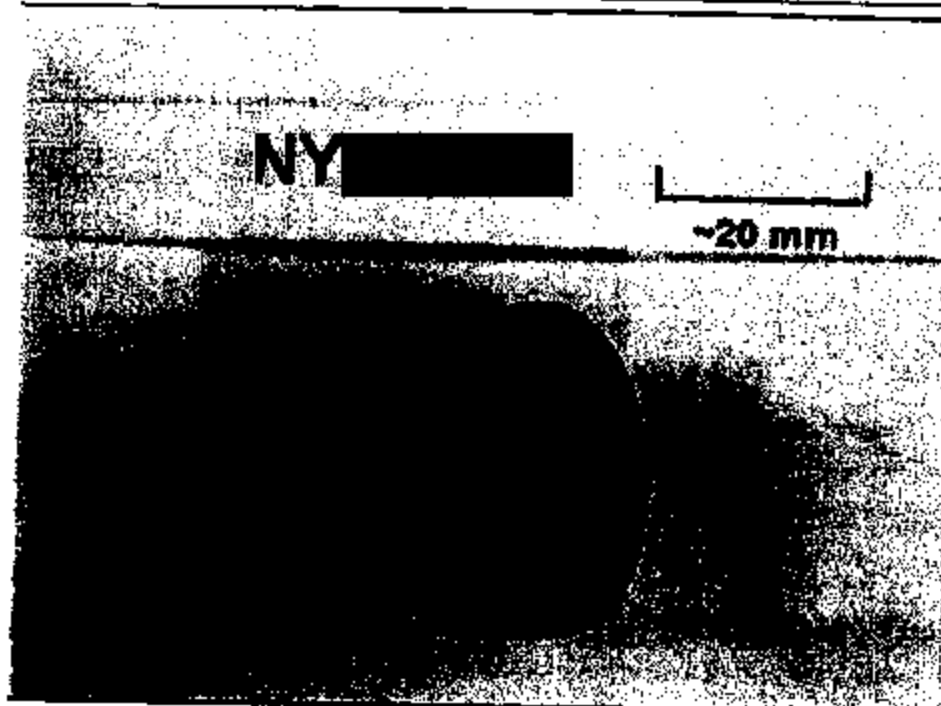


Figure 108: NY [redacted] Showing switch as-received.

~1.8X

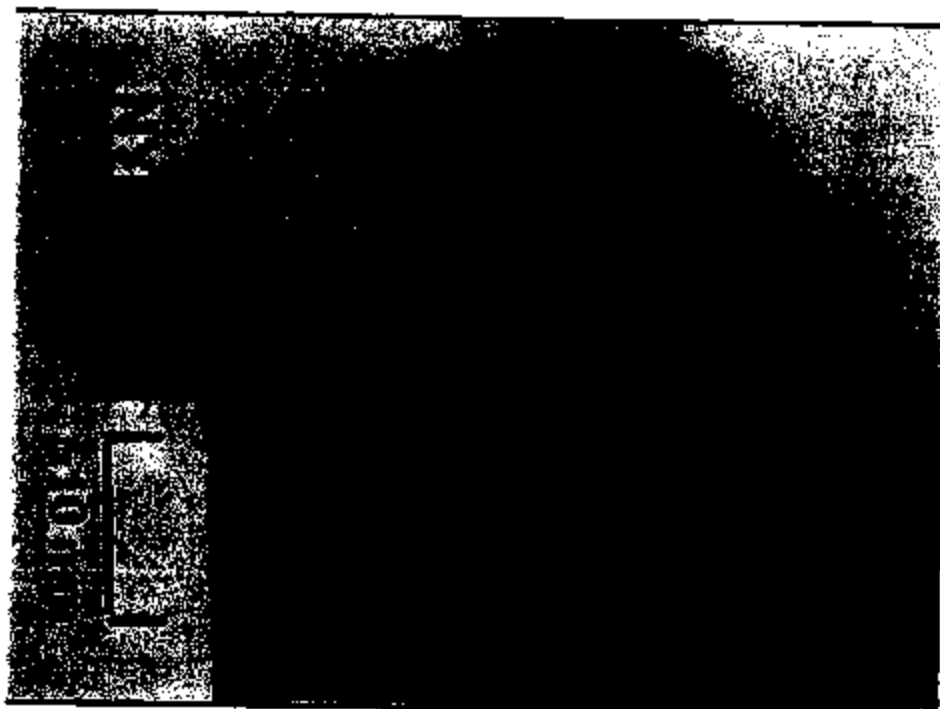


Figure 109: NY [redacted] Showing face of cup.

~2.5X

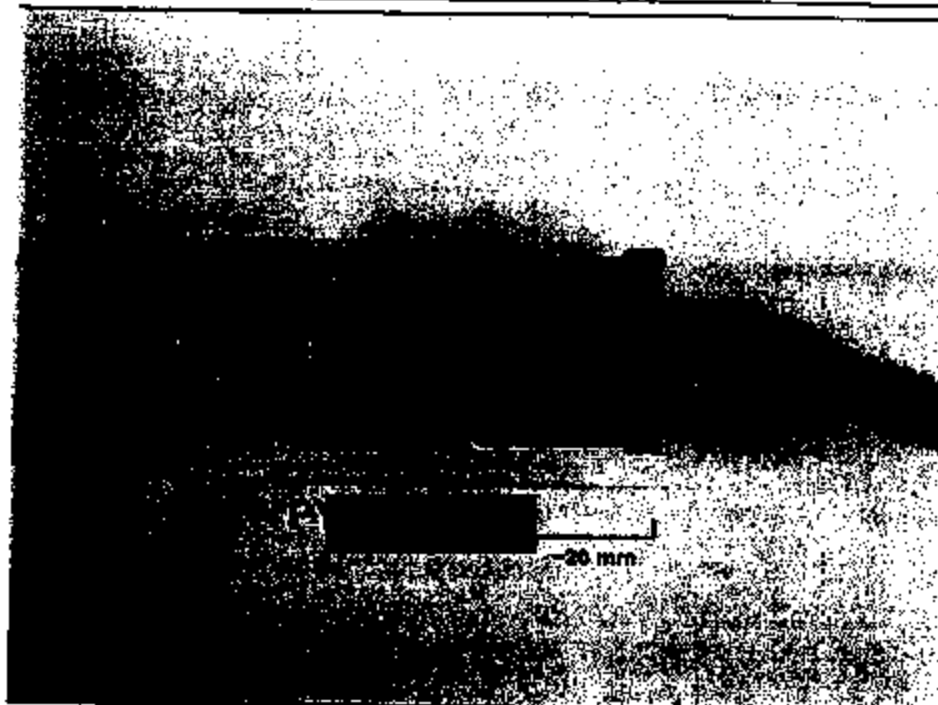


Figure 110:  Showing switch as-received.

~0.9X

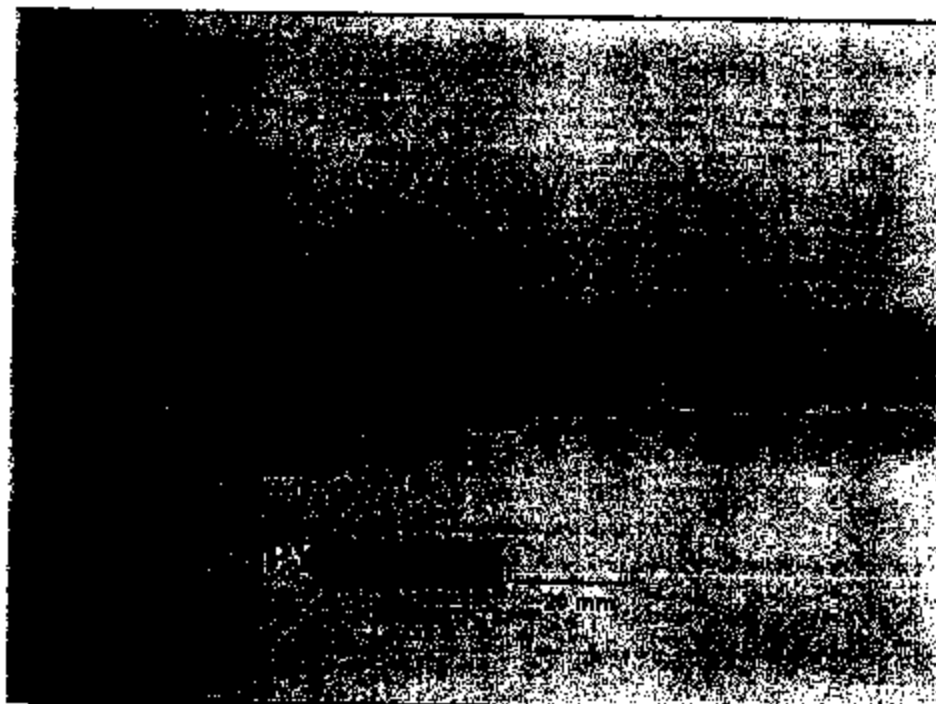
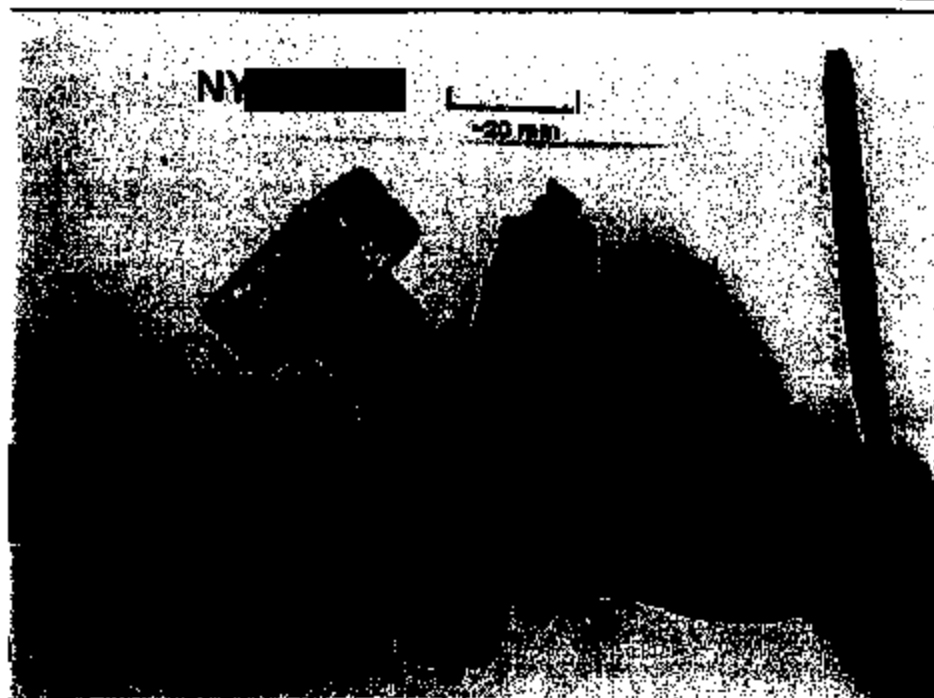


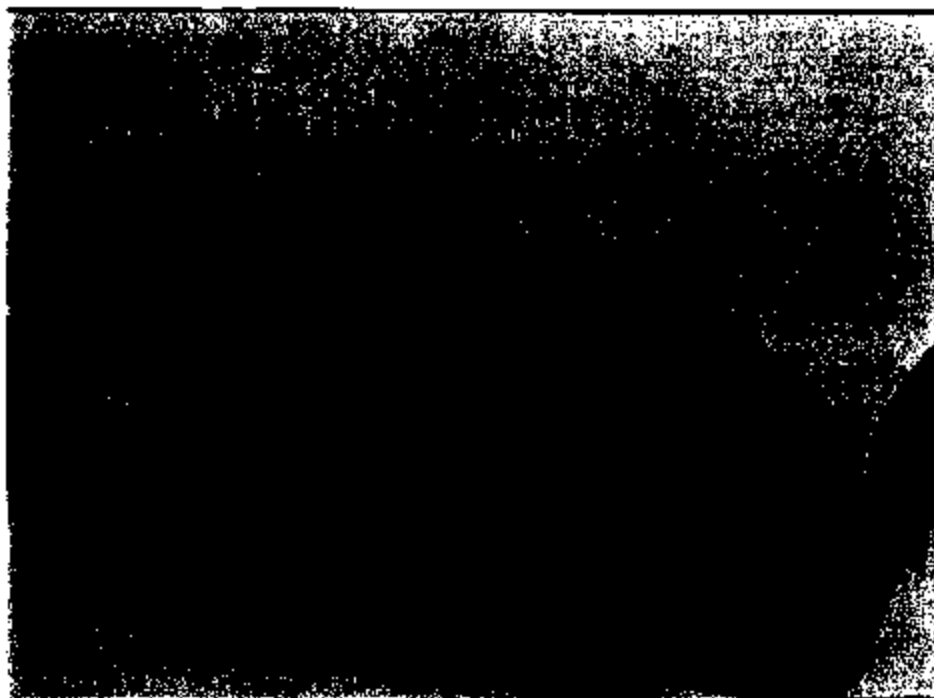
Figure 111: P1  Showing switch as-received.

~0.9X



~0.9X

Figure 112: NY [redacted] showing switch as-received.



~0.9X

Figure 113: NY [redacted] showing switch as-received.

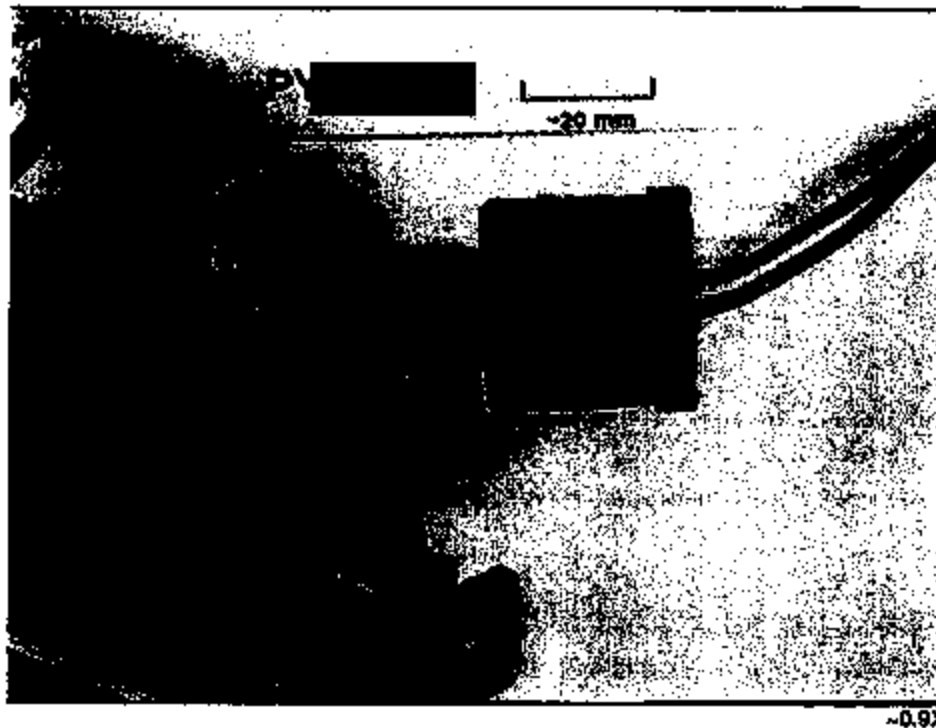


Figure 114: P[REDACTED] Showing switch as-received.

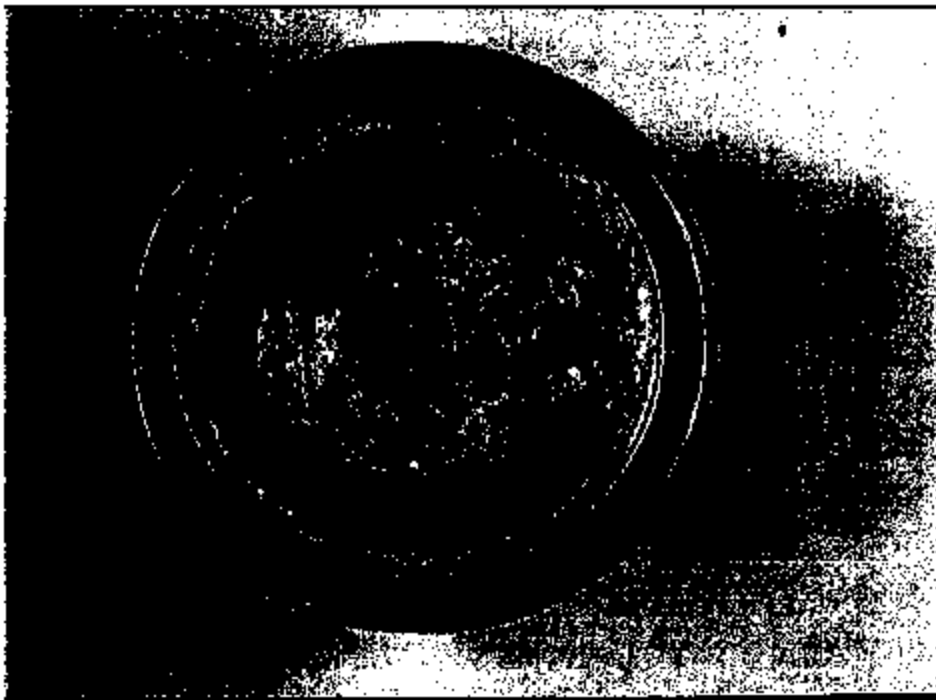


Figure 115: P[REDACTED] Showing switch as-received.



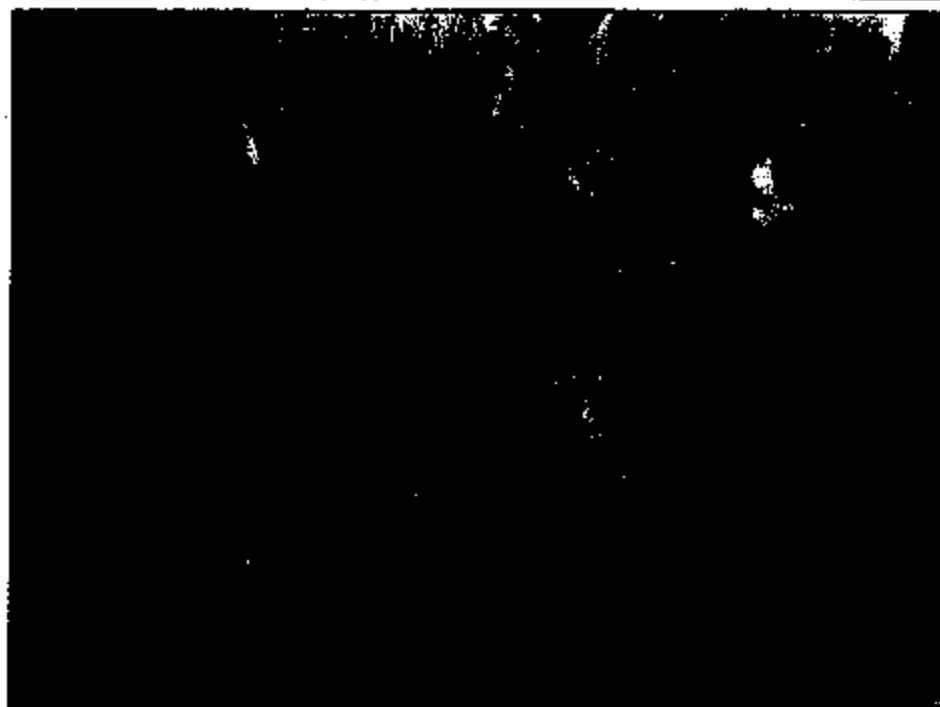
~7.5X

Figure 116: PY [redacted] Showing terminals.



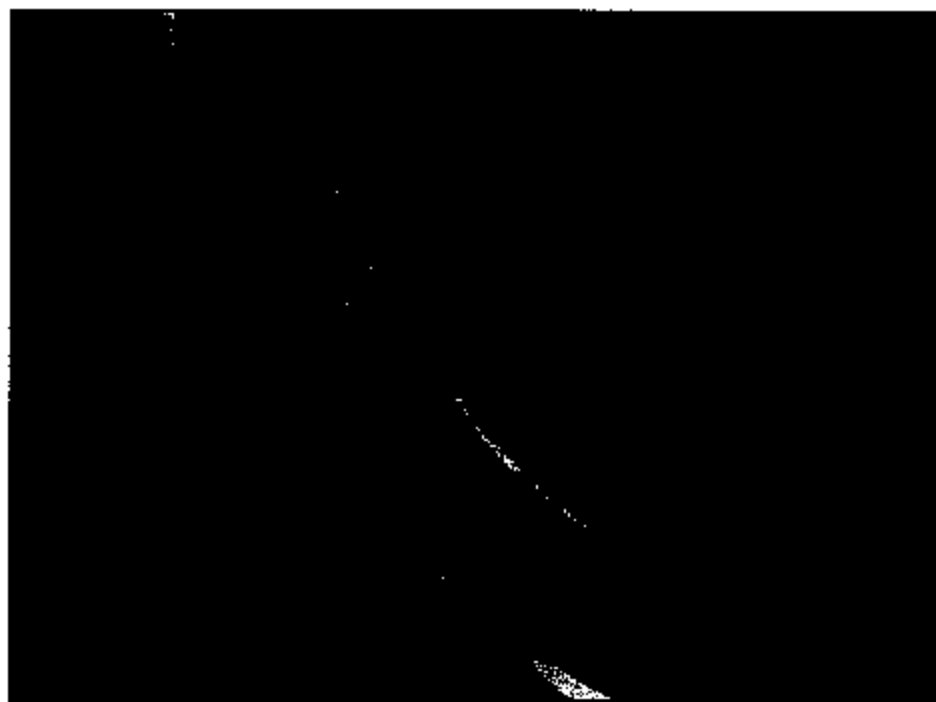
~2.8X

Figure 117: PY [redacted] Showing face of cup after crimp ring was removed



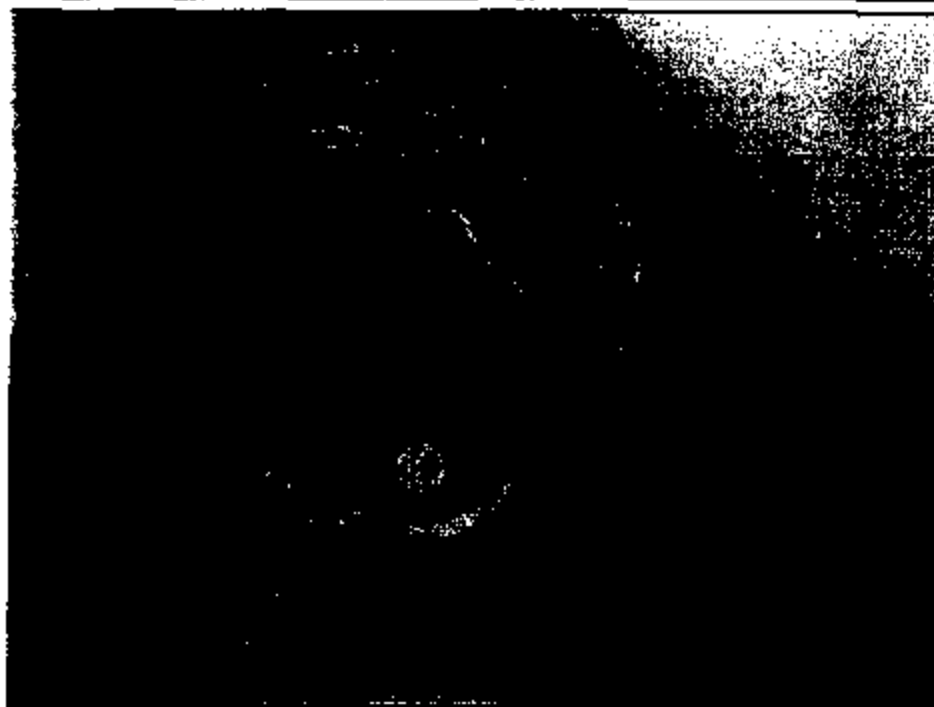
~7.5X

Figure 118: PY [redacted] Showing face of cup.



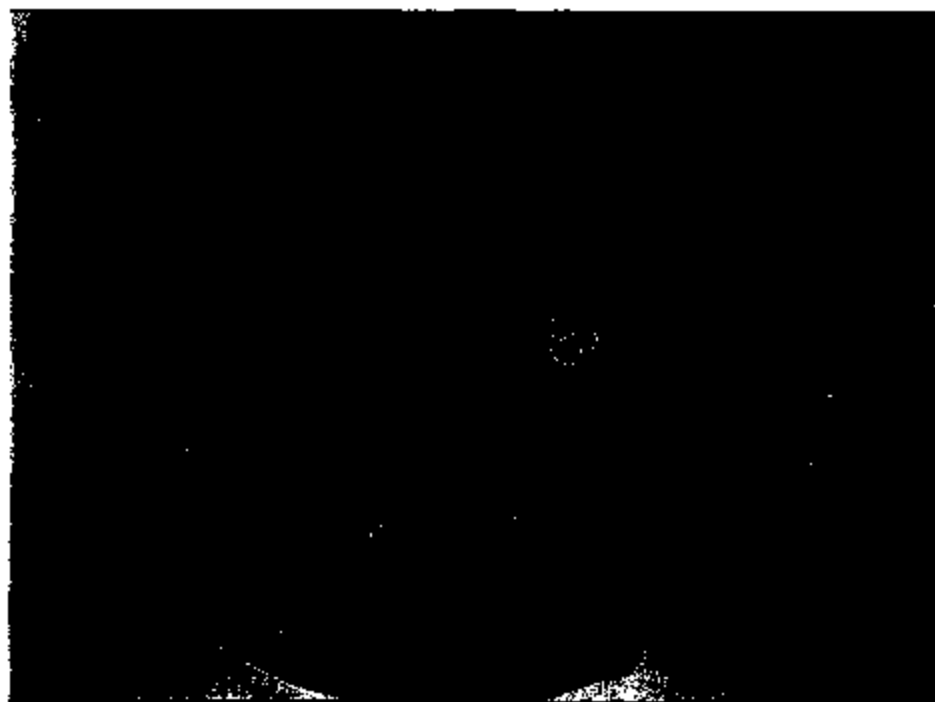
~8X

Figure 119: PY [redacted] Showing area of cup contacted by environmental seal.



~3.9X

Figure 120: PY [redacted] Showing switch cavity.



~4.1X

Figure 121: PY [redacted] Showing switch cavity.



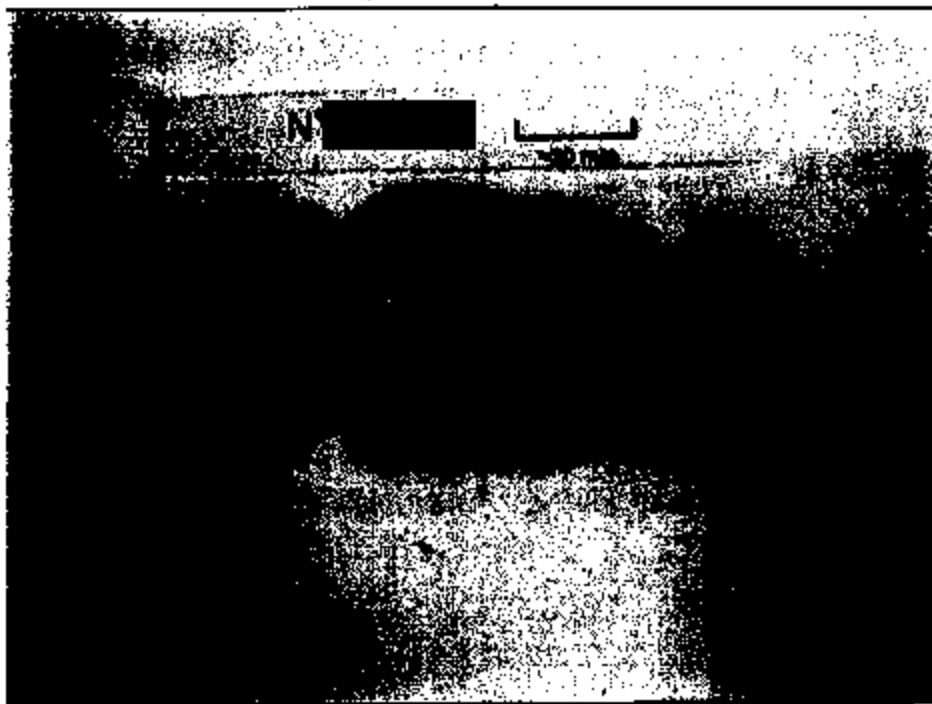
~0.9X

Figure 122: PX [redacted] Showing switch as-received.



~0.9X

Figure 123: PX [redacted] Showing switch as-received.



~0.8X

Figure 124: N1  Showing switch as-received. Note that connector is not fully engaged.



~0.8X

Figure 125: N1  Showing switch as-received.

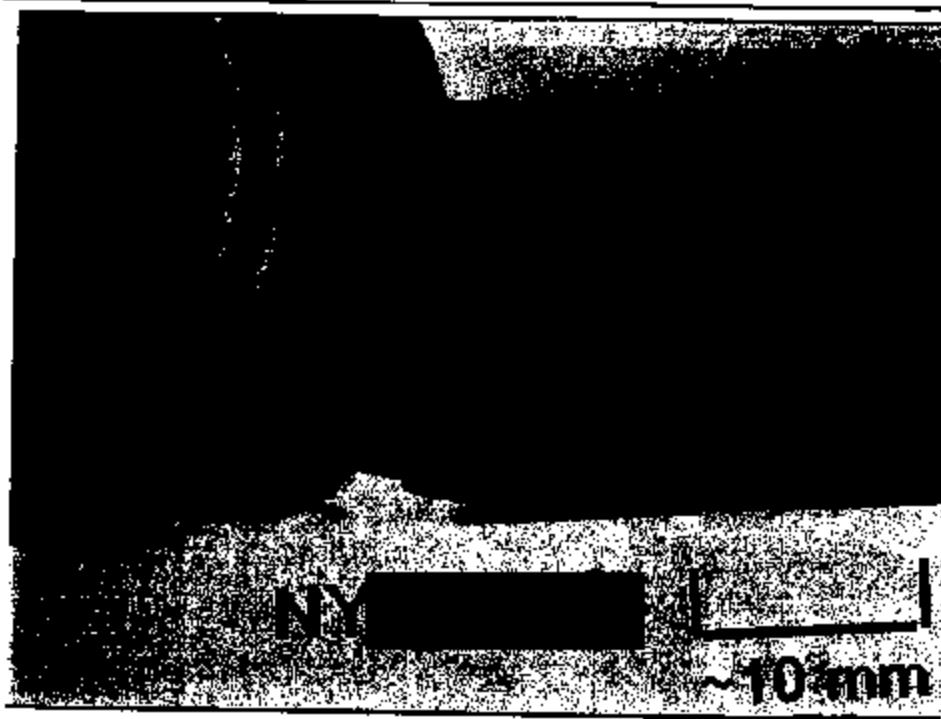
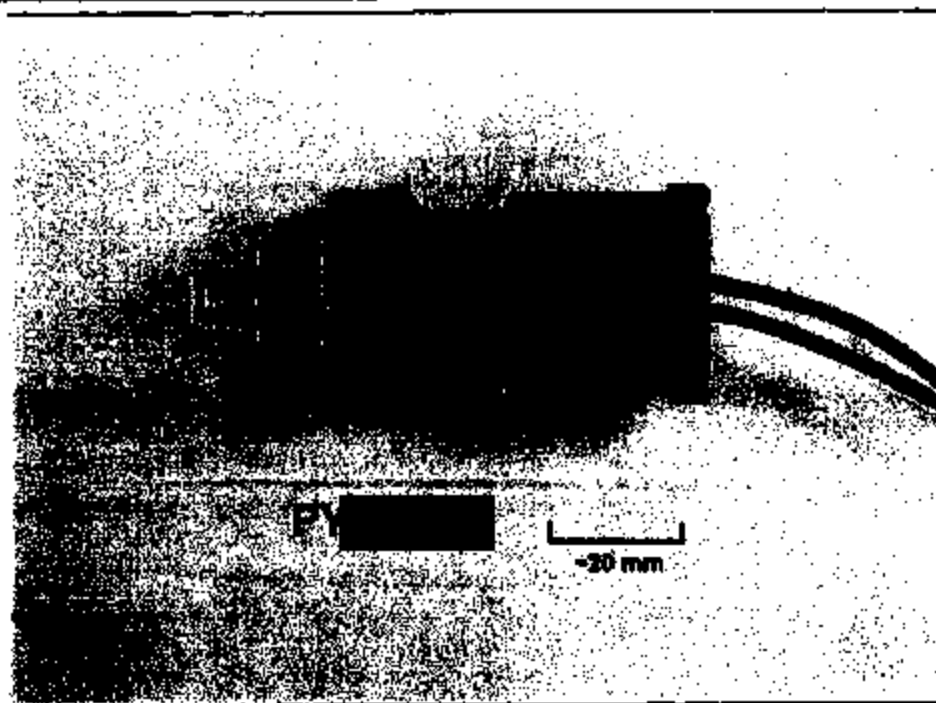
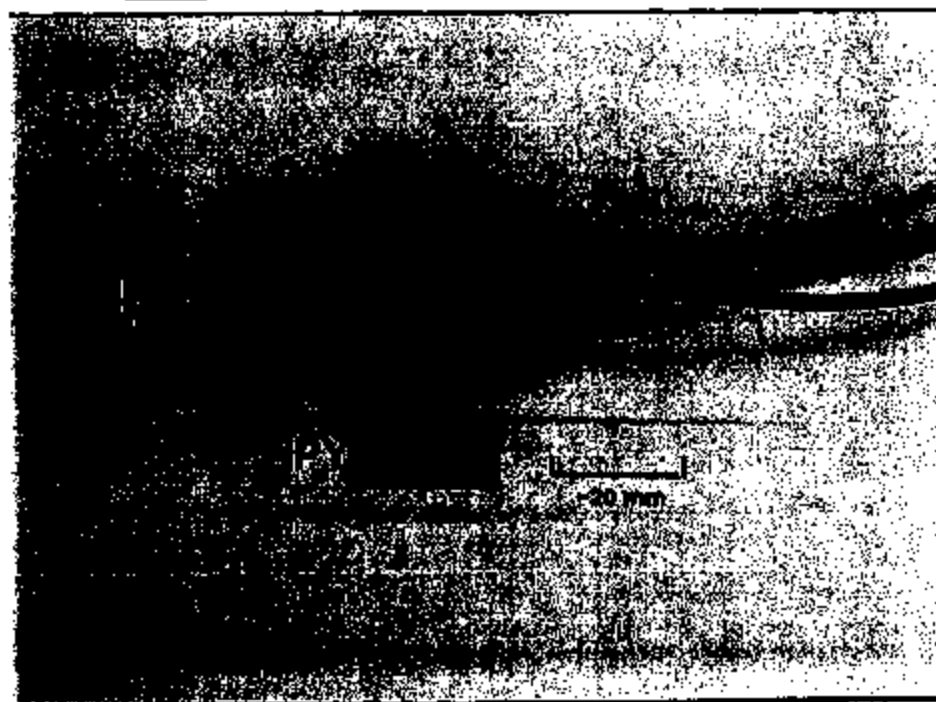


Figure 126: NY Showing tab not fully engaged.



~1X

Figure 127: PY [redacted] Showing switch as-received.



~1X

Figure 128: PY [redacted] Showing switch as-received.

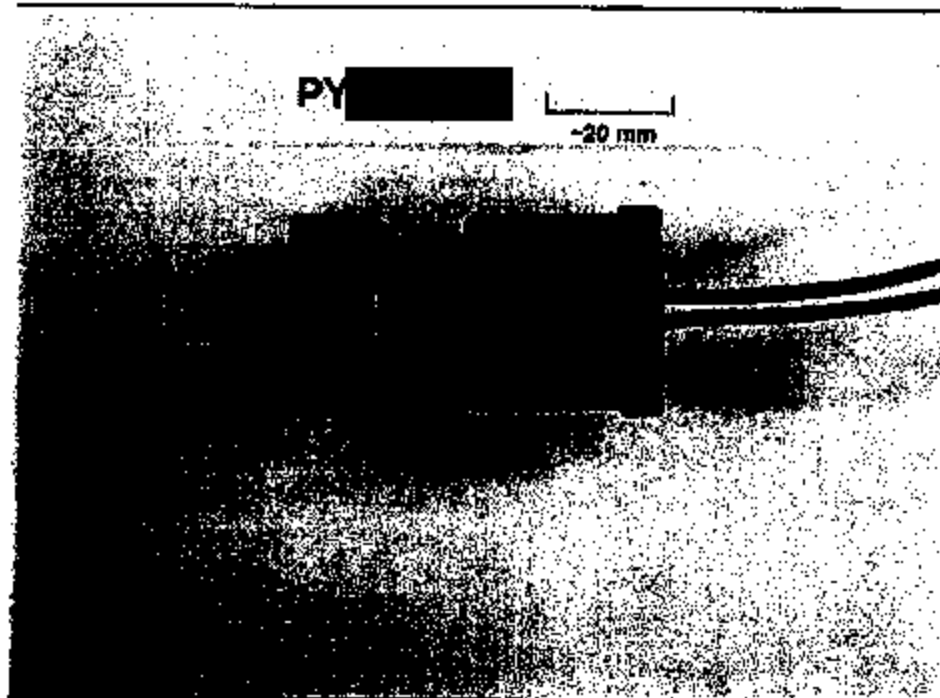


Figure 129: PY [redacted] Showing switch as-received.

~0.9X

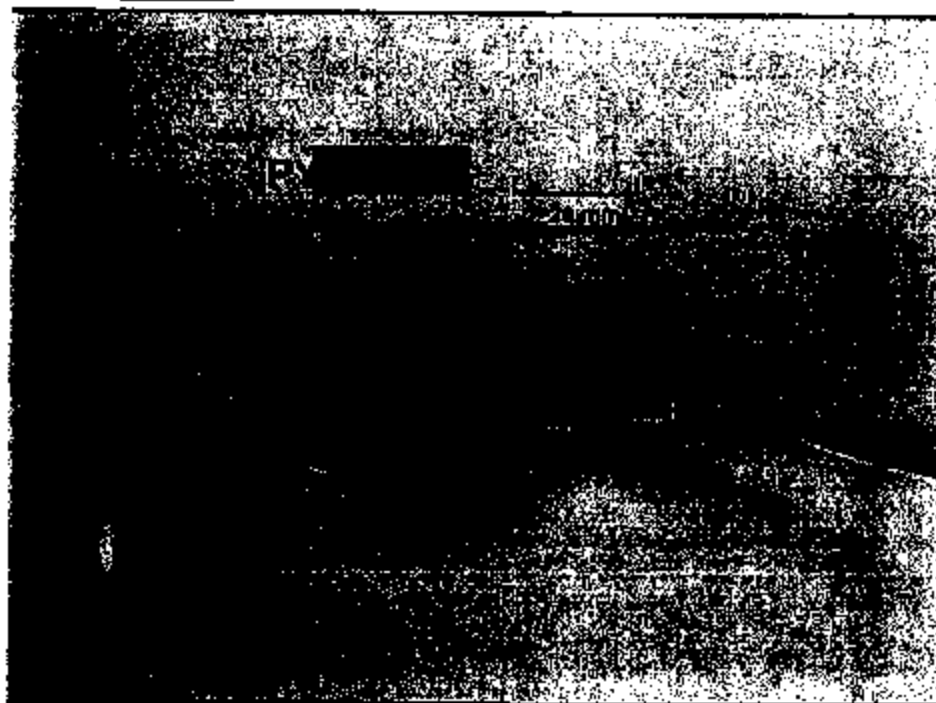


Figure 130: PY [redacted] Showing switch as-received.

~0.9X

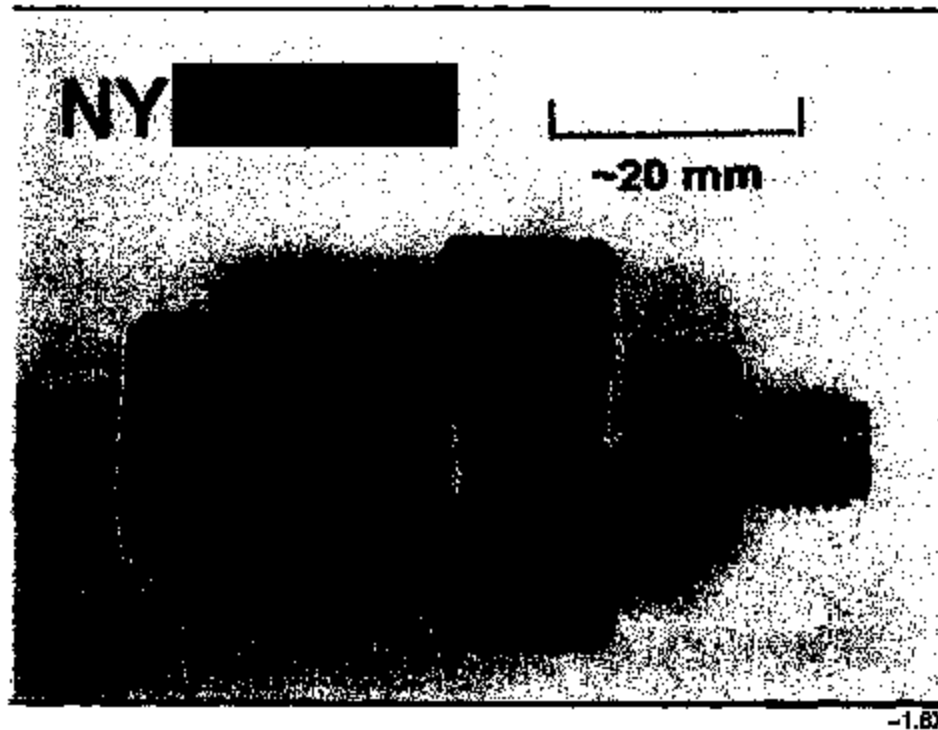
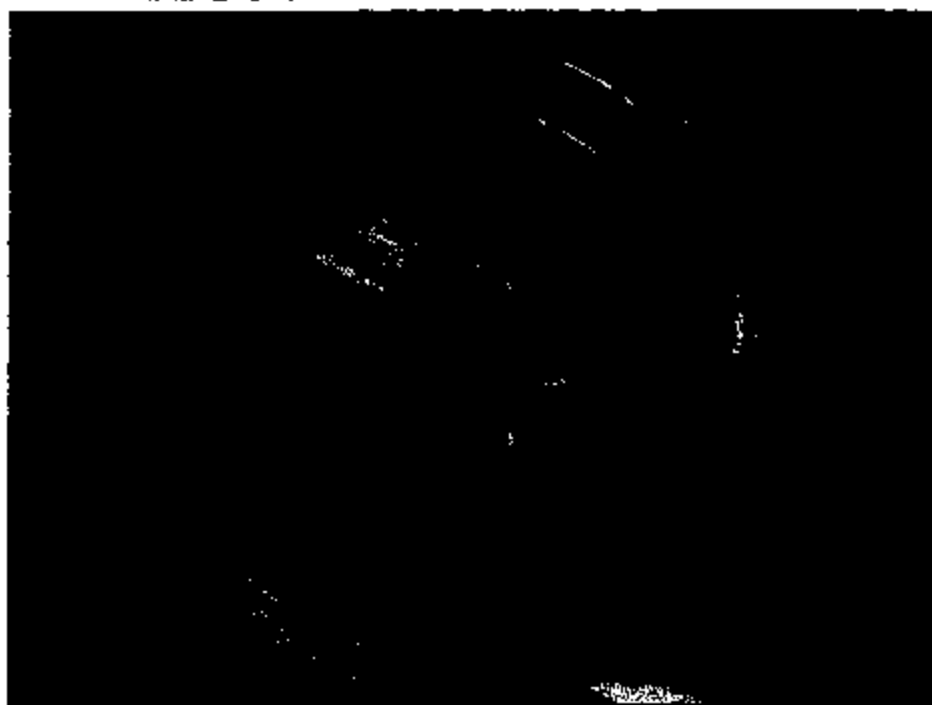


Figure 131: NY [redacted] Showing switch as received.



Figure 132: NY [redacted] Showing terminal cavity.



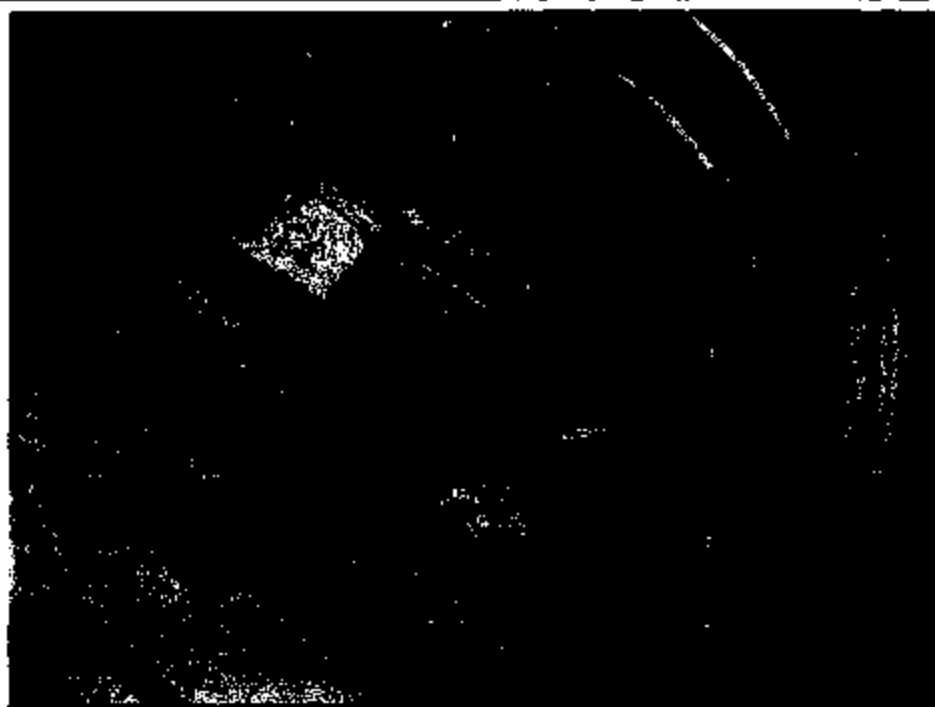
-3.5X

Figure 133: N1 [redacted] Showing switch cavity.



-4.8X

Figure 134: N1 [redacted] Showing switch cavity.



-5.7X

Figure 135: N[REDACTED] Showing switch cavity.



-3.3X

Figure 136: N[REDACTED] Showing face of cup.

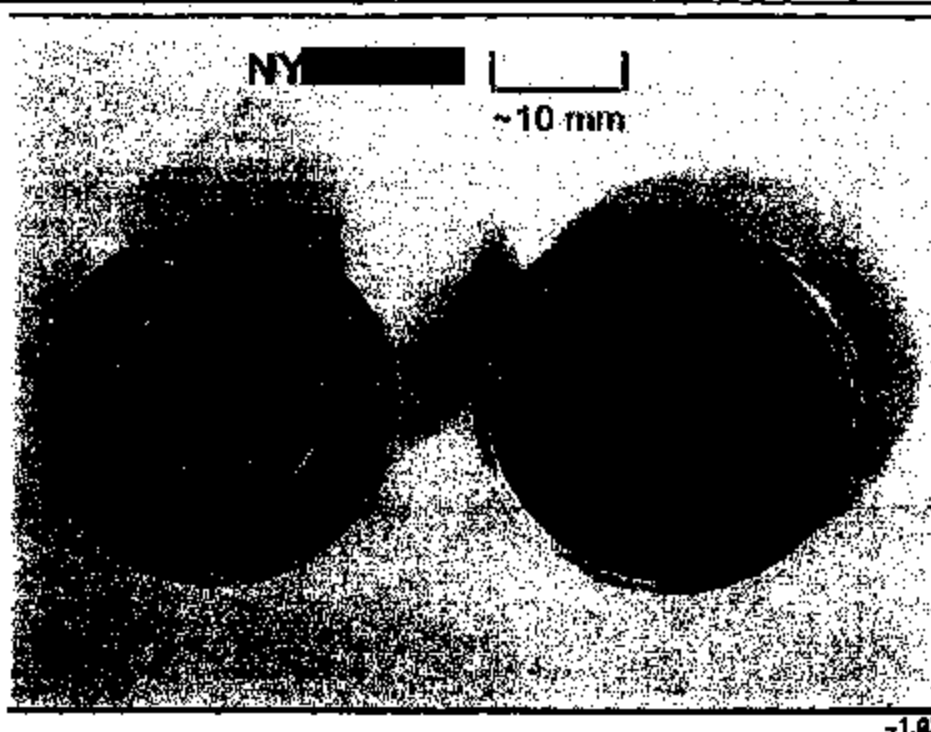


Figure 137: NY [redacted] Showing hexaport cavity and Kapton seals in place over converter and washer.

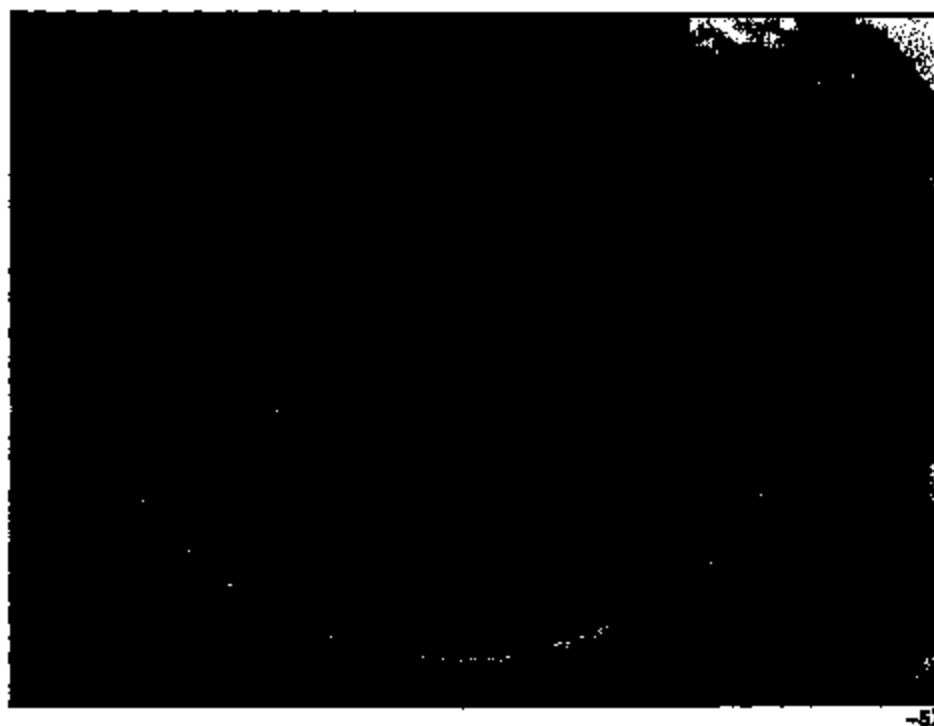
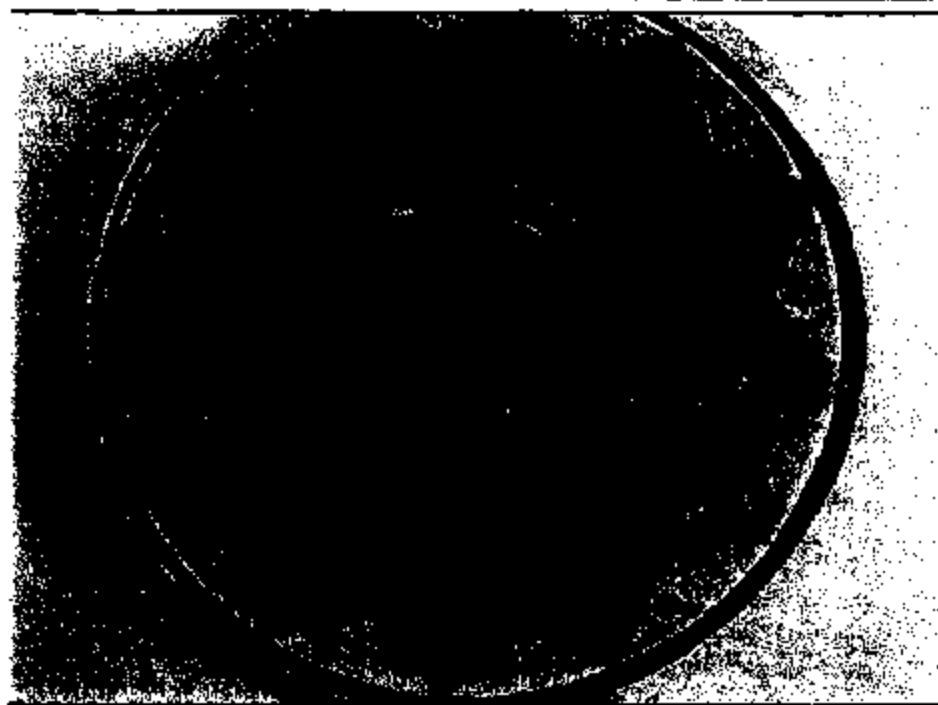
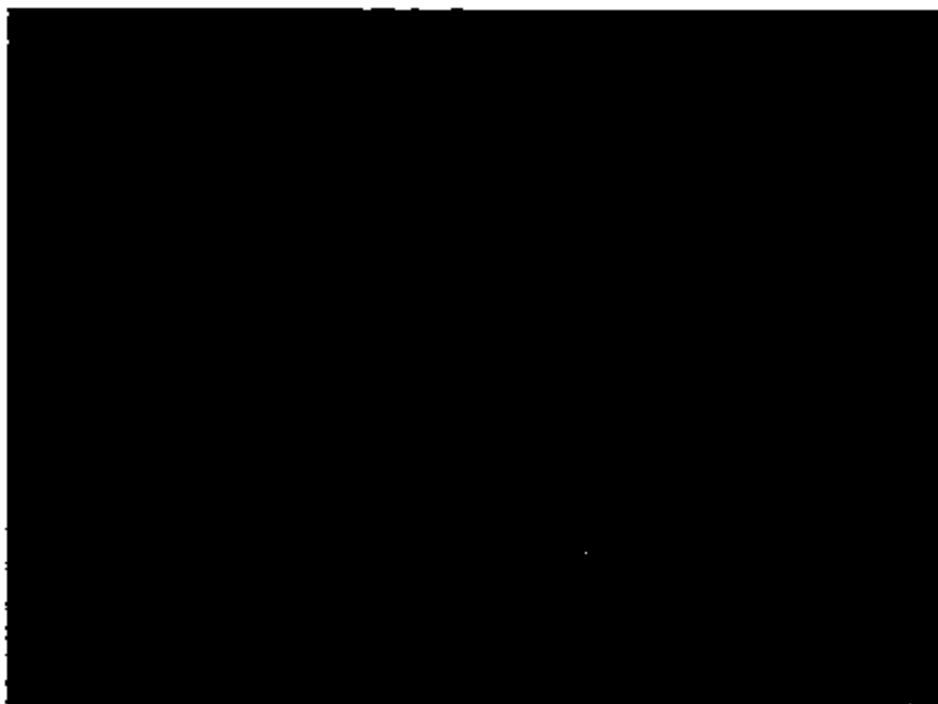


Figure 138: NY [redacted] Showing hexaport cavity.



-3.6X

Figure 139: N [REDACTED] Showing Kapton seals in place.



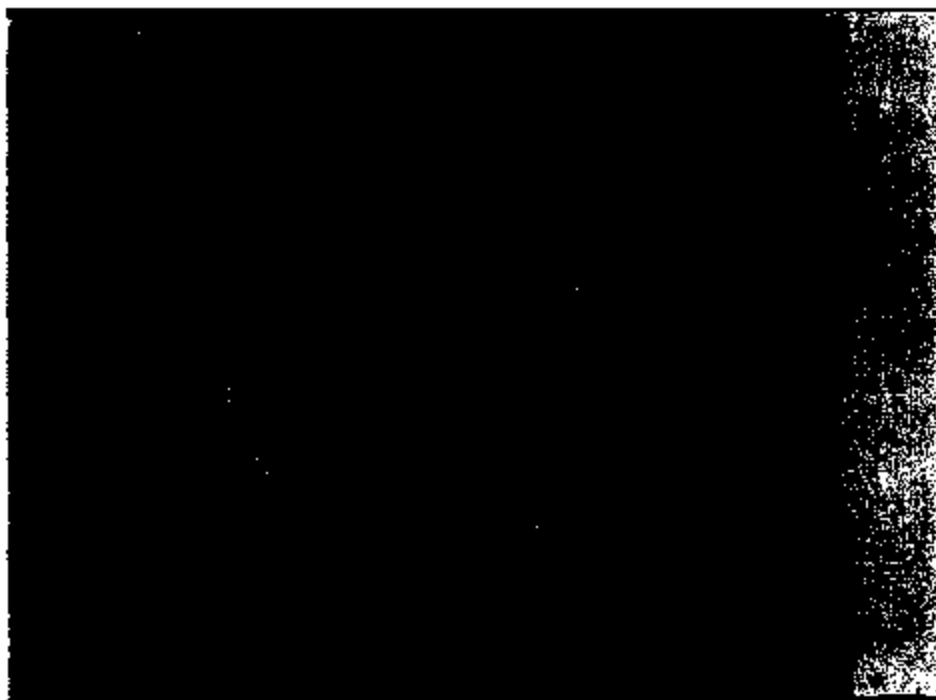
-4.7X

Figure 140: NY [REDACTED] Showing Kapton seal that was adjacent hexport.



-6.6X

Figure 141: N[REDACTED] Showing damage to Kapton seal shown in Figure 140.



-6X

Figure 142: N[REDACTED] Showing opposite side of seal shown in Figure 140.



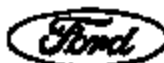
~8.2X

Figure 143: NY [redacted] Showing seal adjacent to hexport.



~5.2X

Figure 144: NY [redacted] Showing opposite side of middle seal.



-5X

Figure 145: N[REDACTED] Showing opposite side of middle seal.



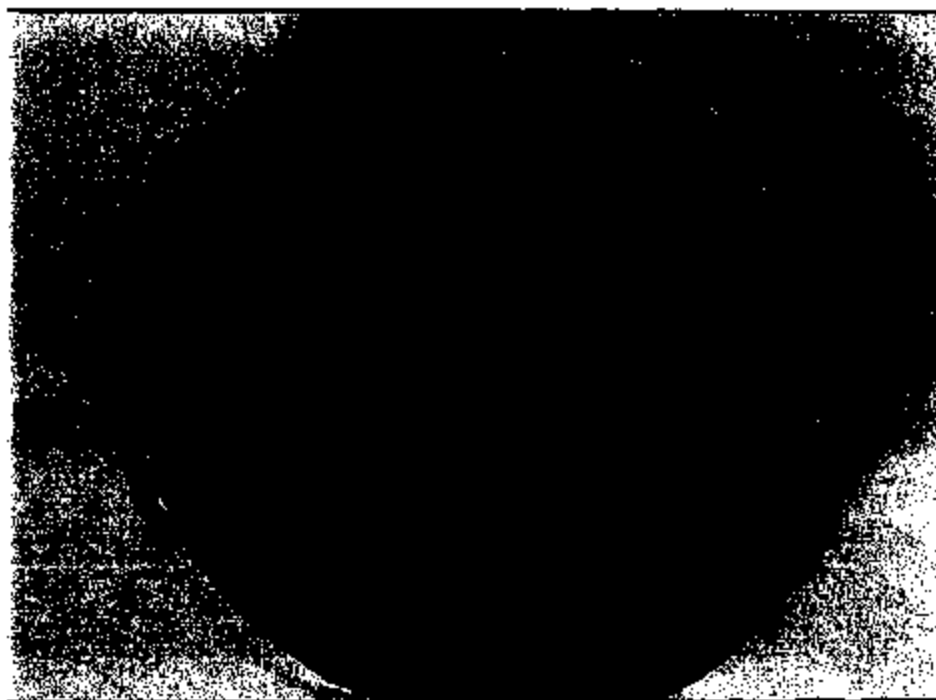
-5.1X

Figure 146: N[REDACTED] Showing seal adjacent converter and washer.



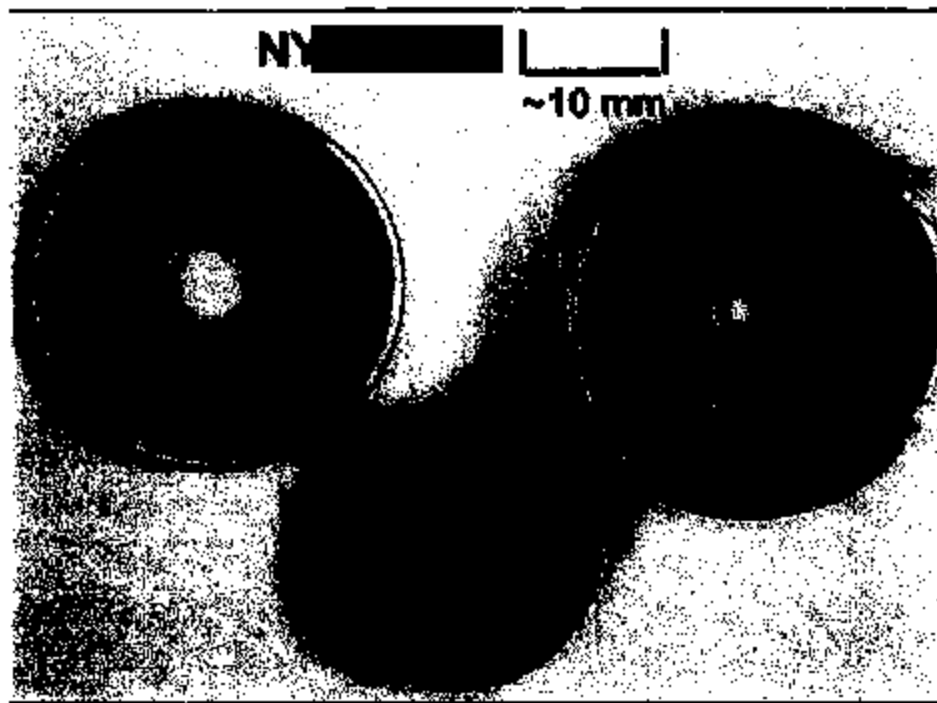
-8.9X

Figure 147: N[REDACTED] Showing opposite side of seal adjacent to converter and washer.



-9.5X

Figure 148: N[REDACTED] Showing washer and converter.



-2X

Figure 149: NY [redacted] Showing washer, converter, and interior of cup.

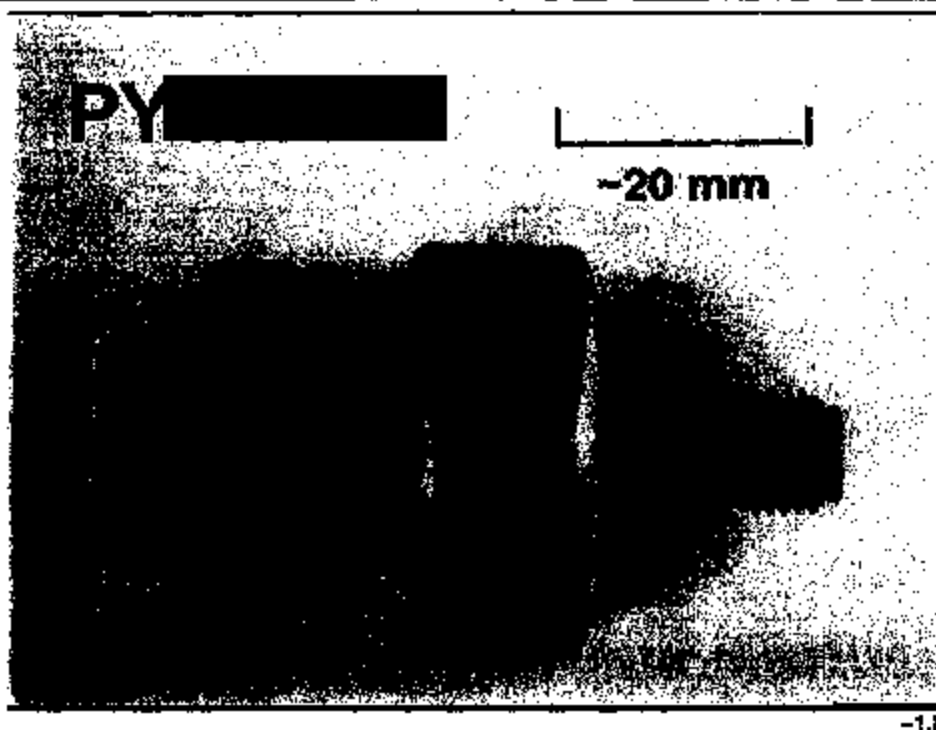
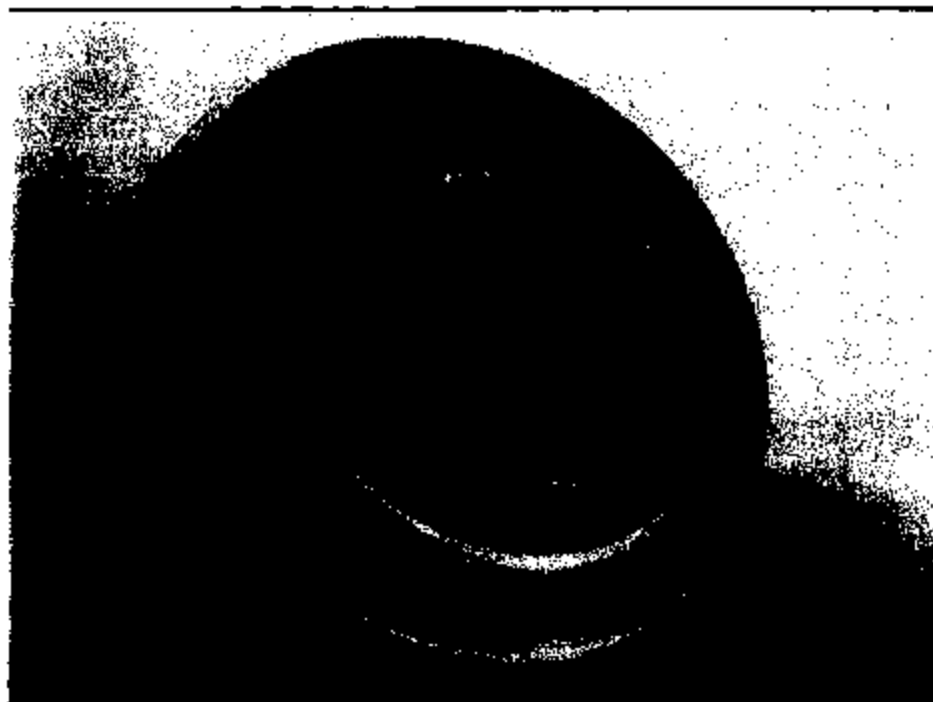


Figure 150: PY [redacted] Showing switch as-received.

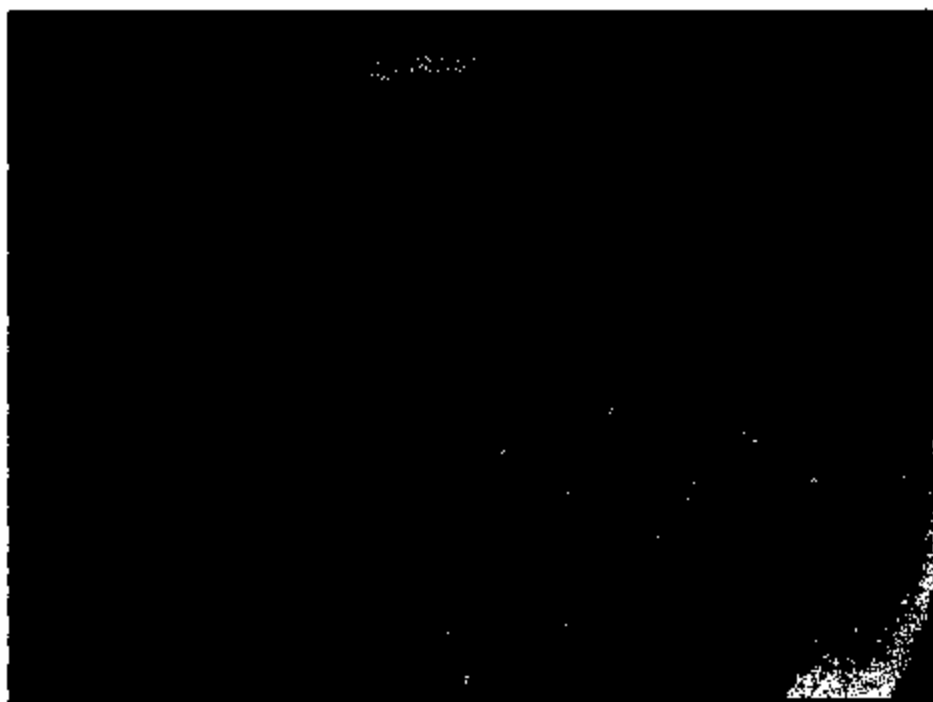


Figure 151: PY [redacted] Showing terminal cavity.



~5X

Figure 152: P [redacted] Showing face of cup.



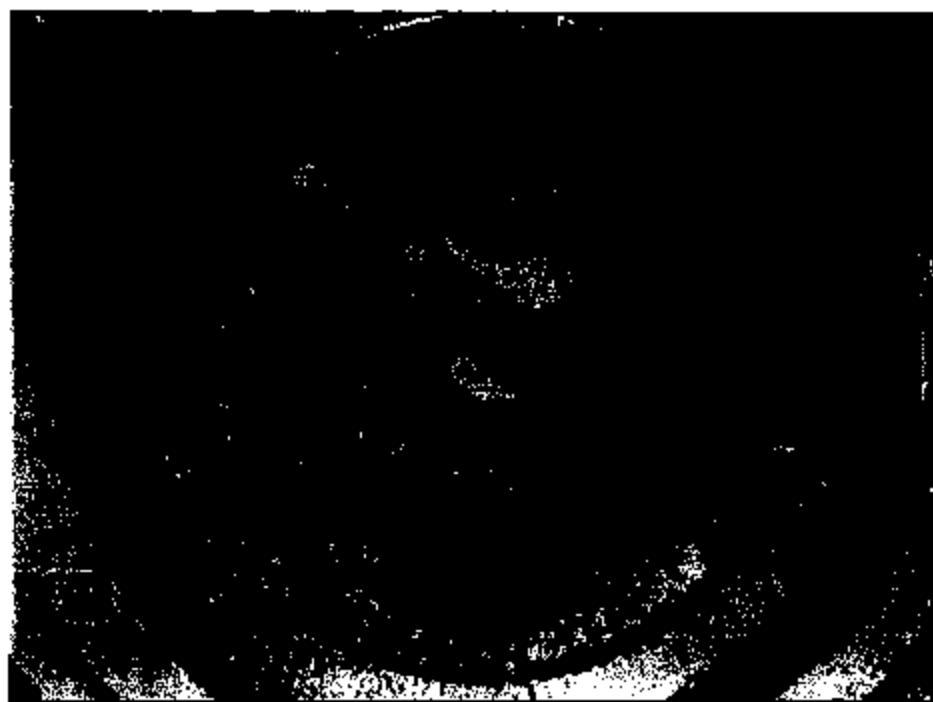
~4X

Figure 153: P [redacted] Showing close up of face of cup.



-2.9X

Figure 154: P[REDACTED] Showing switch cavity.



-5.5X

Figure 155: P[REDACTED] Showing switch cavity.

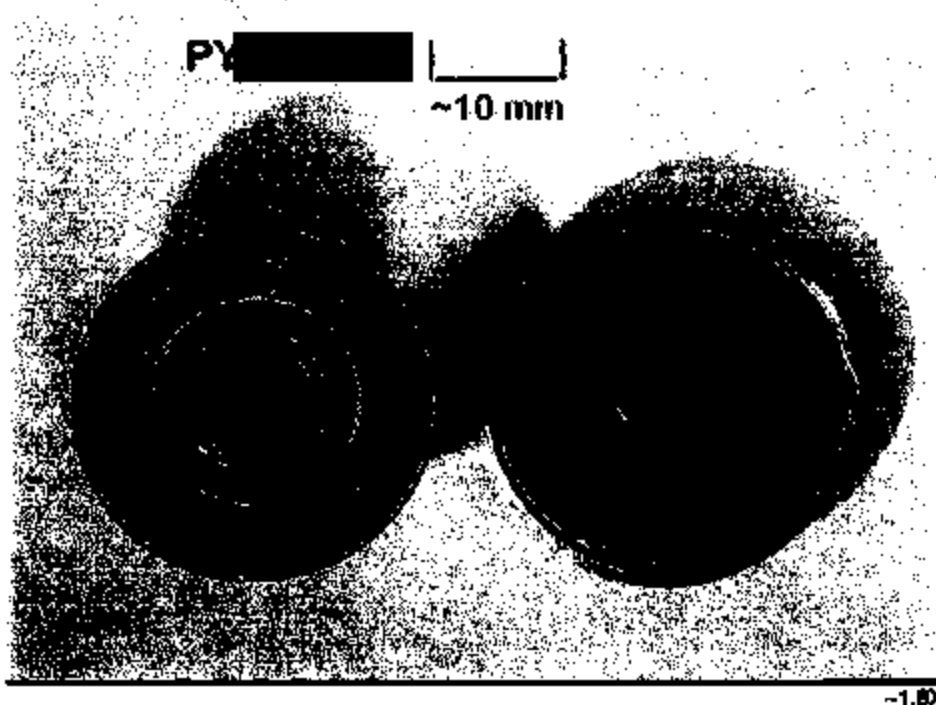


Figure 156: PY [redacted] Showing hexaport cavity and Kapton seals in place on converter and washer.

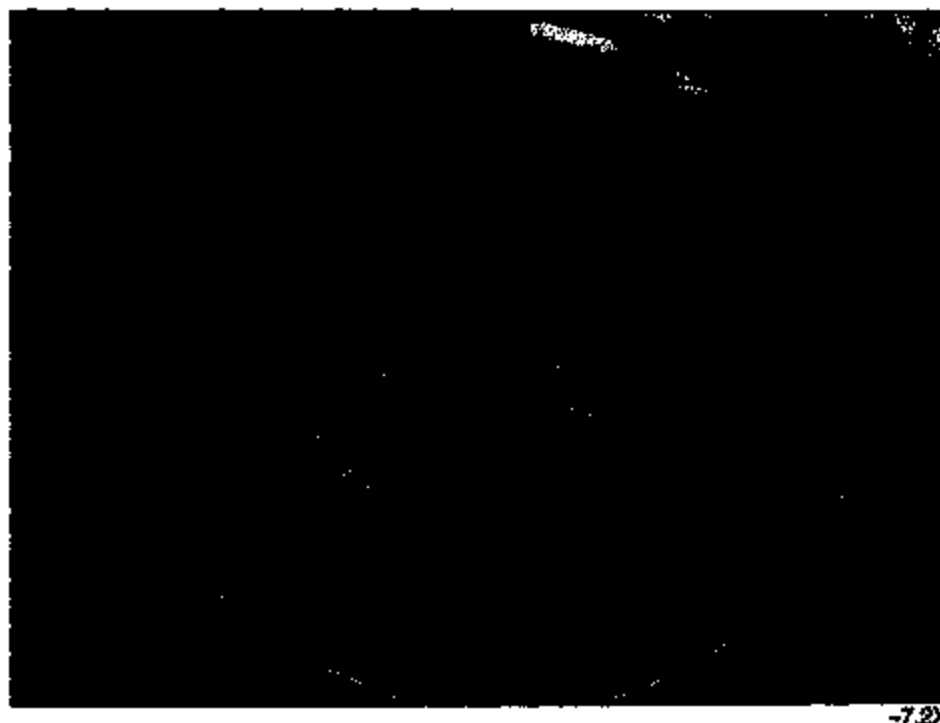


Figure 157: PY [redacted] Showing hexaport cavity.



-3.8X

Figure 158: PV [redacted] Showing Kapton seals in place.



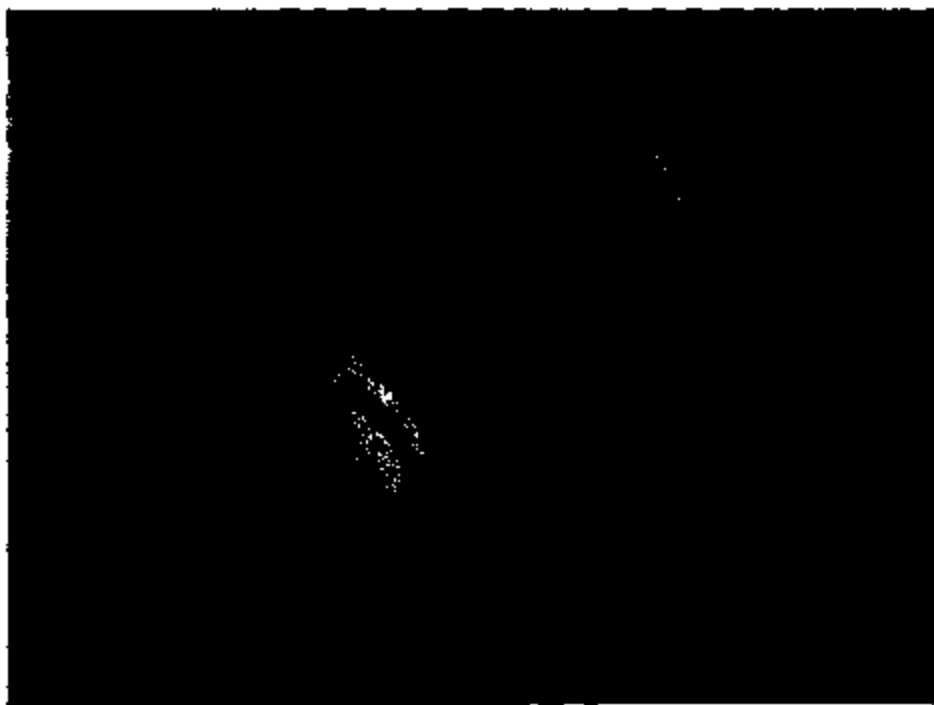
-6.7X

Figure 159: PV [redacted] Showing Kapton seal adjacent hexport.



~7.1X

Figure 180: P[REDACTED] Showing opposite side of seal shown in Figure 159.



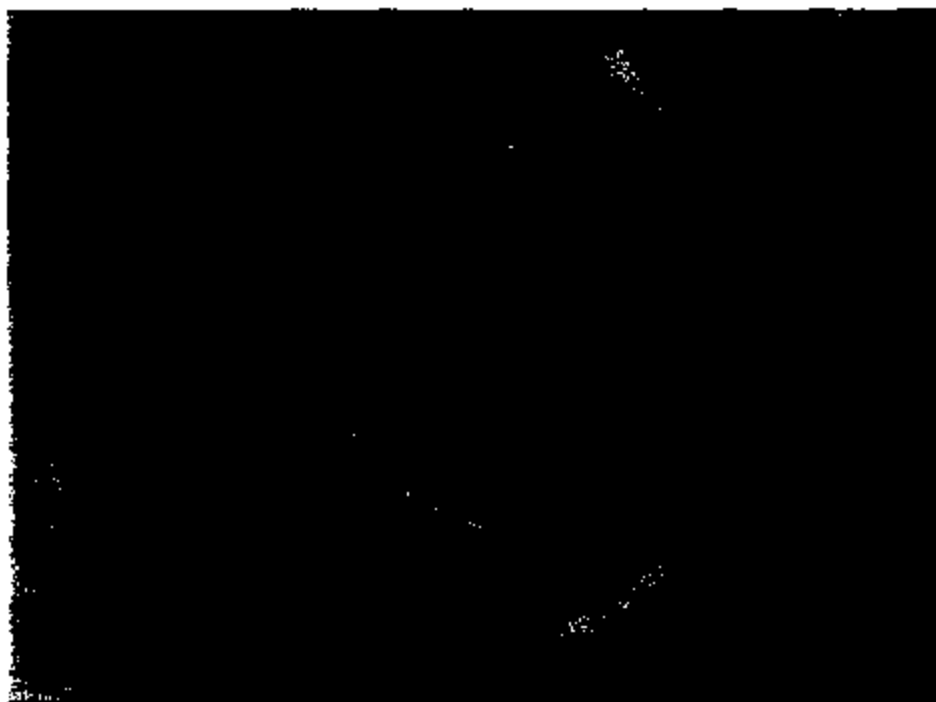
~6.6X

Figure 181: P[REDACTED] Showing middle Kapton seal.



-6.8X

Figure 162: PY [redacted] Showing opposite side of seal shown in Figure 161.



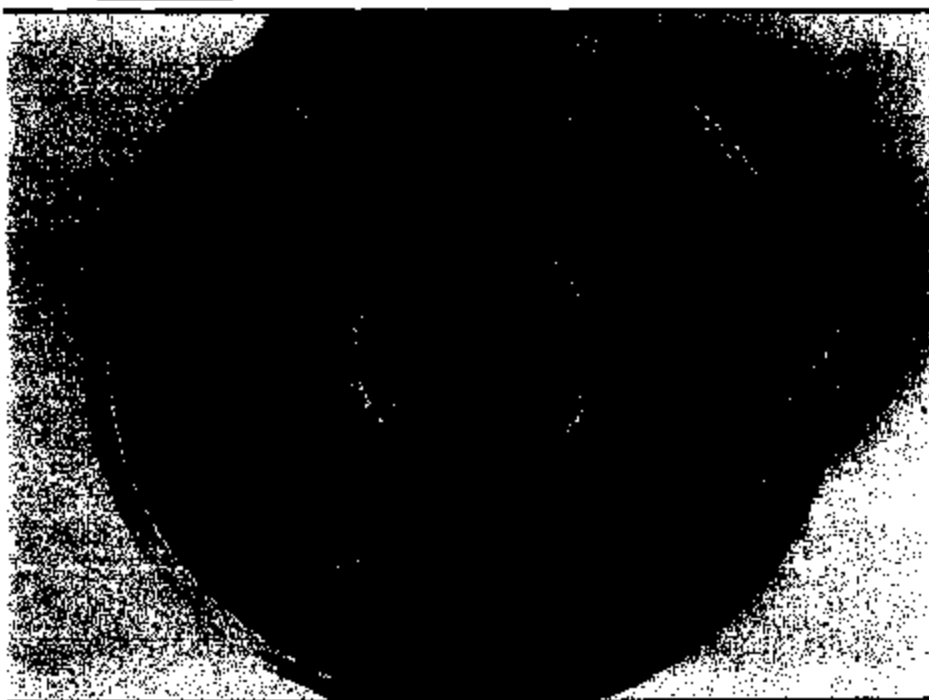
-6.3X

Figure 163: PY [redacted] Showing Kapton seal adjacent converter and washer.



-8.3X

Figure 164: P [redacted] showing opposite side of seal shown in Figure 163.



-3.6X

Figure 165: P [redacted] showing converter and washer

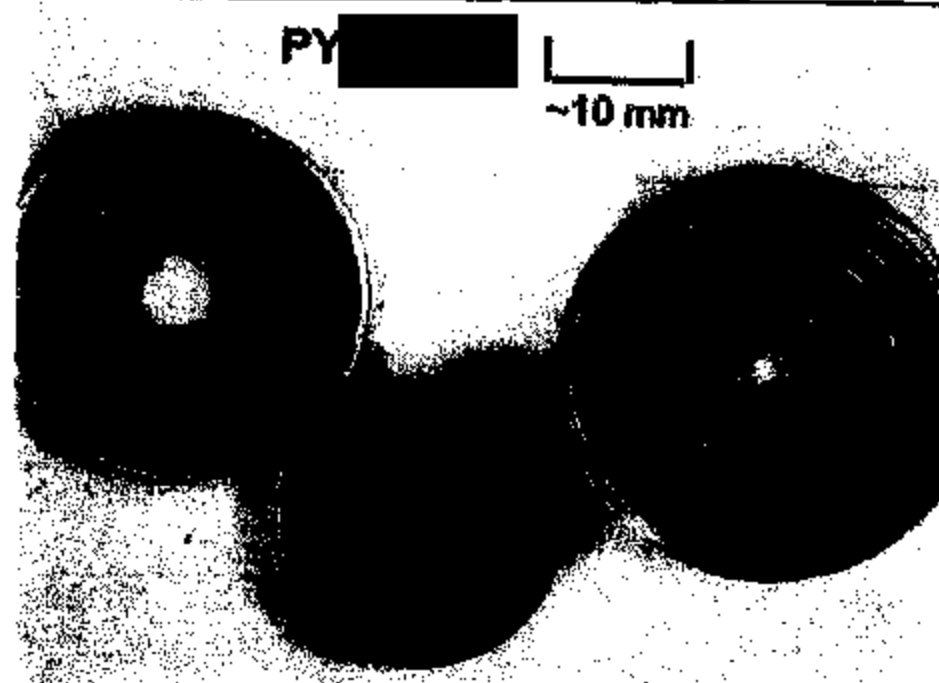


Figure 168: P [redacted] Showing washer, converter, and interior of cup.

-2X

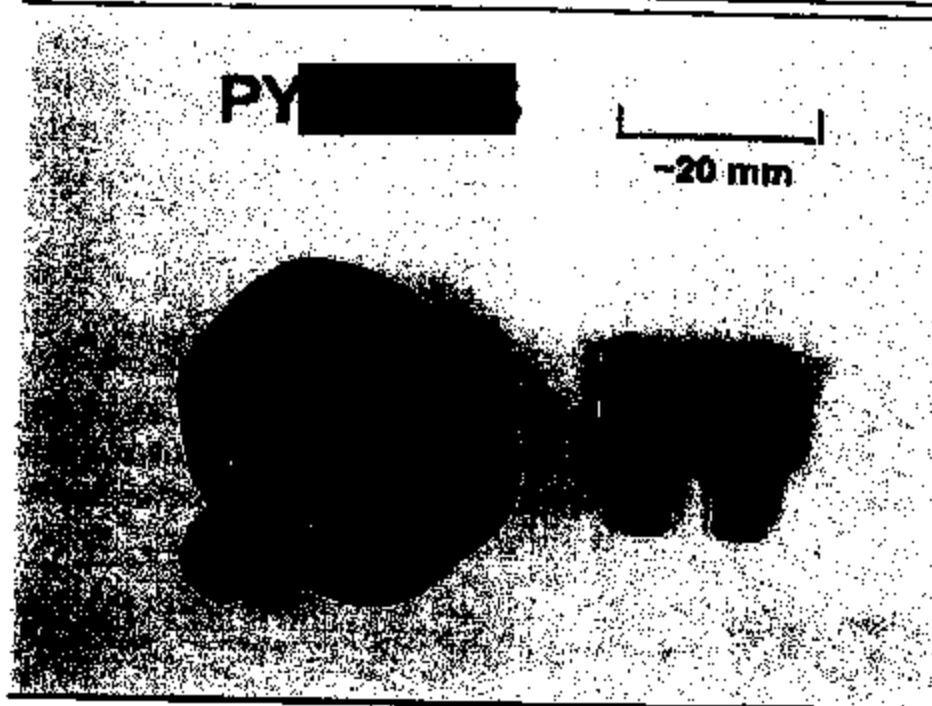


Figure 167: PY [redacted] Showing switch and fuse as-received.

-1.5X

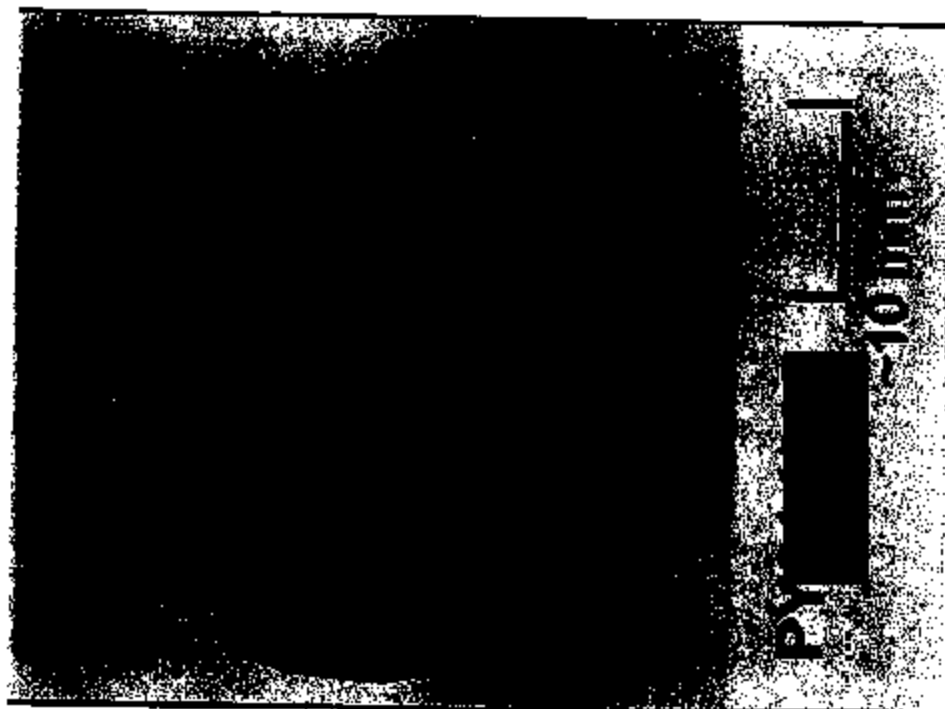


Figure 168: PY [redacted] Showing face of cup.

-2.6X

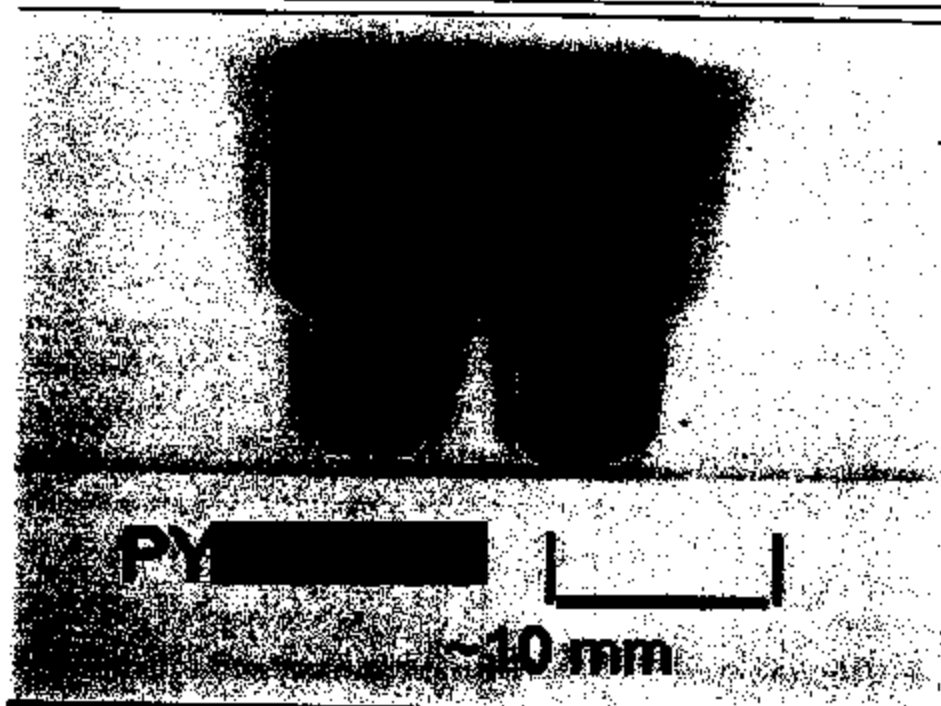


Figure 169: PY Showing fuse. Note that fuse has blown.

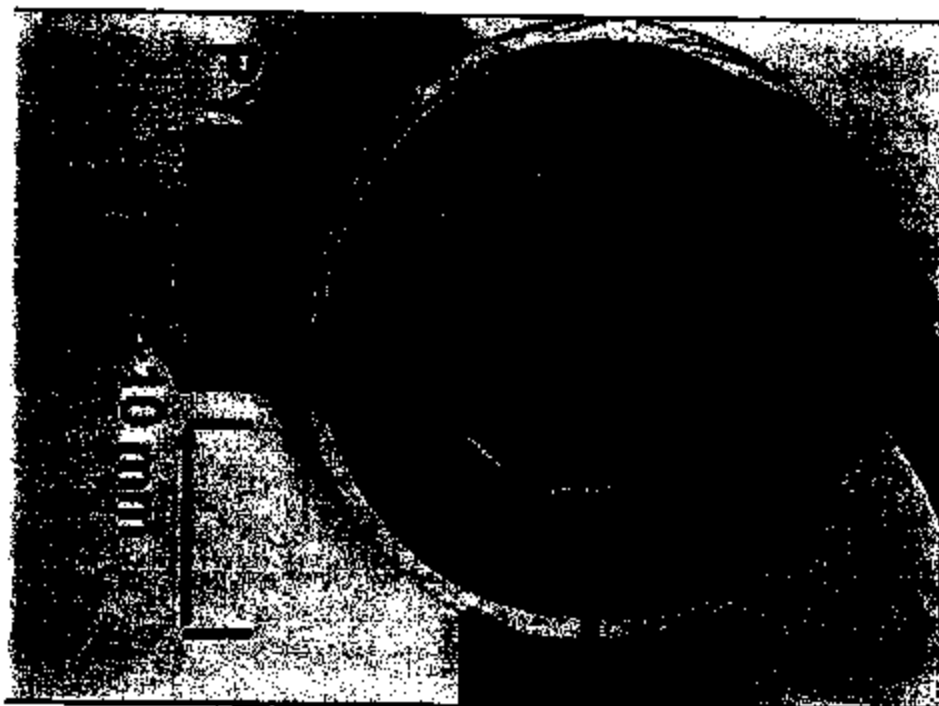


Figure 170: P Showing hexaport cavity.

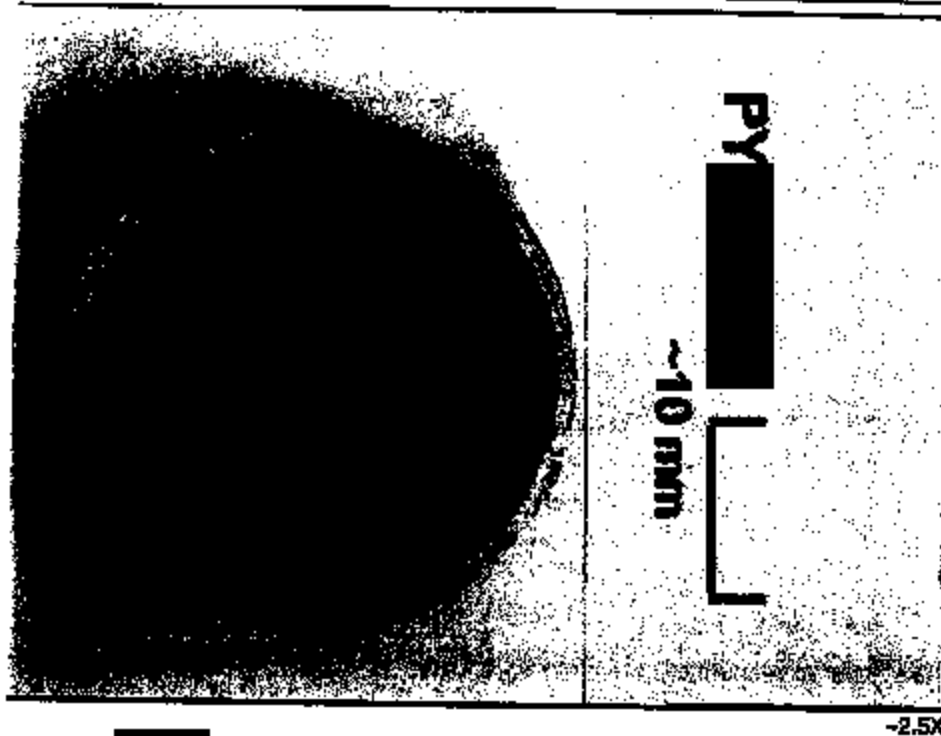


Figure 171: PY [redacted] Showing washer and converter.



Figure 172: PY [redacted] Showing remnants of Kapton seals.

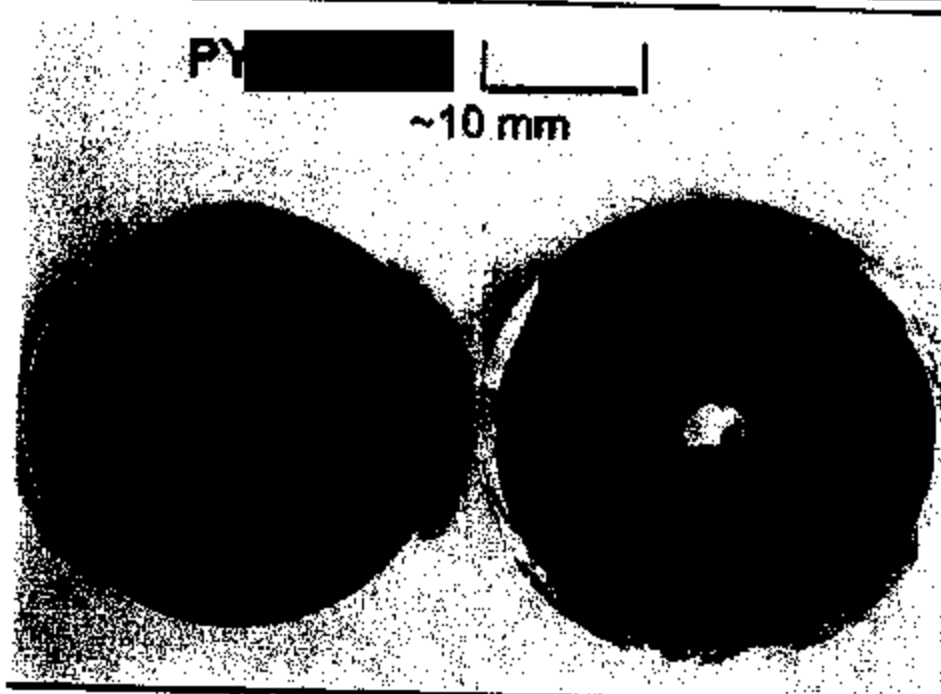


Figure 173: PY [redacted] Showing converter and interior of cup.

-24X

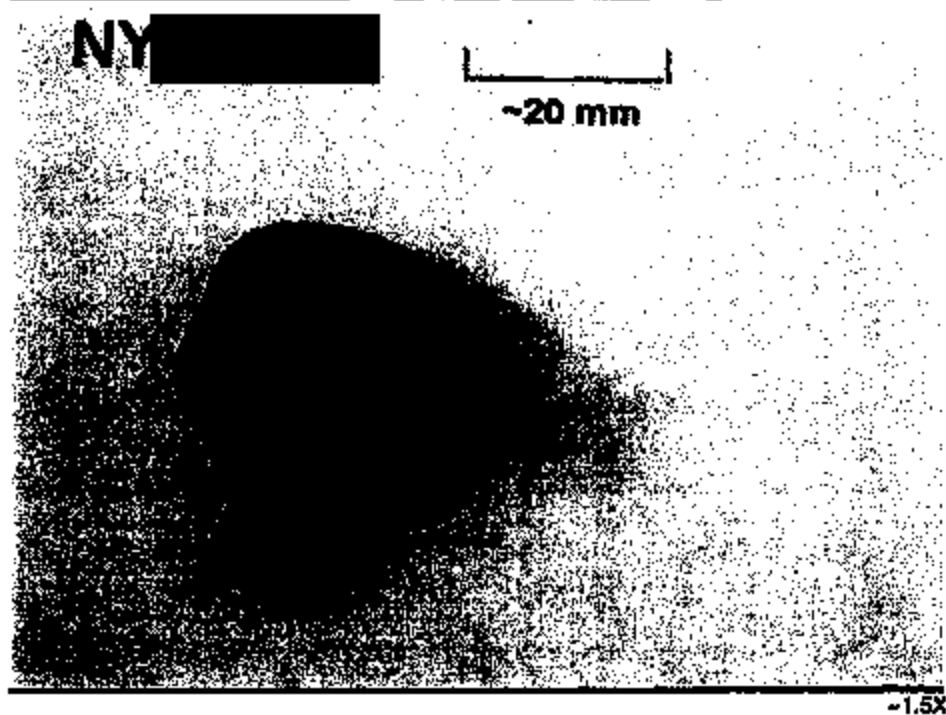


Figure 174: NY showing switch as-received.



Figure 175: PY showing face of cup.

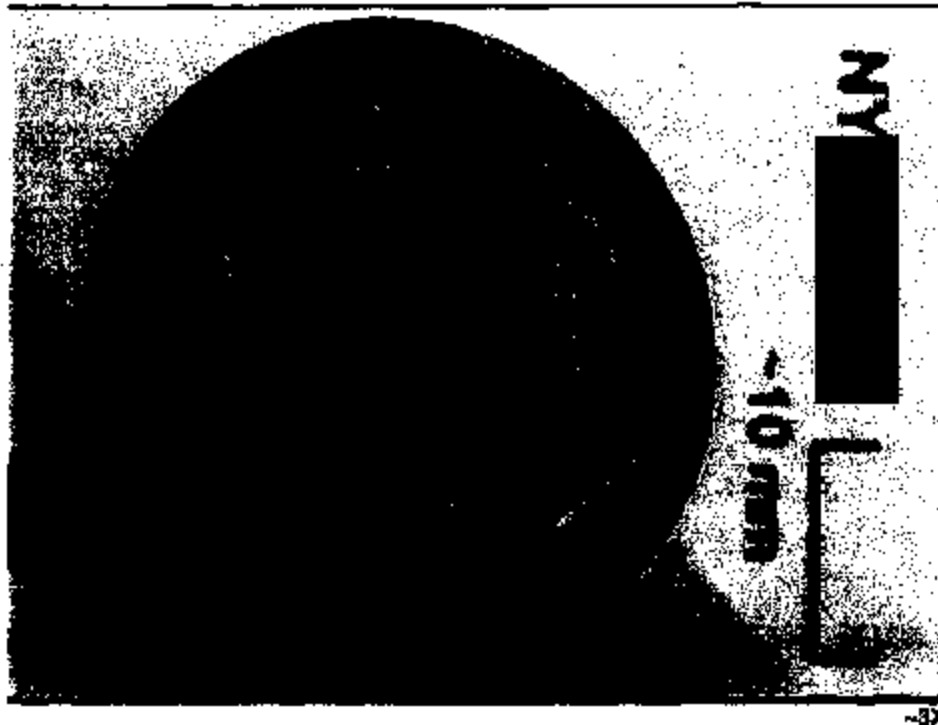


Figure 176: N [redacted] Showing hexaport cavity.

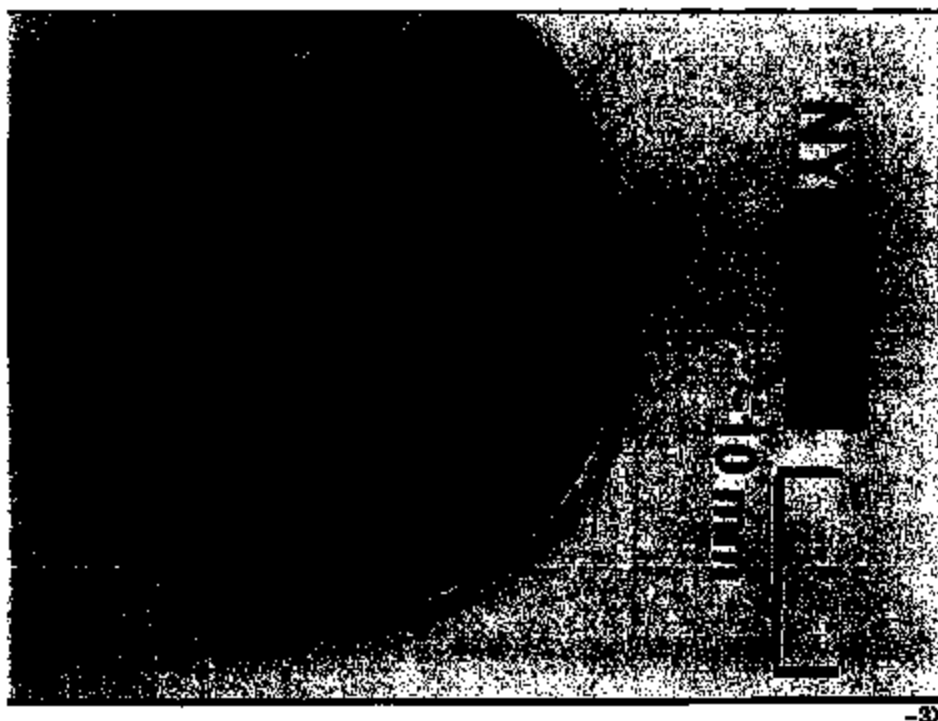


Figure 177: P [redacted] Showing Kapton seals in place.

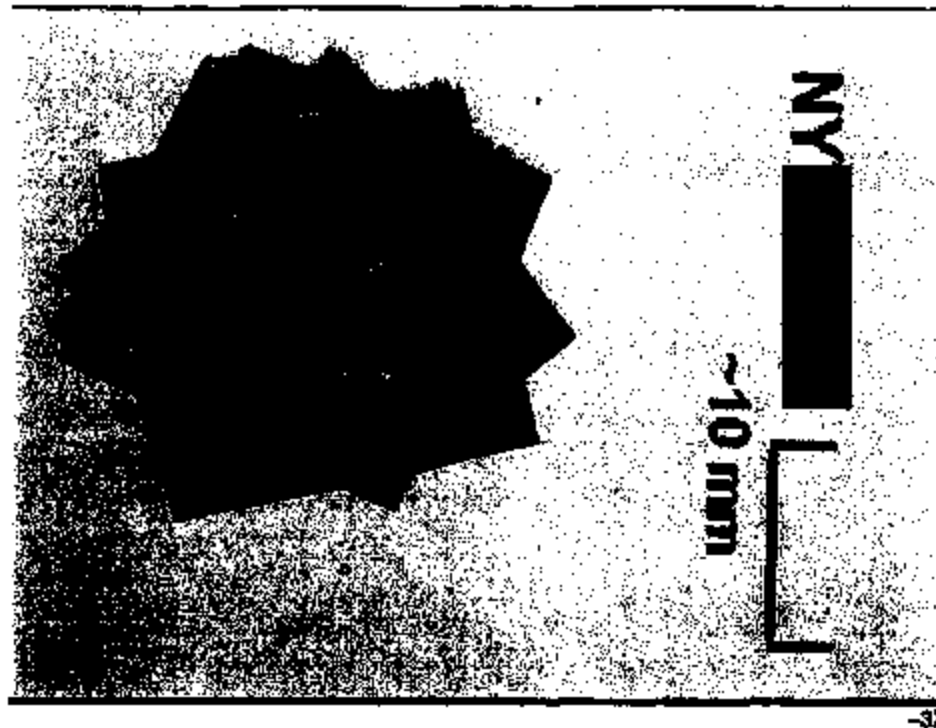


Figure 178: NY [redacted] Showing Kapton seals.

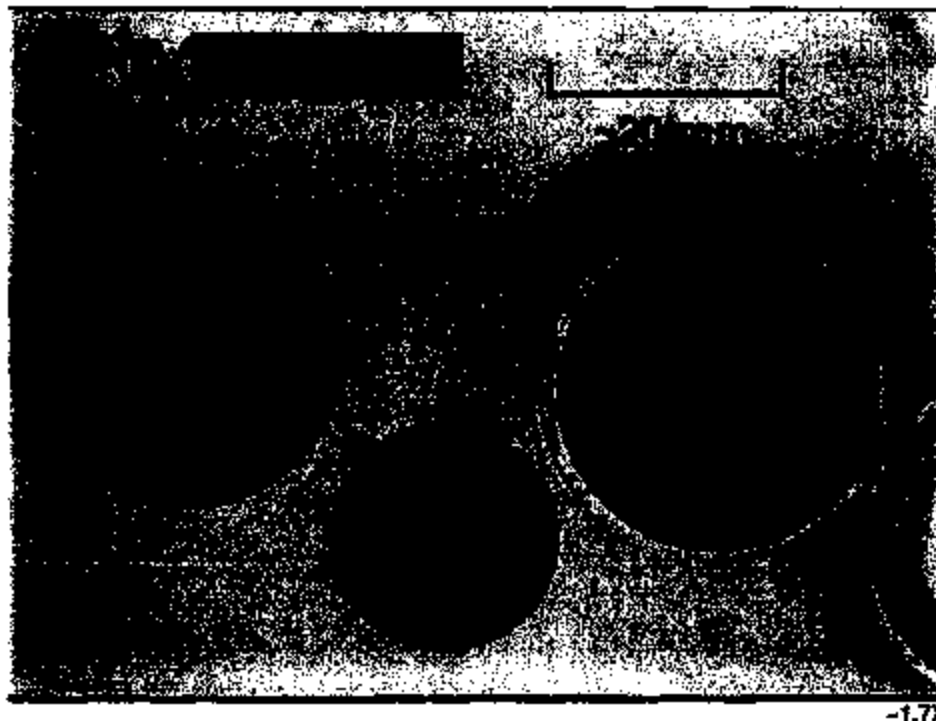


Figure 179: PY [redacted]. Showing converter and washer, disc, and interior of cup.

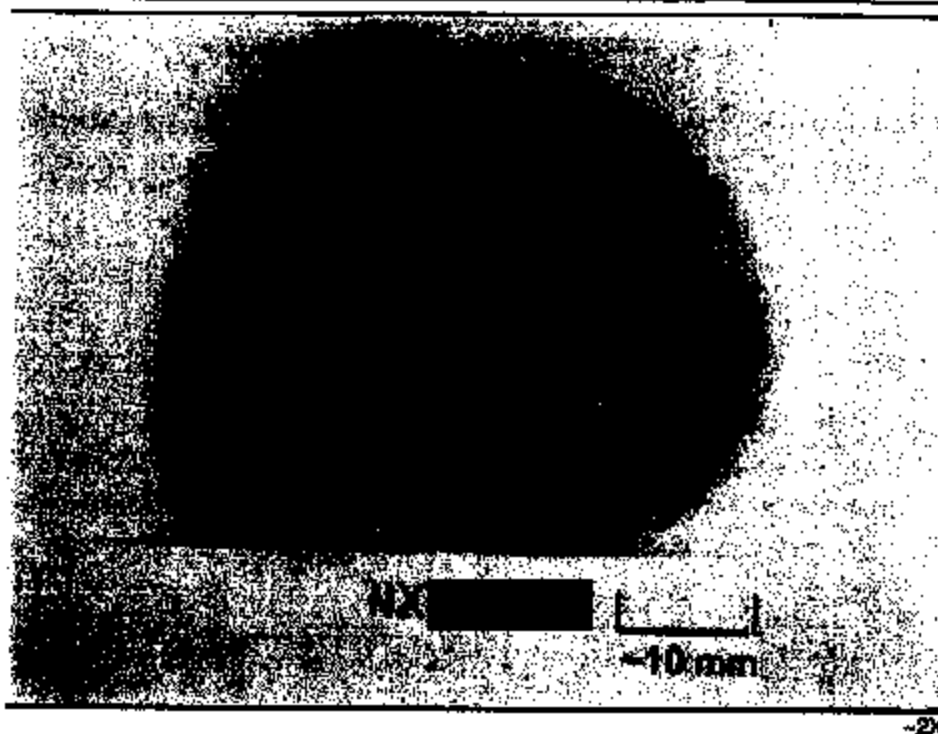


Figure 180: ND [redacted]. Showing switch as-received.

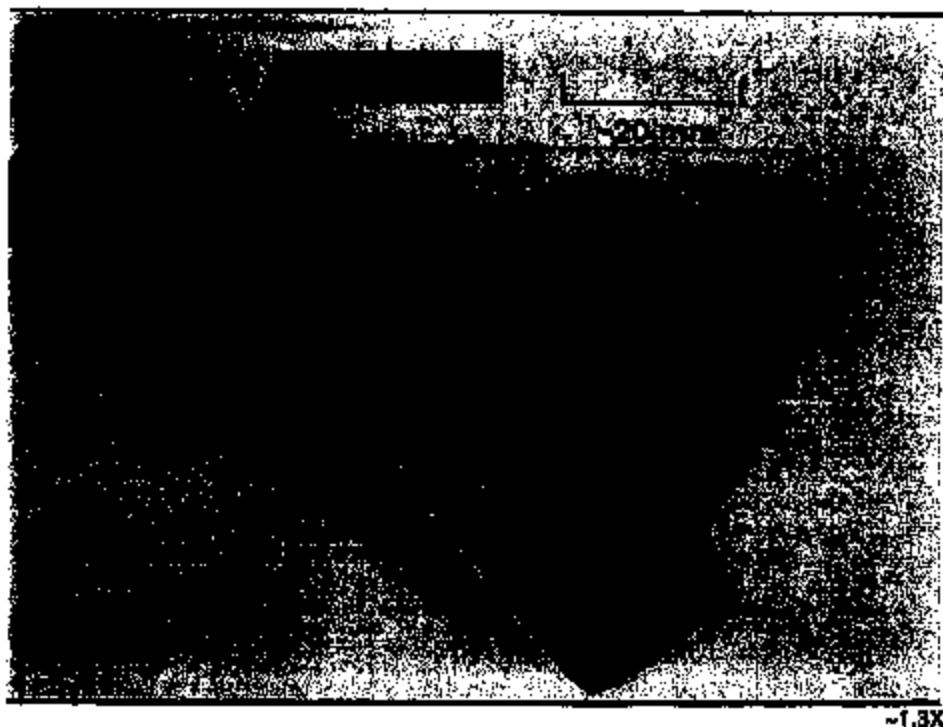
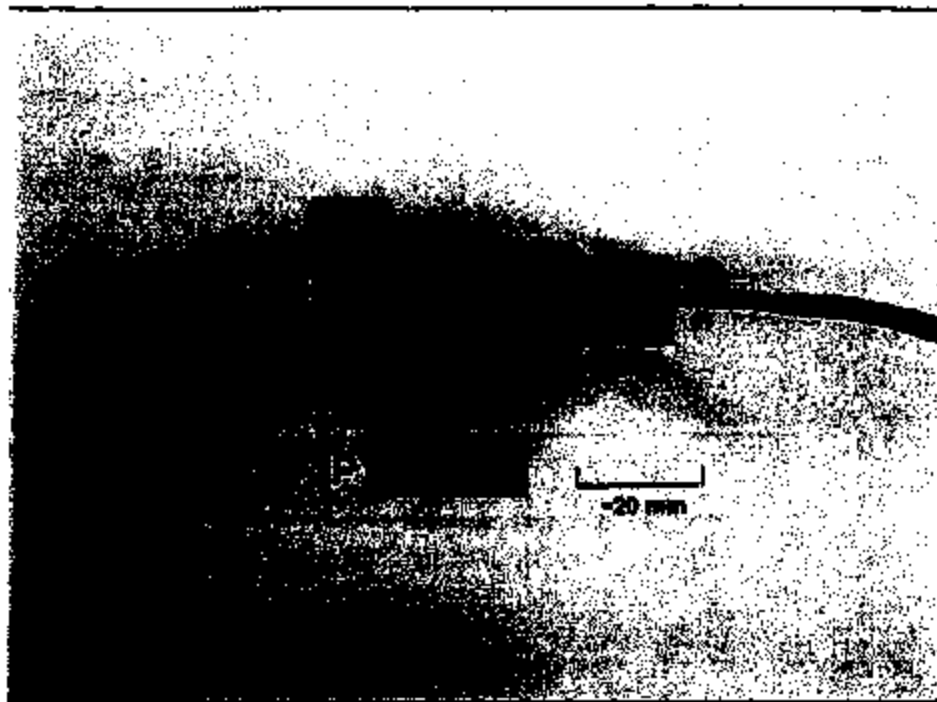


Figure 181: ND [redacted]. Showing portion of master cylinder received.



-0.3X

Figure 182: NX [redacted] showing wiring harness received.



-0.8X

Figure 183: P1 [redacted] showing switch as-received.



-0.8X

Figure 184: P1 [redacted] showing switch as-received.

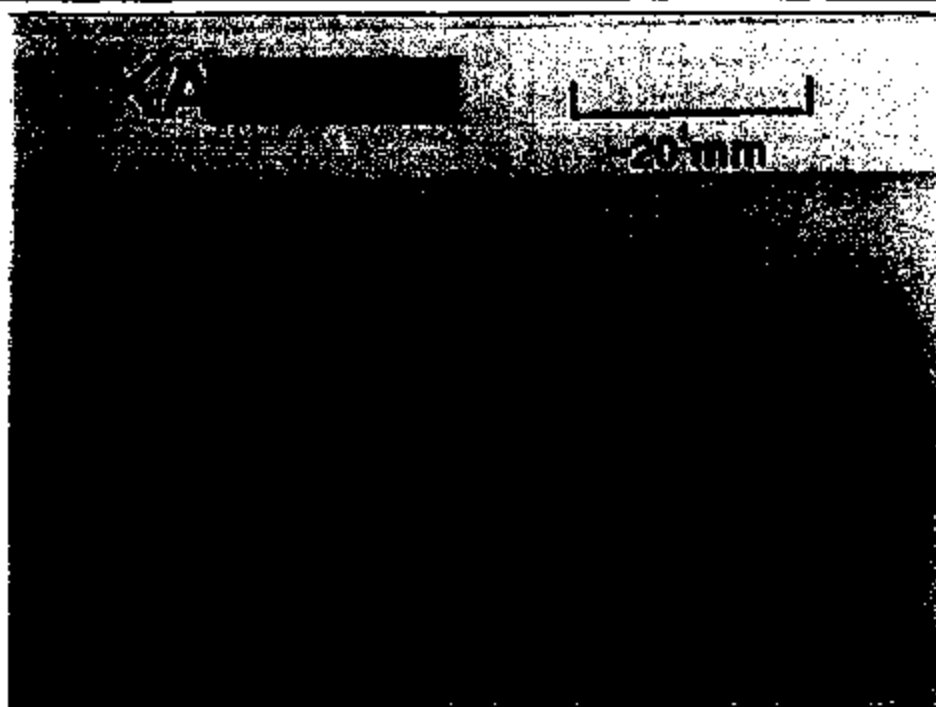
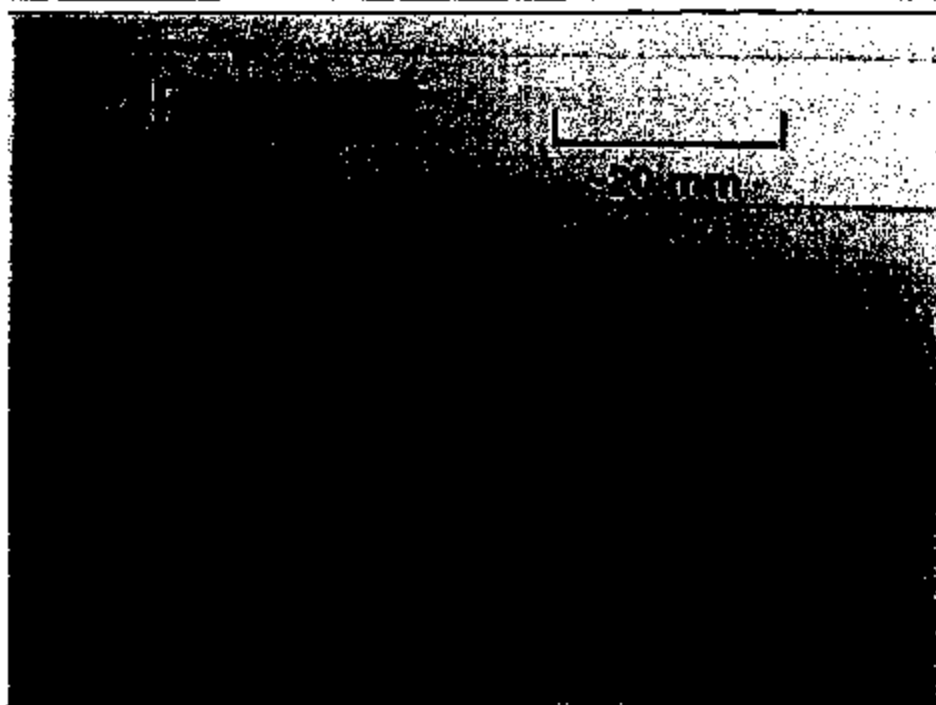


Figure 185: K[REDACTED] Showing switch as-received.



Figure 186: K[REDACTED] Showing terminal cavity.



~1.6X

Figure 187: L [redacted] Showing switch as-received.



~6.6X

Figure 188: L [redacted] showing terminal cavity.



-6.6X

Figure 180: [REDACTED] Showing terminal cavity.

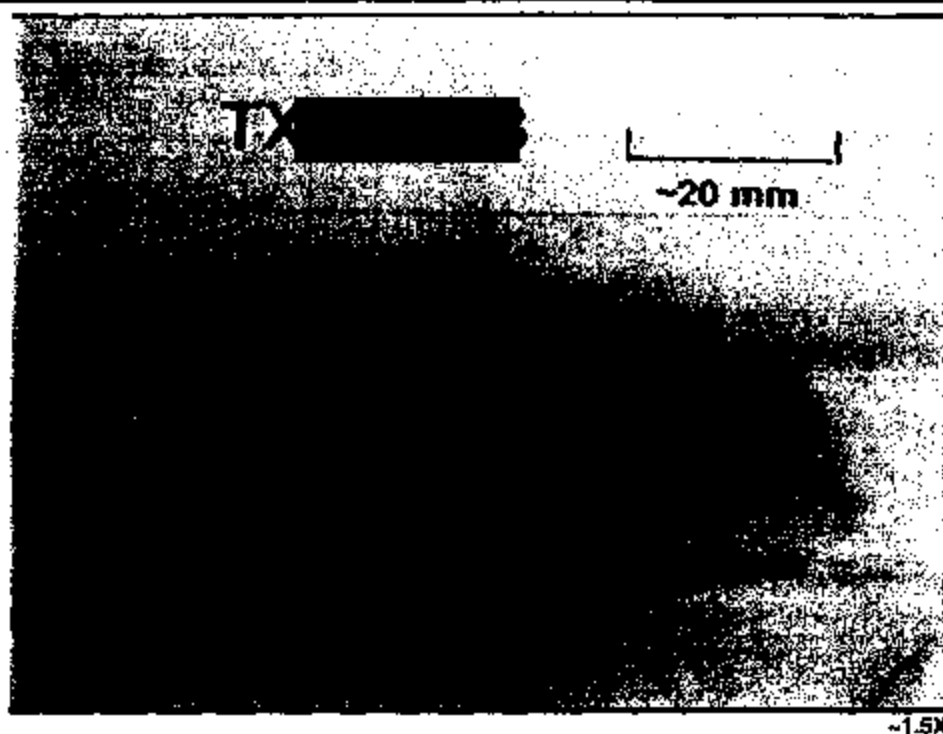


Figure 190: TX [redacted] Showing switch as-received.



Figure 191: TX [redacted] Showing terminal cavity.

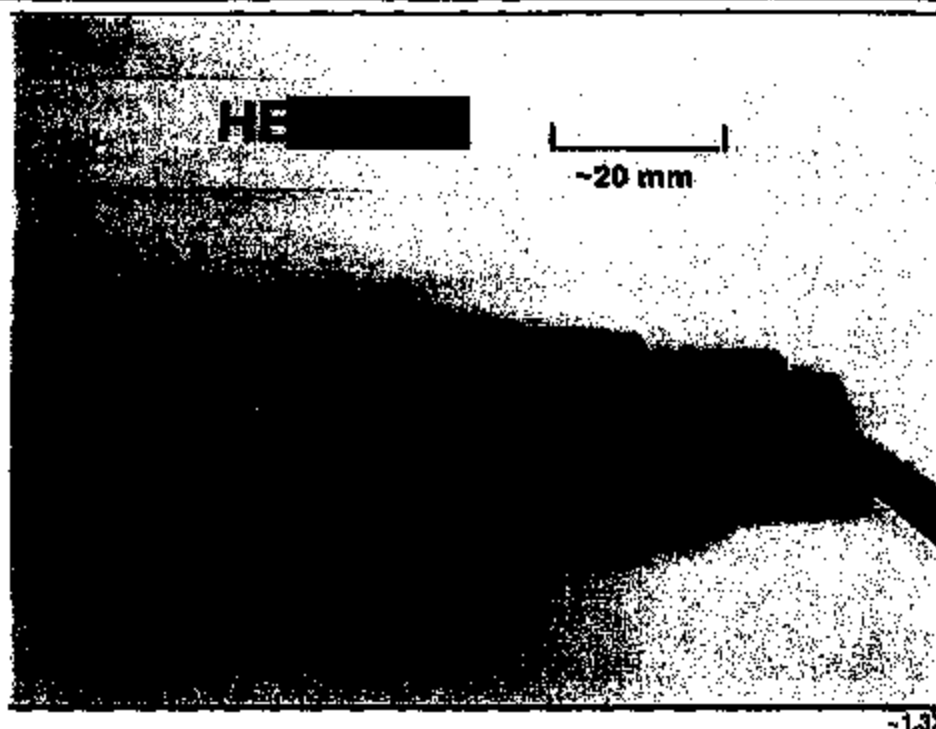
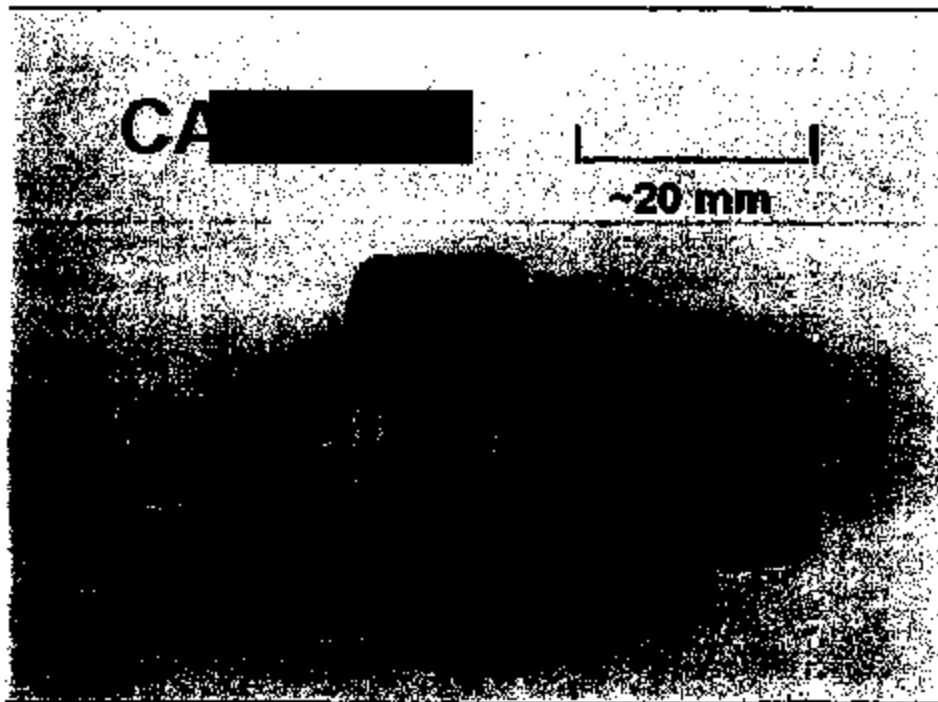
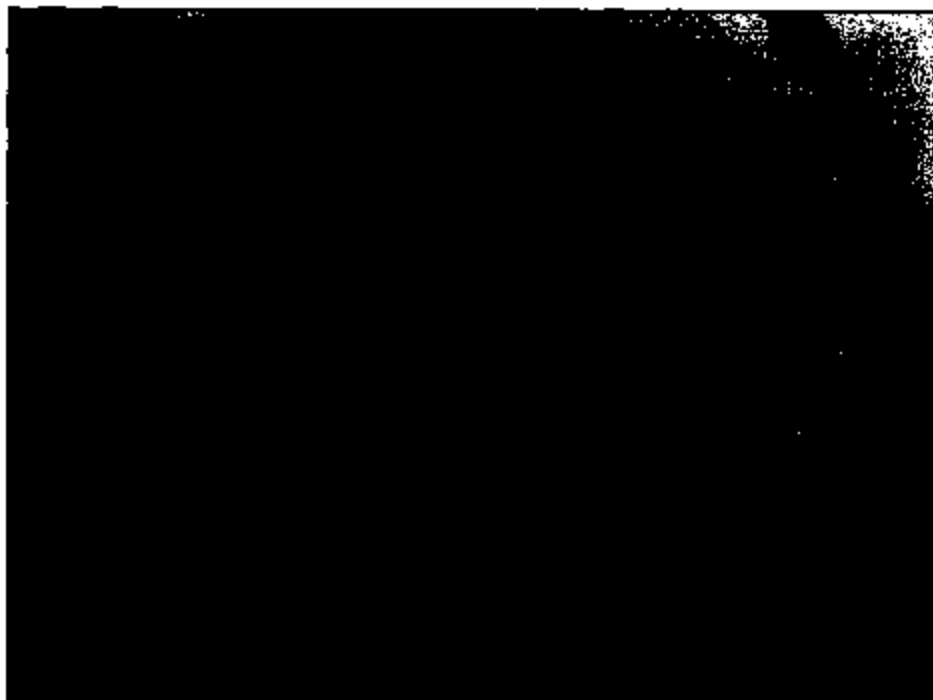


Figure 192: HE [REDACTED] Showing switch as-received.



~1.7X

Figure 183: CA [redacted] Showing switch as-received.



-4.3X

Figure 184: CA [redacted] Showing terminal cavity.

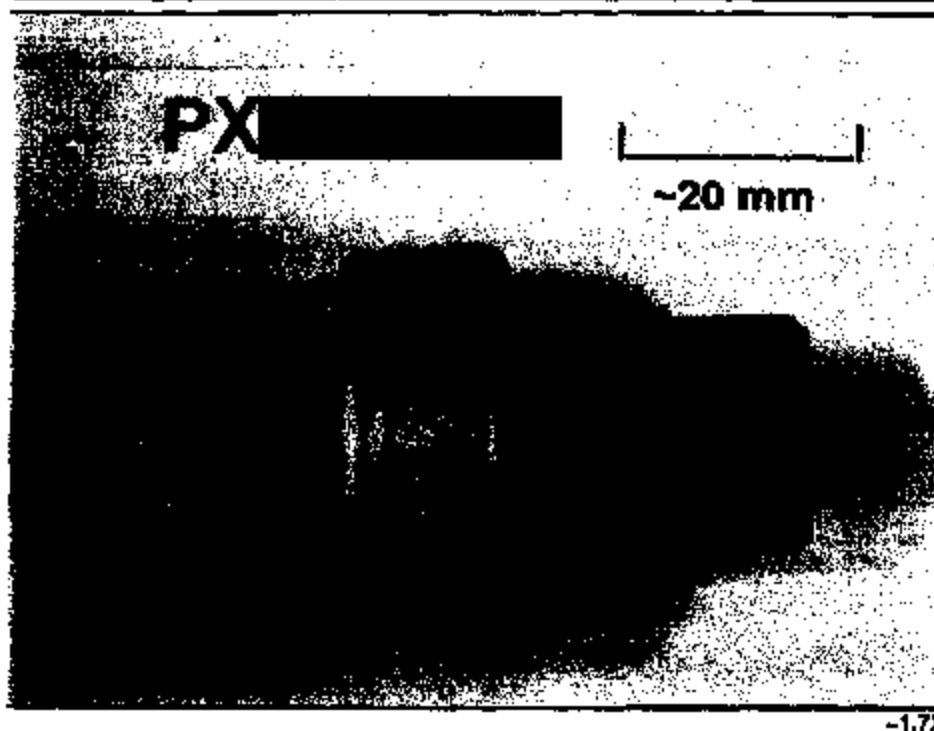


Figure 195: PX [redacted] Showing switch as-received.

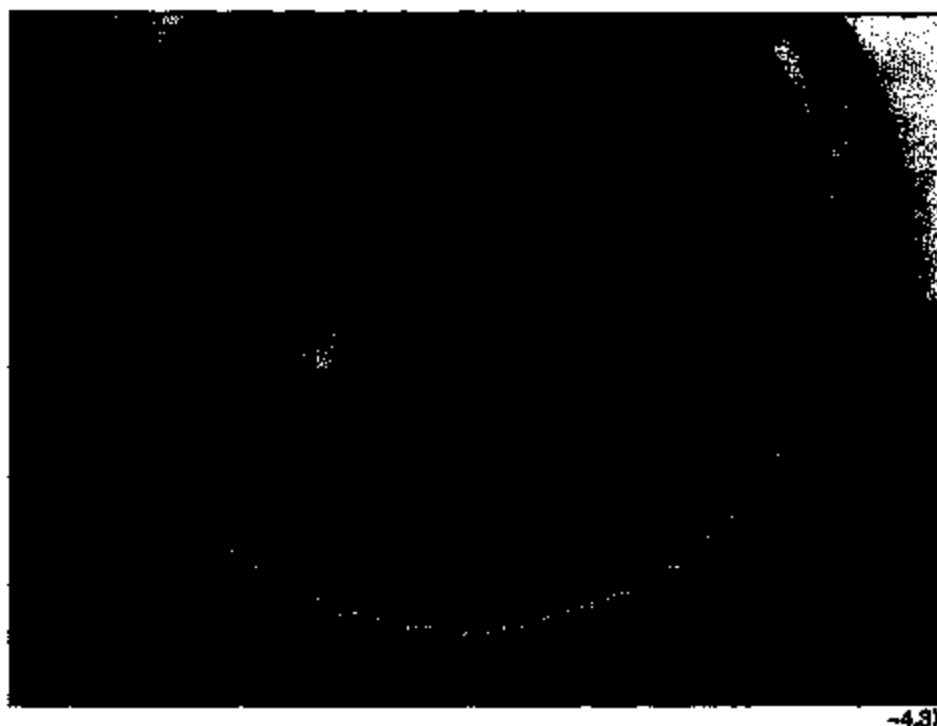
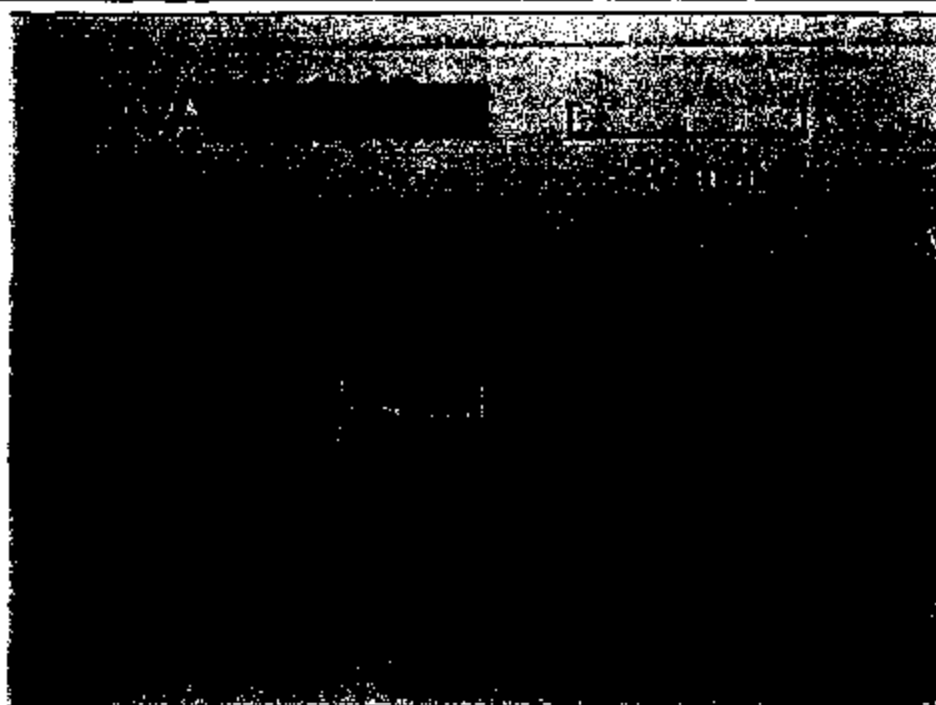
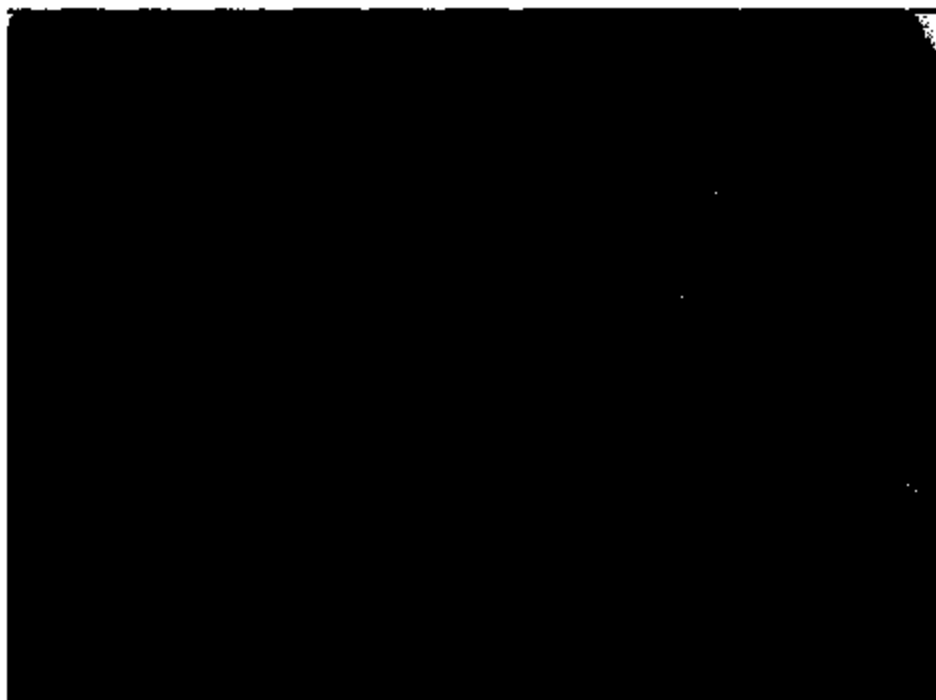


Figure 196: PX [redacted] Showing terminal cavity.



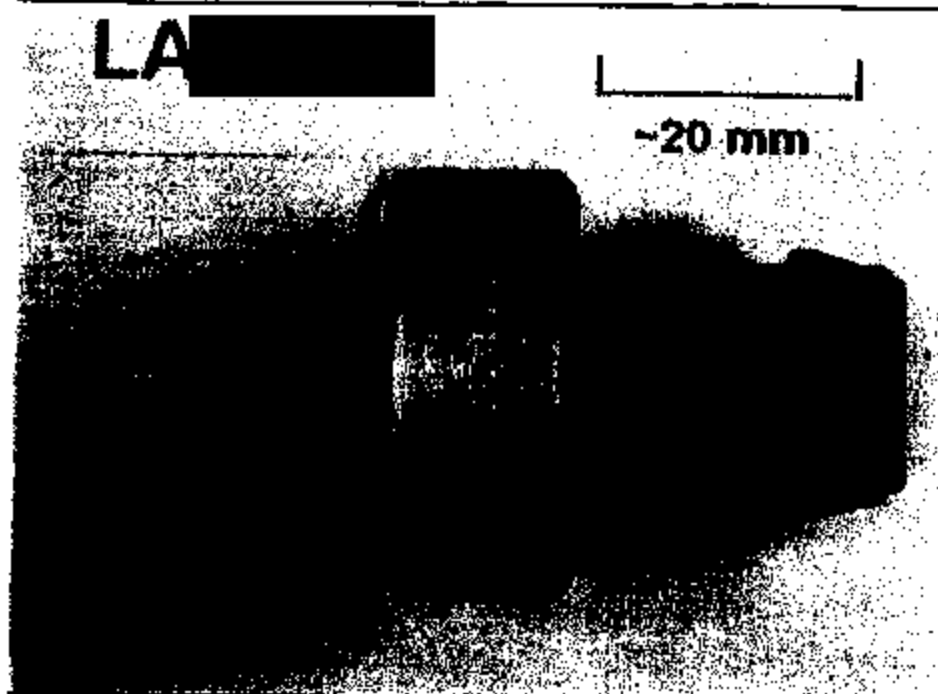
~1.7X

Figure 187: N/A [redacted] switching switch as-received.



~5.8X

Figure 188: N/A [redacted] Showing terminal cavity.



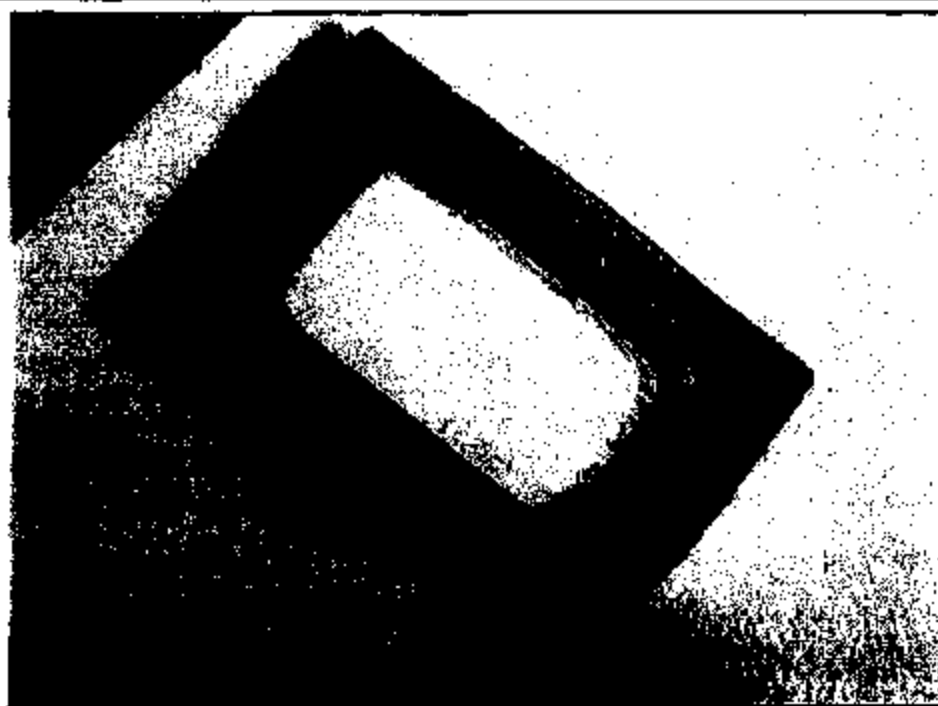
-1.8X

Figure 199: LA [redacted] Showing switch as-received.



-5X

Figure 200: LA [redacted] Showing terminal cavity.



-4.4X

Figure 201: LA [redacted] Showing red seal.

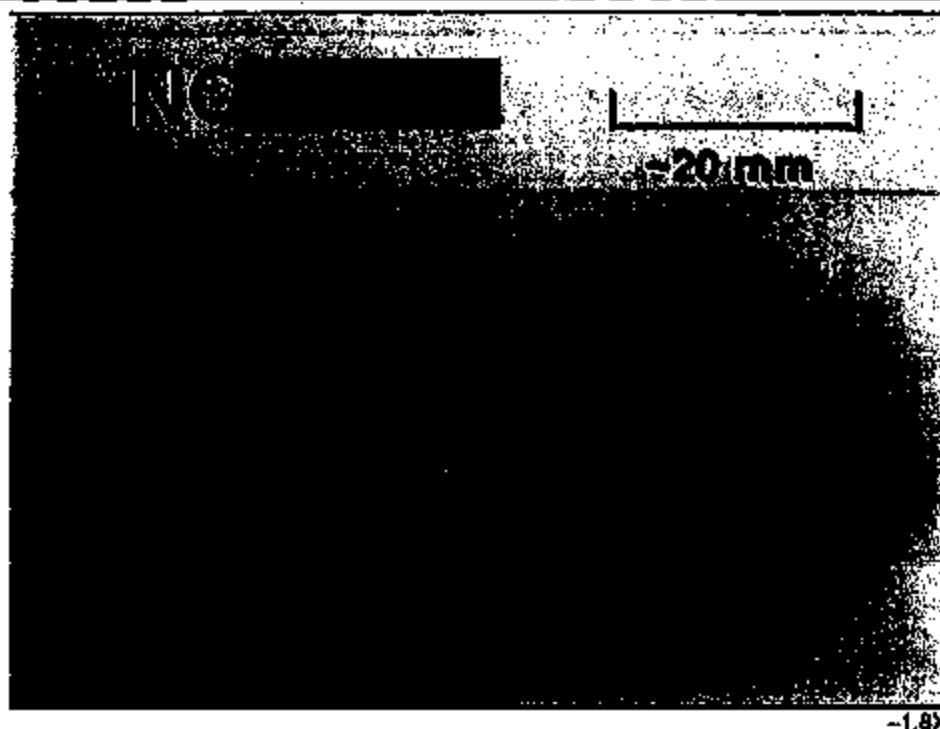


Figure 202: N6 Showing switch as-received.



Figure 203: N6 Showing terminal cavity.

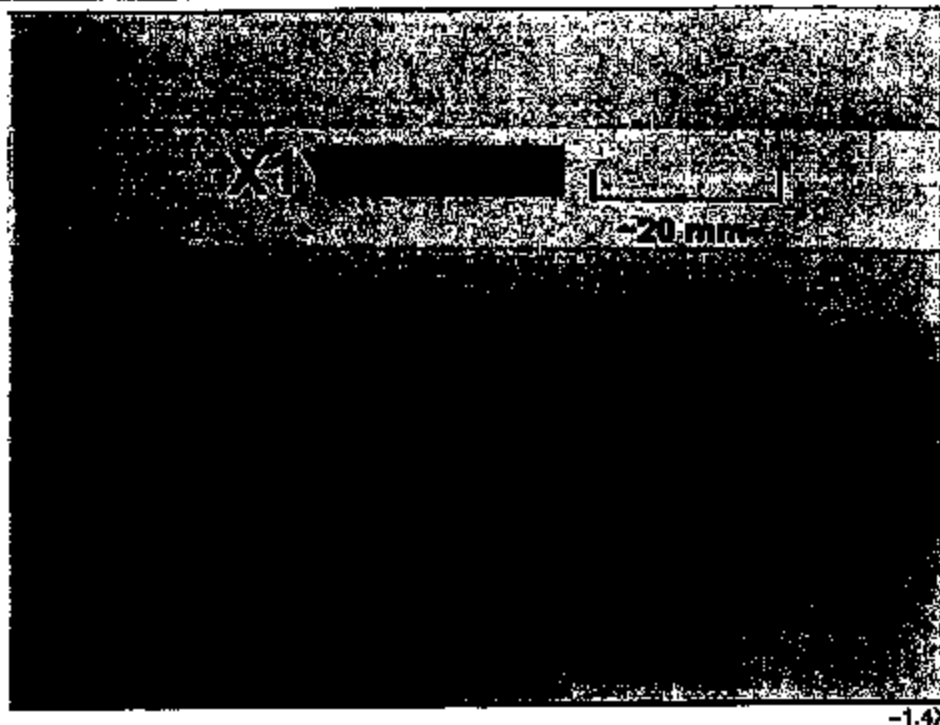


Figure 204: X1Y78209. Showing switch as-received.

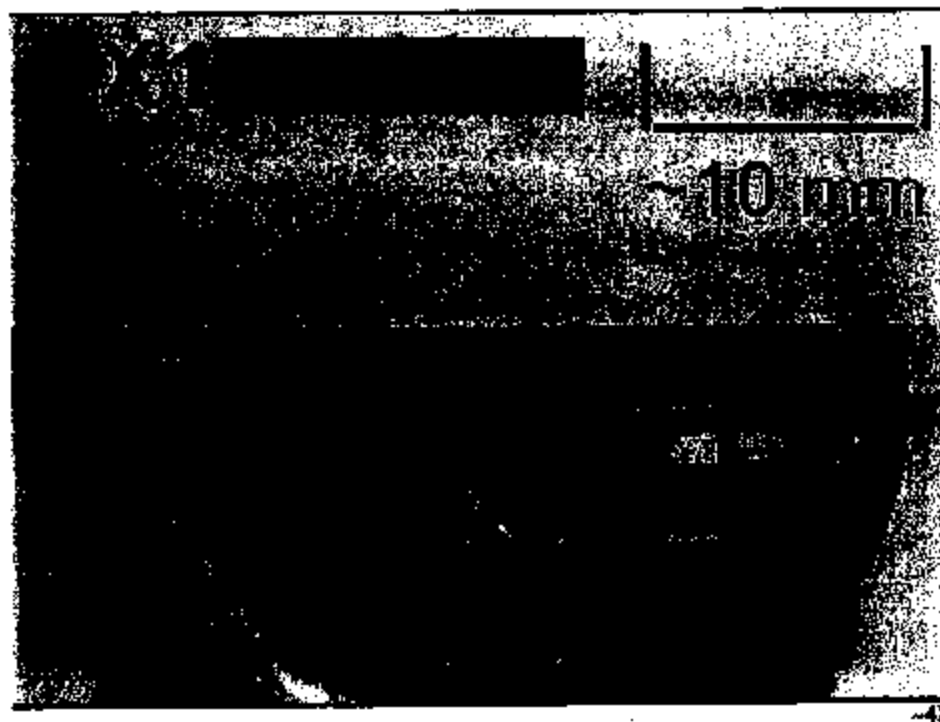


Figure 205: X1Y78209. Showing terminal cavity.

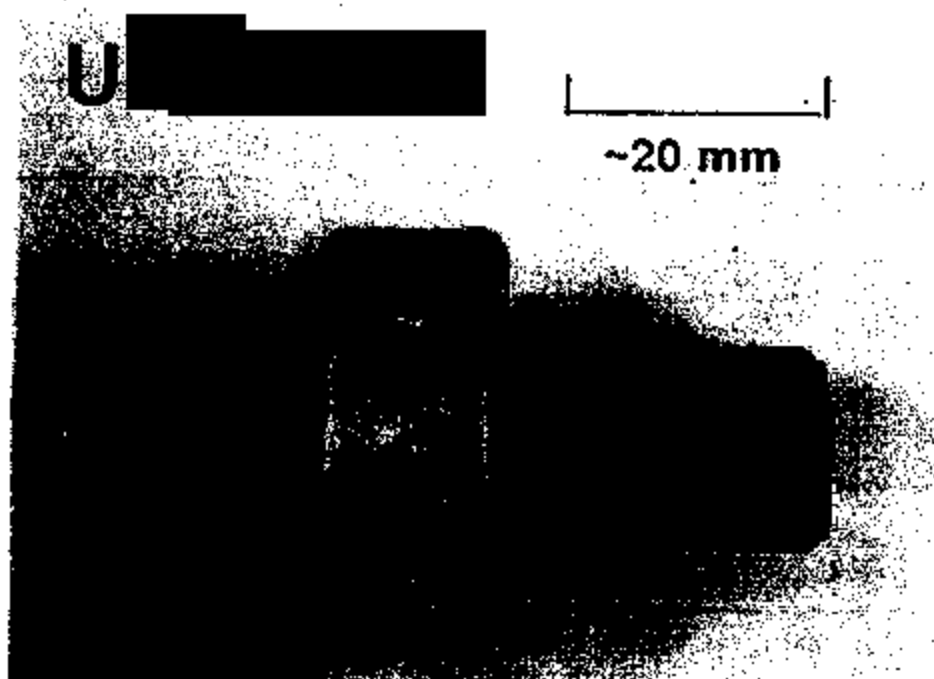
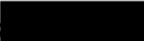


Figure 208:  showing switch as-received.

-1.8X

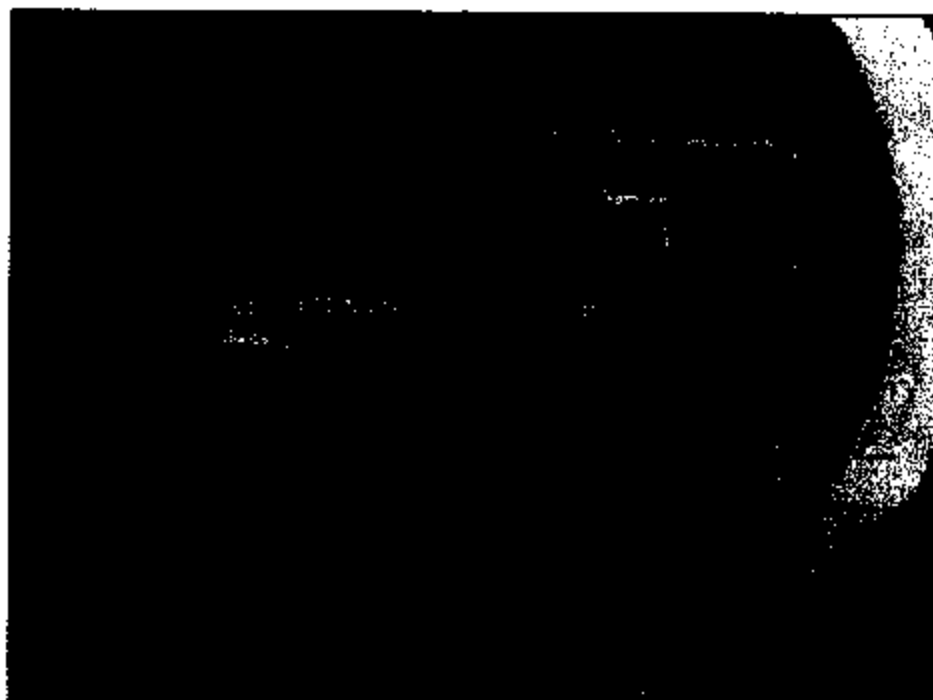
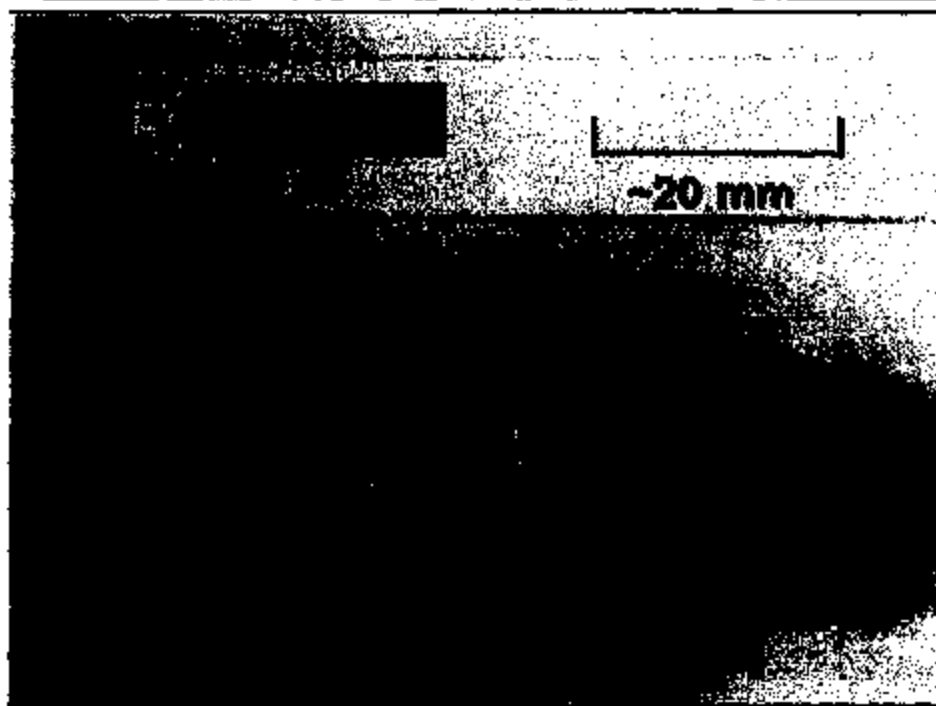


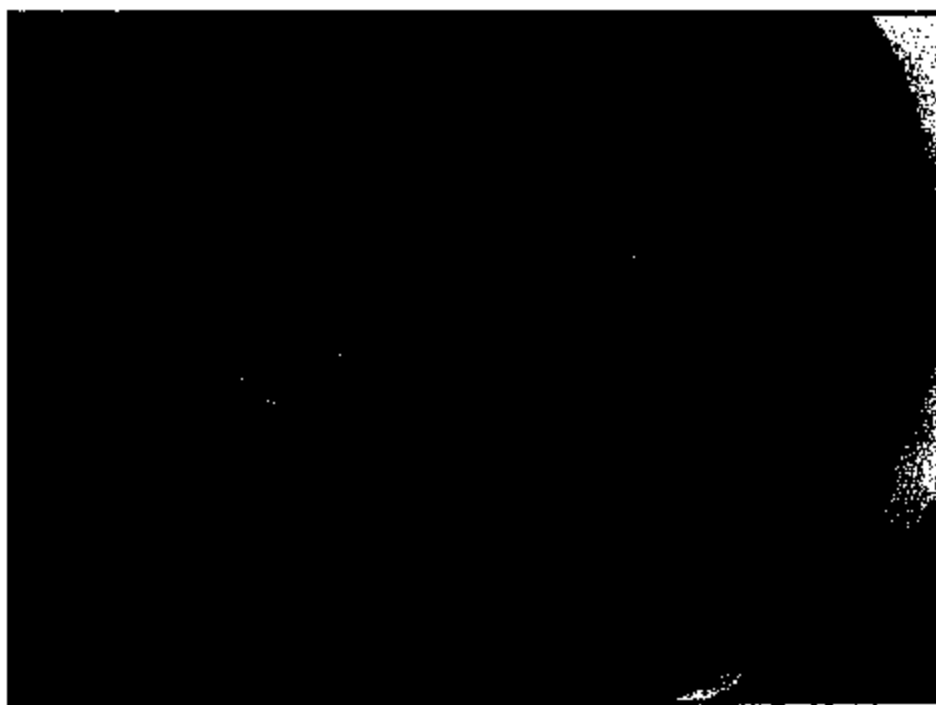
Figure 207: U  Showing terminal cavity.

-5.8X



-1.7X

Figure 208: [REDACTED] showing switch as-received.



-8.3X

Figure 209: [REDACTED] showing terminal cavity.

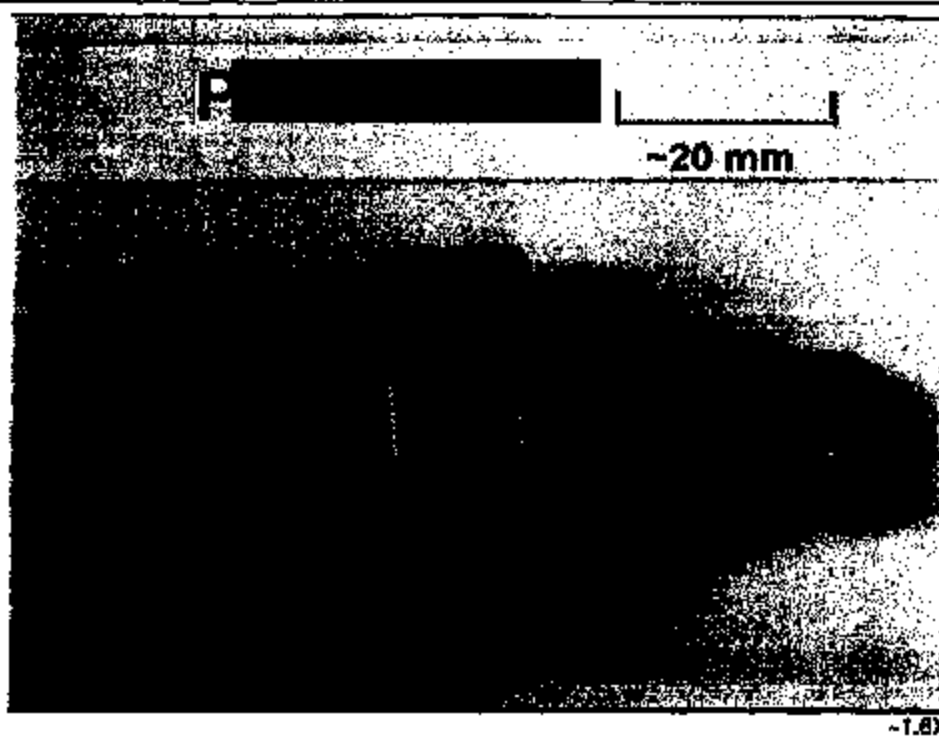


Figure 210: ~~P~~ Showing switch as-received.

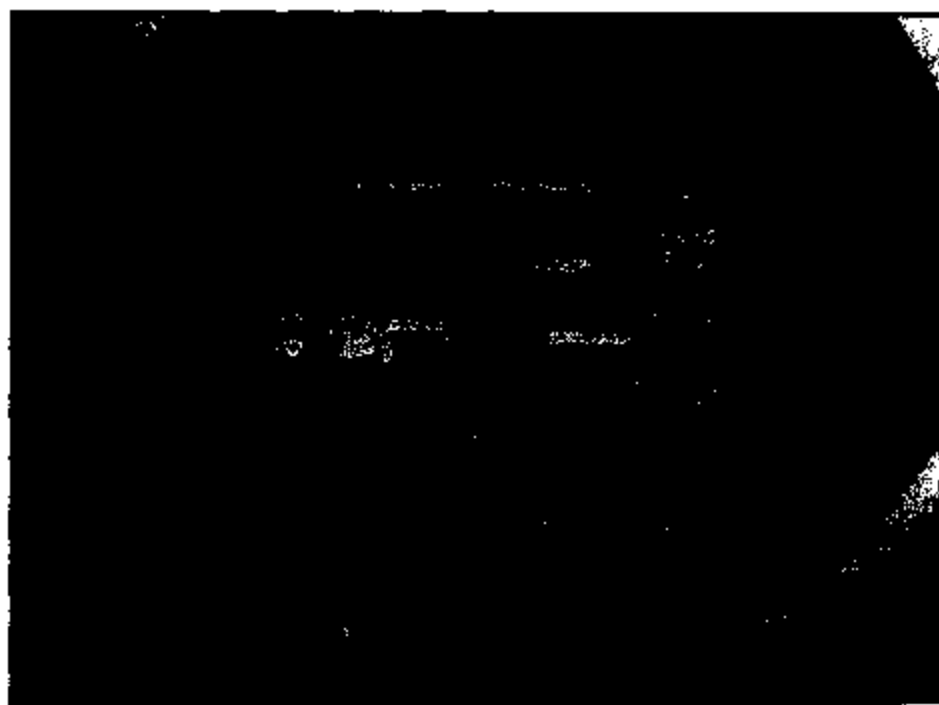


Figure 211: ~~P~~ Showing terminal cavity.

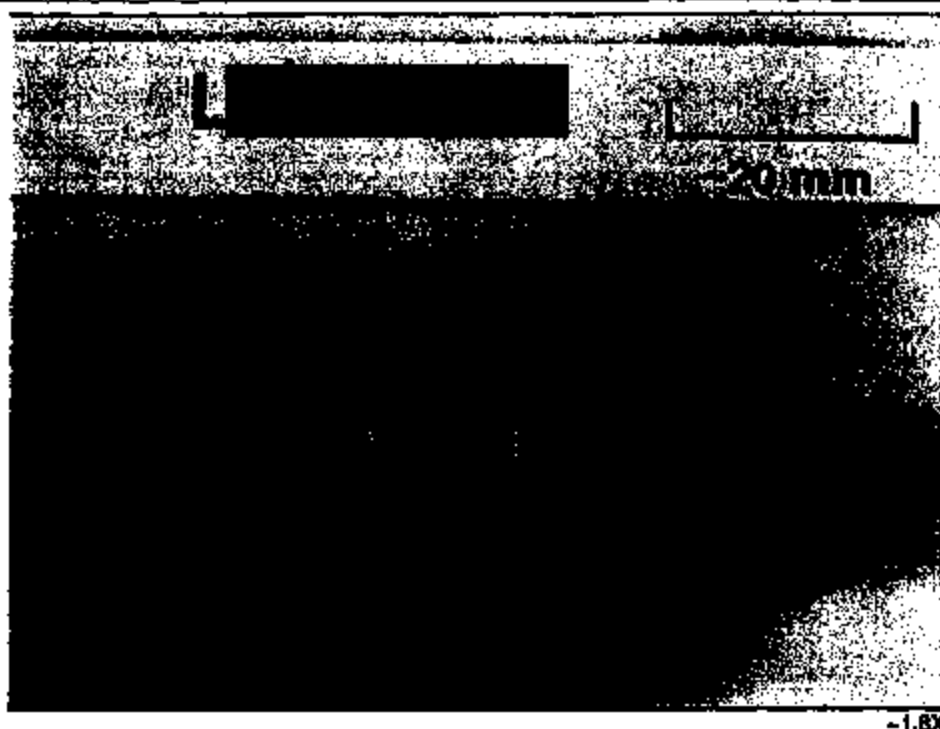


Figure 212:  Showing switch as-received.



Figure 213:  Showing terminal cavity.

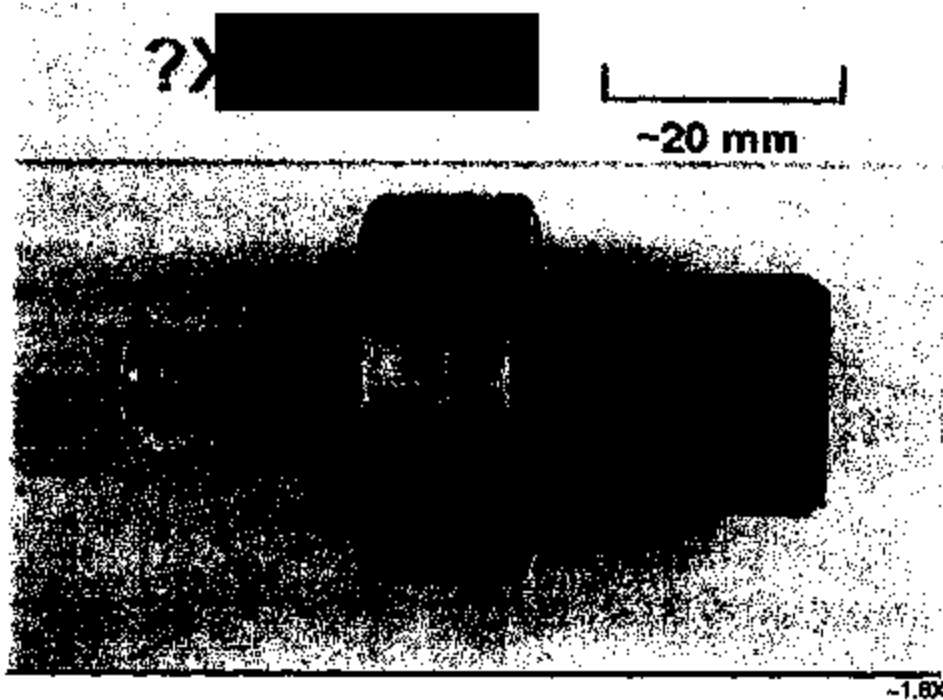


Figure 214:  glowing switch as-received,



Figure 215:  Showing terminal cavity.

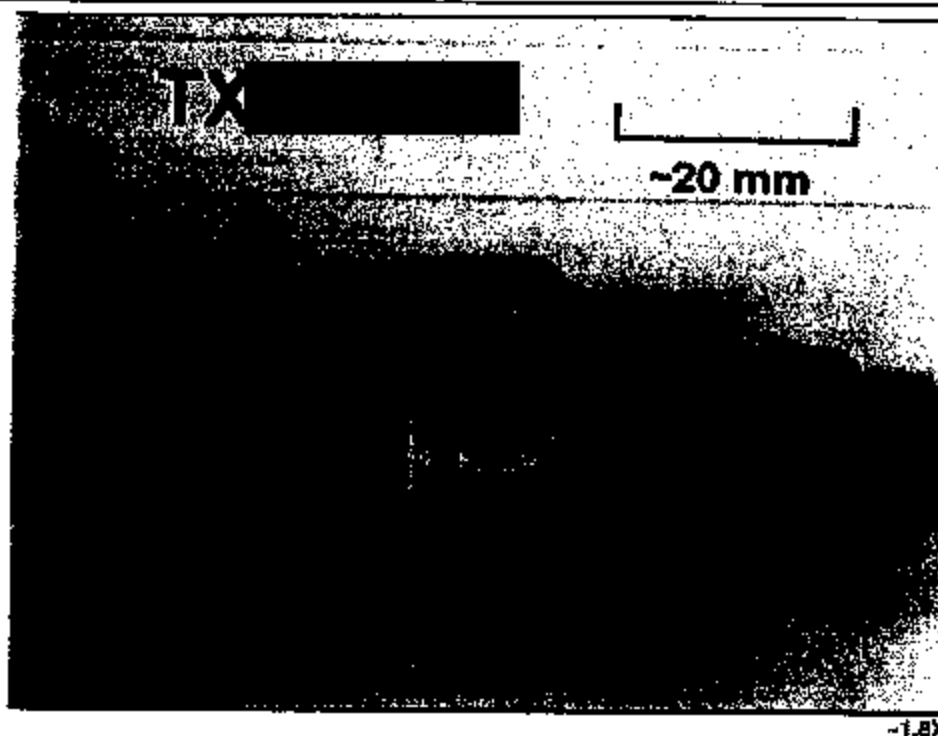


Figure 216: TX [REDACTED] Showing switch as-received.

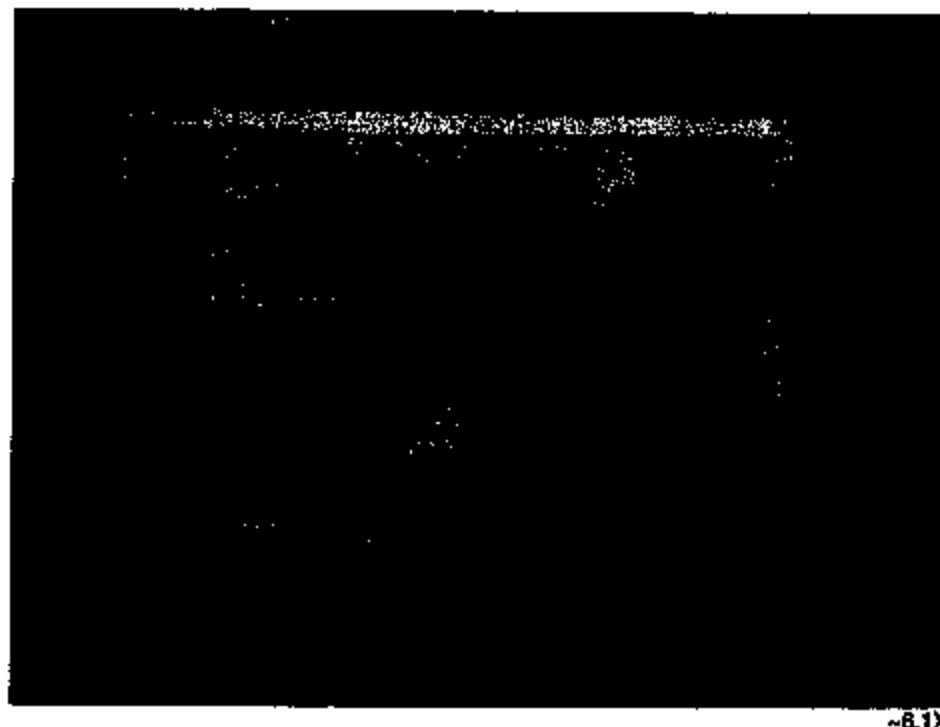


Figure 217: TX [REDACTED] Showing terminal cavity.

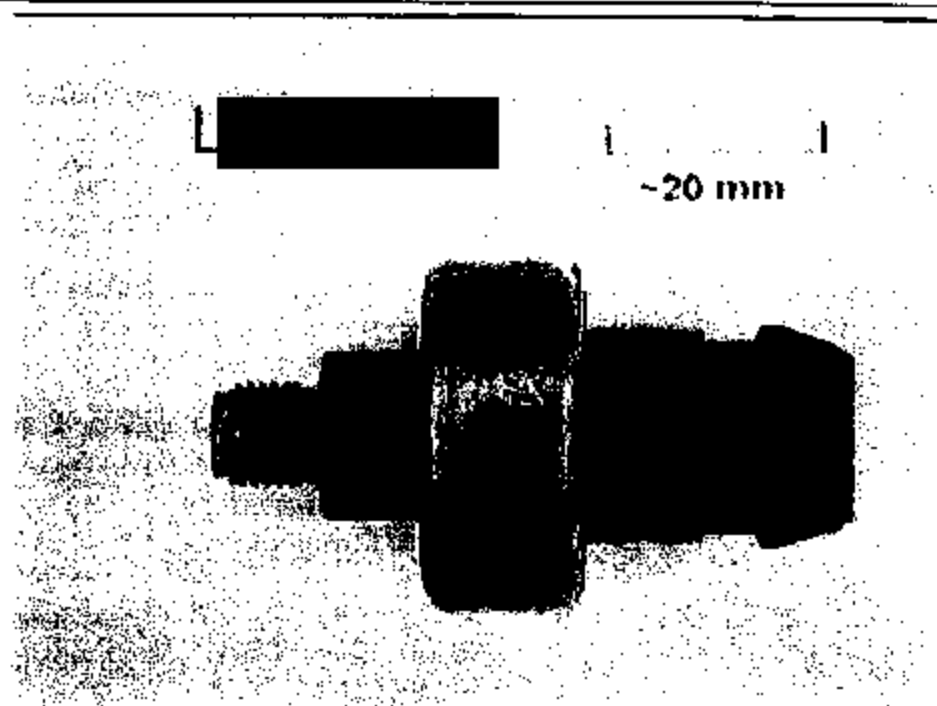


Figure 218: L [redacted] Showing switch as received.

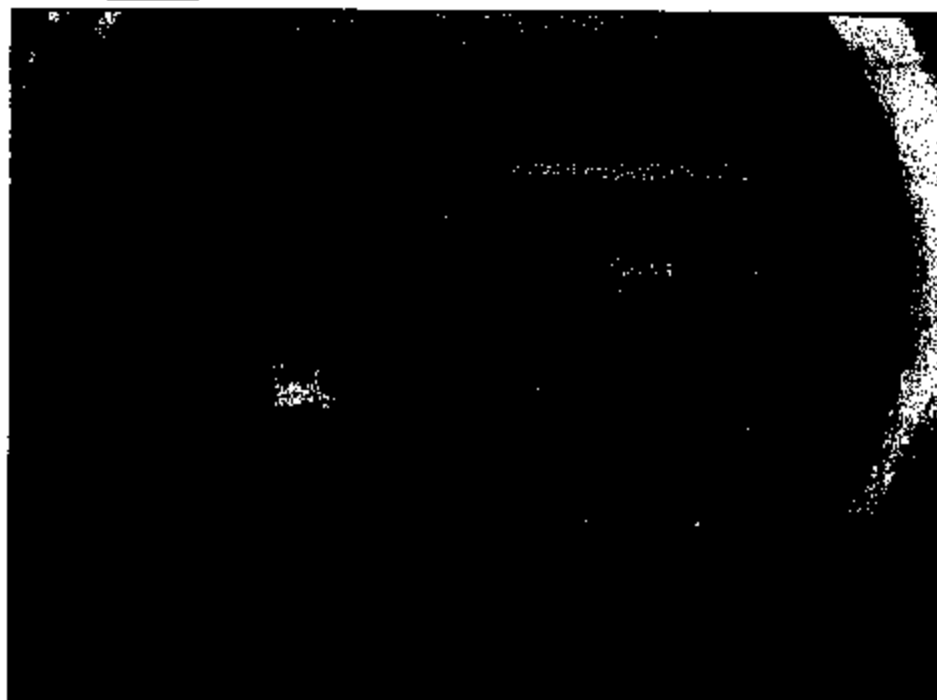


Figure 219: [redacted] Showing terminal cavity.



Central Laboratory
15000 Century Drive
Dearborn, MI 48120-1287

REPORT: 9903244

Request for Central Laboratory Service

Receipt - Copy

Lab Request Number: 009903244

Date of Request: 10/01/1999 03:53:36 PM

Print Date: 01/08/2000 07:03:39 PM

Request Description: BRAKE PRESSURE SWITCH

Requester Information:

Primary Contact: REIMERS, STEVE - 13176

Phone: (313) 390-3288

PROFS ID: SREIMERS

Fax: (313) 390-4145

Secondary Contact: PORTER, FRED - 13177

Phone: (313) 846-3722

PROFS ID: FPORTER

Send Report to:

MD #5011, CUBE #9E008, POWER SUPPLY/EMC/CHASSIS ELEC, AVT 6

Bill to:

Acctg Location: 6100

Dept: T402

Work Task: J00AP

Sample Information:

Total Number of Containers: 10

Sample Handling: Return after test

Source: Not specified

Supplier Code: Not specified

Part/Material Name	Qty	Sample Identification	Part Number	Material Spec	CPSC Code	Supplier
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI
BRAKE PRESSURE SWITCH	1		9F824	N/A	06.06.06	TI

Investigation Information:

Nature of Investigation:

Long Term Project

Potential Recall Problem

Requestor Info. Box:

Do you need to know your CL contact and timing? Yes

Mail typed report

Additional Sample Information/Testing Requirements:

Other (Describe below)

EVALUATE PER ATTACHED EVALUATION PROCESS

Reporting Directions:

Date customer would like report: 10/22/1999

Date customer must have report: 10/27/1999

Report Format(s):

Log-in Information:

Initial Routing: Metallurgy & Mech

Accepted for Central Laboratory by: Wallace, Anna

Phone: 58-47084

View your test status at: 'HTTP://bd4web.pd7.ford.com/kalis'

Program Name: KALISLab Engr Module

Program Version: 3.0.1

**Central Laboratory**

15000 Century Drive
Dearborn, MI 48120-1287
FAX (313) 322-1614

Report 9803244

December 21, 1999

To: B.J. Reimers - Chassis Electronic Systems, AVT6 (313) 39-03286**From:** J.J. Lengyel (313) 59-47487**Subject:** Switch, Brake Pressure

Part Number: ▼F2VC-9F924-AB
Specification: (▼ES-F2VC-9F924-AA)
Supplier: Texas Instruments, Inc.

Received: Ten brake switches [an eleventh added on October 20] were received on October 1, 1999.

Sample Identifications: Switches were identified with RO Numbers.

Sample #	01	02	03	04	05	06
RO Number:	375417-A	069338-01	060685-51	108857-01	066191-02	068853-51
Sample #	07	08	09	10	11	
RO Number:	067205-01	068612-51	023582-52	KA65383	023257-01	

Objective: Provide switch evaluations for mechanical pressure, electrical conductance, materials analysis and visual reviews. The presence of any identifiable discontinuities, leak paths or other abnormalities are to be noted and reviewed in detail.**Conclusion:** The data was gathered for information only in accordance with Requester's evaluation plan.

MECHANICAL TESTING Brake switch performances are noted in the Data Matrix. See, report attachments.

METALLOGRAPHIC REVIEW The reviewed seals showed evidence of abrasion as well as a build up of deposits. This was noted where seals contacted respective converters and washers. Each switch seal in the collection displayed similar damage patterns.

All of the seals exhibited delamination of the Teflon overlays to the Kapton substrates. Seals exhibited tears in the Teflon and cracks in the Kapton which formed leak paths. The cracks in the Kapton are associated with ridges or buckles that formed within the seals. See, Report Data Section and attachments.

Several of the washers had a heavy build up of copper material in the bevel region. The zinc plating is missing in the bevel as well, exposing the base steel, and initiating rust formation.

CHEMICAL ANALYSIS Where possible, internal fluids were collected in vials and sludge residue material was collected from each switch. Collected "fluids" and propanol solubles of the "sludge materials" are predominantly brake fluid [glycol ether based material] and water. Sludge sampled from switches #04, 06 and 08 contain ester(s) and/or organic acids. The other "sludge" samples are predominantly inorganic materials with copper, aluminum, silicon and zinc being the major components. See, Report Data Section for more detailed analysis.



Test Data: MECHANICAL ANALYSIS *Test Methods, Requester's Evaluation Plan /Matrix*

- Pressure, Leak and Observation reviews of Brake Switch -

Brake switch performance & observations are noted in Data Matrix. See, Report attachment

METALLOGRAPHIC ANALYSIS *Surface Analysis (Visual Examination)*

- Visual review of the Kapton elements in the Brake Switch -

Switches were received as-disassembled from the previous Mechanical reviews. The Kapton seals from each switch was separated and starting with the seal next to the converter numbered as 1, 2, and 3. Preceding each examination, the excess brake fluid was blotted from each seal using paper towels. Seals were studied through the aid of a bench microscope capable of variable magnifications ranging from ~7X to ~42X.

Each switch seal in the collection displayed similar damage patterns:

- Seal sides adjacent to the converters & washers show evidence of abrasion as well as a build up of deposits where they contacted the converters and washers.
- The Kapton elements exhibit a radial ridge or buckle which extends across the doughnut shaped depression. Ridges line up among the three seal levels in each assembly.
- Teflon overlays exhibit tears which are either associated with the radial ridge, or occur in the delaminated areas.
- Kapton substrates exhibit cracks which occur along the radial ridges or occur around the ends of the ridges. The Kapton is discolored [dark] at the cracks. The source of the discoloration is not known.
- Tears in the Teflon accompanied by cracks in the Kapton formed apparent leak paths through the seals.
- Visual examination of the washers and converters revealed no burrs or other surface imperfections.

Analysis Notes:

Approximate locations for damage to switch seals are shown in sketches, Figures: 89 through 106. See, Report Attachments: 79 through 90.

For typical examples of damage Figures: 107 through 118. See, Report Attachments 91 through 96.



analysis continued:

- SEM review of Brake Switch washer element bevel areas -

Scanning Electron Microscopy (SEM), & Energy Dispersive X-ray Spectroscopy (EDS)

Each washer was ultrasonically rinsed in methylene chloride to degrease it. The washers are zinc plated steel. One side of the washer is flat (back side), and the other side has a bevel in the inner diameter (front side). The zinc plating is intact on the flat portion of the front side of each washer.

- WASHERS -

The relative ranking of amount of copper and rust present in the bevel (highest to lowest) is #04, 07, 09, 08, 02, 03, 11, 10, and 08.

- **WASHER #02** : The back side is missing some plating, and there are spots with rust and copper deposition. The front side has a build up of copper in the bevel region, as well as rust. See, Figures: 119 / 120
- **WASHER #03** : The back side is missing a small amount of plating, and there are intermittent regions with rust present. The front side has a build up of copper in the bevel region, and an asperity of copper build up and rust extending onto the flat portion. See, Figures: 121 / 122
- **WASHER #04** : The back side is missing some plating, with intermittent regions of rust present. The front side has a large build up of copper in the bevel region, some of which is flaking away. See, Figures: 123 / 124
- **WASHER #06** : The back side is missing some plating, and there are spots with rust and copper deposition. The front side has a heavy build up of copper in the bevel region, and an asperity of copper build up extending onto the flat portion. See, Figures: 125 / 128
- **WASHER #07** : The back side is missing some plating, primarily around the inner diameter, and there is rust present. The front side has a heavy build up of copper in the bevel region, extending slightly onto the flat portion in one area. The zinc plating is not uniformly missing in the bevel; there is a crescent that is intact and uncovered. See, Figure: 127
- **WASHER #08** : The back side is missing some plating, only along the contact point on the outer edge. The front side has some rust present in the bevel, and along the rim of the bevel. See, Figures: 128 / 129
- **WASHER #09** : A large amount of plating is missing on the back side, and there is rust and copper present. The front side has a heavy build up of copper and rust in the bevel, extending at one point onto the flat surface. See, Figures: 130 / 131
- **WASHER #10** : The back side is missing only a slight amount of plating, and there is some rust present in these areas. The front side has some rust present in the bevel, but very little/no copper present. The zinc that was missing appeared to be by pitting. See, Figure: 132
- **WASHER #11** : The back side is missing some plating, and there is rust present. The front side has a build up of copper and some rust present in the bevel region. See, Figures: 133 / 134



analysis continued:

CHEMICAL ANALYSIS *Test Methods/Site Identifications of Analysis & Observations*

Fluids were analyzed as-received. Fluids were obtained from four (4) switch locations:

Location - A - Between exterior plate (Sludge side) & polyimide element

Location - B - Between first & second polyimide elements (counting from Sludge side)

Location - C - Between second & third polyimide element (counting from Sludge side)

Location - D - Between the third polyimide element & Hexport

Analysis Notes:

Each Sludge sample was rinsed with propanol. The soluble & insoluble portions were the analyzed separately.

Switches #04, 10 & 11 appeared to contain less fluid than the other samples. The presence of material pieces, what appear to be from a switch contact element, were noted in Samples #01, 02, 07, 10 and 11.

Water is always combined with the brake fluid in glycol ether based systems (all but DOT 5 brake fluid). Water content was not run on the samples (due to sample size).

Molecular Characterization *FTIR, Qualitative*

- SWITCHES -

Spectra of the fluid samples from the switches are characteristic of a glycol ether based material (brake fluid) and water.

Spectra of the fluid samples from switches #04 and 08 appeared to be slightly different than the other samples, possibly due to a different brand of fluid being used.

Spectra of fluid from switch #08 also contained an ester.

Spectra of fluid from switch #11 from *Location -D-* contained other, possibly nitrogenous, material in addition to the glycol ether based material and water.

Molecular Characterization *FTIR, Qualitative*

- FLUID -

- **SWITCH #09:** Spectra of the fluid samples for a vial from Switch #09 are characteristic of a glycol ether based material (brake fluid) and water.
- **SWITCH #10:** Spectra of the fluid samples for a vial from Switch #10 are characteristic of a glycol ether based material (brake fluid) and water.



analysis continued:

- SLUDGE -

- **SLUDGE #01:** Spectra of the propanol soluble portion of is characteristic of glycol ether based material with evidence of ester and other materials.

Spectra of the propanol insoluble portion of sludge #01 are not infrared active.

- **SLUDGE #02:** Spectra of the propanol soluble portion of sludge is characteristic of glycol ether based material with ester(s), possibly containing phthalate ester.

Spectra of the propanol insoluble portion of sludge #02 are not infrared active.

- **SLUDGE #03:** Spectra of the propanol soluble portion of sludge is characteristic of glycol ether based material with evidence of ester.

Spectra of the propanol insoluble portion is characteristic of essentially inorganic material, probably containing silicates and/or sulfates, including crystalline silicon dioxide.

- **SLUDGE #04:** Spectra of the propanol soluble portion is characteristic of glycol ether based material with ester(s), possibly containing phthalate ester.

Spectra of the propanol insoluble portion of sludge is are characteristic of ester(s) and/or organic acids, possibly containing phthalate ester and other material.

- **SLUDGE #06:** Spectra of the propanol soluble portion of sludge is characteristic of glycol ether based material with ester(s), possibly containing phthalate ester.

Spectra of the propanol insoluble portion of sludge is characteristic of ester(s) and/or organic acids, possibly containing phthalate ester and other material.

- **SLUDGE #07** Spectra of the propanol soluble portion is characteristic of glycol ether based material.

Spectra of the propanol insoluble portion of sludge is characteristic of mixed carbonates and other material

- **SLUDGE #08:** Spectra of the propanol soluble portion of is characteristic of glycol ether based material with ester(s), possibly containing phthalate ester.

Spectra of the propanol insoluble portion of sludge is characteristic of ester(s) and/or organic acids, possibly containing phthalate ester and other material.

- **SLUDGE #09:** Spectra of the propanol soluble portion is characteristic of glycol ether based material and ester.

Spectra of the propanol insoluble portion of sludge is characteristic of mixed carbonates and other material.

*analysis continued:*

- **SLUDGE #10:** Spectra of the propanol soluble portion is characteristic of essentially glycol ether based material.

Spectra of the propanol insoluble portion of sludge is characteristic of mixed carbonates and other material.

- **SLUDGE #11:** Spectra of the propanol soluble portion is characteristic of glycol ether based material with evidence of ester. Spectra of the propanol insoluble portion of sludge is not infrared active.

ELEMENTAL ANALYSIS Sludge Insolubles % by weight¹, Rigaku X-ray Fluorescence

	#01	#02	#03	#04	#05	#07	#08	#09	#10	#11
Aluminum	1	3	18	8	11	14	11	<1	2	1
Barium	-	-	-	-	1	-	-	-	-	-
Bromine	-	1	<1	<1	<1	3	<1	<1	<1	<1
Calcium	<1	4	8	6	23	-	17	<1	<1	<1
Chlorine	<1	-	<1	<1	-	-	<1	-	-	-
Chromium	<1	-	<1	<1	<1	-	-	<1	-	<1
Cobalt	-	<1	-	<1	<1	-	<1	<1	-	<1
Copper	92	63	18	43	16	50	27	81	65	79
Iron	<1	<1	8	4	2	1	1	4	1	<1
Lead	-	-	<1	<1	<1	-	-	<1	-	<1
Magnesium	-	<1	1	<1	<1	<1	<1	-	-	-
Manganese	<1	-	<1	<1	<1	-	-	<1	-	-
Nickel	<1	<1	<1	1	<1	<1	<1	1	<1	<1
Phosphorus	<1	<1	<1	2	<1	1	<1	<1	<1	<1
Potassium	<1	<1	2	1	<1	-	<1	1	1	<1
Silicon	2	11	37	17	39	1	33	<1	<1	2
Silver	-	11	-	-	-	-	-	2	6	6
Strontium	-	-	<1	-	<1	-	<1	-	-	-
Sulfur	<1	1	1	1	<1	<1	<1	<1	<1	1
Titanium	-	-	2	1	3	-	1	-	-	-
Zinc	3	6	6	13	3	30	10	29	26	8
Zirconium	-	-	-	<1	<1	-	<1	-	-	-

¹ Results are normalized to 100% based upon detected elements. (The instrument cannot detect elements lighter than fluorine). They do not include contributions from elements not listed above.

The precision and accuracy of this technique has been estimated to $\pm 10\%$ for a standard size specimen.

² Indicates none detected²

**Discussion:**

Brake switch performance & physical observations as noted in the Data Matrix were observed by Ford Motor Chassis Electronics System's Steve Reimers, Robert Panek from Exponent Failure Analysis Associates and Rob Sharpe for the Materials & Controls Group of Texas Instruments.

Contributors: M.Haga, P.Nailos, R.Pierzeck, T.Murie & A.Zinkosky

Attachments: Mechanical Analysis Performance/Observations Data Matrix [ONE]
As-received brake switch sample photographs [TWELVE]
As-received brake switch X-rays radiographs [FIFTEEN]
Typical brake switch disassembly, photograph [ONE]
Post-Testing disassembly switch images [NINE]
Disassembly detail images [THIRTYFOUR]
Kapton Seal damage sites [EIGHTEEN]
Kapton Seal magnified images [SIX]
SEM Photomicrographs [EIGHT]
Brake Switch Drawing [ONE]

Concur:


P. F. Kias, Supervisor
Metallurgy Section

By:


Jim J. Lengyel (JLENGYEL)
Laboratory Specialist

Brake Switch Testing Checklist:

Report 9903244

Attachment: 001 of 105

Sample ID		01	02	03	04	05	06	07	08	09	10	11
Field Information	01 Log Field Info into Swt. Log.xls	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	Prefix # (on part)	F2AC	F2AC	F2VC	F2VC	F2VC	F2VC	F2VC	F3TA	F2VC	F3TA	F2VC
	Base # (on part)	9F924	9F924	9F924	9F924	9F924	9F924	9F924	9F924	9F924	9F924	9F924
	Suffix # (on part)	AA	AA	AB	BB	AB	AB	AB	AA	BB	CA	AB
	Date Code:											
	RO Number	375417-A	060336-01	060885-31	106857-01	058181-02	058653-51	067206-01	060512-51	023682-52	KA05363	23297-01
02 Photograph Switch	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
03 Unusual external visuals ?	-	-	-	-	-	-	-	-	-	-	-	-
04 Thread Start position (see, inset)	12:00	7:00	NA	6:00	9:00	5:00	4:30	1:00	7:00	5:00	4:00	
04 Check Connection engagement ?	-	-	-	-	-	-	-	-	-	-	-	-
X-ray, if appropriate	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Switch + Connector Assembly	05 Full connector Engagement ?	-	-	-	-	-	-	-	-	-	-	-
	06 Check wire gray seals	-	-	-	-	-	-	-	-	-	-	-
	07 Install Test Switch on Stand	-	-	-	-	-	-	-	-	-	-	-
Switch External Unpressurized	08 Spring to Stationary Terminal, Ω	16 ?	(open)	NA	(open)	(open)	(open)	175K	NA	50K	(open)	~100K
	09 Stationary Terminal to Hexport, Ω	2.5 ?	100	NA	91	(open)	(open)	3K	NA	80K	(open)	~15-20
	10 Spring to Hexport, Ω	10 ?	(open)	NA	(open)	(open)	(open)	440K	NA	50K	4	~100K
Switch External Pressurized	11 Switch Closing Pressure, psig	-	-	-	-	-	-	-	-	-	-	-
	12 Leakage, Proof Test @ 500psi	Leaks	No Leak	No Leak	No Leak	No Leak	No Leak	No Leak	No Leak	No Leak	No Leak	Leaks
	13 Repeat Steps 17 - 20 @ 180 psi	-	-	-	-	-	-	-	-	-	-	-
	14 Spring to Stationary Terminal, Ω	-	-	-	-	-	-	-	-	-	-	-
	15 Spring Terminal to Hexport, Ω	-	-	-	-	-	-	-	-	-	-	-
	16 Stationary Terminal to Hexport, Ω	-	-	-	-	-	-	-	-	-	-	-
	17 Spring to Hexport, Ω	-	-	-	-	-	-	-	-	-	-	-
Switch	18 Remove aluminum crimp ring	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	19 Examine/Photo revealed surfaces	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	20 Remove Cup	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	21 Examine/Photo revealed surfaces	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Techniques	22 base, contacts, terminals	-	-	-	-	-	-	-	-	-	-	-
	23 cup, hexport, seals, etc.	-	-	-	-	-	-	-	-	-	-	-
	24 Metallographic analysis, contacts Corrosion or arcing evidence?	-	-	-	-	-	-	-	-	-	-	-
Positions		Positions relative to start of thread @ 12:00 viewed from connector end (see, inset).										
	Pre-crimp position	12:00	1:00	11:00	11:00	12:00	11:30	11:00	? Carr.	11:00	1:30	11:00
	Low point position	9:00	4:00	6:00	none	none	10:30	9:00	11:00	6:00	? Trk	?



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Figure - 001 -

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Switch Sample 01

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Figure - 002 -

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Switch Sample 02

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Figure - 003 -

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Switch Sample 03

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Figure - 004 -

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Switch Sample 04

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Figure - 005 -

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Switch Sample 05

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Figure - 006 -

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Switch Sample 06

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Figure - 007 -

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Switch Sample 07

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Figure - 008 -

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Switch Sample 08

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Figure - 009 -

RO # 006895278-8

Switch Sample 09